Innovation, Technology, and Knowledge Management

Thomas Andersson
Abdelkader Djeflat *Editors*

The Real Issues of the Middle East and the Arab Spring

Addressing Research, Innovation and Entrepreneurship

Springer

Innovation, Technology, and Knowledge Management

Series Editor

Elias G. Carayannis, George Washington University, Washington, DC, USA

For further volumes:
http://www.springer.com/series/8124

Snow on the desert dunes in the Algerian Sahara.

Thomas Andersson · Abdelkader Djeflat
Editors

The Real Issues of the Middle East and the Arab Spring

Addressing Research, Innovation and Entrepreneurship

Springer

Editors
Thomas Andersson
Jönköping International Business School
Jönköping University
Jönköping
Sweden

Abdelkader Djeflat
Clerse-University of Lille
Villeneuve d'Ascq
France

ISBN 978-1-4614-5247-8 ISBN 978-1-4614-5248-5 (eBook)
DOI 10.1007/978-1-4614-5248-5
Springer New York Heidelberg Dordrecht London

Library of Congress Control Number: 2012948201

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Series Foreword

The Springer book series *Innovation, Technology, and Knowledge Management* was launched in March 2008 as a forum and intellectual, scholarly "podium" for global/local, transdisciplinary, transsectoral, public–private, and leading/"bleeding"-edge ideas, theories, and perspectives on these topics.

The book series is accompanied by the Springer *Journal of the Knowledge Economy*, which was launched in 2009 with the same editorial leadership.

The series showcases provocative views that diverge from the current "conventional wisdom," that are properly grounded in theory and practice, and that consider the concepts of ***robust competitiveness***,[1] ***sustainable entrepreneurship***,[2] and ***democratic capitalism***,[3] central to its philosophy and objectives. More specifically, the aim of this series is to highlight emerging research and practice at the dynamic intersection of these fields, where individuals, organizations, industries,

---

[1] We define *sustainable entrepreneurship* as the creation of viable, profitable, and scalable firms. Such firms engender the formation of self-replicating and mutually enhancing innovation networks and knowledge clusters (innovation ecosystems), leading toward robust competitiveness (E. G. Carayannis, *International Journal of Innovation and Regional Development* 1(3), 235–254, 2009).

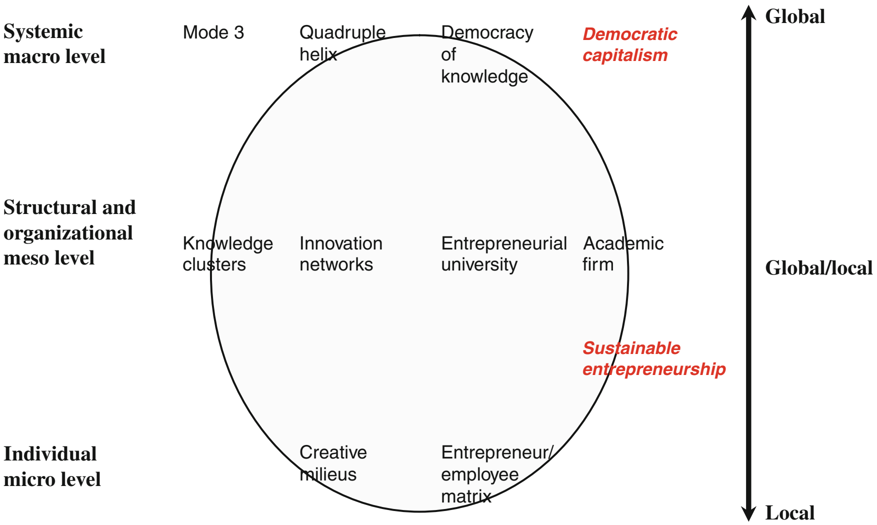
[2] We understand *robust competitiveness* to be a state of economic being and becoming that avails systematic and defensible "unfair advantages" to the entities that are part of the economy. Such competitiveness is built on mutually complementary and reinforcing low-, medium- and high-technology and public and private sector entities (government agencies, private firms, universities, and nongovernmental organizations) (E. G. Carayannis, *International Journal of Innovation and Regional Development* 1(3), 235–254, 2009).

[3] The concepts of *robust competitiveness and sustainable entrepreneurship* are pillars of a regime that we call "*democratic capitalism*" (as opposed to "popular or casino capitalism"), in which real opportunities for education and economic prosperity are available to all, especially—but not only—younger people. These are the direct derivative of a collection of top-down policies as well as bottom-up initiatives (including strong research and development policies and funding, but going beyond these to include the development of innovation networks and knowledge clusters across regions and sectors) (E. G. Carayannis and A. Kaloudis, *Japan Economic Currents*, p. 6–10 January 2009).

regions, and nations are harnessing creativity and invention to achieve and sustain growth.

Books that are part of the series explore the impact of innovation at the "macro" (economies, markets), "meso" (industries, firms), and "micro" levels (teams, individuals), drawing from such related disciplines as finance, organizational psychology, research and development, science policy, information systems, and strategy, with the underlying theme that for innovation to be useful it must involve the sharing and application of knowledge.

Some of the key anchoring concepts of the series are outlined in the figure below and the definitions that follow (all definitions are from E. G. Carayannis and D. F. J. Campbell, *International Journal of Technology Management,* 46, 3–4, 2009).



Conceptual profile of the series *Innovation, Technology, and Knowledge Management*

- The "Mode 3" Systems Approach for Knowledge Creation, Diffusion, and Use: "Mode 3" is a multilateral, multinodal, multimodal, and multilevel systems approach to the conceptualization, design, and management of real and virtual, "knowledge-stock" and "knowledge-flow," modalities that catalyze, accelerate, and support the creation, diffusion, sharing, absorption, and use of cospecialized knowledge assets. "Mode 3" is based on a system-theoretic perspective of socioeconomic, political, technological, and cultural trends and conditions that shape the coevolution of knowledge with the "knowledge-based and knowledge-driven, global/local economy and society."
- Quadruple Helix: Quadruple helix, in this context, means to add to the triple helix of government, university, and industry a "fourth helix" that we identify as the "media-based and culture-based public." This fourth helix associates with

"media," "creative industries," "culture," "values," "life styles," "art," and perhaps also the notion of the "creative class."
- Innovation Networks: Innovation networks are real and virtual infrastructures and infratechnologies that serve to nurture creativity, trigger invention, and catalyze innovation in a public and/or private domain context (for instance, government–university–industry public–private research and technology development coopetitive partnerships).
- Knowledge Clusters: Knowledge clusters are agglomerations of cospecialized, mutually complementary, and reinforcing knowledge assets in the form of "knowledge stocks" and "knowledge flows" that exhibit self-organizing, learning- driven, dynamically adaptive competences and trends in the context of an open systems perspective.
- Twenty-First Century Innovation Ecosystem: A twenty-first century innovation ecosystem is a multilevel, multimodal, multinodal, and multiagent system of systems. The constituent systems consist of innovation metanetworks (networks of innovation networks and knowledge clusters) and knowledge metaclusters (clusters of innovation networks and knowledge clusters) as building blocks and organized in a self-referential or chaotic fractal knowledge and innovation architecture,[4] which in turn constitute agglomerations of human, social, intellectual, and financial capital stocks and flows as well as cultural and technological artifacts and modalities, continually coevolving, cospecializing, and cooperating. These innovation networks and knowledge clusters also form, reform, and dissolve within diverse institutional, political, technological, and socioeconomic domains, including government, university, industry, and non-governmental organizations and involving information and communication technologies, biotechnologies, advanced materials, nanotechnologies, and next-Generation energy technologies.

Who is this book series published for? The book series addresses a diversity of audiences in different settings:

1. *Academic communities*: Academic communities worldwide represent a core group of readers. This follows from the theoretical/conceptual interest of the book series to influence academic discourses in the fields of knowledge, also carried by the claim of a certain saturation of academia with the current concepts and the postulate of a window of opportunity for new or at least additional concepts. Thus, it represents a key challenge for the series to exercise a certain impact on discourses in academia. In principle, all academic communities that are interested in knowledge (knowledge and innovation) could be tackled by the book series. The interdisciplinary (transdisciplinary) nature of the book series underscores that the scope of the book series is not limited a priori to a specific basket of disciplines. From a radical viewpoint, one could create the hypothesis that there is no discipline where knowledge is of no importance.

[4] E.G. Carayannis, *Strategic Management of Technological Learning* , CRC Press, 2000.

2. *Decision makers—private/academic entrepreneurs and public (governmental, subgovernmental) actors*: Two different groups of decision makers are being addressed simultaneously: (1) private entrepreneurs (firms, commercial firms, academic firms) and academic entrepreneurs (universities), interested in optimizing knowledge management and in developing heterogeneously composed knowledge-based research networks; and (2) public (governmental, subgovernmental) actors that are interested in optimizing and further developing their policies and policy strategies that target knowledge and innovation. One purpose of public *knowledge and innovation policy* is to enhance the performance and competitiveness of advanced economies.
3. *Decision makers in general*: Decision makers are systematically being supplied with crucial information, for how to optimize knowledge-referring and knowledge-enhancing decision-making. The nature of this "crucial information" is conceptual as well as empirical (case-study-based). Empirical information highlights practical examples and points toward practical solutions (perhaps remedies), conceptual information offers the advantage of further-driving and further-carrying tools of understanding. Different groups of addressed decision makers could be decision makers in private firms and multinational corporations, responsible for the knowledge portfolio of companies; knowledge and knowledge management consultants; globalization experts, focusing on the internationalization of research and development, science and technology, and innovation; experts in university/business research networks; and political scientists, economists, and business professionals.
4. *Interested global readership*: Finally, the Springer book series addresses a whole global readership, composed of members who are generally interested in knowledge and innovation. The global readership could partially coincide with the communities as described above ("academic communities," "decision makers"), but could also refer to other constituencies and groups.

Elias G. Carayannis
Series Editor

Preface

As we write, a strong media spotlight is shining on the wider region we associate with the Middle East and North Africa (MENA). It is as if the region stands as a focal point for public debate around the world. In a sense, its journey seems to embody the turbulence, conflict and insecurity that afflict the modern world. Its peoples experienced relatively little change to their daily lives over extended periods of time. But this is a region where massive change can unfold and spread with remarkable velocity, as the world has seen following the Arab uprisings that began in early 2011.

For all the attention levelled at the critical challenges facing the region today, there has been limited coverage of what matters more than anything else—the need for change in the way knowledge is developed and used. Investments must be made in people, social and environmental challenges have to be addressed and new economic activities must be enabled to flourish. These requirements are not unique to this region, but they manifest themselves differently in this part of the world. They also have an urgency about them here that is unparalleled elsewhere. Without progress on the long-term agenda centring on knowledge development and use, there can be no answer to the vocal demands we associate with the *Arab Spring*.

Whereas all the Arab countries face more or less the same challenges in this respect, the socio-economic context varies tremendously. The MENA region contains some of the richest countries in the world, but the majority have moderate incomes and large numbers of their citizens live in harsh conditions. Like elsewhere in the world, there is a common interest among policymakers in the role of knowledge and the ascent of a knowledge-based economy (KBE). Yet it is far from well understood how any particular society can go about fulfilling its potential benefits. Capacity building requires serious attention in the areas of education, research, innovation, enterprise development or entrepreneurship, which are interrelated. There is a fundamental need for each society both to be open and learn from the experiences of others and—at the same time—to work out its own solutions. Often, there is more to learn from societies that share similar issues and objectives. Despite the fact that the Arab countries have much to gain from closer collaboration in this field, there are relatively few collaborative projects across the MENA region addressing the critical issues we associate with the knowledge society. Likewise, few books have been published that venture into that space for broader parts of the region.

This book is in the position to draw on a unique joint research project aimed at promoting research and innovation capacity in this part of the world, which is the European Science & Technology International Cooperation Network set up in collaboration with the GCC countries (known as the INCONET-GCC project, funded by the European Commission). Obviously, on the MENA side, the focus here is thus not on the wider region, but the subset represented by the six relatively wealthy GCC countries. At the same time, Yemen (a candidate for GCC-accession), Egypt and Morocco also engaged in this programme. The initial work on this book built directly on the material prepared for the Best Practice in Science and Technology Policies conference hosted by The Research Council (TRC) of Oman at the Intercontinental Hotel in Muscat on December 6–7, 2010. Dr. Talal Al-Balushi and Ms. Umaima Al Mahdori at TRC coordinated the event.

Along with other collaborative events held in association with this project, the Muscat conference presented an opportunity for actors across the GCC countries and the European Union to engage in constructive dialogue on research and innovation, while also bringing on board experts and representatives from other Arab countries. An interim project report, based on the conference and published early 2011, ventured partly into methodological and measurement issues and laid the basis for further work to identify research areas and issues of mutual interest.

Following the report's completion, some of the contributors saw the potential benefits of developing a separate product destined for a wider audience. The initial vision was that of a book examining and communicating the range of issues confronting the GCC countries and the Middle East more broadly in regard to their effort to regain an edge in science, technology and innovation.

In the meantime, the Arab Spring broke out. As we know, the spark was that act of protest and despair by the Tunisian street vendor Mohamed Bouazizi when, following the confiscation of his wares, he set himself ablaze on December 17, less than ten days after our conference had ended. In the same vein, the uprisings reflect political conditions across the wider Arab world, pressing social, economic and environmental issues, and the distinct demand for a greater say by ordinary citizens. A strong feature from the outset has been the exasperation of young people living in societies where investments remain tilted towards traditional tangible assets in land and real estate, where natural resource extraction and the public sector dominate the economy, and which are marked by a deficiency of avenues for quality education, entrepreneurship and civil society engagement.

While the material from the INCONET-GCC conference provided a useful start for the book, we set about adding new material and dimensions, inviting a number of new contributors to cover additional critical angles that require attention in order to get a handle of the present situation, without losing sight of the core task of underpinning a more prosperous long-term development. On this basis, while the examination of conditions in the relatively wealthy GCC countries has remained at the core of the book, an effort was made to cover trends and patterns in the MENA region more broadly. We further ventured into additional aspects that need to be considered in order to get to the roots of the issues at stake in the region's transition, away from its current dependency on natural resources and ever-present public sector. The demographic situation, the state of the educational system, the conditions for entrepreneurship, the management of the natural environment, health and wellness, and the changing role of women all form part of the picture. The way institutions, cultural factors and governance structures play out matters crucially for what steps can be taken and how. Although the scope of these subjects prevents us from exhausting any single one of them, they must all be taken into account.

In parallel, the ongoing INCONET-GCC initiative has continued to deliver relevant output, including bibliometric analysis on cross-border collaboration in science and technology, which we have been able to partly include here. Again, however, the book reaches beyond that project and is one of the first to explore the wider societal and regional context of what has occurred on the ground—in Tunis, Cairo, Benghazi, Damascus and other hotbeds of unrest. While paying heed to the political factors that generally take centre stage in observations of the Arab Spring, this book primarily focuses on the underlying societal and economic issues, including those that we associate with the ascent of the knowledge-based economy. The book is also one of the first to apply benchmarking and critical examination of the range of factors and policies that matter in this area. It represents a unique effort to link between the dramatic events of the present time and the long-term perspective. It mobilises multiple and diverse points of view, from within the region as well as from other parts of the world, by researchers and analysts as well as by policymakers and practitioners in various areas.

We hope that these pages will stimulate new discussion and help inspire the investments and actions required for the region's institutions and aspiring peoples to take further decisive steps to ensure a better use of resources and lay the fundamental building blocks for a prosperous future carved out on their own terms. We are aware that lengthy documents are not the preferred means of communication in this day, marked by the constant arrival of new impulses and pieces of information, including in the Middle East which lacks a "reading culture"; it is the instant messaging made possible through ICT that has carried the banner of recent change in this region. Yet, without some sort of balancing act, through which especially the young can connect to in-depth inquiry, research and quality education, the region will fumble in taking on its critical issues and finding its footing in the world that is in the making.

The book consists of three main parts. The first provides the wider context, sets out the issues, draws international comparisons and addresses methodologies in learning how to approach the policy agenda at stake. The second presents various perspectives on approaches to address key challenges for capacity building and empowerment in relation to S&T, innovation and the ascent of a knowledge-based economy. The third examines further ways of addressing outstanding issues, notably with considerations to the contributions of international collaboration, including within the MENA region. While Part I has been contributed by ourselves

(Thomas Andersson and Abdelkader Djeflat), as the editors of this book, Parts II and III have been written by a number of different authors and edited by us.

We have many people to thank for making this book possible. As editors, we are grateful to all the authors who contributed, as well as the Research Council of Oman, which hosted and organised the Muscat conference, and the participants at that event. We are also grateful to partners in the INCONET-GCC project, notably to Stavroula Maglavera and Euroconsultants, Thessaloniki, who are responsible for the overall organisation, and Jönköping University in Sweden, as the main coordinator of the project's Work Package I. Most of all, we are indebted to the many ordinary people we have met across the diverse societies and communities of the vast region we here refer to, who are open and ready to discuss, exchange experiences and assume new perspectives on all that is going on. While taking full responsibility as editors for any errors or omissions, we are also grateful to Qammar Abbas, Glenn Gran, Matthieu Roest and Sara Johansson de Silva for the compilation of data, supportive analysis and organisational assistance.

Thomas Andersson
Abdelkader Djeflat

Contents

Abbreviations and Acronyms

AIOC	Anglo-Iranian Oil Company
ALECSO	Arab League Educational, Cultural and Scientific Organisation
ASEAN	Association of Southeast Asian Nations
AVET	Advanced Vocational Education and Training
BRICS	Brazil, Russia, India, China, and South Africa
CAAST	Coordination and Advancement of Sub-Saharan Africa-EU Science and Technology Cooperation Network
CIS	Community Innovation Surveys
CMI	Center for Mediterranean Integration
CSR	Corporate Social Responsibility
CTIs	"Centres Techniques Industriels" (or Industrial Technical Centres)
EECA	S&T International Cooperation Network for Eastern European and Central Asian Countries
ESCWA	United Nations Regional Economic and Social Development Commission in Western Asia
EU	European Union
EULARINET	European Union—Latin American Research and Innovation NETworks
FDI	Foreign Direct Investment
FP	Framework Programme
GCC	Gulf Cooperation Council (Kingdom of Bahrain, Kingdom of Saudi Arabia, Kuwait, Qatar, the Sultanate of Oman, and the United Arab Emirates)
G7	Group of seven largest market economies (at the time, the United States, Japan, Germany, Britain, France, Italy and Canada, later expanded)
GERD	Gross Expenditure on R&D
HEFCE	Higher Education Funding Council for England
HEIs	Higher Education Institutions
HDI	Human Development Index

HRD	Human Resource Development
ICT	Information and Communications Technology
INCONET-GCC	Science and Technology International Cooperation Network for Gulf Cooperation Countries aiming at the promotion of bi-regional dialogue
IPR	Intellectual Property Rights
ITU	International Telecommunication Union
KAM	Knowledge Assessment Methodology
KAUST	King Abdullah University of Science and Technology, Saudi Arabia
KBE	Knowledge-based economy
KE	Knowledge and innovation driven economies
LLP	Lifelong Learning Programmes
MENA	Middle East and North African Countries
MIRA	Mediterranean Innovation and Research Coordination Action
MNE	Multinational Enterprises
MPC	Mediterranean Partner Countries (MPC)
NCP	National Contact Points
NICI	National Intellectual Capital Index
NIS	National Innovation System
NSTI	National Science, Technology and Innovation
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
OPEC	Organisation of the Petroleum Exporting Countries
PEIE	The Public Establishment for Industrial Estates, Oman
PIGS	Portugal, Italy, Greece, and Spain
PRD	Provision for Research and Development
PTR	Prevailing Tax Breaks
R&D	Research and Development
RTD	Research and Technological Development
SEA-EU-NET	EU FP7 funded project to facilitate the Bi-Regional EU-ASEAN Science and Technology Dialogue
S&T	Science and Technology
SI	Social Innovation
SME	Small and Medium-sized Enterprise
STI	Science Technology and Innovation
TIMSS	Trends in International Mathematics and Science Study
TIP	Technology and Innovation Platform
TRC	The Research Council (of the Sultanate of Oman)
TTO	Technology Transfer Office
TVET	Technical and Vocational Education and Training
UAE	United Arab Emirates
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organisation

VC	Venture Capital
WBC	Western Balkan Countries INCO-NET
WIPO	World Intellectual Property Organisation

Chapter 1
Introduction

Thomas Andersson and Abdelkader Djeflat

The Arab Spring has added a new dimension to the winds of change sweeping the world. The uprisings were largely of a grassroots, home-grown nature in a region that by many had become viewed as inherently unresponsive to popular needs and also as reactive and mostly on the receiving end in regard to innovative developments in the wider word. They arose from the frustrations and aspirations of ordinary and mostly young and also in part uneducated people, far away from the corridors of big businesses, media companies and government offices. Operating against the harshest of odds, they spread with a phenomenal rapidity in a way never seen before for a movement of this kind, reaping one unexpected victory after the other. It is fair to say the sequence of events we associate with the Arab Spring has come as more of a surprise and also gained more widely spread attention than basically any other societal developments around the world of recent years.

How we evaluate the uprisings and where we expect them to lead varies greatly according to where we come from and the issues on which we choose to focus. Yet, the Arab Spring has clearly brought a change in the way that particularly young people engage in societal issues, and also in the way governments and public authorities view themselves and their constituents. While this applies across most of the MENA[1] region, it extends beyond as it has provoked new reflections

[1] The Middle East and North Africa (MENA), in this book often denoted just the "Middle East", can be reckoned to include 22–23 countries, see further Chap. 2. When referring to the "Arab world", although the wider region is again inferred, some countries obviously fall outside this definition (notably Iran, Israel and Turkey).

T. Andersson (✉)
Jönköping International Business School (JIBS), Jönköping University, Sweden, Europe
e-mail: thomas.andersson@jibs.hj.se

A. Djeflat
Maghtech Network, Clerse-University of Lille (France), Lille, France
e-mail: Abdelkader.Djeflat@univ-lille1.fr

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_1, © Springer Science+Business Media New York 2013

and initiatives in developed countries as well as in other emerging and developing regions.

Already within its first year, the Arab Spring claimed the downfall of four heads of state (of Tunisia, Egypt, Libya, and Yemen), all of whom had held power for many years and appeared firmly in control when the unrest began. It has toppled cabinet ministers and numerous high-ranking public officials across the region. The future course of developments is far from clear, but the Arab Spring is almost certain to pose formidable political and economic challenges to additional regimes. Syria of course finds itself mired in relentless conflict as of the present day.

On the issue of geopolitical imprint, part of the picture concerns the implications for relations between societies associated with Sunni versus Shia Islam.[2] For regimes in Sunni-oriented Arab countries, the Arab Spring meant that they suddenly were face-to-face with a multifaceted yet oddly consistent home-grown opposition movement. Compared to the militant resistance to the West more closely associated with the states dominated by Shia Islam, however, this movement had a markedly human face, with a focus on peaceful demonstrations. Yet, the Arab Spring was also able to diffuse its message much more effectively than any military or terrorist resistance movement ever had—and also proved itself more capable of inflicting real change in the corridors of power. In a way, the uprisings have erased the previous apparent contrast between the resistance of Iran and its Shia allies to Israel and the West, and passive Sunni onlooking.

Within a single year the Arab Spring had in fact affected policymaking in practically all countries in the Arab world. In the Arabian Gulf, favours had been handed out to broad segments of the population. Announcements had been made to invest more in education and to create new jobs. The response of the Saudi regime included a more vocal call than hitherto for closer political ties with its affluent but smaller GCC neighbours.

The events that have taken place, coupled with the underlying structural issues they reflect, cannot be met by minor adjustments to the prevailing order. There is a deep widespread sentiment that real policy shifts, as well as a massive reorientation of public spending, are required. At the same time, the upheavals have interrupted economic activity, fuelled instability and uncertainty over political and economic development, and caused major disruption for many industries and entrepreneurs. Capital flight has combined with a loss of revenues from tourism, lower investment and higher unemployment. Across most of the region the general economic outlook has deteriorated, prompting unease and outright counteraction from many corners. Traditional and fundamentalist religious voices have grown more vocal and may come to exert a stronger influence, if not achieve outright

[2] The followers of Sunni Islam include Saudi Arabia and most of the smaller GCC states, North Africa and also a majority of the Muslim population in Jordan, Lebanon, Palestine and Syria. The main other branch, the Shia, dominate in Iran and its followers include a majority of the population in Iraq and Bahrain. In Syria and Lebanon, minorities that are Shia Muslims or strongly associated with them hold great political power. Oman and many of the Muslim followers in Asia and Africa pay little or no attention to the Sunni-Shia divisions.

political domination, across parts of the Arab region where they previously had been on the retreat. Women, who now represent a majority among those who attain higher education in many countries, meet with new resistance and barriers in the workplace, and also broadly in public life.

The impact of the Arab Spring has reached beyond the Arab world. Of course, public protest is nothing new. However, the grassroots character of the movement, and the way it demonstrated that it was possible to stand up against the most authoritarian and ferocious of regimes, has given rise to a particular kind of inspiration. There is a clear link to the so-called "Occupy Wall Street" movement in the United States, through which notably young people have acted in an unprecedented way to protest conspicuously against huge income disparities, financial company misdeeds and the political influence of the corporate sector. On a different but still related note, at the Multilateral Climate Change negotiations in Durban on December 7, 2011, the US chief negotiator, Todd Stern, spoke out in defiance of basically all other countries of the world that action on climate change would have to be postponed until after the Kyoto Treaty expired in 2020. He was interrupted by a 21-year old student who declared that she spoke on behalf of the US since her government could not. Shortly afterwards, Stern surprisingly backtracked and was suddenly supporting proposals for new collaborative work on global warming to start immediately.[3]

Those who argue that there is no connection because the tough conditions facing youth in the Middle East "are so different from those in the West" have missed the point. The individuals who took action to trigger the Arab Spring showed the world what plain courage, backed by coordinated action and determination among the grassroots, can achieve even in the face of the cruellest oppression or the mightiest of incumbent interests. Their courage and successes have paved the way for others to follow in situations where resistance previously had been viewed as basically futile.

There is no doubt an equally pervasive link to Russia where the president, Vladimir Putin, encountered unexpected and widespread demonstrations in December 2011 following the announcement of obviously fabricated election results, given that the number of declared voters by far surpassed 100 % of the population. Again, the widespread nature of the protest and the initially timid response this time from a usually much less shy regime had hardly been conceivable before the Arab Spring. Young people in South Asia, Africa and Latin America have also clearly taken note of what may be achieved, and so has incumbent regimes basically everywhere.

The purpose here is not to judge what is good or bad. We observe the inevitable: that in a world of growing exchange of information and perceived opportunity but continued institutional rigidity and unfulfilled potential, enormous inequality and the failure of economic systems to apply new knowledge to

[3] In the end, the negotiations did achieve an agreement. Though watered down by the US and China, it was more than had been widely expected.

generate better jobs and societal outcomes, a new outlet has arisen for the energy of frustration of the masses. In this situation, it is becoming essential for governments that they are able to respond in a constructive manner by promoting institutions and policy developments that are apt to make a positive difference in the long run, rather than by reacting with violence or by short term fixes that may allow them to buy some time but make matters worse.

There are other kinds of geopolitical consequences. For years, the stridence of the Iranian revolution, on the one hand and the painstaking, slow-moving stalemate of the Israeli-Palestinian struggle on the other hand, has created deep animosities and a sense of alienation within the broader universe of Muslim countries. Religion has in many cases assumed the perceived role of exclusive guarantor of unity and stability.

The Arab Spring has, however, set additional complex processes in motion. Again, as Sunni societies saw the rise of home-grown grassroots dynamism, attention shifted away from the violent resistance movement. All the same, the aftermath of the Arab Spring has contributed to sharper friction between the adherents of different religions, including Islam and Christianity. While Conservative-inclined religious parties such as Salafi in Egypt have been created (or strengthened), benefitting from the de facto dominance of mosques and the imams as the main established communication channels on the ground, the new liberal movements still lack organised institutions for reaching out broadly in society. In that context, the prevailing structures perpetuate the counter-reaction to the Arab Spring, with the role of women in the economy and in the family at the heart of the struggle. Women freedom fighters, who played a prominent role in the uprisings against totalitarianism, now find themselves targeted by traditionalists. Notably in Egypt, the military dug in its heels to halt the wave of change in either direction, in defence of status quo and its extensive privileges. In the process, however, it has lost its support among the general populace.

Further, the Arab Spring affected the standing of Israel relative to its regional neighbours and global partners, raising questions about preferred alliances of Western regimes and, in many cases, directly or indirectly led them to adopt new and different positions on a range of key issues. Israel deplored the rise of the popular movements, fearing the collapse of order and the emergence of a much more openly hostile and dangerous neighbourhood.

The Arab Spring has been widely expected to bring a more vocal demand for a solution to the outstanding Palestinian plight. The never ending suffering of an entire people living under conditions of despair and oppression stokes a sentiment, however, that hurts not only the standing of Israel and the West but also the forces that favour a more open and tolerant landscape for everyone across the Arab world. That Israel has subsequently shifted attention to confront what is seen as the Iranian threat, where the outlook of weapons of "mass destruction" has also spurred the United States and Europe to deploy a range of actions to isolate the regime, will not diminish those costs. That the Palestinian question must be resolved under all circumstances, sooner rather than later, may at any rate be viewed as a truism. The Arab Spring has however raised the stakes for multiple parties.

Naturally, the occurrence or the consequences of the Arab Spring cannot be understood in isolation. The movement behind the uprisings is linked to a range of other major developments unfolding across our increasingly globalised and interconnected world. It is tied to worsening environmental issues and population growth, which have led to new pressures in commodity markets, rising food prices and social unrest in many countries. The harsh natural environment of the Middle East, prone to calamities and vulnerabilities, including in access to water and food, is under particular stress since high economic growth combines with producer and consumer patterns that display little concern for long-term sustainability.

The movement is also linked to the international financial crisis that unfolded when the real estate bubble burst in the United States in 2008, the further oscillations of which have combined with unaddressed structural issues to cause an explosion of government debt across much of the developed world and sent convulsions through financial markets. The economic fallout of the Arab Spring thus blends with the crisis in the Euro zone where a divide has opened up between the southern European countries with their lower productivity levels and high trade deficits, and their counterparts in Northern Europe, notably Germany, whose economies are more efficient and performing better under the prevailing exchange rate regime.

Additional connections exist with fundamental changes under way more or less worldwide. These relate to the rise of new technologies, especially information and communications technology (ICT) that allows people everywhere to access, use and communicate information on a scale never seen before. The advance of ICT and wider processes of technical progress and raised levels of education bring an enormously enhanced capacity for scientific and research activity and the diffusion and widespread use of new knowledge. ICT has allowed especially the young and unprivileged to gain information and engage in two-way communication at global level. Hence, the advent of new technologies is deeply intertwined with societal and organisational change.

In the so-called developed world, which has accumulated more experience and capacity with new technologies and how to use them, populations are ageing. In the developing and emerging countries, where opportunities exist to leapfrog in the adoption of new technologies and working methods, populations are much younger and as technologically savvy for their age as elsewhere, and might be swayed in their choices of professional direction. Yet, the Middle East is seeing large numbers of adolescents approaching working age, better educated than any prior generation but with many intent on grabbing a job in secure public services or established industry. Meanwhile, these societies are largely devoid of the kind of research and learning institutions that are important for inspiring depth and diversity in the public discourse.

Everywhere, though, the demands on people to gain an education are rising steadily, as are the pressures on them to adjust and keep training and learning in the workplace. Industries and companies are subject to rapid change. Old enterprises are dislodged if they cannot respond to competition and many jobs disappear as work can be rationalised and performed by machines rather than people. New industries, companies and jobs are emerging but their rise is far from effortless. There is a fundamental need for entrepreneurship and experimentation, managing risk, developing the mechanisms required for the provision of seed funding, retraining of those that lose their jobs and allowing individuals to succeed or fail, if we are to create new, high-value-added economic activities and jobs in this era of opportunity and turbulence.

The Middle East in many respects stands out as perhaps the region facing the most intensive contrast between old and new. Here, today's events are unfolding against the backdrop of millennia during which the region belonged among the leading centres of human civilisation and then fell victim to centuries of stagnation marked by only modest change (at least in some of the respects that currently matter most for societies' ability to take advantage of the opportunities associated with technical change and social transformation).

The increased revenues from natural resource extraction in the Middle East, following OPEC initiatives and subsequent oil price hikes from the 1970s onwards, made huge financial resources available to governments and funded ambitious infrastructure projects. The substantial rents generated by oil wealth did lead to improved public services, but they also reinforced structures to secure stable privileges for those in control of those rents. Firmly established political regimes solidified their grip on power. In North Africa, and notably in impoverished Libya, the black gold enabled the leadership (in this case the Gaddafi family) to join the ranks of the richest people in the world. Here, institutional change and modern economic reform evolved particularly slowly, reflecting the determination of the "revolutionary leader" to head off the rise of rival leadership through totalitarian means, while also essentially depriving his people of any orderly conditions to gain a meaningful life and to think for themselves.

Where leaders were less ruthless or outright benevolent, the rents generated by the oil revenue have de facto provided a source of funds for investment and development. They have enabled a massive strengthening of infrastructure, as well as investment in education, health and new social services. Yet the presence of abundant oil wealth poses an ever-present risk of complacency and threatens to entrench the so-called rentier culture—even in the more successful countries.

While this book is concerned with developments across the Arab World, particular attention is paid to the Gulf Cooperation Council (GCC)[4] countries, which represent the most affluent and, thus far, stable subset of the wider region. At the same time, the dominance of the oil economy and public sector growth has been particularly stark in these countries. The revenues accruing to the black gold have enabled higher incomes for the majority of the population, but many of the old issues remain unresolved and new ones are looming. While the experiences of the GCC states in some respects differ from those met by the region as a whole, in

[4] The members of the GCC are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE). The GCC's stated objective is to promote cooperation between its members to achieve unity.

other instances they help illuminate broader trends and what others may encounter in the future. In several places we will put particular emphasis on patterns discernible across the MENA region taken together.

The focal point of this book is not the political and social aspects of the Arab Spring, though these are part of the story. At stake are the fundamental economic and institutional context embracing the Middle East, how that has manifested itself in the movement we associate with the Arab Spring and what is now under way in terms of economic and societal development. Investment in so-called “intangible assets”, people and “soft skills”, or efforts to engage in research, innovation and entrepreneurship, make the news headlines from time to time, but the critical weight of such factors remains much underestimated. Building inspiration and establishing enabling conditions for new initiatives in value-creation is essential, including a mindset that allows for experimentation and risk taking in trying out new ideas, and also so as to turn outstanding societal challenges into an opportunity and a source of development. This, if anything, is why there must be more of in the wake of the Arab Spring if we are to find real answers to the situation at hand.

Against this backdrop, the book consists of three parts:

Part I presents the background by considering key historical, structural and cultural features of the MENA region that are critical for understanding the roots of the Arab Spring and where it may lead. Particular attention is paid to the GCC countries, the most affluent nations of the region, and to what degree they use their natural resource wealth to build a more prosperous future. Human capital, demography, the economic structure, educational systems, and employment all receive attention. In short, conditions stifling research, innovation, risk taking and entrepreneurial effort, combined with the dominance of the public sector, are hindering a move away from oil and gas dependency. The rationale and nature of policy in this area is reviewed, as are methodologies for measuring and understanding where the region stands in the knowledge era. The five chapters of Part 1, which are authored by the editors (Thomas Andersson and Abdelkader Djeflat), can be summarised as follows:

Chapter 2 provides the context for “*The Changing Landscape of the Middle East*”. A cradle of civilisation, this part of the world once produced outstanding science, arts and technical inventions. The dramatic rise of the Muslim world is described in brief—and how it impacted on world affairs and struggled through the onset of colonialism. The Middle East subsequently regained control over its natural resources (which now represent a source of huge revenues for many countries) but has thus far failed to regain its handle on science, technology and innovation. While characterised by strong traditional values, and apparently immune to change in some respects, history has proven that change can sweep the region with tremendous force. Besides illuminating frustration with the political order, the Arab Spring reflects the arrival of the information era and the aspirations of the fast-growing number of adolescents who are bound to clash with the region’s partly archaic educational systems, its mismatch with labour market needs and its hurdles to renewal. True, a ferocious counterreaction, coupled with a fierce economic downturn, has brought many industries and companies to a standstill and further worsened the employment outlook for young people. Tensions between different religious groups have sharpened and there are also adverse consequences for immigrants and for the professional outlook of women. While we cannot be certain of the ultimate fate of the Arab Spring, we can rest assure the underlying, fundamental issues will not go away but will have to be addressed.

Chapter 3 introduces "*Capacity Building, Rationale and Learning from Best Practices*". It initially reviews the increasing importance of technology—especially information and communications technologies (ICT)—and its connections with skills and organisational issues. As product cycles shorten and the pressures for increasing productivity and shedding labour escalate, the need for re-skilling and restructuring is on the rise whereas job creation stands out as an increasingly dire challenge. Applying frameworks such as those of innovation systems, clusters and the Triple Helix or Quadruple Helix linking complementary competencies, it is considered how conditions for science, technology and innovation (STI) can be strengthened. The government has a key role to play in regard to infrastructure, basic research, basic education, the provision of seed funding for commercialisation and so forth. But it is critical that governments enable others to make the progress rather than seeking to "get things done" themselves. With globalisation, the means must further be found to attract and motivate mobile knowledge resources. Large corporations have the market channels and capacity to invest in R&D, while SMEs are less entrenched and more inclined to take the risks required for innovation. Conditions for investment in intangible assets and knowledge-based entrepreneurship must improve across the Middle East to achieve economic diversification and job creation and to obviate escalating unemployment. While the GCC countries with their oil wealth clearly share the risk run by other similar countries of being trapped in a resource curse of choking rent-seeking, the entire region has now been subjected to a "shock" of its own—a new driver to reform and restructure, which is that of the Arab Spring. Learning from the successes as well as failures of others must be intensified, although on terms of relevance to the specific local context.

Chapter 4 presents the "*Basics on Benchmarking*" and proceeds with a discussion of methods for benchmarking performance, processes and policies. The different kinds of benchmarking and how they can be applied for maximum utility merits consideration. A critical aspect has to do with what gets measured and how the results are interpreted and communicated. The indicators developed to gauge innovation have evolved from metrics measuring inputs to outputs and then processes. Today, the emphasis is on the nature of networks, linkages, synergies and capacities for risk management and systems dynamics. Useful benchmarking of the GCC countries should include indicators picking up aspects that are particularly relevant for these nations' transition from natural resource-dependent towards knowledge-based, while still allowing for international comparability. Countries richly endowed with natural resources tend to have access to cheap capital and face challenges due to boosted government, rent-seeking, resistance to societal transformation, and barriers to innovation. At the same time, some such countries around the world have diversified successfully away from their natural resource base. Benchmarking of the GCC countries should include comparisons that can highlight lessons for research, innovation and entrepreneurship in this context.

Chapter 5, on "*Examining Performance*", benchmarks the GCC countries against each other and against selected peer countries in the MENA region, a relevant EU average, and some other points of reference around the world. It maps the strengths and weaknesses of Middle Eastern countries with a particular eye to casting better light on their transition away from natural resource-dependency towards a position as knowledge-based economies. To summarise, several of the GCC countries have achieved an income level—measured by a traditional GDP per capita metric—on par with high-income countries. In ICT, they have recorded remarkable progress, including the diffusion and use of mobile telephony and instant messaging. Although they have also vastly improved their infrastructure and invested in education they remain exceptionally dependent on their natural resource base. Education quality continues to present them with major problems and their record in science, technology and innovation remains meagre. Although individual universities have shot up the international rankings, especially in Saudi Arabia, there are few signs of a genuine research and innovation culture taking hold. As for entrepreneurship and enterprise development, the GCC countries have leapt ahead of their peers in the MENA region, but each country still continues to face specific hurdles.

Chapter 6, on "*Measuring Performance in GCC and selected MENA Countries: In-depth Considerations of Implementation*", ventures further into measurement of policy performances. Finland, similar to the GCC states in that it is a relatively small country well endowed with natural resources which, in part, have been used to support diversification and industrialisation, serves as a referent country on policy implementation. Turning an acute crisis into an opportunity, Finland is notable for its success in bringing stakeholders together in formulating a comprehensive approach to STI policy. Benchmarking is further applied to measure and examine selected indicators of science, technology and innovation output. Countries in the MENA region should go beyond simply assessing their gap in STI performances and policies vis-à-vis peers and advanced countries by undertaking in-depth analysis, e.g. of the mechanisms at work in shaping output and input relations. It is important, for instance, to strengthen support to SMEs to manage the intellectual property rights issues as a whole. While R&D funding matters, it is crucial to tackle absorption and transformative capacity. Governance, quality of institutions and public procurement emerge as key inputs. Lessons are drawn regarding STI policy implementation, including how to shift investments from conventional focus to the local environment for innovation. While one must be aware of the limitations and how to interpret the lessons, benchmarking and learning from international comparisons is greatly needed for disclosing and communicating the room and need for improvement in policymaking and institutional development.

Part II develops a different and yet complementary perspective as it approaches issues, challenges and opportunities in relation to STI and the ascent of a knowledge-based economy throughout the Middle East and the wider Arab world. It discusses how science and technology can be revived and the relevance of the Arab Spring, including for overcoming rentier culture. It highlights inroads into manufacturing, building strong institutions and putting in place professional management and procurement as driving forces for capacity building. Based on considerations of the health sector and environmental issues, it further reviews and highlights the potential for STI to turn burning challenges into major opportunities. Consisting of contributions by diverse authors, Part II contains the following six chapters:

Chapter 7 tackles "*The Relevance of Science and Technology for the Arab Spring and the Key Role of Knowledge Economy*" (Abdelkader Djeflat). Policy-making and governance are subjected to fundamental changes across the Middle East. ICT not only helps by diffusing information broadly in society, especially among the young; it also offers entirely new and empowering communicative tools. These tools served as a leverage factor in making the Arab Spring possible and helped catalyse its phenomenally fast spread and role as a lightning rod for mass communication at the grassroots level. The promise of the knowledge-based economy paradigm made a crucial contribution to the Arab Spring and its gradual appropriation by young people. Acquired other capacities, notably with regard to free expression and power to elect truly representative leaders, are naturally intrinsic to overcoming the issues raised by the Arab Spring. Overcoming the challenges will however also require reforms capable of inspiring and mobilising large numbers of people to utilise new technologies, accept risk taking, innovate and engage in start-ups and entrepreneurial ventures.

Chapter 8 examines "*Research, Innovation, Entrepreneurship and the Rentier Culture in the Arab Countries*" (Omar Bizri), addressing major challenges faced by countries in the MENA region (with a special emphasis on the GCC countries) in youth employment, sustainable growth, inequality and poverty. Indicators suggest less than adequate (and often dismal) performance in the last few decades, for instance in the quality of education, innovation and entrepreneurship. Problems are rooted in fundamental challenges embedded in many walks of life across the region. Additional issues arise from the manner in which scientific, technological and entrepreneurial capacity is set to evolve in the shadow of the *rentier* model that pervades the cultural and institutional fabric of the region. Compounded by persistent ethnic, religious and political conflict, this state of affairs undermines the development of relevant capabilities. Some indications suggest that a gradual change is under way, not least through growing awareness that the management of the region's resources (and its youth) remains below par. Policymakers must work towards more inclusive policies that are able to seriously engage stakeholders and the wider population in the processes of knowledge creation, dissemination and utilisation, emphasising investment in the region's youth and in intangible assets. Nothing less than a radical overhaul of governance procedures, institutional arrangements and infrastructures and an emphasis on innovation and entrepreneurship will convert the numerous challenges facing the region into opportunities and long-lasting benefits. Fresh strategies are needed to make this happen, for which good governance and cross-regional collaboration play a key role.

Chapter 9, on "*S&T Innovation Systems: The Role of Manufacturing, Institutions and Leaders*" (Eoin O'Sullivan), focuses on science and technology policy innovation and the "industrial commons". The complexity and dynamics of national innovation systems make benchmarking S&T policies extremely challenging. For S&T to succeed in advancing industrial competitiveness and prosperity, a holistic approach to industrial innovation systems along with S&T policy and programme design must be adopted. Institutions at three levels—the industrial-innovation ecosystem, intermediate R&D institutions and R&D institutional leaders—are vital for building capacity amongst S&T policymakers fully cognisant of the interdependence of science and technology, R&D and manufacturing. The efficiency of the industrial innovation ecosystem may be enhanced by the alignment and synchronisation of S&T policies with economic policies and high-tech industry development strategies nevertheless. Furthermore, the organisations operating within the innovation system must enjoy appropriate configurations, capabilities and linkages. Intermediate translational research and technology organisations that bridge the gap between public research and industry may play a critical role, but their precise design is context-specific. Finally, a successful intermediate R&D institution depends on the quality, experience and leadership skills of senior management. Extraordinary opportunities nevertheless exist to grow new S&T-based innovation systems. In particular, there is considerable potential to align and synchronise S&T policies with economic policies and high-tech industrial development strategies, given that policymakers are able to draw constructive lessons from the success and failures of other policy experiments before them.

Chapter 10 explores "*Innovation in the Public Sector: Experiences in E-Procurement and University Research*" (Andrea Prat and Erina Ytsma). It initially highlights the role of public procurement in driving innovation in the public sector and then applies bibliometric data to examine cross-border linkages in scientific work. The ongoing expansion of higher education institutions in the GCC countries raises tremendous challenges, not least attainment of requisite quality in research and its relevance to society. Universities cannot meaningfully be regulated or prescribed to achieve excellence in a uniform manner. Any successful strategy needs to embed a strong element of autonomy and local initiative. On the other hand, public support and incentives are critical for spurring progress. Public procurement practices can provide very effective tools in this reform process. Research funding has the ability to strengthen science and research excellence in harmony with local adaptation and diversification. Meanwhile, collaborations between local and international researchers may be of central importance for furthering a knowledge-based economy. One of the initial steps towards increased research capacity should be a careful review and examination of existing scientific output in the GCC countries and international linkages. Against this background, bibliometric data help to perform an exploratory analysis of the research collaboration network of the GCC countries and Yemen. The results demonstrate substantial research collaboration between the GCC and Yemen and, for example, the US and Europe, but very weak collaboration within the region itself, as illustrated by examples from the engineering and medical fields.

Chapter 11, on "*New Perspectives on Health Issues, Research and Innovation*" (Kazem Behbehani and Peter Beales), addresses current trends and issues in public health across the Middle East. The prevalence of Type 2 Diabetes and obesity (including among young people) is relatively high among the GCC countries. Merely increasing public expenditure will not solve the challenges and generate the investment that needs to be made in research, technology and education and in training high-class health-care providers with the requisite skills. A new health research and innovative strategy transcending traditional domains and incorporating lifestyle changes is under development. The Dasman Diabetes Institute is an initiative by Kuwait to develop an institutional platform for a comprehensive approach. Its novel approaches include an electronic health (eHealth) network linking primary and secondary facilities, developed in collaboration with international partners and set to unleash a range of innovations in the form of new and empowering tools for improving healthcare in the community. In addition, an eLearning model and the Diabetes Resource Centre promote health awareness and lifestyles changes. A state-of-the-art Genome Centre for innovative research to develop preventive and therapeutic strategies to control obesity and diabetes and their associated complications in Kuwait has been established. Furthermore, the development of a geographic information system (GIS) coupled with the deployment of m-health solutions is primed to offer new tools to identity and combat the social, economic, behavioural and political determinants of rapidly spreading non-communicable diseases.

Chapter 12 considers "*A Research and Development Framework for Sustainable Development in the GCC Countries*" (Thomas Andersson and John Liu). It surveys the critical challenges associated with the physical environment and prospects for creating a green economy in the Middle East. The GCC countries face major challenges in the economic and social sphere, while their record on the environment is dire. Better indicators are required to measure the state of environmental management and to facilitate an understanding of the causes underlying decay and how they can be addressed. The development and communication of data also needs to be integrated with a strategy that makes local communities more aware of the relevant issues and what role they can play in rectifying the situation. A wide range of environmental problems threatens the region in the years ahead, yet awareness of and capabilities in how to address them are generally lacking. Water and energy—areas where public subsidies heavily distort behaviour and resource allocation—and land and soil treatment are particular concerns. Conversely, the poor environmental record across the region, especially in the GCC countries, represents an opportunity to turn things around. Here, STI policies have a key role to play. A comprehensive strategy is required to translate concern for environmental deterioration into an impetus for better living conditions and the achievement of advantages in the development of new goods and services that are attractive for new and expanding markets. The adoption of a broad-based strategy for recovering large-scale ecosystems, including by greening sizeable areas of land, could generate huge benefits for the region. Modest investments could boost the economy in rural areas and strengthen local institutions and culture, while increasing productivity and spurring job creation.

Part III further examines ways to address key issues through STI and entrepreneurship, paying special attention to opportunities for international collaboration. While observing the trends that are inherent to STI in and around the region, priorities must be geared to evolve based on its needs and opportunities. International linkages and partnerships are instrumental for strengthening the capabilities of individual researchers and universities alike. Fully capturing the rapidly evolving opportunities emanating from ICT requires effective cross-border joint initiatives, as well as collaboration to remove unwarranted hurdles. Examinations of the conditions and issues that have prevented an effective response to the challenge of lifelong learning suggest that the establishment of a GCC/MENA collaborative programme could help generate substantive region-wide benefits. An analysis of trends regarding entrepreneurship among university faculty in Saudi Arabia takes stock of current conditions as well as emerging trends. Considerations of the fundamental challenges confronting the Arab countries with regard to adaptation to a changing world and the rise of a knowledge-based economy lay the basis for recommendations of a two-tier policy track combining short term measures and long-term reforms to help enable mindset change as well as a mobilisation of cultural values. Finally, issues pertaining to the enabling of institutional reform, including in education and entrepreneurship conditions, are revisited. Part III contains the following six chapters, contributed by various authors:

Chapter 13, "*Research Priorities and their Impact on the National Innovation System*" (Cristina Flesia) discusses ways forward in setting directions for capacity building. As universities face growing demands to engage in regional development, adjustment is required both in national policy frameworks and within individual institutions to pave the way for diverse and locally adapted responses. Research priority areas and topics must be determined with a view to social needs as well as to what is feasible given the importance of establishing critical mass and relating to international trends inherent to science and technology. The following areas stand out as important for building research capacity in the GCC countries: environment, water and climate (including marine, agriculture and food), health, energy and information and communication technology. Meanwhile, research and applications in biotechnology and nanotechnology are now an integral part of R&D in many fields (for example, life science, agro-industry, chemical industry, energy and the environment). As for how to collaborate, different schemes offer different advantages. Bilateral cooperation may be effective in developing focused technical capacities, (showing up, for example, in numbers of patents or scientific publications), whereas international cooperation via larger networks may bolster long-term capacity building. Given the difficulties in mustering critical mass in local talents, collaborative projects and networks involving multiple countries may be particularly valuable by providing a larger pool of ideas and contacts, and by enabling a more multidisciplinary approach. They may also facilitate the mobility and exchange of students, researchers and scientists, contributing to a more natural and gradual development of facilities and infrastructures.

Chapter 14, on "*ICT Convergence and Europe's Digital Agenda 2010–2020*" (Sylviane Toporkoff), elaborates on the ongoing trend towards convergence in the e-economy. In the GCC states, key opportunities include the range of options on offer for SMEs to achieve greater reach and higher productivity, along with new openings to cut across traditional sectoral and national boundaries. At the same time, economic integration can further enhance the potential benefits. Drawing on lessons from the digital agenda for Europe (2010–2020), there is a distinct need for the GCC countries to collaborate more effectively to put in place IT frameworks that are conducive to the rise of new applications in areas like e-health, e-education and green IT. Like their EU counterparts, the GCC countries are heterogeneous yet represent a wider community that stands to benefit from further pooling of resources and common strategic initiatives. The mix of rapidly evolving opportunities should be exploited to inspire new and stronger research networks and projects across national and sectoral borders. Cross-regional collaboration can be used to help catalyse necessary change in that regard. One concrete possibility would be the establishment of joint EU-GCC networks for young researchers, which could activate currently fragmented communities and invite participants from across a range of cross-disciplinary issues of relevance to both regions.

Chapter 15, on "*Establishing a New Framework for Lifelong Learning*" (Mohamed Chaib), analyses the factors that have prevented an effective response to the needs of lifelong learning, e.g. with regard to merit-based promotion and cross-generational collaborative learning. A joint GCC/MENA initiative to form a collaborative programme for professional and continuing education could be hugely helpful, leveraging the shared Arab language across the region. Building common ground for collaboration on lifelong learning and continuing education needs to include a strong focus on R&D while also bringing together different types of stakeholders. It should: mobilise much greater interest than hitherto in designing and diffusing work-life-related continuing education programmes for professional development; establish interregional networks to identify best practices; encourage extensive communication between students, faculties and experts; and intensify international scientific cooperation. Given the presence of barriers that inhibit new initiatives, there is a need for experimentation, testing and sharing the experiences of new policies and practices for lifelong learning, while laying the legal and practical foundations for the adoption of new practices more broadly. Plenty of scope exists at the organisational level to establish conditions that can facilitate improved capitalisation on the untapped potential for two-way knowledge exchanges between younger, more technically skilled workers on the one hand, and older, more experienced workers on the other. Finally, the costs for building lifelong learning capacities should be managed within normal government budgets and financial frameworks, while also pooling resources provided by various concerned parties.

Chapter 16 explores "*University-Industry Cooperation and Conditions for Start-ups*" (David Audretsch, Ahmed Alshumaimri and Taylor Aldridge) and revisits entrepreneurship in the GCC region and how it links to the current paradigm of university organisation and higher education. The findings, exploiting new data on attitudes to entrepreneurship among university faculty, suggest that university scientists in Saudi Arabia emulate their colleagues in OECD countries in some ways, but not in others. Scientists who are more productive in terms of publications have a greater propensity to be entrepreneurial in the Saudi Arabian context compared to the OECD. Moreover, younger scientists with less experience are more open to entrepreneurship. This result contrasts with OECD countries, where maturity and experience are more conducive to scientist entrepreneurship. The disparity may reflect a generational shift in attitudes at Saudi Arabian universities, where young scientists are more open about pursuing entrepreneurial activities than their more experienced and older counterparts. In an added contrast to OECD countries, female researchers in Saudi Arabia display no lower propensity for entrepreneurship. Given the growing number of Saudi women engaged in research—and also the varying conditions for female and male entrepreneurship—it will be useful to track how attitudes among women researchers evolve over time compared to those of their male counterparts in the region as well as their female counterparts further afield.

Chapter 17 addresses the task of "*Building Knowledge and Innovation-Driven Economies in Arab Countries*" (Jean-Eric Aubert, Mats Karlsson and Anuja Utz) in the Arab world. Considerable variation can be found across the region in articulating development strategies relating to the rise of a knowledge-based economy (KBE). Basically, all countries struggle to cope with the demand for new jobs, demonstrating that new strategies are needed. The requirements for progress include better-coordinated institutional reforms, the rise of new knowledge-intensive sectors, and the facilitation of international and regional integration. Under the umbrella of a broad economic strategy, steps need to be taken to enact mindset change. In the short run, immediate actions are needed to build self-confidence through visible, concrete results. These include: mobilising diaspora, designing and managing KBE strategy, media campaigns to popularise KBE and dialogue facilitation with key international organisations. In view of its specificities, the Arab world in the long term needs to promote value-related actions by drawing on values that are fundamental to the Islamic culture. This task includes working on the Arab and, more broadly, the Islamic "Umma", or broader community; in other words, strengthening identity. Building knowledge- and innovation-driven economies should be at the core of development strategies in the Arab world. Each country should aim at designing and implementing these strategies, tailored to its specific conditions.

Chapter 18, on "*Special Considerations and Ways Forward*" (Thomas Andersson), reviews and reflects further on selected policy issues, presents processes and outcomes related to a few recent conferences and workshops and offers final remarks. The events referred to, while hosted by Oman were organised to address issues of wider regional and international significance. They focused on

STI as well as on entrepreneurship through higher education. Five selected themes are reviewed in regard to the former: (i) capacity building in research; (ii) technology diffusion and innovation; (iii) social and non-technical innovation; (iv) governance; and (v) digital convergence and ICT utilisation. In this context, it is essential to pave the way for greater diversity, specialisation and relevance in university operations. The book ends with thoughts on how international collaboration can contribute more effectively to constructive institutional reforms. In conclusion, the GCC countries and the MENA region need to collaborate more in the STI field, not for the purpose of stifling new initiatives but to widen perspectives and embark on new learning processes engaging both multiple stakeholders and different countries across the region.

Part I
Defining the Need of Reform: Special Context, Benchmarking and Best Practices

Chapter 2
The Changing Landscape of the Middle East

Thomas Andersson and Abdelkader Djeflat

Fundamental forces are in the process of changing the societal and economic landscape of the Middle East. Region-specific conditions are combining with more universal factors—the sweeping tide of globalisation, technical progress and the introduction of more powerful communication tools. Organisational renewal opens up for novel ways of doing things and reach out to the most distant of societies and previously static economic activities.

The Middle East, meanwhile, is marked by its historic legacy of powerful ancient civilisation followed by centuries of relative stagnation. More recently, rapid economic growth and social change have been seen in parts of the region, including in the GCC countries. However, much of the progress achieved thus far remains dependent on a narrow economic base, notably the riches emanating from abundant oil and gas extraction. Other countries across the Middle East remain plagued by underdevelopment. Some have been deeply affected by oppression and fear, under the iron grip of ruthless power moguls, a situation that has been subject to relentless exposure, through the Arab Spring.

Although change has been under way for some time, the Arab Spring has opened up a distinctly new phase. Multiple voices, including from the young and those on the margins of traditional political power bases, are now being heard in a way that had been unthinkable a few years ago. An intensive search for solutions to economic development and job creation issues has been initiated and is in progress. At the same time, the immediate fallout of the Arab Spring is grim, with dramatic losses in tourism revenue, capital outflows and disturbances in all sorts of economic activity.

T. Andersson (✉)
Jönköping International Business School, Jönköping University, Jönköping, Sweden
e-mail: thomas.andersson@jibs.hj.se

A. Djeflat
University of Lille, 60 Boulevard Vauban, Villeneuve d'Ascq 59800 Lille, France

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_2,

Neither the Arab Spring's political aspects nor its immediate economic consequences are in focus here. Our concern is the socio-economic context underlying the current upheaval, and what ultimately defines the actions that are warranted to address the situation. The trends and issues in scope here span the wider Middle East and North Africa (MENA) region.[1]

In this chapter, we start out to take stock of the historical and cultural background. Although the vast scope of the subject makes it necessary to limit our focus to selected elements, we attempt to cover those main aspects which contributed to where we find ourselves today. We then consider briefly the Arab Spring's bearing on economic structures, demographics, labour market challenges and education. In the subsequent chapters, we look at the state of play in science, technology, innovation and entrepreneurship followed by benchmarking of various performances and policies.

2.1 The Origins and Special Context

What we refer to as the "Middle East" is widely viewed as the "cradle of human civilisation". The region saw the establishment of the first cities more than 8,000 years ago, followed by the first nation states. Here, the balance of power between nomads and sedentary population, and between rural and urban populations, first started to shift as pre-historical military forces were mobilised to underwrite new power structures. It was also here that the ability of humans not only to scribble drawings but to express abstract messages in writing first emerged.

Over the thousands of years that followed, the Middle East remained at the centre of civilisation, alongside Central Asia, the Indian Subcontinent, China and in some instances Europe, as in the days of the Greek and Roman empires or the heyday of Byzantium or Venice. The region played a major role in shaping or perfecting many of the great technical inventions as well as in science, philosophy, linguistics, arts and architecture. The wonders of Muslim buildings in Baghdad and Samarkand in the east, or Casablanca, Cordoba and Seville in the west, are among the most magnificent human construction works found anywhere. The accomplishments of the mathematician and astronomer Al-Khawarizmi in ninth century Baghdad, the linguistic scientist Sibawayh in Basra, the writings of the poet Hafiz at the start of the renaissance in fourteenth century Persia or the Islamic miniature paintings of Bihzad and others of the Herat school in the fifteenth century are the makings of a culture—and of individuals—forever part of a firmament that broke genuinely new ground for humanity in the domains of art and knowledge.

[1] What constitutes the MENA region is open to multifarious interpretation, though the standard definition comprises 19–21 countries. The World Bank and UNICEF denote 19 and 20 countries, respectively. The main difference between the various authorities concerns whether or not to include Djibouti, Mauritania, Turkey, Iran and Iraq. Some authorities go by membership of the League of Arab States, which has 22 members.

Over the centuries that followed—that were to be marked by the expansion of European maritime trade and then industrialisation and colonisation—the Middle East failed to retain its lead. As science and technology flourished in Europe and later in the United States—the regions that have become known as "the West"—the Middle East saw little progress. Middle Eastern societies and political systems went through a painstaking process of finding a new footing amid the end-game of the European colonial era, led by the imperative to organise economic structures capable of harnessing foreign finance and know-how to exploit the natural resource riches found to be abundant in parts of the region.

We will return to where the region stands in the modern age. First let us reflect on the concept of the Middle East and what is at heart there. The region is closely associated with the influence of Islam and the Arab conquest, starting from the seventh century. Various other peoples and religions have played an important role, too. Spanning multiple geographical boundaries, national jurisdictions and cultural frameworks, a mighty civilisation and way of life evolved. In reviewing the story, we take note of events and tools that played a role in shaping that journey, while not claiming to provide an exhaustive examination.

2.1.1 Expansion and Fragmentation

Following the quest for Arabs to unite, made by the Prophet Mohammed, the struggles between Mecca and Medina were overcome as an initial decisive step. Mohammed's followers—including his khalifa Abu Bakr, the military genius Khalid ibn al-Walid, Muawiya, Abd al-Malik and many others—marched on to accomplish an exceptional geographical and cultural expansion.[2]

What ensued is a fascinating and complex story of fierce battles, heavy defeats, an impressive series of conquests, times of unity and serious internal divisions—including a struggle over the role of Arabs versus non-Arabs within Islam.

In their first major advance into new territory, the Arabs conquered the Sassanid Empire in Persia after the battles of Qadisiyya in 637 and Nehawend in 642. Jerusalem (taken in 637), Syria (conquered after the Battle of Yarmouk and the fall of the capital Antioch in 638) and Egypt after the capture of Memphis and destruction of Alexandria, were all wrought from the hands of the Byzantines, who were forced on the defensive.[3] The Arabs, meanwhile, lost no time in marching

[2] These are some of the main leaders who followed Mohammed. Mohammed's very earliest followers are divided into those who joined him on his Hijra (withdrawal from Mecca to Medina), the Muhajirun, and the Ansar, who were the people of Medina who helped Mohammad and the Muhajirun on their arrival. The sources generally name some 40–60 persons.

[3] The zeal and diplomatic skill of the Emperor Heraclius as he clawed back against all odds, coupled with the defence of its mighty Roman walls, saved the legacy of the imperial city of Constantinople for another 800 years, until the Ottomans eventually captured it in 1453 under Mehmet II.

west, advancing aggressively along Africa's north coast. They soon reached the Atlantic and moved on from there to enter the Iberian Peninsula in 711. After the fall of Salado and Toledo, the Arabs established their dominance across most of what is now Spain and Portugal.

During their early expansion, the Arabs were kept together within the first great Muslim dynasty under the Umayyads (661–750), who had gained control after the death of Mohammed's cousin Ali Ibn Abi Talib. With Damascus as the capital, their dominance stretched from the Sindh region in today's Pakistan to the Atlantic coast. Championing a privileged standing for the Arabs in Islam, however, they suffered from internal divisions. Further weakened by military defeat as the Byzantine Empire fought back and reclaimed control over Asia Minor, and also a lack of financial reform, they were crushed by the so-called Abbasid Revolution.

The Abbasids, named after Mohammed's youngest uncle, responded to calls for an increased role for non-Arabs. Establishing the second great dynasty of the Islamic Caliphate (750–1258), they moved the capital to Baghdad and opened for increased influence from the East. Some speak of a "golden age" in which science and philosophy blossomed. The internal divisions however remained, and the capital was moved several times, to Marw in Syria, back to Bagdad and to Samarra.

Gradually, the unified Muslim nation in effect disintegrated, with the authority of the Abbasid caliphs assuming a merely spiritual role. Persian and Seljuk dynasties took over in the East. The Fatimid, a separate line of caliphs, emerged in North Africa, claiming to be descended from Mohammed's daughter. Limited to Egypt, that dynasty ended in 1171. The most consolidated standing through these centuries was attained by the Caliphate of Cordoba. Here, the sole survivor of the Abbasids' persecution in 750, Abd al-Rahman or the Emir of Cordoba, established the Independent Emirate as a continuation of the Umayyad dynasty. Made up of mixed Arab and Berber culture, its people were referred to as the Moors by the Iberians because of their black skin. Once the Umayyads died out in 1031, the Iberian Arabs also fragmented into smaller states, constantly at war with each other and thus gradually weakened.[4]

In practice, the Muslim world thus evolved into a set of separate nation states that fought internally and mostly alone when facing external threats. In some cases though, as when the Crusaders marched into the Arab lands with calls to "free the holy city", the Arabs succeeded in mustering a united effort, most famously under the legendary stewardship of Saladin.[5] In the eastern part of the Muslim world, the mighty Seljuq Empire, in the Turko-Persian realm, likewise united the Eastern Islamic world in the 11th century. It was unable to resist the Mongols, however, who devastated the capital of Baghdad in 1258. With that, the 500-year Abbasid Caliphate formally ended.

[4] Their legacy established an irrevocable bond between the first great dynasty of Islam, across time and space, to later generation followers from the Arabian Gulf to the Atlantic Ocean.

[5] Saladin, or *Salah ad-Din* (1137–1193) in Arabic, initiated the line of Ayyubid Sultans in Egypt. He gathered a large force of Muslims—referred to as the Saracens by the Christians—to combat the Crusaders. Attaining a major victory at Hattin 1187 and eventually settling the peace of Ramla in 1192, Saladin is credited with fending off the Crusaders' onset.

On the same mission, Hulago Khan, grandson of Genghis Khan, destroyed the Abbasid dynasty in Damascus. Jerusalem and Egypt were next in his sights. It was then that another Muslim people, the Mamluks, eventually broke the spell of Mongol invisibility. In the Battle of Ain Jalut on September 3, 1260, the forces of Mamluk Sultan Qutuz and Commander Baibars went through the nightmare ordeal of defeating the Mongols in close combat. In this task they were among the earliest known users of explosive hand cannons, *midfa*, which they deployed to frighten the Mongol cavalry. A new era of warfare technology, and fortunes, had begun.

2.1.2 Loss of Momentum

In the East, Muslims continued to celebrate victory on several decisive battlegrounds. Their old rivalry with Constantinople, the capital of Byzantium which had arisen from the Roman Empire and represented the prime centre of architecture, art and technological advancement in the Middle Ages, tipped to their advantage after the sacking of the city by the Fourth Crusade. Captured by the Ottoman Turks in 1453 and incorporated in their Empire under its new name Istanbul, it regained its geopolitical significance in a new shape.

On the eastern frontier of Islam against Europe, the Turks and the Ottoman Empire launched a major assault. But from an early stage they lost their grip at sea as the Turkish fleet suffered a devastating defeat outside Lepanto in Greece on October 7, 1571, at the hands of Juan de Austria.

The Turks nevertheless pressed ahead with their mission into the heartland of continental Europe. At their peak—following the Battle of Mohács—their gigantic army exerted control over most of Hungary. Eventually they stood outside the gates of Vienna in 1683, merely to suffer defeat at the hands of the Polish leader Jan III Sobieski, who showed up to save Austria at its most threatening hour. Only in the twentieth century, after the Turks' gradual withdrawal and eventual successful defence against the allied forces under Mustafa Kemal Atatürk at the closure of World War I, was today's border settled, with a thin sliver of Europe left to provide a hinterland for the cosmopolitan city of Istanbul.

On the western frontier, the Moors' advance into the Iberian Peninsula likewise led to an early attempt to enter Gaul (modern France). The venture stranded at Poitiers in 732, at which the Franks and Burgundians under Charles Martel won a decisive battle despite reportedly being heavily outnumbered. Instead the Moors consolidated in al-Andalus, dominating the Iberian Peninsula until the fifteenth century. Once the tide turned, however, with the rise of the Spanish *reconquista* and the capture of Granada in 1492, the Straits of Gibraltar became a firm dividing line in the west between the Arab and Muslim world in the Maghreb and the predominantly Christian lands of Western Europe.

In their exchanges with the Europeans, particularly in Spain, the Arabs spurred an extensive transfer of new ideas and technologies, with their arithmetical numbering system and printing skills destined to prove of fundamental importance. Of most immediate significance, however, was their knowledge of how to put gunpowder to military use. First invented in China, for primitive catapults and early cannons around the turn of the first millennium, once gunpowder was shown by the Arabs to be a highly potent military weapon, including in their attack on a Spanish city, the Italians ordered manufacturing of cannons and cannon balls. Military gunpowder applications took off in Europe from the mid-fourteenth century.

Destiny had it that the Spanish and the Portuguese, themselves just freed from the Moors, were to ruthlessly exploit that advantage in the New World. Having crossed the Atlantic and gained access to the gold and silver of the Indian lands, they acquired the combined drive, experience, and muscle to manoeuvre for systematic control of the most lucrative merchandise trade in the world, and once and for all break the traditional standing of the *Silk Road*.

Along with the Dutch, the British and the French, Spain and Portugal were the littoral states and expansionists which set out to overthrow national borders and the structure of the world economy more thoroughly than had occurred at any previous point in the history of mankind.[6]

The international trade was predominantly engineered by privately owned trading houses, and as the volume of exchanges expanded, the pull for developing improved means of transport, better boats and equipment, the development of the steam engine itself, the continued improvement of logistics chains and so on, was at full force. The political impacts were to follow the commercial and the technical, not precede them. The European influence on the status of its trading partners across Africa and Asia remained relatively limited, until the great spurt in colonialism took off in the nineteenth century.

Life in the core of the sparsely populated Arab peninsula took its course amid the big battles. Through the ages, the fishermen went to sea in their dhows or *khashab*, the caravans crossed the deserts, and nomads and their cattle sought out pasture. The women, few of whom feature by name in the male-dominated historical records and tales, guarded the family and raised the children—institutions of primary concern in the Arab world. The Arab woman generally enjoys great pride and respect, within her sphere of influence, for her role as wife and mother, but her access to education and her contribution to wider development has been mostly limited. Yet again, the forces that were to alter the outlook for the mightiest of cities and most numerous of peoples in Asia and the Middle East, along with the significance of the most ancient of trade routes across the most peripheral of lands, were busy at work in the hands of the innovators, traders and conquerors emerging from the West.

[6] Following Vasco da Gama's rounding of Africa in 1492 and the Spanish–Portuguese onslaught in Latin America, the proceeds from the gold and silver of the new world were partly invested to gain control of the new overseas trade routes and for purchasing lucrative Eastern merchandise that had until then been highly scarce in Europe and thus attained enormous value. At the same time, the expansion and exports of early manufactures from Europe amassed tremendous wealth at the expense of the traditional traders of the Middle East, Central Asia and the Far East. In the process they subjected the industries of both the East and the West to a new powerful impetus for change.

2.1.3 The Colonial Era

The more recent history has been deeply affected by the extensive colonisation undertaken mainly by Britain, France and Italy in the nineteenth century. The era lasted until the 1950s, by when most areas in this part of the world had gained independence. Last out, in 1962, was Algeria, where the struggle for independence from France was one of the most violent and dramatic anywhere.

As early as the seventeenth century Europeans gained control over some of the region's strategically important areas. In some cases the occupations were temporary, as in the case of the Portuguese annexation of coastline in Oman. The Portuguese presence still lasted for 150 years, until it eventually came to an abrupt end as the Omanis fought back and regained access to the sea. Most of the Portuguese and Spanish colonial empires subsequently acquired autonomy in conjunction with the independence of Latin American states in the early nineteenth century.

In 1798–1801, Napoleon Bonaparte mounted a campaign in the Orient aimed at boosting French commercial interests, countering Britain's expansion in South Asia and attempting to access knowledge of the region, and Egypt in particular, through science, technology and arts. The mission led to the capture of Malta but suffered severe military setbacks, for instance in Egypt and Syria. The combination of exhausting conflict within Europe itself and military setbacks in the Middle East moderated European advances at the time.

All the same, military and economic dominance, which eventually turned into a dramatic quest for direct control from the 1860s onwards, eventually ushered in the era that became known as the New Imperialism, or the scramble for territory between (especially) France and Britain. The race was particularly swift in the inner African continent, which had largely been unexplored by Western civilisation up to that point.

In North Africa, Italy joined the race in the late 1890s by acquiring Somaliland, Eritrea and modern Libya from the weakening Ottoman Empire with the 1912 Treaty of Lausanne. Ethiopia first fought back but was then temporarily occupied for 5 years. Meanwhile, the Arabs rose against the Ottomans in 1916–1918, supported by Britain and notably Captain T. E. Lawrence, to form a new state with Damascus as its capital. With the secret 1916 Sykes-Picot Agreement, the British and the French had however already agreed to split the region between them. France gained Syria as a protectorate, while Britain obtained the Christian coastal areas that were to form Lebanon, as well as Iraq and Palestine. On the Arabian Peninsula, Ibn Saud created the Kingdom of Saudi Arabia in 1922 with British assistance.

Although the restructuring and reorganisation brought about by the onset of colonialism was less overwhelming than further south on the African continent, it inflicted a heavy legacy here as well. In particular, the detection of oil riches in several parts of the region hastened the rise of close relations between the Western exploration industry and local leaders—relations from which both sides soon acquired enormous wealth. For years to come, however, the former colonial powers maintained the upper hand and held out as long as they could against a more even sharing of gains with local counterparts. An example was the British power game in Iran, following their military annexation of the country during World War II, which created deep animosities.

Of particular relevance in the context of this book is the exclusion of the local population from education, learning and science. Wide ranging attempts took place, especially in the Maghreb, to impose foreign (colonial) language and minimise local language (Arabic) support, sometimes with the intention of heavily impacting fundamental cultural and historical features. The "Our ancestors the Gauls" refrain, expounded in Algerian primary schools during the colonial occupation, illustrates the severity of the campaign. Other restrictions in Algeria included limitations on access to higher and professional education, which was reserved exclusively for French children and a few families considered close allies of the colonial administration. At independence in 1962, only 10 % of the 6,000 students at Algiers University were Algerian nationals.

One of the leaders of the first struggle, Emir Abdelkader, was born in Algeria in 1808 and died in 1883 in Damascus, Syria, where the French had exiled him. His effort to liberate his homeland saw several attempts to acquire technological know-how to set up industrial infrastructure, essentially for military purposes. Many of his technology-transfer policies were burgeoning before he was defeated.

The attempts made by Mohamed Ali in Egypt in the nineteenth century to restore science and technology as a key element of development, notably for infrastructure and industry (and initially with the help of French engineers), were aborted when, seemingly under external pressure from Britain, the French withdrew their support.

The period of outright colonial occupation started to unfold early though. Iraq, Syria and Egypt gained partial independence in the 1920s and 1930s, although it took World War II for the colonial powers to finally depart. In Palestine, however, the conflict was not to be resolved.

These developments provide the wider context for what was to follow in the second half of the twentieth century with regard to the region's troubled journey to regain control over its own destiny. The struggle for control as well as economic benefit from the natural resource base has been the most conspicuous element. Increasingly, however, access to the domains of science and technology has proven one of the toughest. The region's general failure in this respect contrasts sharply with East Asia, where Japan, South Korea, Singapore and others have made headway, not to speak of China in the world now taking shape.

2.1.4 The Blended Regions of the World

Although the Ottomans are gone, many people deep into the Balkans—notably in Bosnia-Herzegovina, Montenegro and Albania—remain faithful to Islam. Later waves of immigration to Germany, France and indeed virtually all other countries across the European continent have led to a widespread presence of Muslim followers. In the Middle East itself, the Arabs have been joined by other major peoples in following Islam, albeit with important differences in interpretation of the historical legacy.[7] The Turks and the Persians at times even overtook the Arabs in political weight.

Muslim communities also exist in other regions, with by far the largest in India, Indonesia, Bangladesh and Pakistan. Other examples include Malaysia and Africa's east coast. The presence of Islam in these areas is rooted in hundreds of years of complex interfaces, involving commerce in gold, iron, slaves and ivory, with heavy engagement by Omani traders who established a strong local presence in and around trading posts such as Zanzibar, spreading a combination of fear and respect for Arab ways.

Hence, Islam is not synonymous with the Arabs or with the Middle East but extends much further. Conversely, many people in the Middle East adhere to religions other than Islam. Although the Prophet Mohammed called for one god and one faith, Islam was generally tolerant and allowed others to choose their form of religious practice.[8] When the Arabs conquered Egypt in the early days of their expansion, they gained the critical support of the Christian Copts thanks to a promise of religious freedom. The Copts are still there today, a minority of approximately 10 million in Egypt. Large non-Muslim minorities also live in Syria, Lebanon and Turkey.

This predominantly Muslim region has also played host to the rational Mutazilites, who stood up against supra-natural features of religion, the mysticists or Sufis, and the dervishes order they created and whose peculiarities included spiritually trance-provoking dances.

Though orthodox Muslim influences have gained ground, promoting adherence to the exact wording of the Koran and constricting the room for interpretive variation, the Middle East has always hosted multiple followers of different religions. The Iberian Peninsula, for instance, had an estimated 7 million Christians and Sephardic Jews when the Arabs arrived, and the latter never achieved a majority there. Animosities between Arabs and Jews on the other hand date back to the early days of Islam and were manifested in various conflicts and friction over the centuries. Today, Israel forms a Jewish state, whereas the Palestinians—who made up the bulk of the population in Palestine over the last millennium and who now are dispersed across Israel, the occupied territories of Gaza and the West Bank, and other countries—are mostly Muslim (though a minority are Christian).

[7] Most importantly, the continued discrepancy in religious interpretation between the Saudi-based Sunni perspective versus that of Shia, centred in Iran and to some extent Iraq, perpetuates the old struggle of the Umayyads versus the Abbessids.

[8] This has no doubt raised respect and is a factor behind the appeal of Islam in large parts of Africa and Asia, where Christianity has become much less established as a religion, despite the European commercial and political onset.

2.1.5 What Characterises the Middle East?

Apart from the role of Islam and its geographical reach, what else characterises the Middle East? A number of cultural commonalities form a principal part of the answer to this question and centre to a considerable degree on Mecca or Medina, which are in the Arab heartland and are closely associated with the journey of Mohammad. Then there are Baghdad, Beirut, Cairo, Casablanca, Damascus, Istanbul, Jerusalem and Samarkand—legendary cities that have served as a cradle for defining important lines of culture and learning. In the modern era we have Dubai, Abu Dhabi and Qatar City, which have sprung to life as international growth hubs and seem to have no limits to their economic, futuristic aspirations.

More encompassing is the intriguing mystic influence of the Moon, around which the Arab calendar revolves, in contrast to the focus on the sun in the west. Another key feature is the role of the written Arab language. As with Chinese, the Arabs speak numerous dialects that have grown so far apart that they in essence represent different languages. However, they still share a written language, commonly known as standard Arabic and which represents a critical unifying factor.

Other popular symbols and features are used to signify Middle Eastern culture: Bedouins, nomads, camels, the desert, palm trees, dates and the pyramids. Allegiance to family and uncompromising defence of community interests combine with an almost limitless hospitality for which Arab people are renowned, including the ancient welcoming of strangers, well documented down the centuries and stretching across cultural divides. On the other hand, the Arabs are also associated by some with shrewd merchandise, arrogance and lack of trustworthiness. Other associations flow from the ancient tales of magnificent palaces and treasures and the magic of supernatural figures, such as the genie in the bottle or flying carpets.[9] Water is seen as the ultimate source of life, through the sanctuary of the oasis or the gifts of the Nile, Euphrates or Tigris rivers, enabling rich cultivation of sunburnt land since the earliest days of human civilisation.

Such connotations have been around for hundreds, if not thousands, of years. Although the traditions associated with, for instance, Bedouin life and ancient trades have only a minimal real-world presence today their imprint on mindsets still matter hugely. There is also stark contrast in the conditions of the majority who inhabit the sprawling cities and the dwindling but still significant share of the population living in the extensive tracts of grassland and desert, often under poor conditions. Many modern-day people around the world harness images unrelated to either of these worlds, however. Commonly they would centre on the imprint of unrelenting confrontation between people, related to differences in religious stance, notably between Muslims and Jews.

Many images hang in the balance, including traditional hallmarks that are transformed and diffused in new packaging by the Western entertainment industry.

[9] Most famous is Harun al-Rashid in *One Thousand and One Nights*, a set of folk tales in Arabic compiled during the Islamic Golden Age.

The Walt Disney tale Aladdin had its distinct composition of good and bad, trusty and trustworthy, borne out less on the basis of the cultural understanding of the peoples of the Middle East than it was shaped by consideration to the hearts of minds of American (or Western) audiences. Diverse expressions of this kind are inevitable in a multi-faceted world where communication flows are ever-growing. The problem arises when there is a massive imbalance in which perspective gets represented.

The messages that have shaped the current views of the Middle East among many people around the world have thus been conveyed by English-language world media organisations such as CNN and BBC basically on the terms of the West, in a never-ending stream of brief messages lasting perhaps a minute or so. In recent times, however, the Middle East has spawned its own TV channels, which opens up for richer perspectives.[10] This has no doubt affected the Western media and led them to weigh their coverage of this complex region more carefully. Still, the fundamental logic of news coverage in our days carries with it contradictory implications for how the region perceives itself. On the one hand, there is the striving towards transparency, the explicit recognition there are more than two ways of looking at a situation, and that all perspectives have a right to be acknowledged and heard. On the other hand, there is the focus of the media agency itself on the shocking and unpredictable, while the continued peaceful co-existence of large communities of people by nature does not represent "news", and thus seldom hits the headlines. The history of the Middle East belongs to us all, however, and the narrative needs to be told and reflected on by probing beneath the surface of often shallow, and subjective views which otherwise are bound to worsen the presence of damaging prejudice.

Core aspects here are the values of the people, their way of life, the making of new technology (and how it is utilised), trade, commerce, investment, education and learning. For thousands of years the Middle East was shaped by these forces. The region rose up and expanded but then fell behind as others came to dominate the means of warfare, travel and international trade. It used to be a major platform for scientific discourse. But whereas it has regained ground economically in recent decades, in a large part thanks to its enormous natural resource wealth, again it lags behind in science, technology and innovation. Hence, it is behind in examining, evaluating and correcting its own economic, social and environmental agenda. It is behind in the creation and development of new enterprises and jobs. Technology offers opportunities, but also presents risks. Without the required tools and competencies, new jobs will not materialise. Rather, they will shrink farther in number.

This is the situation that the Middle East must now deal with. What path will emerge in the wake of the Arab Spring? That is the topic of this book, around which this story swirls.

---

[10] Leon Barkho (2008) demonstrated the bias of CNN and BCC, compared to Al Jazeera, as consciously engineered through corporate culture and terminology crafted to distort the message and show only one side of the story.

2.2 The Era of Change and the Arab Spring

Today's world is marked by sweeping change, carrying with it unprecedented opportunity as well as a host of challenges. As we have seen, these challenges are partly to do with globalisation and technical progress, which bring rapidly increased opportunities as well as interdependencies between the countries and peoples of the world.

The rise of information and communication technology (ICT) should be underlined in this context. Having witnessed the advent of computers and discs and the internet, we are now into the era of mobile technology, along with convergence, the emergence of the interconnected grid, cloud computing and the growth of social networks and instant messaging—all leveraged by interactive services reaching out to the most distant corners of the world.

Despite spreading at staggering speed, the new technological tools have at times seemed out of touch with what happens on the ground, especially in developing regions. Hardware, software and content have been crafted primarily by foreign hands and for purposes that seemed of limited relevance to ordinary people. But, akin to the emergence of the Qatar-based Al Jazeera in the sphere of televised news coverage, digital communication has rapidly become shaped and exploited from within local communities, including in the developing world, and on the terms of new players. This to a large degree reflects the diffusion of ICT that has become possible with mobile telephony, and also the growing competition between services bent to put the needs of users and consumers at the centre of development.

ICT with its accompanying paradigm has the potential to accelerate e-commerce, e-health, e-education and e-government solutions, in response to a range of outstanding issues. For a growing number of people in the MENA region, the impact of ICT is pervasive. The young, girls as well as boys, are as wired as their peers anywhere else. Yet, to some, especially among those lacking educational opportunities and in rural areas, ICT is viewed as a carrier of growing income differentials. Many people find themselves confronted with inadequate and frustrating conditions, without a clear vision for how the technological advance can move them forward.

Strikingly, at a time when technology offers greater opportunities than ever to resolve major issues confronted by mankind and people all over the world, funding to support technological development is under pressure, and fewer of the young appear attracted to the subject. Here, the Middle East is an international focal point, crucially confronting the outstanding bigger question of whether there is to be hope, or exasperation.

2.2.1 *The Varying Record of Governments*

Various initiatives have been taken over the years to develop and modernise societies across the Middle East. Inevitably we can cover only a few aspects here.

Over the last half-century, various countries in the region have displayed noteworthy leadership towards the adoption of new development tracks. Here, Israel's spectacular development path since its creation was to a large extent backed by its immigrant technicians and entrepreneurs, as well as extensive capital inflows; consequently it saw the rise of one of the most research-intensive and innovative economies anywhere. For the Arab world, that record was generally perceived as a threat rather than setting an example. Given its strong Western support, many saw Israel's progress as based on factors that were not accessible to other countries.

Examples closer to home took a little longer to appear and, as they did emerge, the imprint was different. The shifts and turns in the leadership of three main countries are worth noting:

Iran. Following the British–Russian invasion during World War II and the subsequent lop-sided Western exploitation of the country's oil wealth, the democratically elected Mohammad Mosaddegh undertook, during his short spell as prime minister, a series of social reforms and acted against the Anglo-Iranian Oil Company (AIOC) to gain control over the country's oil resources. The then British-led isolation of Iran, including a trade embargo and the freezing of its foreign assets, devastated Iran's economy and was followed by the military coup on August 19, 1953, when the US Central Intelligence Agency (CIA) in effect replaced Mosaddegh with the Shah Mohammad Reza Pahlavi as Iran's head of state (Cole 2009).[11] The Shah subsequently adopted business-friendly policies, but

[11] Similar counteraction, instigated by Western powers, hit other newly independent countries around the time. The Democratic Republic of the Congo represents one of the most significant parallel cases. The (again) democratically elected prime minister, Patrice Lumumba, came to power in 1960 with a programme to nationalise prime natural resources, particularly the copper mines, following the agony of colonisation and in the context of continued foreign exploitation of the country's mineral wealth. A state of civil war took hold as Belgium, Britain and the United States moved behind the scenes to separate the mineral-rich Katanga region. Dag Hammarskjöld, then Secretary General of the United Nations, refused to bow to the pressures of the dominating powers and engaged in ferocious diplomacy, only to die when his plane crashed in the Zambian jungle on September 18, 1961, under mysterious circumstances. Most probably an act of state terrorism targeting the highest level of international diplomacy, the case remains unaddressed to this day. Lumumba, meanwhile, was stoned to death, whereas the man who led the coup, General Sese Seko Mobutu, was to rule the country for 30 years, engineer a personality cult and become associated with "Mobutuism" as a low mark for perverse societal reforms, while acquiring enormous personal wealth borne out as one of the worst state frauds of all time. The democratic Republic of the Congo, for all its wealth, is still today stranded in a state of severe stagnation, domestic violence and suppression of its impoverished civilian population. In Iran, Mosaddegh was placed under house arrest until his death three years later, but the scars remain and the state of conflict with the old foes is as alive today as ever. This disastrous context, seldom spoken of in Western countries, has had far-reaching consequences for perceptions around the world. Less well known, as more or less all developing countries followed suite in claiming control over their natural resources a few years later, the strategy of the multinationals and the Anglo-American alliance subsequently changed tack (Lipson 1985). Ownership of natural resources was mostly given up, with other ways and means adopted to secure the interests of investors, such as maintained control over logistics chains and access to developed country markets (Moran 1985). In Geneva, decades of work by the United Nations to put in place a convention for multimodal transport, to make the markets of developed countries more transparent and accessible for exports

economic growth during his 20 years in power was overshadowed by luxurious spending and enormous private wealth accumulated by him and his wife. The contempt of the masses boiled over in 1979, leading to the ousting of the Shah and his replacement by the Shiite Muslim leader Ayatollah Khomeini. Although the US had not initiated the Iranian plight decades earlier, the dramatic developments surrounding the takeover, including the revenge and humiliation that the US suffered during a militant Islamic student occupation of its embassy in Teheran, brought events a full circle in the eyes of millions of onlookers across the region.[12] Within Iran and the Arab world more broadly, the forces of orthodoxy were strengthened at the expense of those that sought reconciliation with the West.

Egypt. Prime Minister Gamal Abdel Nasser on July 26, 1956, nationalised and seized control of the Suez Canal, a trading route of critical importance to international commerce at the time. Within a few months there was the military invasion of Israel and bombing of Egypt by the French and British air forces. Nasser was a revolutionary who enforced an enhanced role of government, cultivated close relations with the Soviet Union and moved towards a planned economy. Although his initially favourable development record was soon overturned, Nasser has remained a legendary leader figure in the region. After his death from a heart attack in 1970, he was succeeded by Anwar Sadat, who was murdered in 1981 and succeeded by Hosni Mubarak. Both Sadat and Mubarak, who ruled until 2010, made peace with Israel; they also benefited from US assistance and promoted the stark dominance of the military over Egypt's central power structures. They shifted towards supporting a more market-oriented economy, and economic growth under their stewardship was mostly favourable. However, there was little trickle-down of prosperity to the population at large. Income gaps have remained huge.

Iraq. Saddam Hussein attained powerful influence from the mid-1970s and manoeuvred to become president in 1979, a position he retained until 2003. He initiated an economic modernisation process to develop infrastructure, industry, agriculture and education. Running the Baath party and supported mostly by the Sunni minority, he did not hesitate to quell opposition by sheer force and brutality and gradually aroused deep animosity among the Shia majority. In 1980, he launched a military assault on Shiite Iran, which he judged to be internationally isolated and unable to defend itself after the revolution there, a conflict that caused both countries unbearable suffering during its eight exhausting years.

Once Saddam invaded Kuwait and set most of the city and its oil wells ablaze, the international community turned decisively against him. The UN-authorised coalition force that initiated "Operation Desert Storm" in 1991 still stopped short of causing his downfall. Following a heated debate on whether he was on the way

(Footnote 11 continued)
from the third world, was watered down to the point that it had become irrelevant by the time it could be published.

[12] US embassy personnel were held hostage for 444 days. The offense most probably cost Jimmy Carter the presidency and was thus instrumental for bringing the Republicans under Ronald Reagan back into the White House.

to acquire “weapons of mass-destruction”, Saddam was eventually subjugated and toppled by President George W. Bush through a military invasion in 2003. The chaos that followed threw the Iraqi nation into years of turmoil and de facto civil war between its rivalling communities. The Kurdish majority in Northern Iraq achieved greater independence along with enhanced stability and security, whereas strife has continued notably between the minority Sunni and majority Shia factions. Many of the well-educated and many Christians who had previously lived in Iraq under relatively stable conditions have fled the country and provided a source of skilled labour to other countries in the region, not least in the Gulf.

Among major current Muslim Heads of State, King Abdullah II of Jordan, King Abdullah of Saudi Arabia and Sultan Qaboos bin Said Al Said in Oman have taken a number of steps to develop their economies, while striving for harmony with traditional and religious values. In Turkey, Prime Minister Recep Tayyip Erdogan has combined a distinct Muslim profile with a strengthened market economy (including reforms carried out as part of the frustrated EU membership application process) and manoeuvring for Turkey to attain a revitalised geopolitical role, both in regard to the Arab Spring and the Palestinian cause.

The most striking examples of modernisation have for some time emanated from the small (mostly) oil-rich city states in the Gulf. Although short of natural resource wealth, the emirate of Dubai[13] pursued an ambitious strategy to upgrade its real estate and workforce to build an advanced, globally connected service economy. The world’s highest building at the time of writing, Burj Khalifa, stands as a towering symbol of this decisiveness, even though Dubai had to agree to a name change when struggling to repel the severe consequences of the global financial crisis for its debt-ridden economy.[14] Qatar has taken a lead in several respects, literally shaping the new regional media landscape by allowing and defending the rise of Al Jazeera as an outspoken bipartisan media voice. For the first time, the Middle East received comprehensive reporting from both sides on practically any major issue in the region or the world. In developing its small city state, Qatar likewise went its own way in launching ambitious, and expensive, infrastructure and development projects. The Qatar Foundation for Education, Science and Community Development was set up in 1995, followed by construction of 14^2 km of housing and educational facilities at Education City, to which leading Ivy League universities have been attracted to pursue their

---

[13] The development work has been substantially upgraded under of HH Sheikh Mohammed Bin Rashid al Maktoum, Ruler of Dubai and also UAE vice president and prime minister. De facto leader since the mid 1990s, he formally adopted the position of ruler in 2006.

[14] Originally planned to be named Burj Dubai, the name of the building was changed just before the inauguration, in connection with the provision of a financial package of 10 billion USD, provided by Abu Dhabi, to fend off Dubai’s acute financial troubles. The name change has thus implicitly become regarded as perhaps the most expensive in history. In reality there were other parts to the deal, although hardly any ownership share or “say” by Abu Dhabi in Dubai’s flagship carrier, Emirates, the world’s most successful airline company over the last decade, which remains to date a shining symbol of Dubai’s remarkable rise.

programmes. Politically, Qatar has also stood out through its regional leadership against violence and oppression by Arab governments in the wake of the Arab Spring, notably in Libya and Syria.

While less flamboyant, Bahrain and Kuwait have undertaken their specific initiatives, for instance reforms to lay the basis for a dynamic financial centre in the former, and the development of a pioneering centre in diabetes and health research, the Dasman Institute, in the latter. Both states have been weakened by internal conflict, however. In Kuwait, this is essentially a matter of bureaucratic rigidity and political infighting. In the case of Bahrain, the core of the problem is closely associated with the Shia versus Sunni division. The regime has reacted violently against protesters, including the young and unarmed, putting one of the GCC countries at serious risk for the first time since the breakout of the Arab Spring.

Other larger Arab countries initially looked at the initiatives adopted by these city states with scepticism or even outright contempt. Whereas many of the other modernisation efforts, including those pursued by later-ousted regimes in Iran and Iraq, ran into sharp reversal, the sustained development efforts of the smaller GCC countries gradually impacted on mindsets as they started to demonstrate that consistent economic progress could be achieved within the Arab world. It is another thing, as we will come back to, that the GCC collaboration itself achieves a fine balance between the demand for political unification—notably by Saudi interests—and the benefits enjoyed from collaboration limited to certain policy domains (with member countries maintaining cultural, political and economic independence), and thereby supports a diversity of development models.

At the end of the day, the economic transformation experienced by parts of the Middle East in recent decades is among the most impressive seen anywhere around the world. Several GCC countries have risen to economic pre-eminence and are capable of rivalling others almost anywhere when it comes to traditional measures of economic growth. Yet, in the neighbouring countries, there has been much less progress in this respect. Even in the GCC, there are good reasons to question how far-reaching the changes have actually been. What has happened, and not happened, in economic and social terms, and in areas of reform that are critical for future progress?

2.2.2 New Generations: The Arab Spring

Although the change that arrived in 2011—the "Arab Spring"—was sudden and unpredictable, the chain of events that led there goes way back. It includes the ongoing modernisation process—notably increased access to information and communication tools—coupled with a lack of progress under the old regimes. The fuse for uprisings had been laid years before. Ultimately, the spark this time came from North Africa and the streets, not from the politically or economically powerful operating behind closed doors or the walls of marble palaces. The timing could hardly have been predicted, though it may be easy to rationalise it in retrospect. The Arab Spring proved something new: that decisive initiatives in the Middle East do not have to be of government making, or even the making of established institutions and individuals.

For all its achievements, the development process across the Middle East had until this moment left the prevailing power structures basically intact. True, individual leaders had come and gone in Lebanon, Iraq and Iran, for instance. Those shifts were, however, the product of world affairs unfolding well beyond the reach of local communities. Like the economic ups and downs occasioned by recent decades of modernisation, they appeared to follow push from "somewhere else"; somehow it was like a shadow moving on the surface.

A demarcating factor is that the Arab Spring has been genuinely "homegrown". Countries in the West had been noisy in their cry for democracy, but the sound was hollow and in fact viewed as deeply hypocritical by the man in the street. The Arab Spring saw young people in these lands take action on their own. Those who claimed global leadership and who controlled the financial and media empires of the world appeared slow to react whereas the pace with which the events unfolded was staggering. As Western governments after only a brief pause started to speak out against the violence inflicted on the peaceful demonstrators in Cairo's Tahrir Square, it was basically seen as an act of face-saving. In many people's eyes, the Western powers remained opportunists, siding with the old dictatorial guard until the point that the rise of the people of the Middle East had become inevitable.

The landscape changed though as the Libyan regime faced open revolt and struck back without restraint. As Colonel Kadhafi exclaimed that the opposition was to be exterminated, the balance was tipped, causing China and Russia to withdraw their objections to external interference. The subsequent air-borne campaign, in which Western powers took the lead but were joined by some countries in the region itself, and also from elsewhere around the world, largely came across as a rare act of responsible statesmanship. Through this entire sequence of events, it was nevertheless clear that the critical initiative had indeed come from within the region itself, that a bottom-up movement had been capable of swaying world opinion and government positions at home as well as overseas in its direction, and that it had been able to do so over a very limited period of time.

In its first year, following on from its initial spark, the self-immolation of the frustrated and humiliated vegetable street vendor Mohamed Bouazizi in Tunisia, the Arab Spring spread with great force to Egypt, Libya, Yemen, Bahrain, and Syria. In all those countries, it put the leaders, many of whom had been around for decades, under severe pressure. While the impact was less dramatic elsewhere, its reverberations have prompted a tangible defensive response also from the regimes of Algeria, Morocco, Jordan, Kuwait, Saudi Arabia, and Oman (Iran is left aside here, as it already had its own uprisings since before the events in Tunisia, although those flared up again with reference to the developments across the rest of the region). In Qatar and Turkey, if anything, it has resulted in more intensive political engagement to back broad reform agendas across the region, largely in support of the Arab Spring.

The roots of the Arab spring are clearly associated with frustrations over a lack of voice and the ability to have a say and to take individual initiative in building the foundations for a better future. Whereas modernisation and economic growth have generated significant trickle-down and diffusion of economic benefits to most of the indigenous people in the GCC countries, the rest of the region has had a lot less of this. Further, the dearth of diverse employment opportunities persists more or less across the board. Many in the overly young population are confronted with a bleak economic outlook. Following the diffusion of modern media coverage and communication tools, and with an increasing number of the growing generations attaining education, especially in the female part of the population, the absence of more qualified jobs has become highly visible and frustrations are on the rise.

Many elderly people grew up in a situation where the local Imam was the only teacher in a local community that had seen little change to its livelihood for generations. The young of today represent the first generation, at least outside the main city centres, that started out with electric street lights, paved roads linking villages across the barren land and car traffic outnumbering camels and donkeys. For them, it is natural to communicate in real-time through a headset with their peers across distance. They are not only the first to grow up with a telephone, but also with social networking and constant messaging such as Twitter—innovations whose launch on Arab streets is simultaneous with the rest of the world.

The impacts of modernisation have been more all-encompassing in Oman or the UAE than in Morocco or Libya. In Morocco, an estimated one-third of young girls still do not get to read and write, as adamantly traditional parents and relatives keep them away from primary school in rural areas. In most GCC countries, more girls than boys attain tertiary education—not only in progressive communities but even in a conservative nation such as Saudi Arabia.

Interacting on the Internet, boys and girls in the region can establish contact with others anywhere in the world, sensing the same boundless reach and opportunity. For most in the younger cohorts, even in peripheral rural areas, the new era contrasts with the past and they inevitably come to see the world differently than the elderly. At this moment, old ways and new means meet with greater flair and drama in the Middle East than virtually anywhere else.

2.3 Economic Structure, Development and Demography

As can be seen from Table 2.1, the countries of the region display a strong variation in their economic development, as measured by gross domestic product per capita, and the progress of their respective dominant economic sectors. The countries with the highest income rates are small, and basically city states, i.e. Qatar and Kuwait. The remaining GCC countries are at a somewhat lower level, with Oman and, especially, Saudi Arabia stretching over an extensive geographic

Table 2.1 Basic data MENA countries

	Country	Population in millions (July 2011 est.)	Size (km^2 in 1,000)	State constitutional form	GDP per capita (PPP) in 1,000 (2010 est.)	Dominant economic sectors in % (2010 est.)	
GCC Countries	Bahrain	1.2[a]	760	Constitutional monarchy	\$40.3	Agriculture	0.5
						Industry	58
						Services	41.5
	Kuwait	2.6[b]	17.8	Constitutional emirate	\$48.9	Agriculture	0.3
						Industry	48
						Services	51.7
	Oman	3.0[c]	309.5	Monarchy	\$25.6	Agriculture	1.6
						Industry	51
						Services	47.5
	Qatar	0.8	11.6	Emirate	\$179.0	Agriculture	0.1
						Industry	71.8
						Services	28.1
	Saudi Arabia	26.1	2,149.7	Monarchy	\$24,200	Agriculture	2.6
						Industry	61.8
						Services	35.6
	United Arab Emirates	5.1[d]	83.6	Federation with specified powers delegated to the UAE federal government and other powers reserved to member emirates	\$49.6	Agriculture	0.9
						Industry	55.5
						Services	43.6

(continued)

Table 2.1 (continued)

	Country	Population in millions(July 2011 est.)	Size(km^2 in 1,000)	State constitutional form	GDP per capita (PPP)in 1,000(2010 est.)	Dominant economic sectors in %(2010 est.)	
Other MENA Countries	Algeria	35.0	2,381.7	Republic	$7.3	Agriculture	8.3
						Industry	61.6
						Services	30.1
	Egypt	82.1	1,001.5	Republic	$6.2	Agriculture	14
						Industry	37.5
						Services	48.3
	Iran	77.9	1,648.2	Theocratic republic	$10.6	Agriculture	10.9
						Industry	41.2
						Services	47.9
	Iraq	30.4	438.3	Parliamentary democracy	$3.8	Agriculture	21.6
						Industry	18.7
						Services (2008 est.)	59.8
	Israel	7.5	20.8	Parliamentary democracy	$29.8	Agriculture	2.4
						Industry	32.6
						Services	65
	Jordan	6.5	89.3	Constitutional monarchy	$5.4	Agriculture	4.4
						Industry	30.3
						Services	65.3
	Lebanon	4.1	10.4	Republic	$14.4	Agriculture	4.7
						Industry	16
						Services	79.4
	Libya	6.6[e]	1,759.5	N/A	$14.0	Agriculture	2.7
						Industry	66.7
						Services	30.5
	Morocco	32.0	446.6	Constitutional monarchy	$4.8	Agriculture	17.1
						Industry	31.6
						Services	51.4

(continued)

Table 2.1 (continued)

Country	Population in millions(July 2011 est.)	Size(km^2 in 1,000)	State constitutional form	GDP per capita (PPP)in 1,000(2010 est.)	Dominant economic sectors in %(2010 est.)	
Gaza/West Bank	1.7/2.6 (July 2010 est.)	360/5.99	N/A	$2.9 (2008 est.)	Agriculture	12
					Industry	5
					Services (June 2008)	83
Sudan (excl. South Sudan)	45.0[f]	1,861.5	N/A	$2.3	Agriculture	44.6
					Industry	45.3
					Services	10.2
Syria	22.5 (July 2010 est.)	185.2	Republic under an authoritarian regime[g]	$4.8	Agriculture	17
					Industry	16
					Services (2008 est.)	67
Tunisia	10.7	163.6	Republic	$9.4	Agriculture	10.6
					Industry	34.6
					Services	54.8
Turkey	78.8	783.6	Republican parliamentary democracy	$12.3	Agriculture	9.6
					Industry	26.7
					Services	63.8
Yemen	24.1	528.0	Republic	$2.7	Agriculture	8.3
					Industry	38.5
					Services	53.3

Source CIA World Factbook

[a] Includes 235,108 non-nationals

[b] Includes 1,291,354 non-nationals

[c] Includes 577,293 non-nationals

[d] Estimate is based on the results of the 2005 census that included a significantly higher estimate of net immigration of non-citizens than previous estimates

[e] Includes 166,510 non-nationals

[f] Includes the population of South Sudan (8.3); demographic data includes South Sudan (July 2011 est.)

[g] At the time of writing

area. Most of the other countries across the Middle East have distinctly lower incomes, though Israel is a highly developed country and Turkey, Lebanon and Jordan are considered relatively developed.

2.3.1 On the Economic Structure

As for the economic structure, the GCC countries and several others in the Middle East are blessed with natural resources, especially oil and gas, the exploration of which has generated a strong increase in foreign exchange revenue. A considerable share of these resources flows directly to government. In some cases, the returns have been highly concentrated among the few and also served to strengthen the standing of autocratic regimes and privileged interests at the expense of broader-based development. The concept of the so-called natural resource *curse* suggests that a windfall of foreign exchange earnings may in fact turn out negative for economic development. On the other hand, it is also clear that the GCC countries have experienced rapid growth and capacity building in several respects. In some countries, such as the UAE and Oman, the benefits have been widely shared among the indigenous population.

Not all countries have generated growth through oil revenue. Leaving Israel aside, the Emirate of Dubai, whose leaders encouraged the rise of a service economy and boosted real estate investment, achieved spectacular growth despite the absence of natural resource wealth. This included human resources as the indigenous population was very small, whereas immigrant labour has been admitted from (especially) Asia.[15] Several other societies have modernised rapidly too, notably Abu Dhabi (also in the UAE), Kuwait, Qatar and Bahrain. Oman has developed strongly as well, albeit starting out from further behind and with more emphasis placed on preserving its unique societal and cultural features.

The Saudi case is different. The country is modernising rapidly in regard to its infrastructure, real estate and city development. King Abdullah's leadership has also launched new universities and tried to enhance performances in education and in research—on terms that connect to and contribute to economic development in wider society. There are, however, significant issues to overcome. Perhaps most delicate is the role of women, who are strongly protected in Saudi society, by many viewed as oppressed, and expected to keep a low profile in societal affairs. For years, women have not been eligible for identity cards and are not allowed to drive a car. Their contribution in society outside the home and family spheres is thus strongly constrained. However, women today make up the majority of

[15] The small indigenous population in these societies is strongly outnumbered by the immigrant workers, especially those from South and East Asia, which offer comparatively cheap labour while benefitting from incomes that are much higher than they can generally earn at home.

students in tertiary education, which inevitably creates pressure for greater female participation in economic and political life.

Income distribution remains strongly biased, even within the indigenous population. A 2011 report lists Saudi Arabia as the country with the highest concentration of ultra high net worth (UHNW) households in the world at 18 per 100,000, whereas illiteracy rates remain high and the number of poor and undernourished is increasing (UNDP 2009; Global Wealth Report 2011).

Moreover, while the GCC countries continue to be marked by high dependency on a few natural resources, they are also characterised by heavy public sector domination of the economy. The role played by the private sector, including new business development, is relatively weak. Today, all GCC societies, including Saudi Arabia, find themselves contemplating the need for transition from resource-based into knowledge-based economies, though they experience little of the industrial sector dynamism important for driving the economy of most developed countries. Many also have a rather high cost base (with the exception of their immigrant workforce). We will return in Chap. 5 to the extent of these countries' investments in modern infrastructure, education and research.

2.3.2 The Backlash

The momentum that spread across the Middle East that we associate with the Arab Spring first radiated a sense of hope, pride and belief in a better future, especially among many of the young but across broader segments of society too, resonating with a growing aspiration across the region that ordinary people need to have a greater say. On the other side of the coin was a fear that things would be getting out of hand, somehow reflecting the strong common belief in the good of tradition and a deep-rooted faith in greater destiny.

The political, economic and societal outlook following the Arab Spring now presents a spectre of its own. The North African countries, at the forefront of the Arab Spring with their high income differences and large numbers of uneducated and impoverished people, have seen their infrastructure and economic fabric crumble. Conditions for business have been tightened in various ways, e.g., when it comes to profit expatriation, which has contributed to a drastic fall in access to capital. In several of the GCC countries, there were more or less widespread requests for improved wages or other benefits broadly among the population which, in some cases, were pre-empted by the governments' engaging in fiscal stimulus for short-term relief, including handouts to the unemployed. Saudi Arabia is a prime example. Most GCC countries have also created more government and civil service jobs. Some have increased minimum wages and raised student benefits. Several, including the UAE, Jordan and Oman, have dismissed large numbers of immigrant workers.

There have also been declarations on national dialogue to examine and discuss reforms. In Oman, Sultan Al Qaboos quickly strengthened the mandate of Majlis

Shura, which in effect represents a precursor of an elected parliament. In Morocco, King Mohammed VI likewise instituted increased parliamentary powers, though it is not yet known how comprehensive the reforms will prove to be nor whether they will go the whole way. King Abdullah of Jordan pledged political and constitutional reforms, but only within a 2 year framework.

The scope and final destination of the current movement is thus far from given. Many young and educated people in the cities experience a sense of having been liberated with regard to political and economic opportunities. Although new entrepreneurial initiatives have taken off, vocal traditionalist messages have flared up with a strong call for taking society in other directions. The local Mosque forms the centre of the community and an important platform for much reflection on societal issues. Notably in rural areas and among those with limited education, other channels for reaching out with a political message can hardly compete. Family bonds and traditions continue to matter throughout, more so than in developed countries, which went through the societal and economic transformation associated with modernisation much longer ago. Many citizens remain accustomed to stability being contingent on loyalty to unforgiving authority.

At least in the short term, the conservative counter-reaction has nevertheless been somewhat moderated, as demonstrated in the public elections and work on reforming the constitutional frameworks. This applies throughout Tunisia, Egypt and Libya, the three countries in which the ousting of previous autocratic regimes has been marked by sharp economic decline, paralleled by apparent commitments to establish fully ledged democracies. In Egypt, a state of fierce political infighting as well as domestic violence has given way to an elected president championed by the Muslim Brotherhood, apparently outmaneouvring the Military Council. Whether the legacy of the Arab Spring will prevail remains to be seen.

As for alarming trends, however, pressures from segments of the population to strike against minorities, especially religious ones, reflect a weakening of tolerance and trust between different ethnic groups. The hardening climate includes intensified prosecution of Christians in several places. Again in Egypt, the Copts have expressed a deep sense of concern for their future in the country.

A dramatic feature of the Arab Spring has been the role of women at the forefront of the movement. Especially in Yemen, women who fought the regime also stood up in direct confrontation with the ruling patriarchal discourse. In the Maghreb, there is a mixed picture, as the aftermath of the uprisings has seen the rise of a more active women's movement in Algeria. In Morocco, on the other hand, a conservative reaction has pressurised women to fall into line with an orthodox social order. Whether the momentum is stoppable is another matter. The case of Amina Finali, a 16-year-old Moroccan girl who committed suicide after legal and societal pressures led to her marriage to the man who raped her, sparked a new movement. The sole female government minister, in charge of solidarity, women and the family, tried to tone down the affair but large numbers of women reacted with rage, again using social media to speak out against the prevailing order. Women's associations are gaining strength, petitions have been made and actions taken against the various conditions that institutionalise violence against women. The parallel to the events that set off the Arab Spring itself is obvious.

Even in Saudi Arabia, some women have chosen to protest against the more or less official restrictions on what they can do in public. The protests include some women driving cars, in defiance of a state ban on female drivers. Swift action to put an end to these initiatives, including beatings and temporary jailings, have tempered the action but thus far not put it to rest. Another remarkable struggle concerns the role of women in sports. Preparing for the Olympics, the Saudi women's soccer squad went to great lengths to come up with a costume that did not breach the country's decency laws. They received a go-ahead from some officials, only for the Kingdom's then Crown Prince Najad to step in and urge the women not to participate, stating that physical exercise is not for women. If such views are to prevail, the consequences for female health and wellness will be dire, especially given Saudi Arabia's rapidly growing obesity and diabetes problems. With the sudden death of the hawkish Crown Prince just a few months later, in June 2012, however, the future course looks more open in the Kingdom. In the end, a few Saudi women did compete in the London Olympics, although in individual sports, i.e. judo and athletics.

Although the Arab Spring held up a promise to the world of a new impetus for change, the region may yet again slide into untenable conflict. The media are playing a significant role in trumpeting that message across the world. Viewed from outside, it can often be difficult to distinguish between and have a nuanced view of what happens in specific countries across the region. Oman, for instance, suffers from no internal religious friction and enjoys a sense of strong social inclusion, which means much less fertile ground exists for serious unrest and destabilisation compared with, for example, Bahrain, where the Shia majority has long been frustrated by a sense of discrimination at the hands of the Sunni majority.[16]

The lingering conflicts are strongly interwoven with economic contraction. Investment and exports are down in North Africa, and growth after the revolution set to come more from government consumption and less from exports and investment (World Bank 2011). In 2011, the Egyptian economy shrank by around 9 % as investment, consumption and exports fell sharply in all major sectors and some 600,000 jobs were lost. In Libya, GDP for 2011 is thought to have fallen by 50 % in real terms from the previous year. A significant decline is also expected from Syria, while Bahrain, Tunisia and Yemen had forecast negative growth of 1, 5 and 3 %, respectively (Bloomberg 2011; IMF 2011; World Bank 2011). Taking pre-emptive action, the GCC countries have offered higher minimum salaries, increased public subsidies on basics such as food products, and created more public sector jobs.

[16] In February 2011, Oman did experience demonstrations and riots in the coastal cities of Salalah and Sohar. The regime responded with minimal force, however, received strong support from the majority of the population and instituted a range of reforms (Andersson 2012a).

The Libyan economy has naturally imploded under the burden of civil war but could produce a sharp turnaround if a unifying government can bring the ravaged country together. It is striking that even countries such as Jordan have experienced a marked drop in demand, and Oman at least temporarily reported an increase in public sector demand but a drop in private sector employment. Official economic estimates anticipate it will be at least two more years before the Middle East sees a genuine recovery, while in reality the region's current trajectory poses considerable risks for prolonged decline.

Suffering traders and business people have cried out for stability and workers who have lost their jobs naturally feel desperation. The younger generation can, in the absence of counteraction, expect even fewer employment opportunities ahead, except privileged individuals destined to join public services or established businesses, especially in oil and gas. On the whole, the regimes in power are short of plans and ideas how to generate the kinds of jobs that are being asked for by the growing number of increasingly educated people who will enter the workforce in the coming years.

2.3.3 The Demographic Issue

Across the MENA region, traditionally high mortality levels began to decline in the late nineteenth and early twentieth centuries. Fertility levels (births per woman), on the other hand, did not fall much before the mid-1960s and even mid-1970s. The second half of the twentieth century—particularly the last two and a half decades—saw explosive population growth throughout the region. Annual population growth peaked at 3 % in about 1980. The current figure hovers around 2 %, which is lower than in the past but still well above the world average (Roudi 2011).

On average, the Middle East currently has the second youngest population of all regions in the world, after sub-Saharan Africa. Approximately one-third of the total population is currently below the age of 15. A further third is aged between 15 and 29 (Chaaban 2010). Fertility rates have remained particularly high in more densely populated but poorer countries such as Iraq and Yemen.

Rapid population growth in some ways represents an opportunity. Young people mustering energy for new initiatives may, for instance, push for adjustment and action that benefit society. At the same time, there is the task of expanding the education system and other services and societal functions required to harness the new generations, while managing the costs of the transition. With tens of millions of young people now set to enter the region's workforce over the next decade, the stakes are high.

2.4 The Spectre of Unemployment

The pressures of a rapidly growing population manifest themselves in many ways. Lifestyles and consumer behaviour have for some taken on flamboyant features, capitalising on the increasing financial means made available by the exploitation of natural resources and growing regional economies. Although there are signs of increased awareness and interest among the young to take account of the environmental issues that keep worsening as a result of uninhibited consumerism, thus far there are few avenues to turn such sentiments into meaningful action. Meanwhile, the arrival of modern society, including changing social relations, eating habits and physical activity, has been accompanied by health issues that take root early in life and which are partly new to the region. These issues are returned to in Chaps. 11 and 12.

Most conspicuous today, however, is the rise of youth unemployment. Whereas youth aged 15–24 make up 30 per cent of the region's working age population, a quarter or so are unemployed, compared to about 14 per cent in the OECD in recent years (UNDP 2009; Dhillon and Yousef 2009). In fact, the Middle East now demonstrates the lowest youth labour participation rates of all regions worldwide, with an estimated 35 % in work compared to the global average of 52 % (e4e 2011). In the absence of a marked improvement in labour market outcomes, society has to bear lasting high costs for failing to absorb and activate the growing generations in the labour market.[17] As can be seen in Table 2.3, youth unemployment already puts a significant strain on national budgets, and the economic aspects combine with the social and political. Young people who feel left out and have their dreams and visions shattered may fall into despair and decay or seek alternative routes in life.[18]

Costs are also on the increase because girls do increasingly well in education and now represent the majority of university students in many countries, but are overrepresented among the unemployed. They are also particularly tilted towards public sector work due to the orientation of their studies as well as social preferences, whether their own or those of close relatives who want to see them in a particularly safe and stable work environment.

Table 2.2 indicates the massive challenge that lies ahead in reducing overall unemployment across society, and even more so in combating youth unemployment. This is applicable to most of the GCC countries, although Qatar and UAE are exceptions.

[17] It is not possible, and hardly meaningful, to try and put precise numbers on the economic loss. According to some studies though, the current numbers amount to at least US$ 40–50 billion annually across the Arab World, equivalent to the total GDP of countries like Tunisia or Lebanon (World Bank 2008).

[18] This does not mean that they resort to organised military revolt and terrorism en masse. As shown by Cole (2009), the vast majority of Muslims have no sympathy for organisations such as Al Qaeda whose platform for take-up of recruits is limited. The violent street protests against what is perceived as the provocations of Western media, culture and societies, for all their visibility, likewise engage only a tiny share of youth in Arab societies.

Table 2.2 Youth versus overall unemployment rates (latest year available)

	Country	Youth (15–24) unemployment (%)	Overall unemployment (%)
GCC	Bahrain	20.1 (2001)	15.0 (2005)
	Oman	N/A	15.0 (2004)
	Kuwait	11.3 (2005)	2.0 (2005)
	Qatar	1.6 (2007)	0.4 (2011)
	Saudi Arabia	28.2 (2009)	10.9 (2011)
	United Arab Emirates	12.1 (2008)	4.0 (2008)
Other MENA countries	Algeria	24.3 (2006)	9.7 (2011)
	Egypt	24.8 (2007)	12.2 (2011)
	Iran	23.0 (2008)	15.3 (2011)
	Iraq	30.0 (2012)	15.0 (2010)
	Jordan	27.0 (2009)	12.3 (2011)
	Lebanon	22.1 (2007)	9.0 (2007)
	Libya	22.0 (2010)	30.0 (2004)
	Mauritania	N/A	30.0 (2008)
	Morocco	21.9 (2009)	9.2 (2011)
	Syria	19.1 (2007)	8.1 (2011)
	Tunisia	30.7 (2005)	16.0 (2011)
	West Bank/Gaza	46.9 (2009)	23.5/40 (2010/2011)

Source Authors' compilation of statistics based on World Bank data, CIA World Factbook and UNCT Iraq, latest year available

The damage inflicted on human capital partly depends on the duration of unemployment (Ryan 2001). Unemployment terms are generally shorter for youth than for adults, reflecting the natural tendency of young people to move between jobs (O'Higgins 2003). In some MENA countries, however, the evidence suggests that unemployment periods tend to be longer for youth, especially for those that are educated, who may require more time to find a job match for their skills (Kabbani and Kothari 2005).

At the same time, the Middle East relies heavily on low-paid immigrant workers from Asia to undertake a wide range of production and service jobs that are beyond the capabilities or interest of local workers. At the other end of the spectrum, well-paid professionals notably from Europe, the United States and some Asian countries, fill specific knowledge gaps.

In both cases, the local economies run up huge efficiency gains, although there are also significant capital outflows due to workers' remittances. As governments and many employers favour the local population in the workplace, however, promotions commonly bypass merit and competency as the basis for attaining high-paying jobs. Family ties and gender weigh heavily.

Drawing on its long history and rich experience of how to benefit from close ties in Asia and Africa, Oman has pursued its own strategies to lessen its dependency on foreign workers while still taking advantage of immigration. In order to break with traditions of weak work ethic, the government has actively encouraged employment

Table 2.3 Estimated cost of youth joblessness in the Middle East as a percentage of GDP, 2004

Country (2004 est.)	Total (%)	Male (%)	Female (%)
Qatar	0.6	0.1	0.4
Egypt	7.3	1.5	5.7
Jordan[a)]	4.1	0.9	3.3
Lebanon	2.7	0.4	2.0
Syria	9.1	1.2	8.1
Total MENA	6.6	1.3	5.3

Source Target unemployment rate adults, Chaaban (2008)
[a] Numbers for Jordan from 2002

of native Omanis across a range of professions. In some cases, such as taxi driving, jobs have been reserved for locals. Other professions are more or less ascribed to certain foreign nationalities, such as hair care for Lebanese and manicure for Filipinos. It is obligatory for each immigrant to have a local sponsor who carries certain responsibilities for their well-being but whose dominating status frequently positions them to squeeze maximum rents out of their protégés. Oman has continued to rank lower than most of the other GCC countries in labour force work ethic at company level (Global Competitiveness Report 2011/2012).

Again, a drive to find more jobs for locals has meant that many immigrants were forced to leave. In some cases locals took on the jobs that consequently became available, but in other instances organisations lost critical capabilities that could simply not be replaced, adding to the hardships of a mismatch between skills required and those offered by available recruits.

As Table 2.3 shows, unemployment costs as a share of GDP are estimated to be particularly high for women, and dramatically so in Egypt and Syria, two countries that have experienced some of the most intensive turmoil during the Arab Spring. Whereas female workers are now basically as educated as males in parts of the labour market, they work in strikingly different sectors and positions, as seen in Fig. 2.1.

In the wealthier labour-importing GCC countries women are generally relatively prominent in the "service workers and shop and market sales workers" sector, followed by the professionals sector. In poorer countries, a clear majority of the women active on the labour market are engaged in agriculture. The type of available work largely reflects the economic structure, as noted above. Other features are at play as well, however. Compared to men, women are subject to different social and also personal constraints. They are concerned with the limits of working life to accommodate a role as a mother, they display low labour force participation and, especially in rural areas, suffer from poor access to educational opportunities. Their employment pattern across sectors in the Middle East differs more from that of men than is the case in other regions. The current trend towards an increased share of women in tertiary education is putting traditional values and attitudes under pressure, even though women's skills remain unequally represented and under-

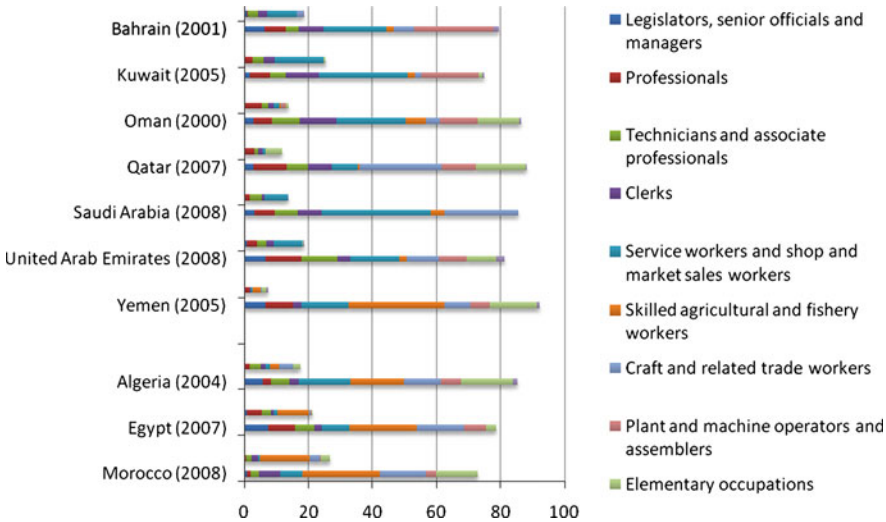


Fig. 2.1 Employment by occupation and country, latest year available), (women/men in per cent of total labour force). *Note* 1 the data for Saudi Arabia display the last four categories under the common label craft and related trade workers and the data for Yemen display categories 2 and 3 under the common label Professionals. *Note* 2 the data for women are presented in the upper lines for each country; those for men are presented in the lower lines. *Source* ILO LABORSTA, *Topic* employment—2C total employment, by occupation (thousands) http://laborsta.ilo.org/STP/guest (accessed 3 and 14 April 2012)

appreciated in the labour market. Table 2.3 conveys that significant gains can be made from integrating youth in the labour market, and notably young females.

Other mismatches are of a geographical nature. Across the MENA countries, 3 % of the land mass houses 92 % of the population, reflecting the rapid urbanisation of recent decades. A large young urban population is looking for employment, while opportunities for advanced jobs are sorely lacking in rural areas. Based on surveys such as that reported in Fig. 2.2, compared to the global average, a relatively large share of employers sees the lack of adequate education and skills as an obstacle to business development. Only a third of graduates are said to have the readiness and skills required for employment—a much lower number than in other regions (Roudi 2011). Employers stressed not only insufficient theoretical knowledge but a lack of soft skills: creative thinking, communication, problem-solving, initiative-taking and leadership. Meanwhile, only one-third of the young people in the MENA region believe that they possess the right knowledge and skills for the demands of the labour markets (e4e 2011). An inadequately educated workforce is rated as the third most important obstacle to business development in Egypt and Saudi Arabia. Egypt is ranked as low as 133rd worldwide in talent utilisation efficiency (Global Competitiveness Report 2011).

Furthermore, an estimated 29 % of the labour force is employed by the public sector, which is way above the world average. Governments account for an even

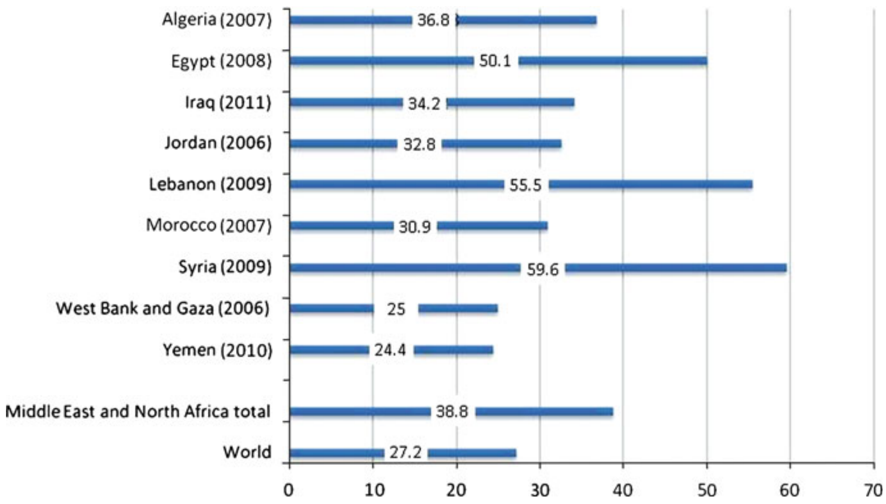


Fig. 2.2 Percent of firms identifying an inadequately educated workforce as a major constraint in enterprise surveys. *Source* http://www.enterprisesurveys.org (accessed 15 April 2012)

higher share of total employment expenditure (ILO 2009). Various reports suggest the public sector remains the preferred employer for the young generation because it is viewed as offering high-status, stable lifelong employment and privileged access to social networks, pensions and even subsidised real estate (Dhillon et al. 2009).

2.5 Education and Employment

Education has a key role to play in shaping an appropriately skilled, creative and innovative workforce and is a prerequisite for driving a modern, knowledge-based economy.

A competitive higher education sector that is effectively plugged into an international context is crucial for building an environment conductive to innovative activities, with both the public and the private sector influencing outcomes. In the MENA region, financial investment in education has by no means been neglected: an estimated 5 % of annual GDP is devoted to education (World Bank 2008).

As for primary education, most countries demonstrate a stark improvement in enrolment rates compared with a few decades ago, though current levels range from 95 (e.g. Algeria) to less than 40 % (e.g. Palestine) (Salama 2009). In secondary education, there has been a similar advance, though the region still lags behind.

In higher education, however, much of the MENA region keeps trailing the wider world. This applies even in comparison with most developing regions, with the exception of sub-Saharan Africa. On the plus side, higher education enrolment reportedly increased by two-thirds between 1990 and 2000 (ILO 2008) and the

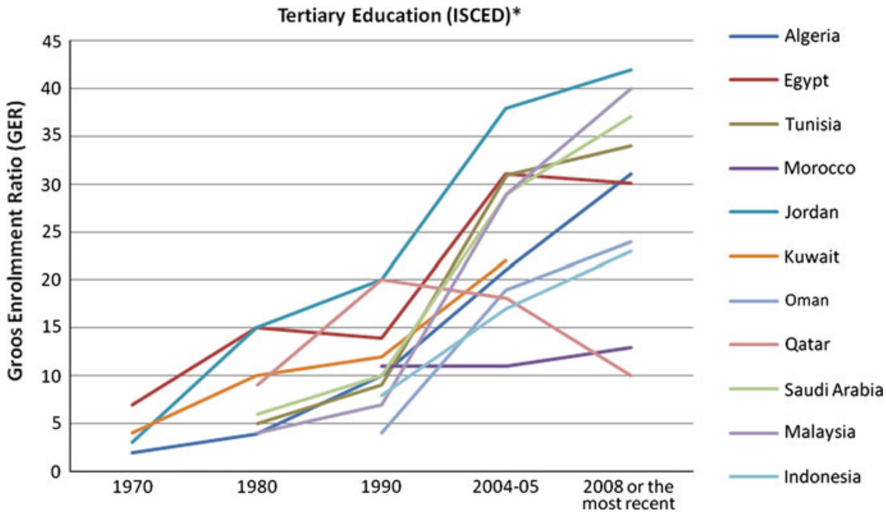


Fig. 2.3 Gross enrolment ratios in tertiary education. *ISCED* International Standard Classification of Education. Gross Enrolment Ratio (GER) designates a nation's total enrolment "in a specific level of education, regardless of age, expressed as a percentage of the population in the official age group corresponding to this level of education" (2005, "gross enrolment ratio"). While the UNESCO definition of tertiary education does not include all forms of postsecondary education (i.e., their classification scheme also accounts for an intermediate level of "postsecondary non-tertiary education"), their figures for tertiary GER help illustrate the discrepancies in higher education opportunities. (UNESCO 2005. Glossary. http://portal.unesco.org/education/en/ev.php-URL_ID=36028&URL_DO=DO_TOPIC&URL_SECTION=201.html). *Source* UNESCO Institute for Statistics 1970–2010

long-term trend points towards continuous growth (Fig. 2.3). We are also seeing greater willingness to invest in education both from governments and other stakeholders.

The large number of new Higher Education Institutions (HEIs), including branches of Western universities, is indicative of changes under way. In Saudi Arabia alone, there has been an increase from eight to more than 100 universities in the past decade (Romani 2009). In Qatar, a new knowledge hub branded the Education City promotes itself as having the world's largest concentration of top-ranked universities in a single area (Buckner Stanford 2011). The region's universities and higher education centres have also climbed the international league tables. Following a recent spurt, five HEIs in the region were represented among the world top 1,000, with King Saud University in Riyadh the leader in 186th place. Saudi Arabian universities were also ranked 302nd, 790th, 955th and 1,000th (Webometrics 2011a). Meanwhile, the Academic Ranking of World Universities for 2011 by Shanghai Jiao Tong University put six Middle Eastern universities in the world top 500, compared to just one in 2003, with a further increase expected

(University World News 2011).[19] Whether this rise is part of a broader boost to innovative research and technological development is another issue.

The MENA region still has only two research institutions in the world top 500, compared with 267 for North America and 167 for Europe (Webometrics, 2011b). Middle Eastern countries claim only a small percentage of the world's total scientific publications and patent filings and continue to rank low in innovation indices.

The international league tables are normally more indicative of research performance than achievement in education. The swift rise of some universities in the GCC countries in the international rankings further reflects strategies to engage foreign researchers in particular publication activities, rather than the onset of a broader research culture. Having said that, establishing internationally ranked universities of high class certainly gives countries greater scope to inspire, attract and retain top talent. Raising general educational quality nevertheless remains a formidable challenge.

Education is normally viewed as one of the most important weapons to deploy against unemployment. However, the education systems of the MENA region have been described as everything from rudimentary to traditional, with an emphasis on repetitive learning and a focus on preparing new generations for public sector employment. In countries such as Morocco and Jordan, the unemployment rate is higher today among those with tertiary education qualifications than among less qualified people. In Morocco, 31.1 % of people with tertiary education backgrounds were unemployed in 2006, compared to 4.5 % of people with only primary education backgrounds (Emperador 2010). In several other countries, such as Egypt and Iran, unemployment is higher among people with secondary education (cf. Fig. 2.4).

Given the weakness of social welfare systems in these countries, low income households cannot afford not to be working and so are occupied in low-paid and informal forms of employment, with low productivity and earnings potential. At the other end of the spectrum, the higher education system is insufficiently matched with labour market needs. Many graduates from higher education thus meet with poor employment opportunities, and almost invariably more so for women than for men. One quarter or more of women with university education were for instance unemployed in Jordan, Egypt, Algeria and Iran a few years ago (World Bank 2007), and the levels are most probably considerably higher in some of them today, following the Arab Spring. Behind this situation lies weak demand for skilled workers (lack of skill-intensive growth) coupled with, as already noted, cultural preferences favouring civil service employment and work at home, with public sector employment considered more "appropriate". Given the increasing share of women in higher education, it is imperative to counter this situation (see further below).

Governments have encouraged youth to gain an education by guaranteeing a public sector job upon study completion (Assaad and Roudi-Fahimi 2007; Roudi

[19] http://www.universityworldnews.com/article.php?story=20110819175018254

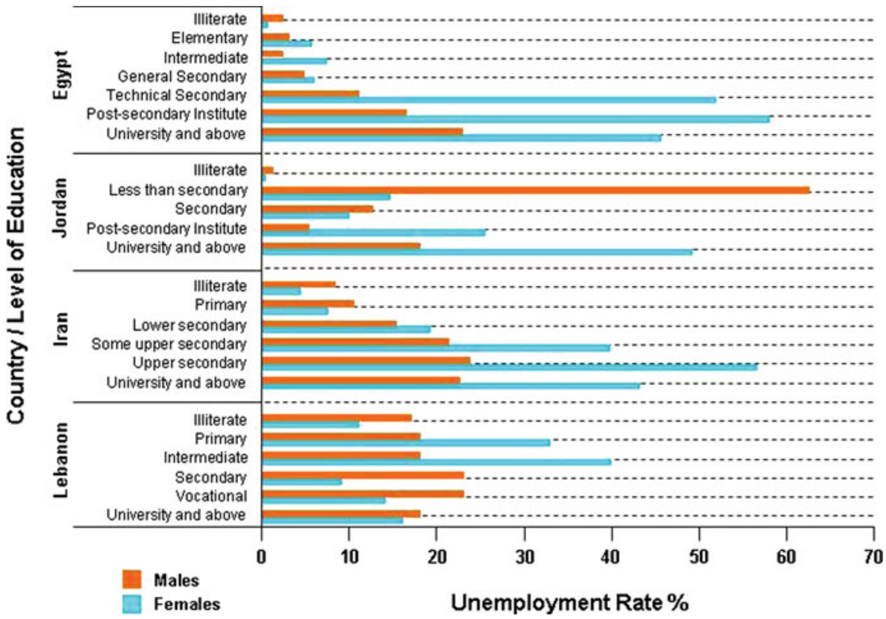


Fig. 2.4 Unemployment rates by level of education in selected Middle Eastern countries. *Source* Dhillon and Yousef (2009)

2011). This legacy continues to influence mindsets and attitudes. Surveys indicate that many unemployed educated young people in the MENA region do not hold realistic perspectives on their future role in the labour market in terms of salary and the jobs for which they are eligible. The wages expected by graduates for instance often exceed the average wages actually offered to workers with similar educational credentials already in employment. Many graduates may thus be classified as "voluntarily unemployed", waiting for public sector employment and unprepared to accept other kinds of work due to their perception of status or prevailing wage levels (Chaaban 2010).

Safe bets such as accountancy, law, medicine or fields of study leading to public sector employment are the favourite choices for top talent in the Middle East (e4e 2011). As seen in Fig. 2.5, social sciences, business and law are overrepresented in all of the countries surveyed by UNESCO. The region also has a notably higher percentage of graduates in education and humanities compared to other developing regions. Arts, humanities and social studies, mostly designed to provide a straight road into public sector employment, are over-represented: between 71 and 76 % of graduates from HEIs have studied these subjects in Djibouti, Morocco, Oman, Saudi Arabia and the West Bank and Gaza (World Bank 2008). Teaching as an occupation has become regarded as a desirable profession, according to one survey, because it is considered as leading to a job within the public sector. As is indicated by Fig. 2.5, there is a tendency among the relatively wealthy GCC countries to expand higher

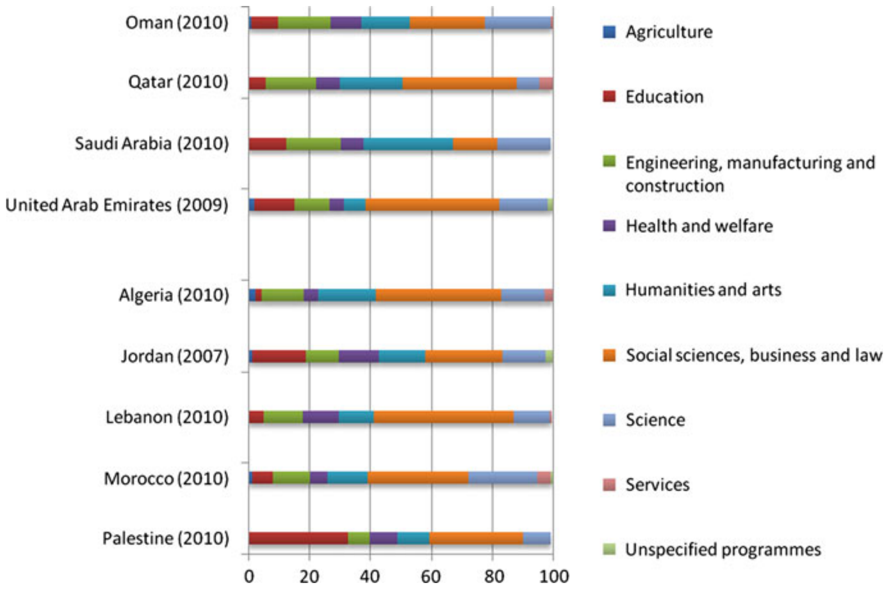


Fig. 2.5 Percentage of tertiary graduates by subject (latest year available). *Source* UNESCO Institute for Statistics http://stats.uis.unesco.org (accessed 15 April 2012)

education more in engineering and also in science, compared to the other countries in the region. As is seen from Fig. 2.6, the share of women remains small in engineering, however, especially in Saudi Arabia and UAE.

The importance of attaining quality in education must be repeatedly emphasised. It appears that the skills of youth in the region have not improved to mirror the patterns in other parts of the world. Critical thinking, practical skills and an entrepreneurial mindset appear less valued than strictly theoretical knowledge (see Arab Human Development Report 2009; Chaaban 2010; Dhillon et al. 2009; e4e 2011; World Bank 2008). Fundamental challenges remain. Basic literacy rates have improved dramatically in recent decades. Morocco is a partial exception as one-third of girls in rural areas reportedly still do not get to read and write. But even for those who do, syntax is a problem that complicates learning. This is the case especially in the francophone countries of the Maghreb due to a common mismatch between the Arabic and French languages that the school system has largely failed to address. Whereas most children have Arabic as their mother tongue, many have French as their main language of learning at school and lack the readiness to bridge the gap. Teachers also lack training in how to help students straddle the divide.

Special attention needs to be paid to soft skills. While a problem-solving approach to education has become increasingly prevalent in other parts of the world, preparing students with the creative and analytical skills needed for a knowledge economy still has low priority among the MENA region's educational institutions at compulsory, secondary and higher level (ILO 2008). Lecture-based

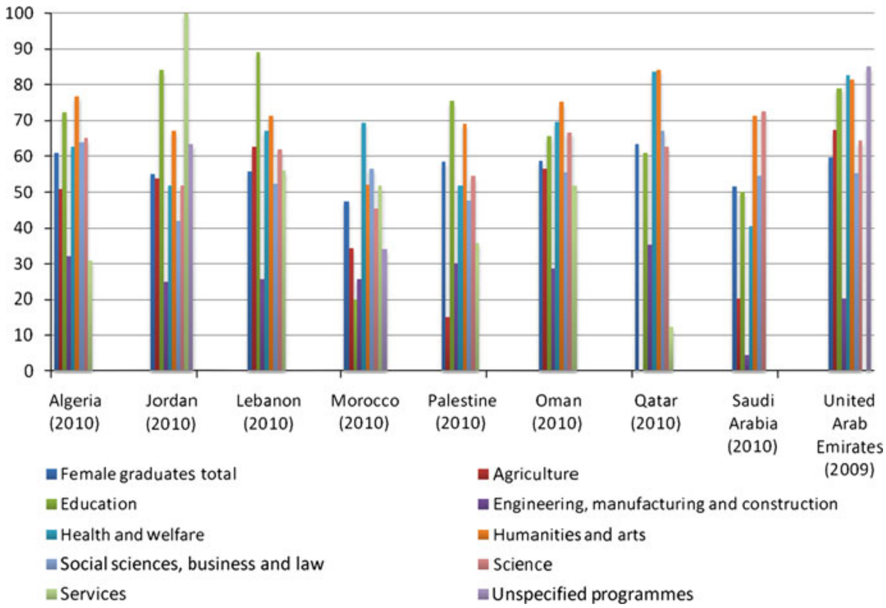


Fig. 2.6 Percentage of female graduates in tertiary education (latest year available). *Source* UNESCO Institute for Statistics http://stats.uis.unesco.org (accessed 15 April 2012)

learning by heart and fact memorisation is accompanied with stringent discipline and an absence of problem-solving teamwork or discussion between students and teachers. Much of the learning material used is out of date and has not kept up with scientific developments (Arab Human Development Report 2009; Assaad and Roudi-Fahimi 2007). It is also worth noticing the absence of focus on students' different prerequisites for and ability in absorbing knowledge and the need for a more individual-based perspective on learning (World Bank 2008). According to a McKinsey study, teachers have usually been recruited from the lowest performing third of secondary school graduates, a fact that does little to encourage higher quality teaching (Barber and Mourshed 2007). In Oman, whereas the educational sector was supported and vigorously expanded, Omanisation policy meant that qualified foreign teachers were dismissed and less experienced and capable local ones charged to take over.

A comparison revealed that baccalaureate exam questions in biology and mathematics in France required students to analyse and apply their knowledge to empirical problems whereas equivalent tests in the MENA region rather asked for memorised hard facts and standard procedures (e4e 2011). Furthermore, when compared worldwide, the MENA region's students attain significantly lower test results in mathematics and science compared to other regions. As seen in Fig. 2.7, no country in the MENA region lived up to the trends in international mathematics and science study (TIMSS) scale average. The high percentage of MENA students failing to meet the lowest performance benchmark indicates that they possessed

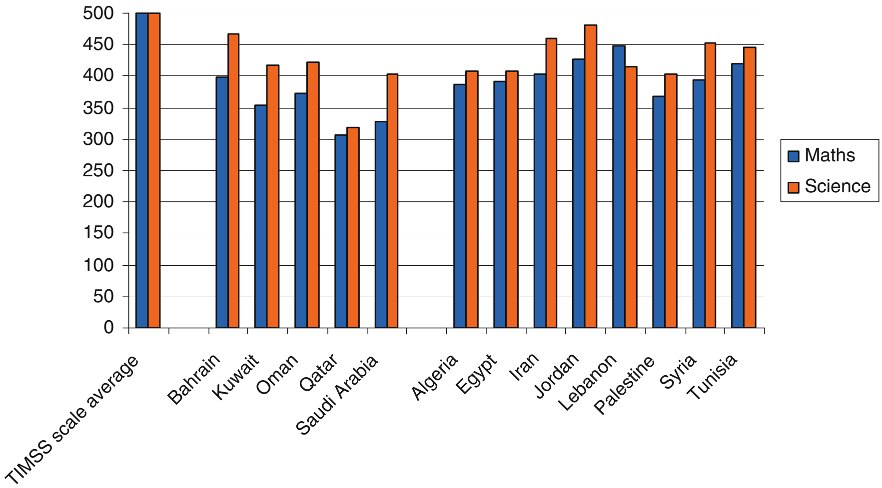


Fig. 2.7 Average mathematics and science scores of eighth-grade students, by country: 2007. *Source* National Centre for Education Statistics

only basic or little knowledge in these areas of study (Dhillon et al. 2009). Except for Bahrain, levels were particularly low in the more affluent GCC countries, underscoring the impression of major quality problems in their educational systems, despite their greater investments in education.

These results are alarming given that competencies in engineering, mathematics and science are generally viewed as indicative of the extent to which the work force is bestowed with the skills that are required for a successful knowledge economy. In the presence of major quality problems in the educational system, longer time spent by children in school may be outright counter-productive. Meanwhile, there is a lack of encouragement and preparation for entrepreneurial activity. This is not merely about gaining acquaintance with the issues that arise when one is trying to start up new businesses, but more broadly a question of attitudes to risk, experimentation and novel ideas.

The role of ICT in education is salient in this context. Young people in the MENA region are by no means unfamiliar with or uninterested in ICT, as exemplified by the uprisings in which social media played an important and dynamic role. Several studies attest to a positive development in ICT use throughout the region, particularly among the GCC countries (Arab Human Development Report 2009). The number of internet users in some of the Gulf countries exceeds the EU average. As for mobile penetration rates, those in the GCC countries now belong among the highest in the world.

Nevertheless, clear signs suggest that the educational effort around ICT is unsatisfactory throughout the school system. Teachers, particularly in public schools, are not up to date and lack opportunities for retraining. Many tend to classroom autocracy—teacher knows best and students should listen and not argue unless they want detention. In ICT, however, all the evidence shows that children, given the opportunity (and often even if not), are fast bypassing their parents and teachers in knowing the latest applications. Teachers who see their standing threatened and do not know how to modify their authoritarian approach while maintaining authority through other means risk losing all and breaking the faith of the young in their elders in more ways than one.

As this example—which has widespread applicability—shows, the quality problem does not merely reside in technical skills, and how subjects are taught. Their true nature has to do with rigidity and outdated practices. Students in the MENA region are often required to choose their future trail for higher studies and make their professional choice already in secondary school, leaving little or no flexibility to change direction later on (World Bank 2008). Many students in effect choose a traditional path in which they lack a genuine interest, out of solidarity with their mentors and coupled with ignorance.

The educational systems of the MENA region are thus overly focused on repetitive learning and do too little to foster the soft skills that are critical for creativity and innovative thinking, as is needed in the evolving knowledge-based society. There are, however, signs of change. A shift seems to have occurred away from curricula that rely on routine and non-participatory learning to those that promote problem solving and application of knowledge. Some countries are granting universities greater autonomy, allowing them to reorganise their curricula, introduce new types of programmes for different populations (e.g. skills upgrading, alternative paths of study), and sometimes introduce fees for specific training opportunities. However, the degree of implementation of these changes varies widely, with Jordan and Iran (rather than the GCC countries) reportedly having gone the furthest (Assaad and Roudi-Fahimi 2007).

2.6 Concluding Remarks

This chapter has reviewed some of the historical and cultural context and economic and societal factors behind the Arab Spring, alongside the immediate issues of politics, governance and the desire of individuals (especially the young) to have a say in their own lives.

The region has been at the centre of world affairs for much of human history and has attained a significant role in developing and making use of new knowledge. In the last few centuries, however, it has fallen behind in these respects and now commands a very small base in science, technology and innovation, as will be extensively discussed in the following chapters. Colonisation and the subsequent harsh transition phase through which the region has attempted to regain its footing have been followed by the hegemony of autocratic regimes. Several countries in the region leapt ahead and presented development models of diverse nature, not least in the GCC where several states have attained high income levels. In many cases, however, economic and societal progress did not filter down to the wider populace. Frustrations have been growing, notably in North Africa, forming part of the backdrop for the Arab Spring.

We have further taken note of the dramatic demographic outlook for the MENA region, including the high numbers of young people approaching working age. Mismatches between the skills that are attained through education and the needs of society appear for various reasons, such as geography, economic structure, quality problems in the educational system, behavioural factors such as jobseekers' expectations and a hesitation in the jobs market to engage females.

Young people must be equipped with the skills and capacities that they need in order to grasp available employment opportunities and also so as to adjust and evolve in response to future labour market demands. There is also a need for reasonable conditions for enterprise development, entrepreneurship and start-up activity.

In closing, this chapter has touched upon the rich and highly diverse historical, cultural and societal factors that characterise the vast region at stake here. Ways forward and solutions to meet current challenges can only be formulated, adopted and carried through on the ground by and with the people of the region, building on the region's own specific strengths and opportunities. Yet the journey cannot occur in isolation, without a foundation of research and quality education, and inevitably it forms part of the rapidly integrating and changing wider world.

Acknowledgments The authors are thankful to Qammar Abbas, Karin Björk, and Sara Johansson de Silva for their substantive input and analysis that contributed to this chapter.

Chapter 3
Capacity Building, Rationale and Learning from Best Practice

Thomas Andersson and Abdelkader Djeflat

In the agrarian economy, the most important investments are in land. In the manufacturing economy, buildings, factories or machinery are in focus. Investments are thus generally of a tangible nature, meaning that financial resources can be attracted with the backing of traditional collateral that is easy for banks and investors to evaluate.

In the knowledge-based world that is taking shape around us, the most crucial assets and investments are different. Value nowadays is above all a question of what is invested in people and knowledge. Education, training, research, management, innovation, networks and organisational change are however of an intangible nature. Their precise worth is much harder to ascertain than that of traditional tangible investment. Irrespective of their value, those who undertake to invest in such assets may struggle to appropriate a reasonable return. As a consequence, underinvestment in intangible assets is likely from society's perspective.

The rise of a knowledge-based economy, in which intangible investments and the development and use of knowledge are becoming essential for economic competitiveness and prosperity, requires that conditions be put in place to help overcome such issues. The inspiration to do so can come from multiple directions. Learning from the outside world must be part of the picture. At the same time, transferring lessons of what works in one societal and cultural context to another is far from straightforward. The willingness to learn from the achievements of others must be combined with homebound strategies that adapt to local conditions, achieve harmony with own values and create a sense of ownership broadly in the population. The rise of domestic role models and sources of inspiration, aside from

T. Andersson (✉)
Jönköping International Business School, Jönköping University, Jönköping, Sweden
e-mail: thomas.andersson@jibs.hj.se

A. Djeflat
University of Lille, 60 Boulevard Vauban, Villeneuve d'Ascq 59800 Lille, France

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_3,

grueling politics, heroic sports or flashy luxury, but in research, innovation and accomplishment for society, represents a critical component. This is, especially the case in the Middle East with its mix-up of the development agenda and widely spread perceptions of an unfriendly Western stance, as explained elsewhere in this book.

In this chapter, we examine the importance of capacity building in science, technology and innovation (STI) and what is the key to success. Following initial observations on the pervasive role of ICT and technology today, we address human and societal capital and the nature of innovation within a systemic context. After discussing at some length issues of general significance to basically all countries, we present some reflections on what is specific in developing or emerging economies. We then move to issues confronting the MENA region specifically, and particularly the GCC countries. We end by staking out a strategy for how to learn from best practice experiences while applying lessons that work in the local context. The ensuing chapters will make use of benchmarking for more precise evaluations.

3.1 Technology ICT and Human Capital

Technical progress—and the ability to exploit it along with other kinds of knowledge through innovation—has long been recognised as an essential building block for economic development and social prosperity alongside education and human capital accumulation.

When trying to explain variation in economic growth between countries over the years, economists have attributed little to country differences in natural resources, land, labour or capital. Almost all variation has been associated with a residual typically ascribed to the role played by technical progress or new ways of doing things (Solow 1951).

For several reasons, technology has now gained added importance, beyond anything we have seen in the past. The fundamental shift that has taken place relates to the rise and diffusion of information and communications technologies (ICT) in the context of a general acceleration in technical progress.

The advance of ICT has made it possible for experts and ordinary people alike to diffuse, access and make use of information on an unprecedented scale. A formidable leverage factor has been introduced in basically all human activities. Through e-science, for instance, researchers from around the world and from across different disciplines are now enabled to collaborate in developing, sharing and examining data (European Commission 2010a). At the same time, industry, the media, policymakers and the general public are gaining access to limitless amounts of information that emanate from a myriad of disparate sources. The result is a multiplication of the knowledge base with implications across the full spectrum of economic and societal activity.

This is not to imply that capturing the benefits of ICT is easy. In fact, many questions have been raised over the years as to how productive ICT actually is.

For quite some time, economists argued that the effects were "everywhere except in the productivity statistics". Those who were sceptics have basically succumbed, however, when confronted with the increasing evidence of tangible impacts. ICT has been estimated to contribute around 20 % of aggregate productivity growth in the most developed countries, and highly significant impacts have been observed at industry and company level as well (OECD 2003). Whereas most benefits were originally sought in the production of ICT, however, the truly convincing impacts have gradually been identified in the use of ICT.

Despite the overwhelming empirical evidence on the importance of ICT, capturing the potential benefits still gives rise to issues. The advance of so-called "codified knowledge", which implies the transformation of knowledge into formats that support its transmission, verification, storage and reproduction, does not mean that so-called "tacit knowledge", which resides in a person's inherent ability and cannot easily be communicated, has become less important. The development of market mechanisms allowing for the effective pricing and management of either kind of knowledge, remains troubled. Investment in ICT is often expensive, and in some areas (and some countries) extensive investments have produced little observable positive impact. Companies that have invested heavily in ICT without undertaking complementary organisational reforms and upgrading the skills of their workforce have underperformed those that invested less.

In fact, there is often a lack of the skills needed for effective use of ICT—skills that are not merely technical in nature. For ICT to fulfil its potential at the organisational level, it needs to be deployed and evolve so as to support core business and essential learning processes. This requires the attention and active involvement not only of IT specialists and technicians but also of top management. Conversely, it increases the need for specialists to communicate better with other layers and departments, and to get a better handle on how to support the organisation's core objectives and key strategic concerns. Many people devote a great deal of time to ICT, but not always in a productive manner—and they may sacrifice other valuable activities in the process. Much of the content produced, diffused and exchanged via the Internet today does not add value to any particular organisation or social cause.

The factors determining the use of technology and ICT at company level have their counterparts at societal level. The extent to which representatives of multiple societal interests have a say, and are able to articulate their needs, will influence the purposes of the applications and their effectiveness in helping to resolve real issues. The interface between technical progress and the societal sphere needs to be constructive. The ability to make use of technology is greatly important for productivity and is therefore a mainstay of a competitive and healthy economy. Yet, there is also evidence that jobs to some extent are replaced by technology. In particular, some analysts argue that ICT has now entered a stage in which it is directly responsible for a decline in employment opportunities and causes an increase in aggregate unemployment (Brynjolfsson and McAfee 2011). As part of the picture, societies around the world appear to be moving towards a greater concentration of wealth in fewer hands. Public indebtedness and macroeconomic imbalances are on the rise in rich countries and we are currently in a state of intensive economic turmoil.

The role of ICT in the overall economy is akin to that of technical progress more generally. In most cases, the introduction of new technology means that more can be produced by less. Higher productivity growth creates potential for higher economic growth. But when productivity increases the question is what happens to the resources that are freed up. Will they be transferred to other, equally or more productive, economic activities? Will there be retraining and reorganisation of the labour force? To what extent do conditions in labour and product markets, and also in corporate restructuring and new business creation, allow for the expansion of other economic activities? The answer to these questions is critical for determining whether higher productivity is accompanied by a broader economic base and, in particular, higher rates of job creation. If technical progress results merely in higher returns for a shrinking share of the overall resource portfolio (whereas other resources end up idle and left to the side) it will fuel an increase in income differences and rising unemployment stemming from job losses in productive companies.

3.2 A Systemic Approach to STI and Education

In order to get a handle on the role of technology, how it relates to human capital, and the role of policies and institutions in this context, it is important to review the nexus of issues we associate with STI. This concept is a broad one. It has been said, for instance, that STI encompasses building technical, vocational, engineering, entrepreneurial, managerial and scientific capacity to solve each country's pressing social and economic problems, transform society and boost the standards of living and the quality of life of the poorest strata of society (World Bank 2008).

With science we basically refer to academic research which is undertaken for the purpose of generating new knowledge. Science may be thought of as *basic* research, which may be more or less explorative. Compared to *applied* research, the findings of basic research are less certain and may also lead in various directions. Who benefits is less predictable (and less controllable). Applied research will be closer to existing economic activity and thus offer more predictable outcomes.

For such reasons, governments concerned with wide-ranging societal benefits are the prime custodians of basic research, whereas most applied research is funded by private companies. It is a different matter that basic and applied research sometimes fuse, and are critically interlinked, which is one reason why governments also take a strong interest in the applied side, and private companies at the technology frontier may also invest in basic research, or be very good at teaming up with institutes and universities engaged in basic research.

Basic research is also viewed as greatly important due to its link to teaching and the quality of education. Teachers who are themselves involved in basic research are likely to be closer to the knowledge frontier and thereby better equipped to inspire their students, because of their access to knowledge which is up-to-date and also belonging to a community intent on sharing. Research into teaching methodology can also enable improved learning processes, for example providing insight into how to tailor pedagogies to the capabilities and attitudes of the individual student, as well as how to instil not only knowledge of substantive facts, but also social skills and creativity in students. Research in social sciences and humanities can also generate valuable insights into social aspects of education and linkages between education and culture.

That said, it should be stressed that real trade-offs sometimes occur between research and education, for instance where a marked imbalance exists that favours appreciation of one kind of activity at the expense of the other. Also, the ability of teachers to stimulate students' fascination with school subjects or to view their university studies as greatly relevant, does not follow from research work with any automatism, but represents a skill and source of appreciation in its own right.

Within the context of the GCC countries and the Middle East the previous chapter already illustrated the importance of injecting new inspiration in, e.g. science and technology, through the educational system. The importance of basic research, and how to frame its linkages to education, needs to be recognised and addressed.

It is further important to review the concept of innovation in some depth. Innovation is one of the most fashionable and yet amongst the least well-understood concepts at the core of stated policy objectives of most governments today, worldwide.

3.2.1 The Evasive and Multifaceted Concept of Innovation

Innovation is basically about putting knowledge or ideas to new use so as to produce commercial value in the market. As a caveat, however, innovations may also diffuse and materialise through channels other than the market mechanism and may enable change through take-up, e.g. by social networks, institutions or political parties. At any rate, we recognise an innovation by its success and ability to be taken up and make a difference.

In practice, the term masks a variety of phenomena. Different kinds of innovation display different characteristics and exert different impacts. Process innovations may raise productivity levels in production, whereas product innovations may exert a stronger impact on widening the economic base. Technical innovations may be capital-intensive whereas non-technical (or service) innovations may be more labour-intensive. Incremental innovations tend to cause merely marginal upgrades of production efficiency or capacity and require relatively limited responses by way of restructuring. By contrast, radical innovations may wipe out entire industries and call for massive relocation of resources to master new technologies and skills.

Measurement of innovation is mostly still focused on the manufacturing sector, although services have now grown larger in most economies. In the service sector, innovation is as important as it is in manufacturing, but here innovation draws less on R&D and has more to do with organisational changes. Despite exceptions in this regard, the service sector may also thrive more on incremental rather than radical innovation compared to manufacturing (Carvalho 2006).

A crucial point has to do with the extent to which innovations are driven by two-way information exchanges between technology providers and customer interests—between the suppliers of new knowledge and those who call for new products to offer solutions to outstanding needs. The greater the sense of mutual receptiveness—a dynamism encompassing both "push" and "pull"—the more likely that there will be strong underpinnings for innovation. A myriad of factors is at play in this respect and will influence what kind of impact the development and use of technology and new knowledge will ultimately have on productivity, growth and jobs.

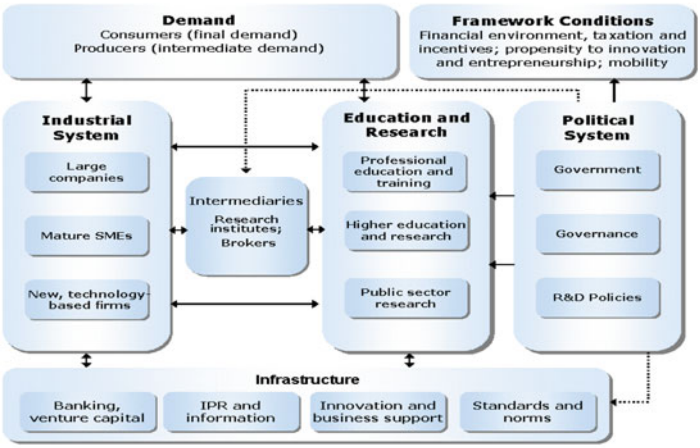
Whereas most attention has been paid to the link between academic research and innovation, it is common that innovations flow from insights that emanate from other knowledge sources. Innovations may be based on the exploitation of technologies that are already in use elsewhere although new to the local context.

The effort of practitioners that may have few or no academic roots represents an important source of innovation as well—and relatively more so in countries with less research capacity and tradition. So-called inventors' networks are often made up of practitioners and enthusiasts, some of whom may be viewed as outcasts or eccentrics. The extent to which they meet with serious possible outlets to present their ideas or prototypes for consideration by potential developers can make a big difference.

Furthermore, we observe stark examples of successful innovations in developing countries that are primarily associated with organisational changes, on the shop floor or in the way that logistics or communication chains operate. Bangladesh, for instance, has generated and benefited from business model innovations that enhance industrial competitiveness and increase output and jobs by realising economies of scale from the expansion of low-cost output.

The ability to absorb and utilise new technology and the capacity to innovate resides largely with private enterprises. On the other hand, obstacles to innovation exist within any established organisation because innovations threaten the established ways of doing things. The willingness of management to tolerate challenges to the ruling order will matter greatly, as will active testing of alternative avenues in the pursuit of problem-solving.

Many innovations within organisations occur at mid-level rather than at the top. One of the challenges is for businesses to create and maintain innovation capabilities in-house so that absorption and anticipation capacity is maintained as a basis for the ability to appropriate returns. Conversely, there is an equally critical task to engineer greater openness to ideas from outside. "Open innovation" has taken hold as a fashion in many modern organisations, partly to try to reduce resistance to new ideas. The knowledge base of any organisation or country can be



Source: Kuhlman and Arnold (2001)

Fig. 3.1 The innovation system

leveraged if it is brought to bear on knowledge imported from elsewhere, just as it can be a potential source of benefits for other parties.

3.2.2 Inter-Related Success and Leverage Factors

Against this backdrop, a country's ability to make use of STI will inevitably depend on a number of institutions and capabilities. Scholars have increasingly focused attention on the need to move away from a linear representation of how STI works. The qualities that are essential for effective "output", i.e. success in innovation, have been described as emanating from within an "innovation system". The term signifies that individual bits and pieces are interdependent. Some public institutions must, for instance, co-exist and interact with market-based mechanisms (Metcalfe 1995).

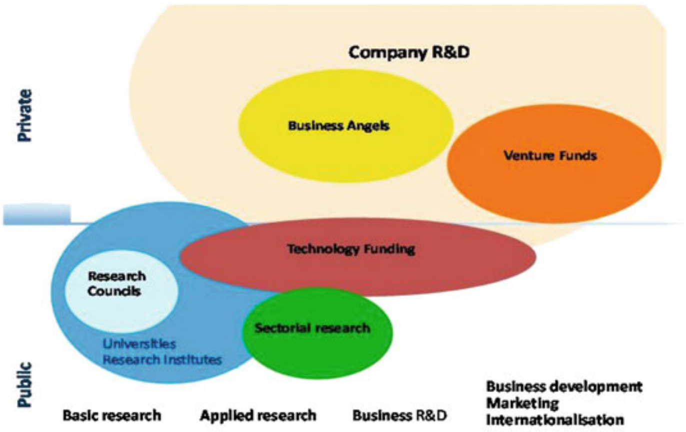
Innovation systems may be conceivable at various levels, including the local, regional, national or international level. Generally the term has been applied at the national level, i.e. National Innovation Systems (NIS), reflecting the legacy of the nation state in determining many of the requirements for innovation. Figure 3.1 illustrates what mainstream analysis would regard as comprising an innovation system, highlighting the ways in which its components are taken to be inter-related.

Interconnectedness is important in STI systems, with inspiration and synergies flowing both ways between its various actors and competencies. The prerequisites for success in STI cannot be left to markets or the exclusive control of any individual ministry or authority, but require active engagement by multiple stakeholders. At the same time, policymakers may enable or leverage STI through various mechanisms, including:

- *General framework conditions*, such as macroeconomic policy, the basic functioning of both factor (capital and labour) and product (goods and services) markets, the legal system, taxation and governance frameworks.
- *Investments in science, research and innovation*, including public and private spending on research infrastructure, R&D, venture capital and other sources of funding for seed or expansion of innovative start-ups.
- *Regulations and procurement policies*, determining the directions and governance of universities and research institutions, patent legislation and other intellectual property rights, conditions impacting on channels for commercialisation of and related kinds of soft infrastructures provision. Using procurement by the public sector to raise competencies and spur new and innovative solutions, including to outstanding societal and environmental issues.
- *Human capital*, sharpening quality requirements and open up for responsiveness to demand factors in all kinds of education, finding ways of making career paths more dependent on relevant capabilities and raising the mobility of experts and other professionals.
- *Adaptation capacity*, inducing a willingness among key institutions to accommodate and adjust to change, try out new ideas and appreciate success as well as tolerate failure in the context of innovation and entrepreneurship.

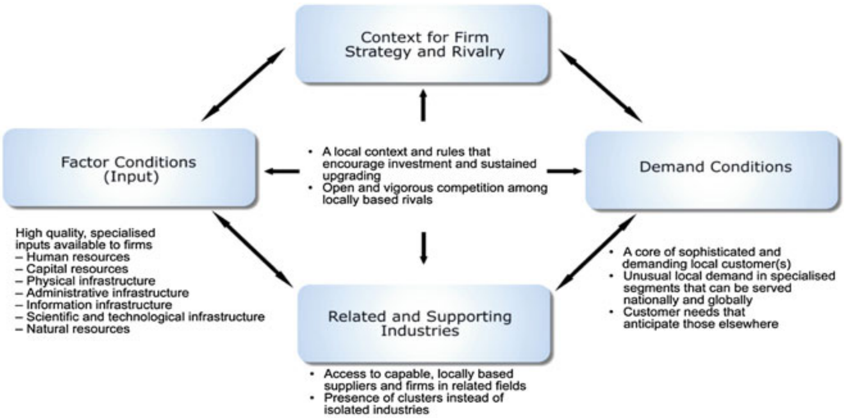
Effective funding of research and innovation requires the presence of multiple actors and instruments, as illustrated by Fig. 3.2. Each of the different stages of the innovation process gives rise to its specific issues, ranging from basic research (left) through to business development and internationalisation (right), where the bulk of financial investment inevitably will be destined. In between, there is the dearth of resources often referred to as "the valley of death" (for new ideas), which is caused not by a lack of money per se but by the absence of an effective interface between the highly divergent competencies (among researchers, financiers, entrepreneurs, etc.) that need to combine in order for ideas to advance across that space.

The notion of "clusters", championed by Michael Porter (1990), emphasises the importance of developments within a population of co-located, interconnected firms and other entities in a particular field. As shown in Fig. 3.3, Porter conceptualised the different influences shaping competitive conditions. Clusters may demonstrate various kinds of dynamics, with forces spurring or hindering innovation forming part of the picture. Whereas the interacting firms and features inherent to their behaviour are at the centre of the cluster concept, it observes that governments (and other public actors) have a role to play in engineering the creation or (in particular) the strengthening of clusters. "Industrial districts" and "development blocs" represent related conceptual models, which underline the importance of synergies between complementary assets and actors. The same applies to the notion of the innovation system which, however, puts stronger emphasis on the role of public institutions in the innovation process, alongside private sector actors.



Source: NISTEP (2005).

Fig. 3.2 Research and innovation funding system

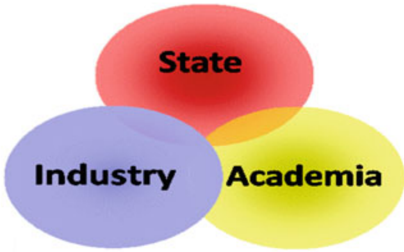


Source: Porter (2001).

Fig. 3.3 Porter's diamond model

Henry Etzkowitz's Triple Helix concept (2002) outlined the importance of a constructive interface between the inter-connected spheres of government, academia and business, as shown in Fig. 3.4. Its focus is on the way businesses, universities and public actors all enrich the Triple Helix, stressing organisationally overlapping and increasingly flexible roles for the actors. The university is an enterprise founder through incubator facilities; industry is an educator through company universities; and government is a venture capitalist.

Fig. 3.4 The triple helix



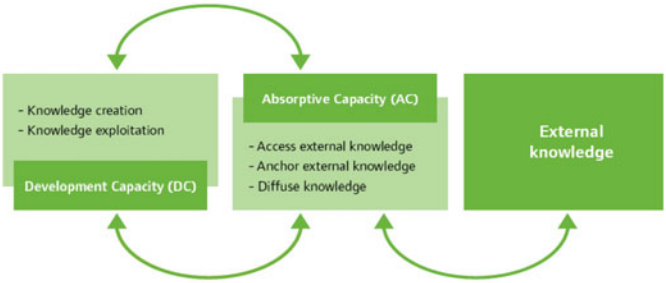
Source: Etzkowitz (2002).

Further structuring of the influence of complementary factors, such as the relationships between the relevant actors and technologies in innovation ecosystems, has occurred through approaches such as the Mode 3 Innovation Ecosystem and the Quadruple Helix, as named by Elias Carayannis and David Campbell (2009). That framework puts emphasis on civil society as a complementary space for individuals to activate themselves in issues of societal/economic relevance and thereby promote bottom-up initiative and diversity in the innovation space. A concept recently embraced by the European Commission, among others, is that of the Knowledge Triangle, which treats education, research and societal impact/ innovation as a series of complementary outputs viewed as relevant for all sectors of society.

Viewed from another angle, STI may be argued to depend on two overriding kinds of complementary capacity: (1) acquisition and use of existing knowledge, and (2) production and use of new knowledge. If progress is slow in one of them, the system's overall performance will suffer. Managing both is far from trivial. Intellectual property rights (IPRs) in a way represent an effort to strike a balance, granting certain proprietary rights to those who come up with new ideas while leaving room for new knowledge to be diffused and used by others (although there are other aspects to balancing "new" and "traditional" knowledge).[1] The outcome influences the different steps of the knowledge chain as well as the links between them, and also how developments within a particular country or economy relate to what is going on in the wider world.

What scope exists for institutions, incentives and actors to serve as "knowledge brokers" and link between complementary competencies? See Fig. 3.5 for an example of a model aimed at measuring outcomes in this respect. Here, the ability to learn is at the centre of the innovation system. Economic agents innovate by learning, and they learn by consumption (demand) as a platform for innovation (NESTA 2008). The interface between a region's demand and consumption of

[1] Patents, for instance, represent a sort of compromise that leaves inventors with a temporary monopoly on the use of their inventions. There is no single optimal best solution that can help determine exactly where to draw the line on the optimal stringency of patent support.



Source: NESTA (2008)

Fig. 3.5 Innovation by absorption: interwoven knowledge linkages

external knowledge (innovation, technologies, services, etc.) may or may not match its efforts in knowledge development and utilisation.

Local conditions are greatly important for the ability of a region or a country to plug into evolving global knowledge chains. It is well established, for instance, that communities tend to develop more strongly when universities are located nearby. The performance of industrial research institutes may likewise much depend on whether they are strategically located vis-à-vis relevant industries. Despite the rise of ICT and the ability to diffuse codified information, proximity and daily personal human interface still matter across the STI system.

At the same time, it is also imperative that the local environment is open, and sometimes international linkages matter more than local ones. Observations of enterprise development in Norway, for instance, found that businesses develop more favourably if they are not linked to other national enterprises but instead are outwardly oriented and collaborate globally rather than locally. The rise of new interactive means for global exchanges, such as open software or virtual science labs or networks, may lead to various new patterns of this sort. In their different ways, however, the frameworks and concepts noted above all serve to highlight the importance of linkages and interactions in STI. That does not translate into an obligation for policymakers to adopt a policy for cluster promotion or to take the lead in innovation systems development. But STI policy needs to embrace the fact that outcomes depend on a range of interdependent actors and competencies, with the role of Government merely one among many. Not least at regional and local level will it be essential to unleash value-enhancing creativity and interaction among multiple stakeholders (Andersson 2012b). The common focus on national institutions and performances may distract attention from critically important cross-border linkages and processes. In many instances, realising complementarities and synergies across such borders may belong to the most effective vehicles to enable improved performances.

3.3 On the Rationale for Research and Innovation Policy

The importance of STI alongside human capital formation is now beyond doubt. Still, the ability of STI to respond to, and be inspired by, the real challenges confronting people and society merits attention. Today this is commonly linked to the question of how to build a vibrant link between STI and the "Grand Challenges" of our time: addressing global warming, disease and health problems, poverty, access to clean drinking water, deforestation, trust and security, etc. Other pressing concerns focus on whether STI contributes to enhanced industrial and societal performance locally, economic diversification and job creation, or whether it helps to upgrade the capabilities of SMEs, reduce road accidents and resolve urban congestion, preserve threatened languages and culture, distribute food and pharmaceuticals, etc. Such questions are often mixed with considerations of whether STI is driven mostly by intra-disciplinary criteria and career paths, or whether it is strongly motivated by the need to respond to real practical and societal issues.

It should be made clear that science and basic research differ from mainstream corporate affairs in vital respects. These activities are not about attempting to achieve certain predetermined objectives. There are many mistaken and inevitably frustrating expectations out there in regard to what can and will be achieved by science and research, and by when. A private company will, or at least should, be better than a university at identifying and addressing the challenges that are within the realms of its core business. A public authority should be best placed to understand how to carry out its main public-service task.

Yet science and basic research matter. Different scientific disciplines offer researchers and students a structured mindset and set of tools that allow them to draw on and add to extensive globally accumulated stocks of knowledge. Interdisciplinary research may enable building new combinations in this regard—combinations that may play a key role in generating new knowledge (thinking "out of the box").

STI policy in a broad sense stands at the heart of the long-term challenge of creating scope for framing the best possible conditions for society to evolve towards addressing outstanding imperatives and harnessing new opportunities. Science and research capacity is a key platform and source of strength to any country's management of knowledge in today's rapidly evolving environment, while also plugging into the expanding cross-border knowledge flows that characterise our globalising economy.

Effective setups for research, innovation and education do not evolve spontaneously, even though some have argued otherwise over the years. Institutional infrastructures and the interplay between scientists and universities or public research institutes on the one hand and business on the other is for instance a natural concern for government and policymakers at various levels. Likewise, cultural factors blend with experience and the availability of skills in influencing the level of trust between individuals and organisations, the extent to which different competencies can be combined, and what risks can be tolerated by business people and investors. Conditions in this regard give rise to issues that cannot just be left to the market alone to sort out, applying to all countries, whether established industrial economies or emerging ones.

Nevertheless, there is a distinct need to be clear about the rationale for government policy in this area. What is the role of government? Are there ways to achieve a particular objective other than having government running the show, or pointing the way? Are the public policies under consideration in a particular case framed to underpin a healthy future landscape of science, technology and innovation?

In an orthodox (economic) sense, there is a rationale for science and technology policy because market forces will not do well in handling the totality of prerequisites. Different kinds of knowledge generation are needed. Attempts to commercialise new technology are inherently risky. New solutions should to some extent be diffused and be applied throughout society.

Fulfilling the potential of basic research tends overwhelmingly to require access to public funding. In the case of applied research, the investor can anticipate higher returns, and here private funding may thus contribute significant resources. But a large chunk of the societal return is likely to accrue to other players. Conversely, the public science and research agenda naturally differs from the private sector R&D and innovation agenda. The public orientation is inevitably longer term and more apt to accept capacity-building for its own sake. While this will cause frustration with those looking for immediate returns, it helps illustrate why government involvement is needed. Private industry will be the best placed to push ahead with research where results are imminent, but more fundamental breakthroughs will often require interaction among a broader community of more collegiate actors engaged in science and basic research.

Education provides a useful parallel. First, it is more in society's interest than in the interest of the individuals concerned that people gain an understanding of science and technology and can inspire others to learn too. Second, a narrow segment of high income earners are dedicated and can afford to send their children to the schools they prefer. At higher levels of education, heavy gains accrue to the individuals themselves. With awareness and the required liquidity, they can and will pay themselves. As with research, however, there is no perfectly functioning market for investment in human capital. If people do not have the cash, they may well run into difficulties in borrowing the funds with no collateral other than the future income that will flow from their education. This is partly because it is difficult to know with certainty beforehand what the outcome will be, as neither the educational institution nor the student may perform as expected. Also, the more basic the education is, the more important it becomes for society that individuals receive it. The term "education" is here used in a wide sense, to incorporate the kinds of attitudes and skills that will make children capable of, e.g. curiosity, teamwork, empathy with others, resolving problems as they arise, adapting to changing circumstances, etc. If they do, they will share with others what they learned. If they do not, and take simpler jobs and/or find themselves unemployed, they run a greater risk of resorting to crime or flawed behaviour and may drag others down with them. It is thus very important for any society that everyone has the opportunities and incentives to study at primary and, to some extent, secondary level, and also to address the imperfections in capital markets that hinder those who wish from studying at tertiary level. This is the basic reason why many countries make primary education obligatory, subsidise secondary education heavily and provide public lending schemes in support of those students who choose to continue with tertiary education.

Again, there is a rationale for public funding to support basic science and research that is curiosity-driven and not motivated by immediate applications or commercialisation. However, its development will be influenced by the linkages and synergies that arise with other kinds of competencies. No individual government or ministry can handle that framework alone because outcomes will depend on multiple factors and interactions. The benefits that arise out of science, technology and innovation depend on the actions taken by multiple stakeholders, within and across national boundaries. Institutions, culture and how knowledge generation goes together with widely held attitudes and values will matter greatly for what outcomes are achieved.

With intensifying globalisation, a critical issue concerns how immobile factors (such as infrastructure but also "culture", amenities and traditional local institutions) can help create a "glue" for a particular location that enables it not only to attract increasingly mobile international flows of capital, labour, technology, expertise and ideas, but also enables a strengthening of societal and environmental assets—a genuinely enhanced "productivity" from cooperation. A rationale for government to realise such glue may stem from scale effects, or positive or negative externalities. By building critical mass with regard to key assets and realising supportive infrastructure or the presence of key amenities, governments may play a crucial role in creating a stimulating environment and building a fruitful scientific as well as wider societal culture for knowledge creation and use.

STI policy may not be effective, however, if it is applied piecemeal by just handling individual "market failures" one by one. Policy must address linkages and matching mechanisms, which translates into a task of rectifying systemic failure among the inter-related determinants of science, innovation and entrepreneurship, as conceptualised in the literature on innovation systems, clusters, the Triple Helix, or the Quadruple Helix. There is also the critical task of ensuring a long-term sustainable development, taking societal and environmental effects into account, in addition to the industrial, economic and societal aspects.

STI policy goes beyond traditional market and policy failure. Its role includes ensuring that: sufficient resources exist for science, research and innovation; required infrastructure is in place; playing rules and conditions are conducive to investment and risk management; appropriate synergies and linkages are present in the system; and that positive spillover effects are harnessed whereas negative externalities are countered.

It is critical to recognise the limitations in the role of government. Especially for more radical innovations, the progression of new knowledge into economically significant activity depends on what room there is for risk-taking by individuals and for companies to grow. In situations and societies where there is little room for true acceptance of success or forgiveness of failure, newcomers face a strong disincentive to challenge incumbents. Governments are generally not best placed to understand and address such factors, but should work in close collaboration with others to establish framework conditions that do more good than harm. Strong management along with healthy organisation and governance structures matter critically for success.

Rather than being the prime actor, the government should put the other stakeholders at the centre of the scene and define its own success in the light of its ability to mobilise them and catalyse their success. In other words, government should focus less on what it does itself and more on how it helps to launch and sustain a high level of activity and robust performance among the multiple stakeholders engaged in research and innovation, including universities, industrial institutes, labs and private companies. It should look for ways of stimulating innovation by catalysing demand in response to outstanding issues. Finally, there is the task of removing barriers, including in many cases vis-à-vis other countries in order to counter artificial national "lock-in" of innovation systems.

3.4 MNEs, SMEs and Entrepreneurship

In any economy marked by high R&D-intensity, most R&D is pursued by relatively large companies that are already well established in their line of business and have attained a presence in foreign markets. Such multinational enterprises (MNEs) must generally be highly adaptive to conditions in different countries and capable of relocating operations for maximum operating efficiency. Establishments abroad are typically made by setting up new ventures (so-called greenfield operations) or through mergers and acquisitions with existing firms. The latter allow for more rapid market entry than the former, but also involve complicating compromises on how to handle the assets and culture of organisations that are marked by different origins and experiences.

Today, MNEs are very important for the transfers of technology and skills between different countries. Through their bargaining power they can often extract favourable conditions from the countries in which they locate. On the other hand, their businesses tend to be accompanied by a range of assets and competencies whose benefits cannot be fully internalised within their organisation. The greater the recipient country's absorptive capacity, the greater the share of the returns it is likely to reap.

MNEs are generally skillful in teaming up with universities or research institutes that undertake relevant basic research. Through financial injections or linkages to their existing market channels, they may be able to add substantive value to those research efforts. At the same time, those firms are in a prime position to take advantage of the new technologies and gain control over enabled commercialisation processes in established as well as in new markets. For universities, research industries and corporations in emerging and developing economies, it is very important to position themselves as attractive partners to MNEs. At the same time, they need to build the capacity and competencies that enable them to share parts of the gains. Here, there is normally no contradiction. Rewarding research collaboration will typically be nurtured by sharp and professional innovation capabilities on both sides.

In order for MNEs to localise top-notch research activities in a particular environment they would typically have to conclude that it offers them favourable conditions for a long-term presence there. In the process they transfer significant capital and competencies to the local environment and become less footloose as they go. The fierce international competition that MNEs face nevertheless means that they wage a constant battle to raise productivity. They thus also shed labour and typically keep moving towards higher-end skill requirements across the board. In the knowledge-based society, new jobs do not arise primarily in big business.

Again, the public sector cannot lead the expansion of new jobs, and surely not at the levels of public sector development and with the demographic profiles that now apply in the Middle East. Hence, in practice, new business start-ups and growth in small- and medium-sized enterprises[2] offers the main alternative. In the vast majority of countries, SMEs account for a growing share of employment. In many regions they act as the only remaining viable channel for building a sustainable dynamic economy as big business internationalises and becomes more footloose across the board.

As discussed in the previous chapter, the Middle East is marked by a strong dependency on natural resource revenues, a large public sector, fragmented national markets, conditions that provide a particular emphasis on investment in tangible rather than intangible assets, security in large organisations rather than entrepreneurship, already-proven solutions rather than assuming risks, and so forth. Given the prevailing economic structures, accommodating the demographic trends in the Middle East means that more focus must inevitably be placed on self-employment and job creation in the private sector, including conditions for start-ups and expansion of SMEs.

On the whole, SMEs are more vulnerable than large enterprises. They fall prey to liquidity problems more easily, partly because they have weaker bargaining power than large firms, and may in fact be totally at their mercy in jurisdictional systems that lack orderly dispute resolution mechanisms. They invest less in R&D, and their processes for competency upgrading may be problematic. With regard to ICT, the dominant position of incumbent vendors coupled with a lack of technical skills may drive up costs and result in sub-standard support services for SMEs. Likewise, SMEs may not be able to afford the time and effort to identify

[2] The OECD defines SMEs as having less than 250 employees, whereas micro firms have less than 10 and small firms less than 50.

educational or training programmes relevant to their requirements, though there are generally few providers that meet their special needs.

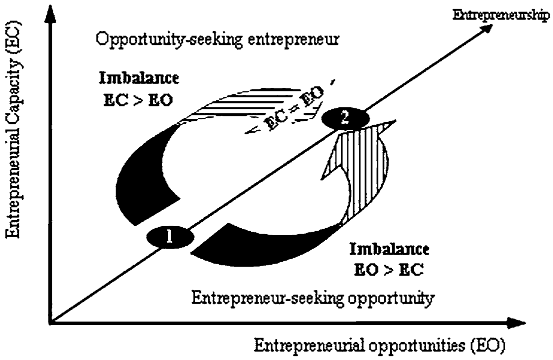
What we refer to as SMEs are a markedly heterogeneous group of firms. For instance, just like the individuals—"entrepreneurs"—who start a business are driven by varying objectives, the options and behaviours of SMEs will vary too. One can distinguish between necessity-based survival businesses; lifestyle businesses, scalable start-ups, buyable start-ups and social entrepreneur ventures—to name a few. The Global Entrepreneurship Monitor (GEM) report notes that systematic differences emanate from the entrepreneur's level of education (whether he or she starts from scratch or from a university or established business platform), age, gender and access to mentorship, financial resources and supportive business networks.

There is further a difference between start-ups that depend heavily on the credentials and capabilities of the founding entrepreneur, and a large community of more mature SMEs that are more about "business-as-usual". Differences exist between technology-based and service-based SMEs, between those that are internationalising and those with a primarily local orientation, and so on. A limited proportion of SMEs can be characterised as high-tech, while an even smaller fraction of start-ups (not synonymous with the high-tech category) can be referred to as gazelles who actually achieve rapid growth.

Compared to large firms, however, many SMEs harness distinct benefits. They tend to enjoy relatively low overheads, have less costs embedded in existing activities, be less constrained by multiple stakeholder interests and, therefore, they are often more flexible than large firms. The advance of ICT, if rightly exploited, offers SMEs new ways and means to access markets and intelligence, and also to engage in new kinds of business networks and collaboration where size is less of a prerequisite.

Further, whereas life in a young or a small company typically remains less secure than that in a big established firm, not only do large companies also experience finite life cycles but the tendency today is for those cycles to grow shorter. Career prospects in a large company are crucially shaped by the values and priorities of superiors, as well as require constant consideration to peer pressure. The sense of security in a big firm is thus, in part, illusory. The same applies to work in the public sector, and even more so once that too is subjected to scrutiny and evaluation of its results, which inevitably need to happen.

For any firms, big as well as small, success in the long term is critically about constant renewal and innovation. Again, large firms have more resources to invest in intelligence and research activities. They may excel in putting out new products for sale to new customers in new markets with great speed (e.g. Google and Android). On the other hand, changes in customer tastes or legislation, technological breakthroughs, or new competitors leverage the scope for disruptive innovation which may cause their downfall unless they adapt (Nokia). Further, as they establish themselves in particular niches, they tend to innovate by way of developing variants of their core business. Large businesses thus almost invariably develop a culture of "staying in line", partly reflecting their specialisation (their



Source: Andersson et al. (2010b).

Fig. 3.6 Matching entrepreneurial capacity and entrepreneurial opportunities

ultimate source of strength), and thus have a tendency to adopt an entrenched culture that makes disruptive innovation extremely difficult to execute.

SMEs are, in a sense, “not there yet”. With a greater dependency on learning-by-doing, they will generally require their staff to handle more multi-task assignments as well as offer a larger window for experimentation and trying out what is new. On that basis, SMEs may enjoy an advantage in being more nimble and flexible than larger entities. In many industries, corporate directors of big business compensate for this state of affairs by staying alert to opportunities to acquire smaller innovative companies (cf., “Buyable start-ups”). The popularity of “open innovation” is underpinned by such sentiments in large firms.

Without the efforts and the risks assumed by individual entrepreneurs, there will be no new business enterprises, and any job creation strategy will stall. It is worth reflecting on what is the limiting factor here.

Where the availability of entrepreneurial capacity exceeds the opportunities, unfulfilled expectations discourage even an otherwise positive attitude towards entrepreneurship. Similarly, entrepreneurial opportunities in excess of capacity will not generate commercial outcomes (see Fig. 3.6). Both imbalances depress the level of entrepreneurial activity. Consequently, the growth of entrepreneurship is the product of a three-pronged strategy:

- developing entrepreneurial capacity;
- cultivating and detecting entrepreneurial opportunities; and
- attaining an equilibrium encompassing a higher level of both entrepreneurial capacity and opportunities from the creation of entrepreneurial growth companies.

Creativity in business involves the generation of new ideas that are converted into economic activity. In this, training that serves to generate creative thinking must be accompanied by a strong culture of commercialisation. If a new thought has been developed, in order to test the market it has to be validated. Only when a prototype has been created can the competitive environment be assessed, the product tested, feedback obtained and used to refine its properties and a business plan tightly constructed and executed when the new entrepreneur is ready to seek outside investors.

The process fostering entrepreneurship starts early. On the question whether an entrepreneur is borne or grown, there is no absolute answer; personal traits matter. Still, any human being will have his or her curiosity, imagination, team-working ability, and judgement when to assume risk, hugely impacted during childhood and through primary school. Then in secondary school, and even more at university level when professional skills are attained, the degree to which mindset and also practical conditions that can help enable entrepreneurship form part of the picture, will influence the choice of career paths and avenues in life. Again, the mission of an entrepreneur is seldom easy, but it can lead to path-breaking results, and society needs that some talented and highly motivated individuals choose to make that effort.

In practice, SMEs and entrepreneurs are constrained or grounded not by individual hurdles but by the combined weight of all. Limitations in the strategy or skills of the business owner, or weaknesses in the business idea and plan, may be aggravated by regulatory and bureaucratic impediments, weaknesses in the reliability of customers or business partners, legal deficiencies meaning conditions are lacking to contest late or non-payment of invoices, or other hurdles that sap the energy of the individual or the organisation. It may be difficult to discern what constitutes an unfair and costly impediment and what is merely indicative of normal market competition.

Experience worldwide demonstrates the difficulty of improving the situation for SMEs and entrepreneurship through piecemeal efforts. Under no circumstances can government agencies boost entrepreneurship and SME growth by just giving money away to entrepreneurs who want it. Any such policy is bound to end in failure. Enterprise creation or development is not a jobs programme for the unemployed or local populace.

Rather, policymakers need to be mindful of the variety of factors that matter to the business environment for young and small enterprises. These will include, for example, regulatory issues and red tape, the conditions that influence attitudes to failure and success, the availability of workers with relevant skills, the tendency for investors and business partners to respect a business deal and engage in long-term collaboration of mutual interest, mentorship and coaching, access to seed and venture capital, business angel activity, supportive specialist services and so forth.

Different kinds of entrepreneurs and SMEs meet with different requirements and issues. The category of knowledge-based potential high-growth start-ups will suffer disproportionately when conditions are lacking for risk-taking, seed funding, investment in intangible assets, mentoring and coaching from experienced business people, etc. Further, while learning by doing will matter to all, supportive business services of relevance to entrepreneurs in their area of specialisation will make a major difference to start-ups with growth potential. In arts and crafts, food, agricultural product refining, fragrances, textiles and embroidery, business renewal is likely to be dependent on innovation in design, branding and marketing. In pharmacy and biotech, the means for rapid upscaling and access to global marketing channels are crucial. Throughout, opportunities for networking and partnering approaches that can help pool resources, competencies and market channels can make a crucial difference. Local connectivity and adaption is required to assure relevance. Women entrepreneneurs, for instance, may not fit in, or even be allowed to join, male-dominated networks.

The development of a service industry that is of high relevance to SMEs may require certain initial, and perhaps also continuous, public support. Again, it cannot be prescribed by top-down government policy. Pools of competent human resources, useful networks and effective brokering services tailored to the needs of entrepreneurs and SMEs can only evolve over time by responding to market needs, not in response to the directions of government officials.

Some Middle Eastern counties have recently pursued reforms to facilitate entrepreneurship and SME development. But fundamental questions on attitudes to entrepreneurship and the conditions confronting entrepreneurs and SMEs remain. This is especially the case for women entrepreneurship which meets with greater hurdles in this region compared to other parts of the world, where it now tends outgrow entrepreneurship by men (GEM Report, 2011). Nowhere in the Middle East or North Africa is it yet possible to find a truly dynamic environment that provides a combination of seed funding, business angel activity, supportive specialist entrepreneurship networks and constructive brokering functions. Also, where there is intensive dialogue and collaboration among the GCC countries on geopolitical and security issues, they devote scant common effort to progress in these areas.

3.5 Addressing Context-Specific Systems

Virtually every country and region displays an eagerness to understand how it can become more competitive in—and benefit from—science, technology and innovation (STI). Because so many factors interrelate, and outcomes are context-specific, there is no one size that fits all: no single optimal solution is at hand to merely plug in to fit a particular need. Paradoxically, this lack of universally applicable solutions and lessons makes it even more important to study and learn from the experience of others.

To what degree are policy lessons applied in developed countries relevant to emerging or developing economies? There is no universal answer. Naturally, developed countries have greater human resources and can draw upon a longer track record in policy development. On the other hand, emerging economies may have fewer costs embedded in existing policy frameworks and more altitude for trying out new solutions, not because attitudes would be more open in a general sense but because the established ways of working would be less entrenched. This creates opportunities for “leapfrogging” in terms of both technical and institutional development and shifting directly into the solutions of the future rather than the past.

The required governance model needs to cater for the different parts of the innovation system and enable productive linkages between them. The potential contribution not only of education and innovation, but also of science and research, matters for any economy—though the best model for realising it will vary. Achieving results on all fronts will most certainly spread resources too thinly. Still, there is a case for all countries to pave the way for capacity building in both applied and basic research. Promoting only applied market-led research will be neither sufficient nor effective for basically any country, just as advanced countries cannot blossom on the basis of government-funded basic science alone. The desirable share of basic research is naturally lower in developing economies. Still, they too need to start building the basic research component from early on, because that is the one that is the least trapped in meeting short-term objectives, and the most prone to diffuse its results widely and enable the establishment of linkages with other researchers around the world engaged in basic research work. There is a definite need to create conditions that allow both kinds of research to evolve, especially as basic research is particularly important for linking to higher education. In addition, applied research requires strong business sector engagement but needs the link to basic research for access to a recruitment base.

The view that STI capabilities are critically important for emerging and especially developing economies deviates from what used to be the mainstream position of development theory. The prevailing perspective up to some 10 years ago held that developing countries should give priority to other more urgent needs, such as basic education, infrastructure and building labour-intensive industry, rather than concern themselves with science and research.

Of course, as already noted, it is true that a country's level of development and other factors do motivate differences in priority and how long one can anticipate it will take before particular actions will produce results. This holds true for government just as it does for the private sector. It is not reasonable to recommend an under-developed country to invest massively in basic science, for instance. Private companies in such a country may also not invest in R&D at all.

Related to this is the notion that any government needs to embrace specialisation, which goes beyond the traditional notion of complying with "comparative advantage". Fostering specialisation is rather about "core business", strengthening a critical mass of interlinked actors and resources, and paving the way for learning processes that are sufficiently focused, encompassing not only private companies but also the profile of universities, research institutes and collaborative agreements with external partners. In this context, it is not possible to foster specialisation without any element of "picking the winners" policies. Yet, the role of government must not be to back particular actors in the market place. The task is one of fuelling, or enabling, favourable development processes, and the rise of capacities that can allow the forces of customer demand and societal needs to "pull" innovations and their realisation in the economy.

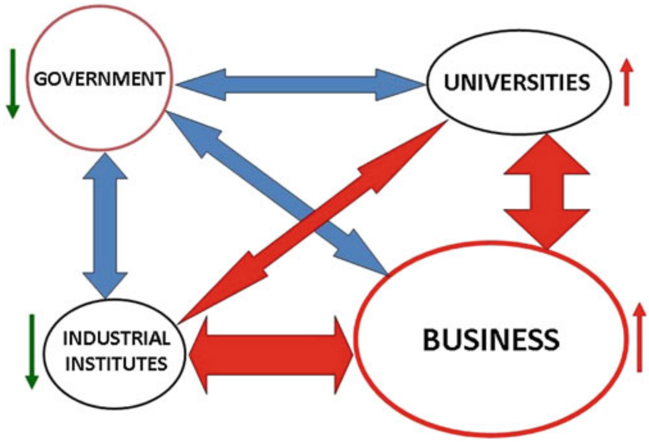


Fig. 3.7 "Developed" country research map

Such observations exemplify issues that manifest themselves in particular ways for countries in earlier development stages. Not only does the research side tend to be weak in developing economies, but the connection to demand for innovation tends to be poorly developed as well. Also, the environment that is required for the development of new high-risk and potentially high-growth companies is generally absent, diminishing the scope for developing new growth capacity and creating jobs.

While the mechanisms that surround the financing and development of innovation are partly generic, limitations in data, including with regard to fundamental building blocks or linkages, tend to diminish the usefulness of innovation policy analysis in these countries. Mapping the prevalence of R&D not to mention innovation, is often very hard to do.

Consider a stylised map of the extent to which R&D is undertaken in different societal spheres—and the links between those spheres. In Figs. 3.7 and 3.8, the size of the circles symbolises the share of total R&D that each main sphere (government, university, business and industrial institutes) tends to account for in this kind of set-up. The red linkages denote dynamic and evolving collaboration; the blue ones indicate more static relations. The vertical arrows also indicate whether the weight of a sphere in R&D tends to be increasing (red) or decreasing (green).

For developed countries where data abound, establishing such a map is fairly straightforward. While there will be national differences, a stylised outcome may resemble Fig. 3.7 with a fully developed and increasing role for private sector R&D. The government is still important, notably in funding basic research, and links exist between the government and the other actors. But the government share of the overall R&D effort is still modest and may be in decline, although the government will keep representing an important funder of R&D in the other spheres. At the same time, the importance of the university sector is on the increase (in some countries the weight would be relatively higher on industrial

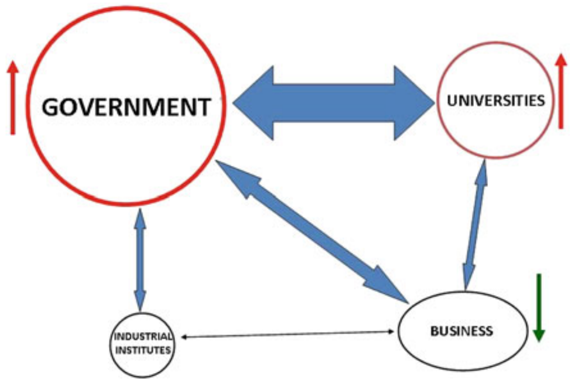


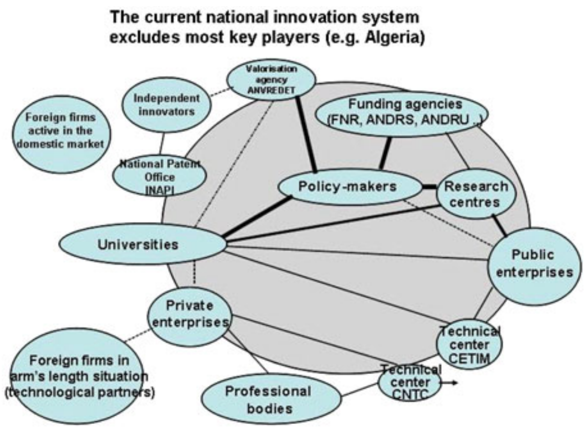
Fig. 3.8 "Developing" country research map

institutes) in a situation where, unlike as in the past, universities are now increasingly active in developing linkages with the corporate sector, especially with large companies. Industrial institutes are here depicted as dynamically related both to universities and to the corporate sector, in which they typically connect more effectively with SMEs compared to universities. In some cases, however, the role of both industrial institutes and universities remains stagnant. Overall, industrial institutes' share of total R&D is mostly on the decline, whereas universities are tending to see an increasing share.

The situation is quite different in developing and emerging economies. Figure 3.8 illustrates a stylised set-up for institutional imbalance, generally marked by heavy dominance of the government sector and a weak interface between private companies and the other R&D actors, including universities. The government's predominance in the R&D effort typically increases further as it seeks to channel more resources to R&D, although it may try to stimulate research elsewhere in the institutional fabric. Business sector R&D, on the other hand, tends to be stagnant. Universities may be granted greater public funding but their linkages with the business sector tend to develop slowly. The chief private investors in R&D are often large multinational companies that operate in either traditional natural-resource industries or in the manufacturing sector, depending on the country and sectoral prerequisites. Industrial research institutes tend to be equally underdeveloped.

The above can only be understood as stylised features that may not be applicable in each specific case. Some emerging economies, notably in Southeast Asia, have enjoyed great success in important areas, including vibrant industry linkages with universities or institutes. A lack of data and institutional knowledge often clouds a mapping of this kind at country level, however, impeding a well-founded analysis of the nature and implications of R&D investment in developing and even emerging economies.

All the same, attempts can be made to visualise how intricately a particular research or innovation system may be evolving. This typically requires consideration of the many stakeholders and potential facilitators whose commitment to S&T and innovation could potentially make a major difference beyond the



Source: Djeflat et al. (2008).

Fig. 3.9 Innovation system limitations

traditional realms of the triple helix as indicated above. It is important to gain an understanding of systemic aspects and the nature of interactions, including to what extent they are marked by "inclusion" or "exclusion" as a strategy (Devalan 2006). For instance, a study of Algeria's industrial sector identified three levels of engagement in the innovation system, illustrated as a circle in Fig. 3.9. The following observations can be made of the different levels:

Level 1: Fully included are research centres and some funding agencies essentially of a public nature, either general or sector-specific.

Level 2: Partly included in the system are several key players and stakeholders: the national patent office, valorisation agencies, universities, private and public enterprises and certain industrial technical centres.

Level 3: Foreign companies, independent inventors, private companies (mostly SMEs) and professional bodies are totally excluded from the system.

The implied weak innovation inputs and the fragmented nature of the innovation system constitute fundamental challenges and high-priority issues for government to address. In emerging economies, establishing a constructive interface between the different societal spheres partly involves other players—and different issues—compared to developed countries. Some face dire challenges in how to put public investment to productive use, how to motivate collaboration between different stakeholders, or how to ensure a positive association for R&D and innovation with fundamental cultural and societal conditions.

As part of the picture, some developing and emerging economies consist of nation states that were carved out during the endgame of colonialism, with boundaries that may not necessarily follow natural dividing lines between different economic and societal "zones". Whereas each country may also be lacking a critical mass of financial and human resources in STI national governments in such countries often act so as to further reinforce a fragmentation of the regional landscape into artificially secluded national STI systems. Then again we have those countries that gain access to huge financial revenue to back the development effort due to their natural resource base.

3.6 Resource Wealth: A Blessing or a Curse?

Once a formidable centre of scientific learning and discovery, the Middle East is now seriously behind the international curve in this area. Research and innovation have not been perceived as priorities, though the region is nevertheless intensively engaged in an attempt to realise the opportunities offered by modern technologies. Throughout, there is also a major preoccupation how to facilitate new industries and enterprise development and thereby fuel a broadening of the economic base to create new jobs. It is widely understood that these tasks require extensive investment in education, as well as an element of research and innovation.

Across practically the entire MENA region, a great deal of technology continues to be acquired from external sources. Of course, any country or region in today's technically inter-related world depends on knowledge exchanges across borders. The balance or complementarity that is attained matters, however, for the terms on which the exchange occurs. A weak position for the MENA region may be seen as natural, given its limited output in research and innovation and the fact that key positions are filled mostly by administrators and government bureaucrats rather than engineers or managers of private-sector-related companies. High fees and excessive usage of integrated technology contracts throughout the region indicate the scope of the problem. Inefficiencies commonly derive from the influence of well-organised vested interests that profit at the expense of less informed counterparts.

At the same time, extensive financial resources are available in parts of the region, especially in the GCC countries, mostly due to the hydrocarbon sector. Other industries, based on innovative capabilities, need to see the light of day if there are to be real opportunities for building an acceptable basis for working and living in the modern era.

Traditional development theory focused closely on how developing countries could capitalise on their natural resources as a cornerstone for development (Nurkse 1953; Rostow 1960). However, researchers later concluded that natural resource wealth serves as a drag on growth rather than as a facilitator (Auty 1990; Sachs and Warner 1995; Gylfason 2001; Jones 2002). The notion that high dependence on natural resource extraction may hinder economic growth is known as the natural resource "curse".

Much of this discussion has centred on the so-called "Dutch disease" syndrome: as natural resource abundance boosts foreign exchange earnings, it leads to an appreciation of the exchange rate and the subsequent crowding out of other activities in the open and tradable part of the economy, while benefitting public sector growth and non-tradables. Natural resource production is capital-intensive and tends to require high fixed costs. At the same time, commodity prices are generally volatile, bringing the risk of severe macroeconomic fluctuations, including periods of low returns. This may hurt growth performance in itself (van der Ploeg and Poelhekke 2010), while high volatility further undercuts the support of long-term investment, such as R&D.

Gradually it has become clear that macroeconomic considerations, while relevant in many situations, tell only part of the story. Influences on the directions of human effort are critical. Rich natural resources serve as a lure for rent-seeking—gaining privilege and a share of the riches through political clout rather than economic achievement—and complacency when it comes to pushing for competition and economic efficiency (Corden 1984; Auty 1990; Sachs and Warner 2001). Even where regimes make the effort to distribute the returns more widely among the wider population, there is the danger of picking up the habits of a "cosy life".

Because natural resource riches tend to accrue directly to the government, the latter tends to gain an inflated status relative to other stakeholders. The proportion of national income that flows to the population at large will be smaller as a result. Also, since government revenue is not collected through general taxation, there is less accountability and pressure for public resources to support societal objectives (Devarajan et al. 2010). Even when it comes to the resource basis itself there tends to be a lack of investment in supportive knowledge generation. Low private spending on R&D tends to go hand-in-hand with failure to inspire the creation of specialised educational institutions and programmes. In short, there is a risk of natural resource wealth translating into poor governance. Some have argued that this also follows from reduced incentives to develop democratic institutions, though the empirical evidence appears inconclusive.

Other studies have further examined how the curse operates through micro and institutional factors (Isham et al. 2005; Sala-i-Martin and Subramanian 2003; Bulte et al. 2005; Arzeki and Bruckner 2009). Part of the impact may emanate from less pressure to undertake necessary structural reforms, such as those aimed at opening up for more competition, sharper frameworks for education, merit-based promotion or the establishment of new enterprises (Amin and Djankov 2009). The availability of huge financial resources in few hands leads to a concentration on efforts to invest in safe, tangible assets, such as land or housing. There is thus a tendency towards weak incentives and motivation for institutions and individuals to engage in R&D, entrepreneurship and start-up activity.

While such arguments appear plausible in a general sense, the causal link between natural resource abundance and growth remains contestable. If earnings from natural resources as a share of gross domestic product is used as a proxy for natural resource assets, the group of countries that are defined as rich in natural resources will by definition include agriculture-dependent and undiversified economies. These would probably be better defined as "innovation and human capital poor", and an economic preponderance of natural resources is then as much an outcome of slow growth as the opposite (Smith 2007).

Others have questioned the extent to which natural resource abundance really can be observed to act as a drawback for a given economy. Lederman and Maloney (2007), for instance, found that Sachs's and Warner's results to that effect did not hold given a different specification of the studied time period, although they concluded that high export concentration does hurt growth. Gylfason's result also appear to depend on a few outliers that have achieved high growth without natural resources. Herb (2005) and Alexeev and Conrad (2009) evaluate a range of recent statistical studies and conclude against the presence of a natural resource curse, especially when it comes to oil and mineral wealth. As for volatility, a well-developed financial system will cushion the degree to which there is a negative impact (van der Ploeg and Poelhekke 2009).

Recent experience, especially that of the GCC countries but also of others in the Middle East Africa, Latin America and East Asia that are rich in natural resources, has demonstrated there is no generally applicable notion of a curse (Fasano 2002; Sturm et al. 2008; Frankel 2010).[3] The experience of several developed countries, including Australia, Canada, Finland, Norway and Sweden, lends weight to this conclusion.[4]

The GCC countries nevertheless represent the most compelling case, due both to their high growth over a sustained period of several decades and their continued extreme dependence on limited natural resources, notably oil and gas. To be sure, their advance has been interrupted by the financial crisis of recent years, with their real estate investment and equity positions in debt-struck overseas markets taking a toll on accumulated net wealth. So far, the GCC countries have largely continued to develop relatively well in a situation marked by extreme economic turmoil in the wider world. Their behaviours have nevertheless adjusted—a fact that also relates to the question what the eventual fallout of the Arab Spring will be. Reportedly, they have become more eager to attract new investment projects, especially those that can generate new jobs. On the other hand, they have also become more cautious about spending resources on uncertain or unproven projects. If anything, they have become less prone to risk-taking. Meanwhile, their oil dependency remains unabated.

In order for the GCC states to succeed in technology and innovation, they must craft their STI policies with a view to their very special institutional set-ups. Again, the most prominent are oil and gas predominance; a large public sector; large capital stocks and a rent-seeking culture; skills mismatch and distorted incentives for skills and career development; and high reliance on imported (mostly cheap) immigrant labour. The current conditions give preference to large-scale economic activity, ranging from construction to manufacturing. Investment

[3] The most impressive case in Africa is that of Botswana, which has demonstrated stable high growth in the last few decades thanks to substantial income from mining, notably of diamonds. Exceptionally high price stability for this commodity has helped fuel predictability in public revenue and underpins constant growth. Looking ahead, however, conditions may well become less favourable. Botswana remains highly dependent on diamond production and exports, where extraction conditions are set to become increasingly demanding (Kojo 2010).

[4] For instance, Finland and Sweden displayed important spillovers and spinoffs emanating from the pulp and paper industry, benefitting the long-term growth potential of these economies as a whole (Blomström and Kokko 2007).

in tangible assets is strongly favoured relative to investment in intangibles. There is limited R&D and innovation is much less related to R&D than is the case in OECD countries. Small companies are disadvantaged due to lack of scale and weak bargaining power. Opportunity-based entrepreneurship is limited and mechanisms for the provision of seed funding and mentoring in regard to start-ups are deficient.

The GCC countries are faced with the need of adopting another path forward. These countries do have significant financial resources. In a world marked by high mobility of key human resources, they need to complement their strengths in tangible assets by success not only in attracting talent but also in mobilising it to play a role in shaping a more creative environment.

We will see in later chapters that the peculiarities relating to science and technology include a tendency to condense it to a few geographically concentrated institutions covering limited areas where governance is top-down and decision-making processes often slow-moving. Innovative capacity in the private sector tends to be weakly connected to the domestic science and research base. Besides oil and gas, the private sector generally invests very little in research, and most universities focus almost entirely on higher education. In this set-up, the scope for innovation is mostly incremental rather than radical.

A critical mass of human resources and local talent is key for attaining the fruitful scientific and technological environment that is essential for investment in research capacity. The GCC countries have invested in land and buildings to host research centres, and in infrastructure, but they have made few efforts to make funding available for research itself or seed funding for commercialisation. Investment in, and accumulation of, human capital is vital. International collaboration and networks can contribute importantly in the process. However, all organisations are handicapped by the absence of a research culture and an educational system that awakens curiosity and inspires interest in science and technology. All also suffer from the limitations in regard to innovation and entrepreneurship. The role of a "rentier" culture in this context is further explored in Chap. 8.

3.7 Towards a Relevant Policy: Searching for Best Practice

What are the key factors and determinants that help shape good policy responses and facilitate their implementation? What are the key characteristics of "good" policy responses? How do we go about transforming lessons from what worked—or did not work—elsewhere to another context?

In presenting "best practice" and attempting to draw meaningful lessons from it, key questions concern the relevance and efficiency in the formulation and implementation of policy; what constitutes proper prioritisation and sequencing over time; and how to go about coordination, consistency, credibility and coherence. A particular challenge is the degree to which policies applied by developed countries are of relevance to emerging or developing ones.

Note that different criteria are applicable for identifying best policy practice in different cases. The following may apply:

- Resource efficiency, i.e. best possible use of available resources.
- Adaptive efficiency, i.e. ability to change along with changing circumstances.
- Relevance, i.e. addressing the "right" issues.
- Appropriateness, in a number of respects which may be more or less crucial in a particular case, e.g., as regards timing or the duration of a measure.
- System efficiency, taking into account whether potential synergies are captured.
- Evaluation practices applied, and how lessons are put to use.

In terms of drawing lessons from best policy experience, salient questions include:

- How *generic* is a particular problem or solution? Is it independent of the institutional context or merely a component of a specific system? This is associated with the issue of whether stand-alone or systemic responses are most important.
- How *transferable* is a lesson? A practice that works well in some contexts may be difficult to transplant to others.
- How *robust* is a lesson? Can it be expected to remain a good response over time also when new modes of production and innovation enter the scene?

Some practices are completely, or at least reasonably, generic. They have been successfully transplanted, imitated and copied and seem to have become reasonably robust—they have worked well for longer periods of time. But other policy instruments have proven non-generic, non-transferable and non-robust. A complicating factor here is the potential benefit of designing and implementing those combinations of policies that can be most effective, including those that are directly targeted towards science and technology, as well as those addressing other relevant areas such as human capital management, labour markets, finance, environmental externalities or entrepreneurship.

With regard to governance, further aspects of best practice should be borne in mind:

(1) Relevance and efficiency in the formulation and implementation of policy, including proper prioritisation and sequencing over time. This includes addressing urgent, fundamental matters, going to the real source of a particular problem, while also building realistic expectations of impacts over time. Some policy measures will have immediate results given that they are undertaken under certain conditions; others will under all circumstances be felt only gradually, meaning that there is need for patience. The long-term and short-term impacts at the same time go partly together. Some short-term effects cannot be attained unless structural, long-term impediments have been removed.
(2) Policy coordination, i.e. the ability to manage existing or potential linkages (efficiency-enhancing as well as delimiting) between relevant components of

the institutional and policy framework. An example is the importance of linking policies in the areas of research, education and innovation.

(3) Policy consistency, i.e. to what extent is it possible to ensure that policies are not contradictory or conflicting in the achievement of objectives.

(4) Policy time-consistency and credibility, i.e. that the mechanisms for policy formulation are trusted in the sense that current regulations and practices are not undermined by uncertainty of the future, including the anticipation of unpredictable adverse future changes in design or implementation.

(5) Policy coherence, which means exploiting systemic opportunities for making actions and programmes across government departments and agencies mutually reinforcing, thereby building synergies which can leverage policy effectiveness.

Beyond these aspects, the issues of adaptation, inclusion and, ultimately, appropriation of the STI policy tools encounter other limitations that can be summarised in a few elements (Gottlieb 2009). Best practice, if interpreted in a strict sense, assumes the answers have been predefined from outside and that failure to adopt what the rest of the world is doing will be perceived as less than professional. This may convey the impression that the region is unable to come up with its own answers, indicating weak leadership lacking ownership of the results. When work is undertaken from outside, by experts relying on their notions of best practice in other parts of the world, this gives rise to particular risks. If the region establishes its own best practice, on the other hand, it is likely to elicit its own standards and perhaps miss out on important opportunities.

Also, what is commonly accepted as best practice may or may not be represented by common practice. It may simply be what everyone else is doing. "Herd behaviour"—many actors are looking around at what others are doing and willing to copy their blueprint—is commonplace in today's world. It may look inconceivable that everyone else has it wrong, but willingness to go with the flow may dim the quest for the optimal approach in a specific case, allowing the real question as well as the appropriate answer to go unnoticed, thereby perpetuating unfulfilled opportunities.

3.8 On the Application of Best Practice

The American- and French-origin universities in Beirut and Cairo founded in the late 1800s and early 1900s supplied valuable lessons for best practice in operating private higher education institutions in the Middle East. The American University of Beirut, the Université Saint-Joseph de Beyrouth and the American University in Cairo have ample experience in how governance, quality assurance and funding can achieve academic success and recognition, as well as contribute to human development in the host societies and the wider Middle East (Bertelsen 2009).

Specific considerations should weigh heavily in determining what lessons are going to be useful for the GCC countries. At least four aspects are relevant here: (i) GCC countries have a relatively high dependency on a few natural resources (especially hydrocarbons) and have thus a relatively pressing need to diversify their economies; (ii) the public sector plays a major economic role in GCC states for both historical reasons and because the government is the direct recipient of the natural resource wealth; (iii) the GCC countries are lacking both tradition and mindset for science and technology where they now stand out as relative newcomers making efforts to strengthen their position; and (iv) demographics—coupled with the state of the labour market, human capital and cultural dimensions—call for measures to enhance the mechanisms for overcoming mismatches in knowledge development and use.

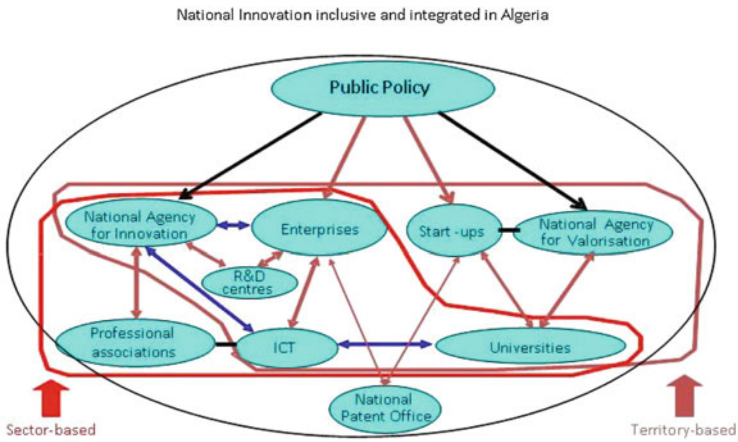
The research, innovation and growth ambitions of the Middle East used to draw inspiration from the United States in particular. In recent years, attention has shifted to other often-cited successful countries with dynamic innovation-inducing industrialisation experience, notably South Korea and Singapore. It is clear, however, that neither the United States, with its large domestic market and entrepreneurially oriented business climate, nor Asian countries like South Korea and Singapore, each with its hard-work ethos, respond to the same parameters in terms of economic structure, human capital or demographic aspects.

Simplistic and politically motivated reporting that has depicted the achievements and institutions of other countries as a "model" worthy of emulation does not always facilitate orderly comparison or inspire the learning of lessons from elsewhere. Analysis of best practice needs to be undertaken in a way that helps distill what elements of a particular approach make it relevant in the specific case. This is all the more so since successful policy implementation requires the mobilisation and engagement of all key stakeholders, as shown in Fig. 3.10.

Effective policy may require that time-contingent items are taken into account, especially at the meso-economic level and in consideration of sectoral policies when stages in a product or industry life cycle often matter crucially (OECD 2005). The relative importance of a particular sector to the value-added of an economy should also be taken into account. In several GCC countries services represent more than 70 % of employment, reflecting the typically depressed standing of manufacturing in a relatively high-cost economic environment endowed with significant natural resource revenues and foreign exchange earnings.

The significance of institutional factors is often underestimated when considering lessons learned from best practices. Deficiencies in wider framework conditions (often a lack of weak regulatory enforcement and scarcity of human resources), standards, dispute resolution mechanisms, law enforcement, taxation and IPR, may combine in disastrous ways. In IPR, best practice generally fails to incorporate alternative methods of protection, such as confidentiality agreements and trade secrecy, secrecy not covered by legal agreements, and lead-time advantage over competitors.

Innovation policy and knowledge-economy issues can be addressed at varying levels, including local, regional, national or cross-border. In the policy context,



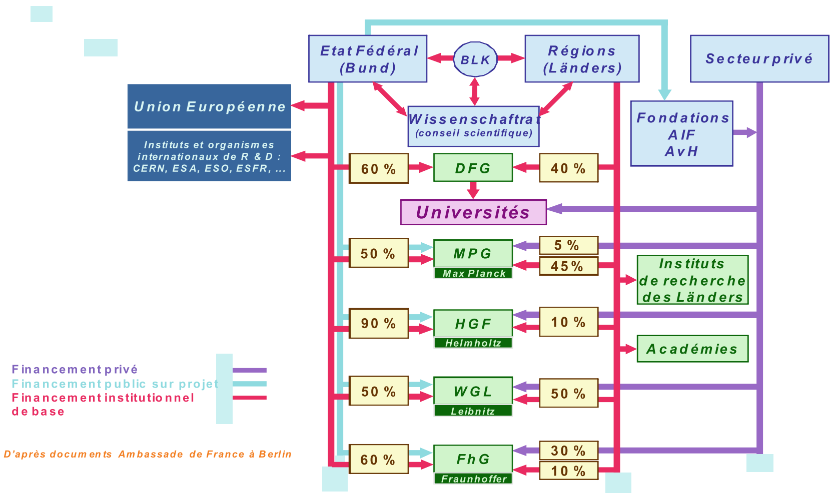
Source: Djeflat et al. (2008).

Fig. 3.10 An all-inclusive innovation system

there is often a compelling case for addressing them at country/national level, reflecting the continued significant role played by the nation state as carrier of important institutional conditions, including cultural and country-specific traditions. At the same time, economic and industrial development prospects may be hugely enhanced when policy analysis and implementation cross national borders, and allow for synergetic strengthening of cross-border processes.

Depending on the purpose, the use of best practice may thus require comparisons with the performance of entire systems, at national level and also beyond that. Alternatively, however, it may also usefully focus on selected items. The German innovation system, and the way it links universities with industry, is considered one of the best (See Fig. 3.11 for a French reading). It is backed by one of the most sophisticated funding systems, which mixes public (including EU) and private funding (including foundations). Public R&D policies are organised along federal lines. In this context, various vertical policy coordination arrangements exist which primarily coordinate public R&D funding. The federal level provides R&D funds, particularly in the form of institutional (co-)funding of non-university research organisations, and project funds through various thematic R&D programmes. By contrast, the role of the *Länder* is chiefly to finance the higher education sector. The *Länder* have operated their own innovation policy programmes since the mid-1970s in response to economic recession and structural change (Scherzinger 1998). In doing so, they have concentrated on areas in which they are least subject to the constraints of joint policy-making (Kaiser and Prange 2004).

While the prospects for successfully reproducing this entire system are neither feasible nor recommendable, parts of it can be used as best practice and inspire policymaking in this field elsewhere in the world. Here, the system can be considered as three interlinked subsystems:



Source: French Embassy in Germany.

Fig. 3.11 The German innovation system

- Subsystem of university-industry *intermediation*
- Subsystem of R&D public-private *funding*
- Subsystem of private sector, federal state and regions (Länder) *coordination*

The funding subsystem has attracted a great deal of interest among both developed and developing countries. France adopted it as the basis for its similar Instituts Carnot model. Other countries suffering from poor governance of the STI system may adopt the coordination subsystem to help overcome some of their difficulties.

The Fraunhofer institutes, which helped generate a critical mass of resources in different areas and international excellence combined with high levels of regional adaptation, have likewise been coined a case of best practice in the establishment of public–private partnership in the field of S&T and innovation policy (see further Chap. 9). At the same time, the German system would generally not be viewed as one of the best when it comes to generating a flow of dynamic new high-tech companies. Partly for this reason, a shift has taken place in partnership policies—not only in Germany but in many other places as well—away from "institutional-based" collaboration towards project-based partnerships (Leitprojeckte, Bioregio Projects) that involve multiple actors in the innovation system.

The above does not imply that best practice can be selected for parts of the process while neglecting the rest. The model put forward by Aghion et al. (2009) for instance, relies on close links and non-separability between three processes—funding, development of autonomy and incentives.

Best practice policies are perhaps most helpful where complexities are limited. On a systemic level, their application can easily run into difficulties. This is because interdependencies between system elements and process path dependencies analysis science-industry linkages, did not find a single best practice. Instead, each country had to choose between a variety of measures that suited its individual needs.

In an extensive effort to map best practice, OECD (1998) assessed performances in eight areas across member countries. Some of the practices were observed to be relatively more "vertical' in nature, such as support of industrial R&D, whereas others crucially had to be systemic to succeed, such as governance or evaluation policy. In a general sense, the areas whose success depended most on a systemic approach displayed fewer best practices. Also, on the issue of evaluation specifically, countries displayed weaknesses particularly in taking systemic aspects into account along with making use of the recommendations of evaluations in the design of new policy initiatives (Andersson 1998).

Hazelkorn (2005) undertook a review of university research management in OECD countries, examining both the impacts of government funding, priority setting, regulations, etc., and the role played by university management. The report clearly pointed to the complex interface between government policy frameworks and institutions' own strategic, organisational and managerial efforts. While it also identified best practices among universities in different respects, especially in the establishment of new non-traditional universities, it underlined the benefits of continuous learning, and that higher education institutions around the world should engage in more orderly sharing of experience.

Determining best practice in a strict sense is, in fact, too ambitious a goal (Jang and Vonortas 2002). There may be a tendency to pick best practices on the basis of subjective judgment, applying three criteria: (a) What has been more sophisticated? (b) What has seemingly worked better? and (c) What has pertinent implications for the country? Instead of looking for the "best"—a rather static approach—it is important to recognise the importance of continued improvement in evaluation practices.

Among the early applications in the policy field, the Australian federal government launched the Best Practice Demonstration Programme in 1991 as a means of encouraging the adoption of international best practice to improve industry's position against overseas competition. It defined best practice as "a comprehensive, integrated and cooperative approach to the continuous improvement of all facets of an organisation's operations. This refers to the way in which leading-edge companies manage their organisation so as to deliver world class standards of performance" (Prescott 1993). Benchmarking is not mentioned explicitly but is nevertheless embedded in this approach.

O'Reagain and Keegan (2000) view best practice as a key element in a multi-stage analysis of innovation systems and policy performance. The proposed approach starts by the selection of areas of improvement, for which best practice is then identified. The second stage consists of developing a set of indicators to use in benchmarking vis-à-vis best practices. The third stage involves studying the best practice processes in great detail, especially the conditions under which best practice is achieved. The approach ends with recommendations on how to adjust conditions to the best practice case. Similarly, the OECD (1998) envisaged a dynamic learning cycle as countries learn from each other and measure and gradually improve their performance in a step-by-step fashion.

It is important to be aware, however, that institutional, cultural and sociological factors are critical for success in STI policies. Achieving outcomes hinges on overcoming resistance, to move so as to gain the adherence of vested interests as well as of the general public. How this can be done may in fact not be possible to publicise, if success is to be feasible. This means there is a real issue of limited transparency.

In this context, it is worth stressing that useful lessons are derived not only from strong performances but also from observing failures and “worst practices”. Most societies are notoriously weak in recognising the true source of problems where their performance is particularly “bad”. In the US, for instance, blindness to fundamental systemic deficiencies is striking in areas like health-care costs, legal system costs and crime rates (the US spends a much larger share of its GDP on health and legal costs, and has much larger shares of its population without health insurance or behind bars than any other developed country). This is no coincidence and, in a way, self-explanatory as it reflects its structure of vested interests that gain from the current state of affairs and the lack of incentives to address the outstanding issues. The real question has to do with the lack of counter-forces capable of speaking out in the interest of the wider societal interest. Empirical work plays a key role in providing the metrics and revealing the implicit measures, policies and processes that prevent or may enable success. Equally, it has a key role to play in disclosing lessons from policy mistakes and errors, particularly those associated with persistent barriers and impediments.

Acknowledgments This and the ensuing three chapters in Part 1, which were prepared under the responsibility of Thomas Andersson and Abdelkader Djeflat, draw in part on “Best Practice in Science and Technology Policies”, the interim INCONET-GCC Report. Sara Johansson de Silva is thanked for statistical analysis and Qammar Abbas, Glenn Gran, Matthieu Roest and Jassim Sheikh for data compilation and analytical contributions.

Chapter 4
Basics on Benchmarking

Thomas Andersson and Abdelkader Djeflat

The previous chapters have addressed the special context of the Middle East followed by capacity building in STI and entrepreneurship. We further discussed aspects of drawing lessons from the experience of other countries, in particular by examining best policy practice.

In this chapter, we proceed on the subject of benchmarking, i.e. how to measure where countries in the Middle East stand relative to the rest of the world, covering a number of those factors that we associate with a knowledge society. The focus here is on the measurement issue—*how* best to gauge, compare and interpret what we find. In Chap. 5 we will proceed by embarking on the actual benchmarking itself.

We should be aware that any statistical measurement that compares people and societies is bound to pose interpretative problems. Nevertheless, in this and in the following chapters, we aim to demonstrate that useful observations can be made, and we will attempt to draw some definite conclusions. At the same time, we will underline the importance of care in interpretation and usage of the results. What is most important, however, does not necessarily have to do with the precise data. Most critical is the way in which the results of the analysis are shared, and how they can help encourage wider buy-in among stakeholders for taking action on what really matters.

In benchmarking, it is pivotal to identify a point of reference for organisations, regions or countries, so as to help facilitate understanding of how they perform relative to their perceived peers. Some see benchmarking as offering a way to compare one's performance squarely with those of the "best". Best in class may

T. Andersson (✉)
Jönköping International Business School, Jönköping University, Jönköping, Sweden
e-mail: thomas.andersson@jibs.hj.se

A. Djeflat
University of Lille, 60 Boulevard Vauban, Villeneuve d'Ascq 59800 Lille, France

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_4,

not always be the most useful yardstick, however. Benchmarking should be used to help achieve greater clarity which strengths and weaknesses make a real difference.

The extent to which benchmarking is relevant depends on what gets measured as well as the way in which it is interpreted and communicated. Before benchmarking the standing of countries in the Middle East on STI or other factors that shape a knowledge society, it is thus important to have a handle on the special features of these countries as well as what matters in those areas. Equally fundamentally, making use of technology and skills in innovative ways is about achieving something unique. All cannot and should not be measured and compared on the same basis.

We start this chapter by examining some pertinent features of benchmarking as a methodology. We then proceed by describing different types of benchmarking and by raising some issues with regard to the objectives. Finally, we look at how benchmarking may be structured so as to be useful in the context of GCC and Middle Eastern countries.

4.1 Types of Benchmarking[1]

As Table 4.1 shows, benchmarking can take a variety of forms. *Performance benchmarking* compares metrics portraying the relevant characteristics of benchmarked regions/states. *Process benchmarking* compares the structures and systems that constitute the practices and functioning of benchmarked regions/states. *Policy benchmarking* compares public policies considered to influence the nature of practices and thence the characteristics of benchmarked regions/states.

As benchmarking becomes more sophisticated, it generally builds on the preceding modes, i.e. it is difficult to undertake process benchmarking without first undertaking performance benchmarking. Similarly, policy benchmarking usually builds on the findings of process benchmarking exercises.

Although performance benchmarking provides the comparative yardstick facilitating understanding of differences between countries and regions, it does not provide the tools to allow for real lessons on policy. For instance, innovation metrics are not sufficient to evaluate the functioning of innovation systems. While performance benchmarking can be considered a form of stocktaking, process benchmarking is based on insights into what makes processes effective and efficient. Inevitably more reliant on qualitative data and information than performance benchmarking, process benchmarking represents a shift away from focusing on what is relatively easy to measure and towards getting a handle on how to learn about much less tangible relations and issues. The aim is not necessarily to search

[1] This section builds on Andersson et al. (2010a), including the unpublished peer review provided by Robert Huggins.

Table 4.1 Summary of types of benchmarking and benchmarkers

		Types of benchmarkers		
		Independent benchmarkers	Single-region benchmarkers	Multi-region benchmarkers
Types of benchmarking	Performance benchmarking	Metrics-based comparison of characteristics, undertaken by regionally external organisations	Metrics-based comparison of characteristics, undertaken by authorities/stakeholders representing one region	Metrics-based comparison of characteristics, undertaken by authorities/stakeholders representing more than one region
	Process benchmarking	Structures and systems comparison of practices, undertaken by regionally external organisations	Structures and systems comparison of practices, undertaken by authorities/stakeholders representing one region	Structures and systems comparison of practices, undertaken by authorities/stakeholders representing more than one region
	Policy benchmarking	Comparison of the public policies influencing processes and performance, undertaken by regionally external organisations	Comparison of the public policies influencing processes and performance, undertaken by authorities/stakeholders representing one region	Comparison of the public policies influencing processes and performance, undertaken by authorities/stakeholders representing more than one region

Source Andersson et al. (2010a)

for best practice but to improve a system's performance by considering another system's features while taking institutional, cultural and other relevant differences into account.

Policy benchmarking forms part of a wider toolbox for policy learning. The objective is basically to search for relevant experience across time and space and carry out comparisons in a way that enables us to learn lessons of maximum benefit. Its role is to help "find" policies and strategies that may usefully inform policymaking. On this basis, a learning process may advance gradually by examining and building on the measures taken by comparator regions/states, appropriate adaptation in local implementation, and perhaps also through feedback and recycling of ideas to peers. Such peers may not only be studied but also engaged in a process of mutual collaboration, examination and learning from two-way exchanges. The purpose should not be to copy or emulate but to adapt, synthesise and inspire future policies.

Policy benchmarking[2] represents, first, a systematic approach to compare operations on an ongoing basis with the benchmarking partners to identify best practices and performance gaps, bearing in mind that information on policies and performance data usually has a rather short shelf life. Second, policy benchmarking represents an effort to capture and monitor the outcomes of actions. Correctly performed, it may enable a more thorough understanding of what factors contribute to best practice and enable real improvement. Third, it aims for policy outcomes to be accurately "measured" against those of benchmarking partners. Finally, through the injection of new ideas, methodologies, strategies, and technologies it constitutes a valuable learning exercise and makes it possible to gain knowledge through exposure to the experience of others.

Policy benchmarking can be approached either in a normative or positive manner. In the normative approach, the issue arises how to define a mechanism that works. The criterion for benchmarking may rest, for instance, on the assumption that unregulated markets do as good a job as can be done in matching supply and demand. In that case, the role of policy becomes to remove whatever interferes with the workings of the market, be it weak property rights or price controls (UNIDO 1998).

In the positive approach, benchmarking is about identifying which policies work best under specified conditions. The specificity clause is crucial. Without a thorough grasp of the conditions under which policies succeed, benchmarking exercises may lead to the wrong conclusions since similar policies cannot be expected to render similar results in different environments. If, for instance, the successful Asian industrialising countries are chosen as a standard for GCC states to compare with, it is vital to account for exogenous factors such as the role of close economic relationships within Japan, China and the ASEAN countries, along with domestic factors that influence the effectiveness of policy implementation.

---

[2] Tatiara District Council "benchmarking policy" Rev 02 (8 September 2009).

The positive approach is more likely to serve as a consensual tool than a normative one, since it rests on more widely shared criteria about what constitutes policy success, such as sustainable gains in welfare, growth, equity, jobs, earnings and quality of life. One of the key objectives of positive policy benchmarking is to identify and remove bottlenecks on the supply side that make social and private returns to investment diverge either through under-investment or through rent seeking.

A number of benchmarking exercises around the world have attempted to integrate the three modes, generally with a focus on policy benchmarking. In the US, both the independently undertaken State New Economy Index and Metropolitan New Economy Index integrate policy benchmarking for the purpose of understanding how policy can influence industrial structure, skills and innovation. Policy benchmarking is most prevalent in Europe, where it, draws on European Union funding. Here, projects[3] focus on innovation and regional policy benchmarking. The so-called Innovation Alliance of 13 European regions[4] has applied benchmarking of regionally implemented policies, and notably of governance in each region. In Japan, benchmarking of R&D activities, notably in basic science, involved both policy and performance benchmarking.[5] Metrics and qualitative analysis of the scientific level attained by domestic scholars need to be evaluated taking into account the evolution of R&D activities and policy support of science worldwide.

While it is relatively straightforward to rationalise benchmarking *à posteriori*, as a result of learning, accumulated experience, theorising and conceptualisation, it is difficult to form *a priori* a framework that can offer an effective instrument for policy inspiration and support. Questions need to be raised regarding, for instance, qualitative versus quantitative measures, region versus international, relevance to cross-border coordination or multi-level governance and what data are available.

4.2 Issues in Benchmarking

Some of the issues encountered when benchmarking economic and policy performance include (c.f. Table 4.2):

- *Comparator for best practices*. What is the basis for the choice of comparators and what is the logic behind the group? The meso dimension of the exercise matters when considering sectors.

---

[3] See http://cordis.europa.eu/fp7/projects_en.html.

[4] European Innovation Alliance (EIA), launched at the Innovation Society conference, Stockholm, 16 June 2006: http://www.ab.lst.se/upload/Projektwebbar/InnovationSociety2006/Dokumentation/Innovation_Alliance_Memorandum.pdf, as accessed on 19 March 2010.

[5] NISTEP: Comprehensive Analysis of Scienceand Technology Benchmarking and Foresight, May (2005). http://www.nistep.go.jp/achiev/ftx/eng/rep099e/pdf/rep099e.pdf (consulted December 2010).

Table 4.2 Relevant to policy benchmarking for an emerging economy

Referent and comparator	Qualitative/ quantitative	Region versus international	Governance multi-level	Data
Top performers in the world	Opinion survey (when?)	OECD	Governance of the state	Ranking
Best performers in the group	Hard data (where?)	EI	Key players in territory	Scores
Best performers in the region	Discrete	BRIC	Company-level governance	Trends
Best performers in the sector	Averages	PIGS	Governance of universities	Discontinuity
Better rather than best	Mixing both	LDCs	Governance of other players	Quality of data
Others	Others	Others	Others	Others

Source The Authors

- *Qualitative and quantitative benchmarking or metrics*. In some cases it may be natural to apply metrics for performance and qualitative benchmarking for policy, but the decision of which measure to use must always take into account the intricacies of how best to communicate findings and the relevance of different measures.
- *Region versus international*. Known groupings such as the EU and OECD can be used as references as done in part of this report, but other groups may be more relevant, e.g. the BRIC (Brazil, Russia, India and China) or PIGS (Portugal, Italy, Greece and Spain). The former represents a formidable force already today, which is set to gain further importance in the future given the size of the economies, their population and natural resources. The latter group has rather entered a stage of chronic trouble and decline, due to the combination of public sector dominance, stifled conditions for private sector growth and associated increasingly serious macroeconomic and structural problems. Although none of these groups are directly relevant as reference points for the Middle East of today, it is important for countries in that region not only to benchmark themselves against the traditional culprits, but also against other emerging fast-growing economies.
- *Governance issues*. Initially linked to macroeconomic decision making, governance has gradually extended to include various key players and stakeholders. Decentralisation of the decision-making process means that new entities and their governance need considering through a multi-level governance system.
- *Data*. A core issue when choosing metrics, particularly for performance benchmarking. While hard data may seem the obvious preference, they are not always easily accessible and viable (particularly in developing countries that do not systematically collect all requisite information). Obtaining fully comprehensive and updated data is an issue that should be kept in mind throughout. In many cases,

opinion surveys represent the only available source of data for comparison and thus have their advantages, despite their subjective nature.

In theory, various indicators can be used to measure output or dynamics in an innovation system. The most relevant, however, tend to require data from relatively sophisticated surveys, which are simply not available in most developing countries. This makes it generally difficult to compare the state of innovation with developed countries, which collaborate closely in collecting data in a comparable and consistent manner. In addition, issues that are critical in a particular country may be subtle and hard to capture based on established statistics. One of the Gulf region's challenges will be to put in place more relevant and demand-led collection and use of a rich set of innovation data.

A host of issues arises when applying benchmarking in the areas at stake here:

1. The challenge of identifying what represents a viable measure of outputs or results relevant to understanding real performance, rather than mere correlations or two-way causalities: The recording of apparent policy failures may for instance merely amount to observing the presence of a problem. For example, a weakly educated labour force, lack of communications infrastructure or a large rural population will have implications for the effectiveness of many national policies.
2. How to factor in the significance of institutional constraints in policy benchmarking: A poor growth record may lead to institutional chaos and it can thus create a negative feedback loop resulting in deteriorating policy quality along with further suppression of economic activity. Multiple institutional constraints may likewise complicate measurement and interpretation of what represents the true obstacles to progress.
3. Addressing time-lags and response times appropriately: While some policies may result in immediate outcomes, others would generate results only gradually, over an extended period of time. The lack of early verifiable results tends to diminish the political viability of many policy measures which may indeed be a prerequisite for overall success.
4. Striking the appropriate balance between applying operational measures and the relevance of measurement: What is most straightforward to measure, such as the amount of funds that are invested in R&D or the number of scientists who work in the industry, may not be helpful for understanding what really matters, such as what outcomes are generated by investments, or what determines the effectiveness of the processes that lead to certain outcomes. In reality, one needs to apply measures that are available, because there may be no options, or because that is the only way to attain comparability with what is achieved elsewhere. On the other hand, in many instances it is possible to attain a sharpened precision in what gets measured, and how that is linked to the true objectives of certain policies, by making a greater effort to think through what is crucial for evaluating outcomes, and preparing for that at an early stage in a process of policy implementation. Simple additions may also help greatly, such

as arranging with basic accounting of primary facts in the specific case.[6] This aspect is further discussed below.

5. Picking proper reference points: No matter how good an indicator is, if one compares performances with the wrong reference point, the resulting insights will be greatly reduced. This matter will be further expanded in Sect. 4.3.

As indicated in the fourth point on the above list, there is a fundamental trade-off between measuring what can be measured but does not matter, and trying to measure what matters but cannot be measured. Some of the traditional input and output measures which have been around for years have been carefully progressed by a cadre of statisticians across different countries working closely to ensure maximum consistency and credibility for the resulting data. A prime example is the systematically developed and internationally negotiated framework for defining and calculating what is to be included in expenditures on Research and Development (R&D), for instance as a share of gross domestic product. That effort, which has enabled the widespread and relatively comparable measurement of R&D activity, has resulted in considerable benefits, e.g. by making companies much more aware of the importance of R&D. In addition, it is thereby possible for diverse countries around the world to know with reasonable accuracy how much they spend in this area relative to others. Comparing how much the public and private sectors respectively produce and invest, or how much basic and applied research is undertaken, allows for further insights into the *nature* of R&D and how synergies between different kinds of R&D contribute to the economy and society.

As a rule of thumb, the developed world has for some time now been aiming for R&D investment to reach 3 % of GDP, with 1 % financed by the public sector. Few developing or emerging economies are anywhere near that level, although China is on a ferocious advance that by 2010 had taken it significantly above 2 %. Qatar is among the other countries that have attained the generally "desired" levels in terms of public investment, while the star performer worldwide is Israel—the only nation in the world that consistently invests more than 4 % of GDP in R&D, partly due to its spending on military research, but also with high levels of activity in a range of other areas (Puchet et al. 2010).

But information on how much is being spent, even on the worthiest of objectives, does not tell us the story of what is actually being achieved. Again, our guides for measuring outputs are established traditional measures for scientific publications (in the case of academic research) and patents (in the case of private sector outcomes). Neither of these sets of measures is ideal. Scientific publications are of modest relevance in some disciplines, but citation numbers or more sophisticated impact measures merely illuminate the degree of appreciation for the work in academic circles, not really where it took us. Patent statistics, on the other hand, are disadvantaged by the increased global prevalence of strategic patents (whose number may be of little commercial relevance) and the lack of information

[6] A simple form of competence audit, for instance, can benefit from a league table of the most successful companies (as measured by revenue or net profit) in a region.

Table 4.3 Evolution of innovation metrics

First-generation input indicators (1950s–1960s)	Second-generation output indicators (1970s–1980s)	Third-generation innovation indicators (1990s)	Fourth-generation process indicators (2000s plus emerging focus)
R&D expenditure S&T personnel Capital Tech intensity	Patents Publications Products Quality change	Innovation surveys Indexing Benchmarking innovation capacity	Knowledge Intangibles Networks Demand Clusters Management techniques Risk/return System dynamics

Source Milbergs and Vonortas (2004)

on what happens to patents after filing. Deficiencies in the internationally fragmented frameworks of intellectual property rights protection mean that many innovators (for instance those engaged in open innovation) do better to put their ideas in the open where they cannot be challenged rather than try in vain to protect them by filing patent claims that could never be defended in the courts of advanced countries' legal systems anyway.

In the measurement of innovation, we may conceptualise various stages, or "generations" of metrics, as illustrated by Table 4.3. They can be characterised, respectively, as:

1. *A linear conception* focusing on inputs, such as R&D.
2. *Inputs complemented* by accounting of intermediate outputs, e.g. related to scientific publications or discoveries.
3. *A richer set of innovation* indicators and indexes based on survey and integration of different relevant data.
4. *The new generation of metrics*, grounded in a knowledge-based networked economy, where ecosystems of innovation now matter crucially.

As can be seen from this table, there has been a gradual advance in searching for indicators viewed as capable of measuring what has been viewed as increasingly relevant for understanding innovation. This does not mean that the traditional measures, such as R&D expenditures, have been thrown out. On the contrary, those indicators remain a major building block for international comparison and for calling the attention to policy makers that efforts are required in this area. Nevertheless, there is now a high level of understanding to not remain at that stage, but to measure as well the importance of the networks, clusters, or behavioural factors that matter crucially for the processes leading to certain results.

In each particular area, a host of measurement issues arise. For instance, NESTA (2003) classifies approaches for identifying clusters. Three possible quantitative approaches and one qualitative approach are:

1. Gathering detailed company-level information on industrial, geographic and economic data (e.g. employment and revenue) to identify where certain

industries are concentrated, along with their core competencies. One problem with this approach is that cluster-based activities are not necessarily well reflected in industry statistics.

2. Applying input–output data to identify relationships between relevant industrial sectors. This approach may enable a useful graphical representation, facilitating intuitive understanding of the links between industries. However, it is generally difficult to obtain information at the regional level.
3. Using detailed company-level information from surveys. This qualitative approach for cluster identification relies more on the knowledge of experts than on statistics. Three criteria are at the centre here: (i) the structure of clusters (firms and interactions among firms), (ii) the presence of competencies (in terms of scientific and technological content), and (iii) performance measures, e.g. with regard to profitability.

For any areas measuring interactions and soft factors, issues such as these abound. It should furthermore be noted that much of the commonly reported and used data in this field refers merely to the macro or industry level. Much of the information that is most crucial for understanding the research–industry interface—and its link to human capital—requires observations at the individual company or business unit level and examination of the evolution of linkages and interactions between them over time. A comprehensive approach to understanding innovation capabilities requires attention to conditions prevailing at the level of individual enterprises, or even individual workers or consumers. It may also require a combination of input, throughput and output factors (Carayannis and Provance 2008).

As for the Middle East, micro data collected through questionnaires and within project frameworks is mostly just not available. The so-called Community Innovation Survey (CIS) has however brought some change in this state of affairs. The CIS approach, first executed by national statistics agencies in the European Union, Norway and Iceland and later expanded to a number of countries outside Europe, now represents one of the leading methodologies for measuring and comparing innovation performances at company level internationally. Based on a questionnaire featuring a core set of questions harmonised across countries coupled with diversified questions of interest to specific countries, the CIS uses a representative sample of business establishments, stratified by sector, establishment size and region. The main statistical unit is the enterprise. The target population consists of firms with ten or more employees.

The first CIS covering a population of enterprises in the Middle East was carried out in Abu Dhabi in 2009. Application of the standard platform allowed for comparability with other economies. Specialised topics were added on basically two fronts: the issue of natural resource dependency and the issue of evaluating the significance of specially identified gaps, for example in the labour market (Andersson et al. 2010a).

4.3 On Points of Reference and Types of Comparison

The issue of measurement must inevitably be granted attention in any expert or policy work on best practice. Here, the focus is not on statistical intricacies. Chapter 5, which applies benchmarking as a measurement and evaluation tool, will make further observations in this regard. In this section we note a few critical methodological issues, in particular how to determine the points of reference and what principles to observe in choosing comparator indicators or performance. These aspects are decisive for what insights can be derived from benchmarking work and comparative analysis more generally in this area.

Relating the record of the GCC states in science and technology to those of other countries in the Middle East may, in some cases, produce a comforting picture. A comparison with developed countries or emerging Asian economies will paint the region in a much less favourable light. Comparing salary levels among researchers, or the number of scientific publications produced, will render similarly contrasting results, although with somewhat different patterns taking shape depending on which precise indicators are being looked at.

No country should compare itself with a predestined static "model" for emulation. Useful lessons may be drawn from observations of what is undertaken or in progress in any other society. The lessons will generally become relatively more useful, however, in proportion to how similar the countries are in:

- Economic development
- Economic structure
- Economic, and possibly geographical, size
- Institutional, cultural and societal fabric
- Policy objectives.

On this basis, it might be thought that countries should first and foremost examine the experience of their neighbours, i.e. those countries that look as much like themselves as possible. This does not, however, represent any generally valid recipe for obtaining useful lessons. Neighbouring countries may not, in fact, constitute good points of reference merely because of geographical proximity. Further, countries are likely to be relatively well informed already about the deeds of their nearest neighbours and for various reasons be relatively unsusceptible to accepting lessons drawn for their experiences. Countries probably also face similar limitations in terms of their insight into what is going on "elsewhere" and any need for radical solutions. It is, therefore, important to expand the set of reference points to include not only countries that are relatively similar in all of the above respects, but also those that are exposed to *other* kinds of impulses and experiences, albeit maintaining some points of similarity to retain relevance.

The most critical factor of all is an ability to initiate a constructive learning process. Comparisons should thus be made with the most relevant and useful reference points around, while also striving to ensure that what is measured is applicable in the local context. Particularly for developing and emerging economies this may require a balancing act, and not least in the Middle East. This is both because of relatively weak availability of internationally comparable data and because the region possesses highly delineated structural conditions. Fundamental differences exist vis-à-vis other countries in terms of which major issues need addressing to achieve a significant improvement in performance. As a consequence, international comparisons may either make use of indicators that simply do not produce comparable results, or that are hardly relevant at all. To obtain an optimal outcome, it is vital to agree to points of reference and comparison areas in each context. Also, it is important not only to build on existing indices and undertake survey work so as to allow for effective international comparisons, but also to adjust and extend the choice of indicators and methodology to fit the imperatives in each case.

In Chap. 5, we turn to the actual measurement of performance. While applying a consistent set of reference points to facilitate structured and informative conclusions, we will keep the caveats and limitations of the comparisons in mind. The focus will be on the GCC countries, whose standing and record we compare internally, with selected peer countries in the Middle East, and with other points of reference in the wider world. Before that, however, the final section of this chapter reviews the challenging specificities of the Middle East that should be borne in mind, and suggests how comparisons with other countries should be viewed.

4.4 Types of Economy in Focus

Countries that are richly endowed with natural resources face a special challenge as they move towards building knowledge-based economies. The task is not merely one of shifting the economic structure away from dependency on natural raw material production to other sectors. In fact, these countries may do too little to draw upon and capitalise on their presence of natural resources, for instance by investing in R&D or fostering innovation to upgrade, expand on and enable downstream (or upstream) business opportunities that tap their natural resource base. A general case also exists for such economies to invest more in the skills directly relevant to their specific natural resources in order to strengthen value-added in specialist areas. Nevertheless, success in fostering knowledge development in natural resource-rich countries generally interrelates with these countries' ability to capture opportunities for growth in economic activities *other* than those that are driven by their ample supply of natural resources.

Countries that are richly endowed with natural resources typically have access to cheap capital, can afford to buy different types of expertise from overseas and have interventionist governments. The abundance of resources in itself brings a drive for rent-seeking behaviour. In this kind of environment, resistance to societal transformation feeds naturally and includes resistance to innovation, which is, by its nature, socially disruptive. While resource-rich countries such as Australia, Canada, New Zealand, Norway and Sweden have managed to diversify and develop endogenous knowledge capabilities, they too have had a history of strong state intervention, large state-run corporations and well-organised vested interests. It is also safe to say that these economies remain largely influenced by the availability of their natural resources and tradition.

Table 4.4 classifies different types of economies. Some belong to more than one category, reflecting their richness in economic and industrial structures. Developing countries rich in natural resources can benefit from the successful experience of those that have earlier managed to diversify away from dependency on natural resources, including other developing economies and now-industrialised countries that started out as natural resource-based. To a varying extent, the latter category includes those that still depend, in one form or another, on their natural resource base for their prosperity.

The success stories can be meaningfully contrasted with the many countries that have not diversified successfully, oftentimes locked onto declining development paths weighed down by their dependency on sunset industries and rent seeking.

Some specific observations distilled from the table exemplify the importance of special consideration of natural resource-rich economies (Andersson et al. 2010a):

Capital. These countries typically have a strength in the availability of financial resources. On the other hand, focus on traditional returns favours investment in land and buildings, whereas the tradition and expertise to invest in intangibles are lacking. Instead of asking how to convert knowledge into capital, the question for these countries is rather "How to convert capital to knowledge?" Clearly, there is no single answer that applies to all situations.

Labour. Unskilled labour is cheap and abundant and there is a tendency for indigenous labour to perceive rent sharing from natural resources as an inherent right, weakening incentives for effort in education as well as in the workplace. Meanwhile, labour tends to be imported (both expensive skilled labour and inexpensive unskilled). Relevant questions here include "How do you incentivise innovation and entrepreneurship in the domestic labour force?" Or, "How do you domesticate and anchor valuable mobile skills?" The experiences of countries such as Australia and Canada are instructive, as are those of small countries with profiles similar to GCC states, in some respects, like Luxembourg and Switzerland.

Locals tend to enjoy preferential treatment in public sector jobs and hence mostly specialise in less productive sectors. Many skilled immigrants stay for a short period to gain temporary benefits but then leave, e.g., to utilise better long-term security in some Western countries.

Social capital. The availability of natural resource rents commonly fortifies a centralised power structure with a small hard core of closely connected individuals who guard their privileges to access and control those rich resources. In the Middle East, that situation blends with the limited supply of skilled professionals and the traditionalist trading culture to create an environment prone to a cautious, marginalist and short-term approach to commercial deals with outsiders, tight control of financial resources and high reliance on tangible investment: As part of the picture, human resources tend to be scattered across fragmented organisations

Table 4.4 Gross generalisation of characteristics for types of economy

	Natural resource-rich economy	Industrial Economy	Knowledge-intensive high value economy	Developing economy
Capital	Liquid (cash), cheap, abundant, depleting slowly	Fixed assets, expensive, non-abundant, and depleting slowly	Intangible assets, expensive, abundant, non-depleting	Cash-strapped, expensive, non-abundant, depleting quickly
Labour	Abundant, unskilled is cheap, skilled is expensive	Increasingly less abundant and more expensive (both skilled and unskilled)	Relatively abundant, expensive (both skilled and unskilled)	Unskilled labour is cheap and abundant; skilled labour is expensive and scarce
Knowledge	Limited (often to natural resources and wealth management), expensive (often expertise has to be imported)	Specialised and locked-in, process-specific, price-quality oriented. Novel knowledge developed elsewhere and imported	Complex and advanced, novelty-oriented, focused on new niches and new product markets	Limited, expensive, and generic in nature aimed at maintenance of existing resources
Infrastructure	Good	Good	Very good	Poor
governance	Ranging from strong state role to state-led economies. State-owned firms play a substantial role	Led by state-unions agreements/consensus. Large industrial agglomerates play important role	Market driven. Stronger role for universities and other knowledge producing players	State-led with foreign firms and investments playing an important economic role
Examples	Arab oil-rich countries, Nigeria, Venezuela, Australia, Canada, New Zealand, Norway, Sweden	Brazil, Korea, China, and also Canada, US and Germany	Most EU,Japan, and US	Majority of regions and countries in the world

Source Andersson (2010a)

which display limited exchanges between them but rather form isolated islands. Key questions in that set-up centre on how to inject a more inclusive mindset from early on, promote increased mobility and cross-fertilisation across the human and disciplinary walls that have been raised, and catalyse the appearance of other kinds of collaboration through partnerships of the sort that can generate demonstrable effects and inspire others to follow suit.

Knowledge. The question is how to diversify (making use of current comparative advantages or on the basis of a strategic vision of the future)? And what is a realistic time horizon? How do you get others to think of you beyond your natural resource profile? International partnerships and hosting to international centres of science (e.g. ITER, CERN and EMBL) can help to alter profiles and domesticate some expertise. Studies of other related economies can also help reveal the presence of lost opportunities, such as under-investment in research into energy production-related innovation even in a country such as Norway (IKED 2004).

Infrastructure. Though not a major drawback for most resource-rich economies, infrastructure development and conditions for its use are often weakly tailored to specific development opportunities. Resources in this area could generally be used more strategically as tools for stimulating local innovation through public demand and tailoring local solutions to local problems. Examples of critical modern infrastructures include high-performing e-infrastructure, e.g. by way of fibre, broadband, special research and education networks, virtual labs for collaboration using e-science data, and the introduction of cloud computing. This kind of infrastructure investment and use cannot be optimised merely through focus on equipment and technologies, but outcomes will depend on the way in which user communities become active and engaged in pulling for new infrastructure through their demand for new services and content to meet with their interests and outstanding needs. Korea has pioneered comprehensive approaches in several respects. In recent years, interesting examples have materialised from a diverse set of other countries, including Estonia, Jordan and Kenya, to mention a few.

Governance. Resource-rich economies, with their abundance of capital and public sector ownership and initiative, typically need to make special efforts to boost research culture, innovation, spin-offs from large state-run companies, and entrepreneurship. Progress in such respects is not achieved by government or private firms in isolation, but is critically dependent on engagement and commitment by a range of stakeholders. A fundamental question is how to establish the kind of collaboration that can allow for real teeth in putting enabling conditions in place and for hurdles to be removed. Finland, Ireland and China Taipei represent examples that have managed to get this done.

In the following, benchmarking of the GCC countries aims to incorporate indicators that are capable of reflecting the specific challenges and opportunities that confront the transition of natural resource-rich economies towards knowledge-based ones. The availability of cheap capital, vested interests, inflated government, resistance to societal transformation, lack of research culture, and barriers to innovation and entrepreneurship form part of the picture. It is desirable that benchmarking takes on board comparisons with the kind of countries that have either previously succeeded in diversifying their economies away from that sort of position, or those that are on the way towards doing so.

Chapter 5
Examining Performance

Thomas Andersson and Abdelkader Djeflat

5.1 Introduction

In this chapter we benchmark the performance of the GCC countries in a number or areas that have a bearing on STI, entrepreneurship and associated enterprise development in the knowledge era. We apply standard indicators, mostly taken from official statistics. In order to undertake international comparisons in some areas where no such data are available, we also consider the findings of opinion surveys and informal data sources.

As we will see, a number of issues arise. The indicators are generally at a highly aggregated level and may not seem to measure precisely what we would like to know to determine where the countries stand and what the issues are. As is inevitably the case, some of the data are also not entirely new, since there is a delay in the publication of the underlying national and/or international statistics. Given the pace of change in this field worldwide, and also in the Middle East, this is not very satisfactory, and we will attempt to point out some limitations that follow from this state of affairs. The caveats of using opinion surveys were already commented on in the previous chapter. We will, nevertheless, argue that the performances measured are relevant to help understand the situation and developments at stake, and that the results should thus be taken seriously. On the other hand, it is also clear that benchmarking of this kind can only provide us with parts of what we need to know and take into consideration, when embarking on policy analysis and implications of direct relevance to the countries, areas and peoples at stake here.

T. Andersson (✉)
Jönköping International Business School, Jönköping University, Jönköping, Sweden
e-mail: thomas.andersson@jibs.hj.se

A. Djeflat
University of Lille, 60 Boulevard Vauban, Villeneuve d'Ascq 59800 Lille, France

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_5,

This chapter is structured as follows. The next section examines the reference points for our international comparisons of national performance. From there, we examine levels of economic growth and development, economic diversification, research and innovation inputs, traditional output measures, education-related measures, ICT aspects, measures related to business development and competitiveness, the quality of scientific institutions, and the quality of government procurement policies.

5.2 Points of Reference

As discussed in the previous chapter, countries may be benchmarked relative to relevant comparators, taking into account their special characteristics and the area being studied. The institutional issues are complex, and not easily summarised. It can still be hugely beneficial to undertake consistent comparisons of one's performances compared to those other countries which one identifies as most meaningful to compare with. For this chapter, we benchmarked the GCC countries against each other, against selected peers in the wider MENA region, against a specially designed proxy for a relevant EU average and also at times against a few other relevant comparator countries in other parts of the world.

We used the so-called EU 12 + 3[1] as one point of reference, in part because the GCC countries are approaching (and in some cases have already attained) an income level on a par with the most advanced EU countries, and partly to be pragmatic and obtain an easily available measure. This comparator may be viewed as representative of the "medium-high-income European segment", while excluding the largest EU countries which may provide a somewhat less relevant comparison for the relatively smaller GCC countries.

Depending on data availability, comparisons are also drawn with a few peer countries in the MENA region. Those included here are mostly among the largest and most development oriented, such as Egypt and Morocco. Some comparisons, for example with Yemen, illustrate contrasts in performance but may not be entirely relevant for understanding policy differences due to stark variation in resource availability and political conditions.

As for other comparisons, we identified the following sets of useful comparators: (1) Tunisia and Jordan, as competitive countries within the wider MENA region; (2) China and India, as developing countries which stand out due to their rapid development in innovative capacity during the past decade or so; (3) Brazil

[1] To obtain a relevant comparison for the relatively small, wealthy GCC countries, we used KAM data "Aggregate Western Europe", relabelled EU12 + 3, as comparator. This excludes the largest economies, that are members of the G7 (France, Germany, Italy, UK), but includes the high-income "old" EU countries, and also the advanced non-EU high-income European countries (Iceland, Norway, Switzerland). Thus, the average is calculated for: Austria, Belgium, Cyprus, Denmark, Finland, Greece, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and Switzerland.

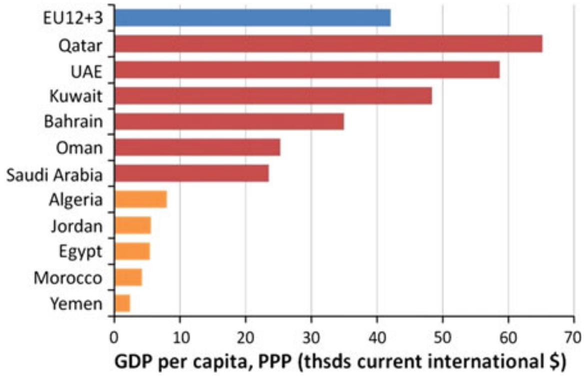


Fig. 5.1 GDP per capita [*source* World Bank (2010). Data are from 2008 or latest available]

and Malaysia, as other developing countries with high dependency on natural resources but noted for success in diversifying their economies through innovation and new high value added activities; and (4) the United States and (as an individual EU country) Finland. The latter two provide points of reference among industrialised nations with a substantial original natural resource core to their economic development, but which now are at the forefront of technological and non-technological innovation.

Throughout, however, we refrain from venturing into consistent comparisons with all these possible contenders, in order to avoid overloading the figures and tables with data. Outside the MENA region, and apart from the EU comparator (which we have tried to incorporate throughout), we benchmark against the others selectively in cases where comparison was deemed particularly useful.

5.3 Level of Development

How developed are the countries of the Middle East? The traditional measure in this area is gross domestic product per person (GDP per capita), which in principle shows the value of all goods and services a country produces in a year, divided by its population. Applying this measure, Fig. 5.1 shows that three GCC countries have achieved an income level that is by now considerably above that EU parameter (only Luxembourg, Norway and Switzerland are roughly on a par with the top performers). The difference is stark compared to other prominent MENA countries, including Egypt, Morocco and Jordan.

The level attained by the leading GCC countries is obviously closely associated with their huge oil and gas revenue. Since these countries also have small populations among which to divide that revenue, the effect is doubly strong. As Fig. 5.2 shows, only Saudi Arabia and Egypt have relatively large economies, and neither belongs among the very richest societies in the region. As was discussed in Chap. 3, natural resource wealth is obviously not sufficient for generating high incomes, even in small countries. Sensible policies are required, too.

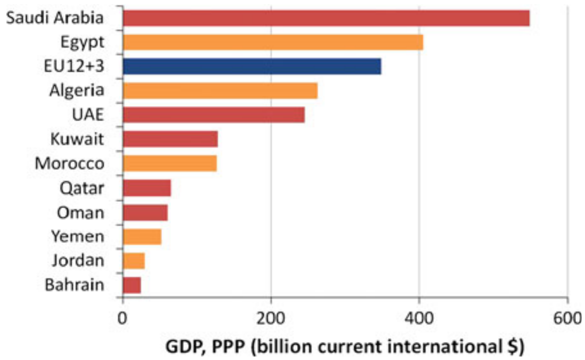


Fig. 5.2 GDP: total amounts [*source* World Bank (2010)]

The limitations of the traditional income measures need to be pointed out. Not all goods and services are priced in markets, and thus are either not properly reflected in the value estimate (such as the public sector) or measured at all. This includes work by mothers and wives at home, subsidiary farming and unrecorded business—all of which goes unnoticed in the formal economy. A significant proportion of people in the GCC, and notably women, are clearly engaged in such activities. An estimated 50 % of the workforce in Oman is engaged in the biological resources sector, which accounts for only 3 % of market GDP and 2 % of the country's exports (Ministry of National Economy 2011). These economic activities, including traditional fishery, clearly have low productivity (though not as low as the statistics would suggest). As for the wider MENA region, there is no doubt that countries such as Egypt, Morocco or Algeria—not to mention Libya—have even higher levels of undocumented economic activity, leading to an underestimate of the region's gross economic output compared to high-income European countries.

On the other hand, substantive negative impacts of economic activity also go unrecorded in GDP. A noteworthy example is the presence of extensive degrading effects on "natural capital" (environmental or ecological resources). All countries fail to record most of the ongoing losses in that category. Though the precise numbers are unknown, unofficial estimates point to annual losses in GDP in the range of 3–8 % across the MENA region (Hallegatte et al. 2011). The nature of the impacts differs between the GCC countries and their peers, but the effects are huge in both cases. The GCC countries are among those with the largest "carbon footprints" in the world. This aspect is further examined in Chap. 12.

A salient aspect of the MENA region as a whole is a skewed income distribution. The countries with relatively low income, but also some of the middle income countries with large population (e.g. Egypt and Morocco) have large numbers of poor people, with inadequate access to basic services including basic education and health services.

Furthermore, the GCC countries are marked by an extraordinary sectoral concentration. Figures 5.3 and 5.4 illustrate that the GCC countries suffer from low economic diversification, measured by traditional methodologies. The share of

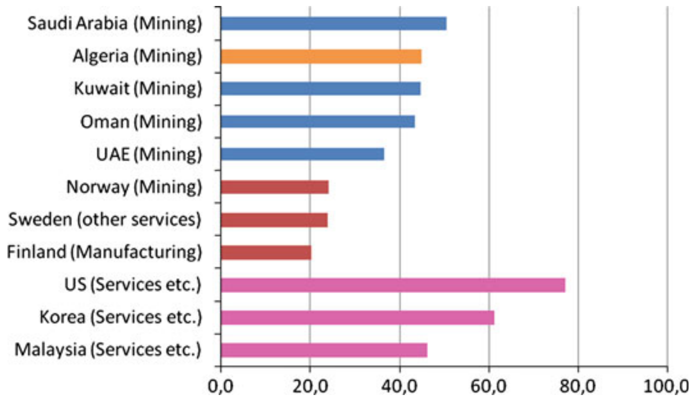


Fig. 5.3 Economic diversification (share in percent of largest economic sector in total value added) [*source* World Bank (2010). Data are from 2008 or latest available]

high-tech exports in total exports, for instance, suggests the presence of a "Dutch disease" effect, i.e. the crowding out of an open tradable sector. At the income and cost level now attained, the ability of the GCC countries to shift from a traditional industrial model based on routinised and mature technologies, to one that is nimble, knowledge intensive and capable of generating economic activities with higher value added, is of central importance.

Figure 5.5 shows the level of expenditure on R&D in those countries for which official data are available, as well as the unofficial estimates for Oman and Qatar. With one exception—Qatar—the GCC countries are way below the EU average in R&D spending. They also, in fact, lag their peers in the MENA region.

Given the scarcity of data, it is difficult to obtain any well-founded picture of the nature of R&D systems across the region. It is clear, however, that the main R&D resources are highly concentrated to a few sectors and also in academia. In some cases a few industrial research institutes account for a significant share. The hydrocarbon industry is basically the only sector exposed to fully fledged international impetus through Multinational Enterprises (MNEs) that invest heavily in R&D, including to a varying extent in the GCC region. Even then, the numbers are miniscule when related to the value of economic output. Oman is the only country in the entire Middle East that has put in place a fully developed open research grants system, managed by The Research Council (TRC), to which academic researchers can apply and be subjected to professional peer review evaluation (Saif 2011). Qatar has implemented a partial system of that sort and the UAE several years ago decided to do likewise (though has yet to implement it).

In the private sector, there appears to be little investment in proper R&D outside the hydrocarbon sector. This does not mean, however, that private companies lack innovation. Conditions in this area are not well known, but the only CIS carried out in the region thus far (Andersson et al. 2010a) found that Abu Dhabi's corporate sector appears to compare reasonably well in innovative activity with most countries

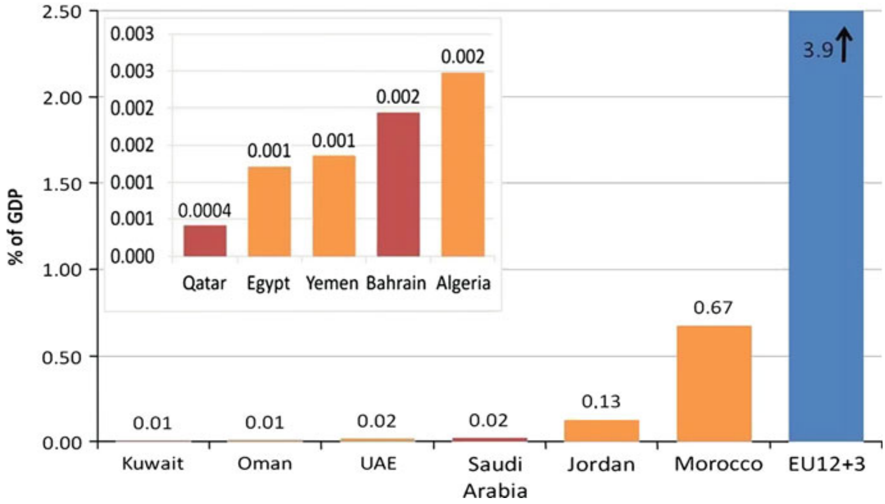


Fig. 5.4 High-tech exports as percent of GDP [*source* World Bank (2010). Data are from 2008 or latest available]

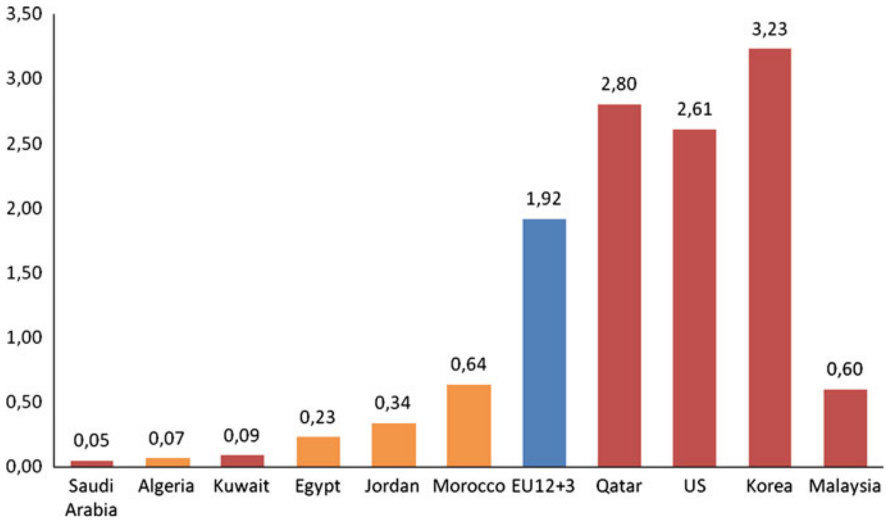


Fig. 5.5 R&D expenditures as percent of GDP [*source* World Bank (2010), except Oman and Qatar (informal estimates)]

in eastern and southern Europe, and also relative the other MENA countries for which data are available (Fig. 5.6).

It also appears from that survey, however, that innovative firms active in innovation are found primarily in three sectors: oil and gas, manufacturing and business services. These also serve as the main markets and partners for others in

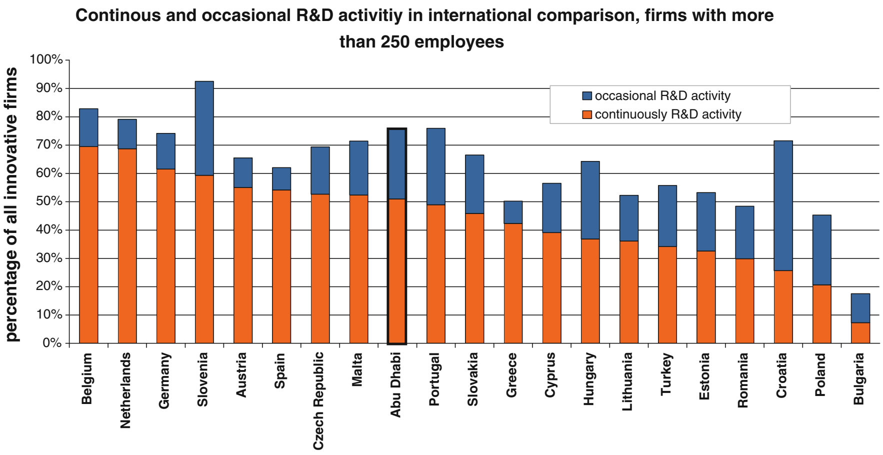


Fig. 5.6 R&D activity in large innovative firms in international comparison [*source* IKED-CIS pilot data innovation survey, SCAD (2009), and Eurostat]

innovation. On average, Abu Dhabi firms appear to lag in collaboration with other actors in innovation, both locally and internationally. The share of co-operating firms among innovative firms is considerably lower in Abu Dhabi than in most European countries, including in the Mediterranean countries.

The implication is that the GCC countries have not yet raised their R&D to a par with GDP, and also seem to lag in other aspects of innovation. Put differently, innovation has failed to keep up with economic growth (even when compared with the meagre numbers achieved by the peers among the MENA countries).

The low level of R&D spending is mirrored in weak scores on traditional output measures, such as scientific publications and patents. Table 5.1 suggests the GCC countries do significantly better than their MENA peers, with the exception of Jordan in the case of scientific publications, but that their lead is insignificant compared to the gap between them and advanced industrialised countries. Here, the implication is that higher public investment has translated into somewhat stronger performances, but not at a level commensurate with the rise in income levels.

Naturally, historical and institutional factors, along with economic structure, need to be taken into account. Chapter 17, among others, discusses some of the factors that explain current conditions. On the other hand, it should be stressed that changes are under way. Some studies have found high growth rates in the scientific output in several of the GCC countries, including in Saudi Arabia where several universities are gaining ground in the international league tables. Chapter 10 further presents a closer analysis of publication patterns across the region as reflected in cross authorship between the scientists from different countries. In patents, the data suggest less of a revival for the GCC countries, although they are ahead of their MENA peers who seem to be lacking patents almost completely.

Table 5.1 STI output

	Country	All publications/ million people 2009–2011	Articles published/ million people 2009–2011	Patents granted by USPTO/ million people average 2005–2009
GCC	Kuwait	864.1	699.3	3.5
	UAE	910.1	665.8	1.6
	Bahrain	641.9	480.8	0
	Oman	541.5	423.8	0.5
	Saudi Arabia	529.6	437.1	0.9
Other MENA	Jordan	795.2	677.3	0.1
	Egypt	244.7	198.1	0.1
	Morocco	166.2	124.5	0.1
	Algeria	179.2	138.7	0.01
	Yemen	18.6	15.4	0
Other World	EU 12 + 3	5,505.5	3,883.0	74.7
	UK	7,550.4	4,788.3	64.8
	US	5,238.2	3,321.6	308.8
	Korea	6,441.9	5,096.2	151.1
	Japan	2,420.3	1,762.6	284.9
	Malaysia	929.3	649.4	5.6

Source ISI web of science (http://apps.webofknowledge.com), The World Factbook (CIA)

5.4 Towards the Knowledge-Based Society

Mobility and the availability of skilled labour—and the means through which they are incentivised—matter crucially. Higher education is critically important for outcomes in this context, as are upbringing and training—from an early age and throughout life. The portability of pensions and other social benefits matters greatly for job rotation and movement between societal spheres. Traditions and policy frameworks influencing family and gender are also highly significant.

Figures 5.7, 5.8 and 5.9 present selected cross-country comparisons of human-capital-related performance. It is immediately clear that the GCC countries have done well in quantitative terms compared to others in the MENA region. The high rate of illiteracy in Morocco (reportedly 44 % of the population), where we have already noted the desperate situation of girls' education in rural areas, is a case in point. Yemen is only slightly better off on this count and also displays a lower level of enrolment in senior secondary school than the rest of the region.

The GCC countries have escaped the gravity of the illiteracy problems that continue to plague the wider MENA region. Expenditure on tertiary education varies markedly, as seen from the comparison between Oman and Kuwait with the EU average, shown in Fig. 5.10. Here, Kuwait is at a higher level, whereas Oman is lower on the ladder. Figure 5.11 suggests there are limited differences in

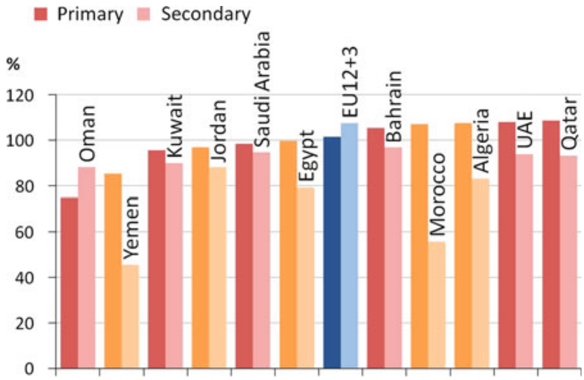


Fig. 5.7 School enrolment at secondary and primary level (enrolments as percent of relevant age group) [*source* World Bank (2010). Data are from 2008 or latest available]

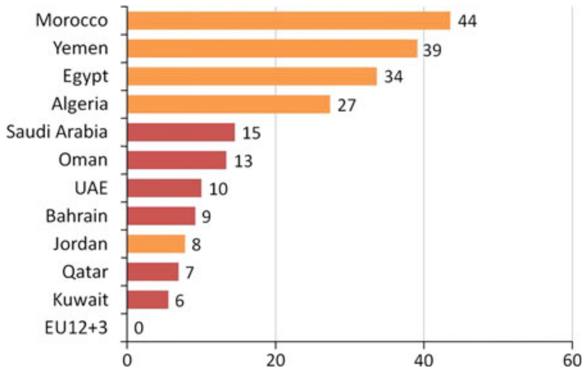


Fig. 5.8 Illiteracy rates (percent of adult population, 15+) [*source* World Bank (2010). Data are from 2008 or latest available]

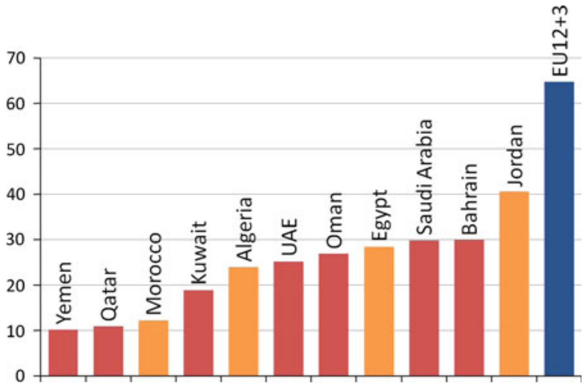


Fig. 5.9 Gross tertiary enrolment (percent of relevant age group) [*source* World Bank (2010). Data are from 2008 or latest available]

expenditure per student at secondary and primary level within the MENA region, compared to the higher EU level, especially when it comes to secondary school. Such numbers say nothing about quality, however. Examining enrolment rates, technical skills and various indicators of other skills, several studies have concluded that the GCC countries continue to perform weakly when compared

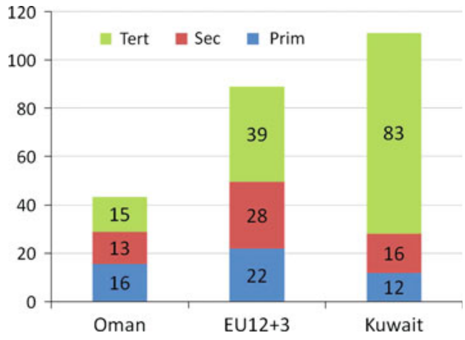


Fig. 5.10 Expenditure per student as percent of GDP per capita, primary, secondary and tertiary level [*source* World Bank (2010). Data are from 2008 or latest available]

with their prime peers in the MENA region, and even more so relative the emerging Asian economies (Nour 2005; Arezki and Nabli 2012).

Modern communications infrastructure is now an important driver of change, both because of the connectivity it brings for all kinds of professionals, including in science and research, and also for private companies and individuals. Accessibility, quality and functionality, along with the downward pressure on cost and prices arising from the articulation of customer demand presented with viable consumer options, are essential for information exchange and networking.

Figure 5.12 highlights the relatively low presence of secure servers in the GCC countries, indicating a remaining digital gap between the most advanced European countries and the MENA region in this respect. Figure 5.13, on the other hand, sends another message. The number of Internet users is higher in the UAE and Bahrain than the EU comparator level but significantly lower in the other MENA countries. More spectacularly, mobile subscription penetration is considerably higher in several of the GCC countries, whose population now belongs among the most wired in the world. The other MENA countries lag far behind in this regard, although mobile telephony and ICT use is advancing rapidly across the entire region.

With convergence well advanced in the GCC (85 % of mobile subscribers had internet access as of 2010), the region is at the forefront of the information society in several respects. Half of the population under 25 across the MENA region is estimated to be active in social networking. Twitter is intensively used in the UAE and SMS traffic has exploded across most of the region. This does not necessarily mean that content quality is as advanced, though. Education plays its inevitable part. The continued weak presence of content in Arabic language is another aspect, which means that the many less educated who understand little or no English have few sources of information that is accessible for them. Measuring the value of information use and its impact on the general population is far from straightforward, though its widespread impact on attitudes and behaviour is there for anyone to see in the Arab Spring itself. This matter was touched upon in Chap. 2 and will be returned to in Chap. 7.

It is well known that cost influences Internet and mobile telephony penetration. Figure 5.14 compares country scores as of 2010 using an index that weighs price

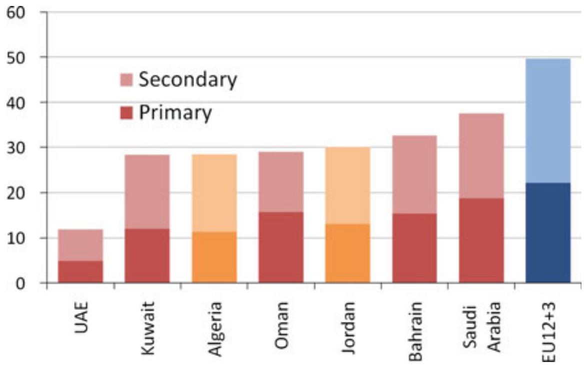


Fig. 5.11 Expenditure per student, as percent of GDP per capita, primary and secondary level [*source* World Bank (2010). Data are from 2008 or latest available]

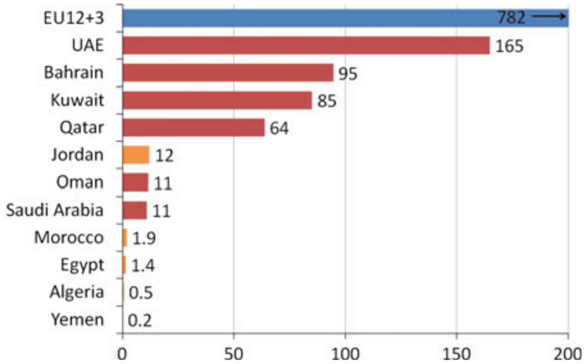


Fig. 5.12 Secure Internet servers, per million people. [*source* World Bank (2010). Data are from 2008 or latest available]

levels for fixed telephony, mobile and Internet services. As expected, prices in the GCC countries are in most instances highly competitive and basically on par with the EU. In the MENA countries, the situation is different.

It should be underlined that the price variation across countries generally has little to do with income disparities and differences in affordability of infrastructure per se. Rather, the main determinant is the quality of policymaking, and the degree to which sound management have ensured effective public goods infrastructure, coupled with regulatory reforms to break the rigidity of state monopolies. It is not least crucial that governments have opened up for competition in the development and launch of new applications and services. A strong correlation exists today between the underlying policy environment and Internet and mobile telephony use across countries worldwide (UNCTAD 2011).

An important ongoing development in ICT use is also that which is popularly referred to as “e-Government”, or “e-participation”. The purpose here is to use ICT for better diffusion and greater relevance of public services, and also to raise the ability for citizens to voice their concerns and demands, while making sure that public authorities are sensitive and responsive. In this area, several of the GCC countries have made remarkable progress in just the few last years, indeed to a great extent since after the Arab Spring broke out. In particular, the UAE has

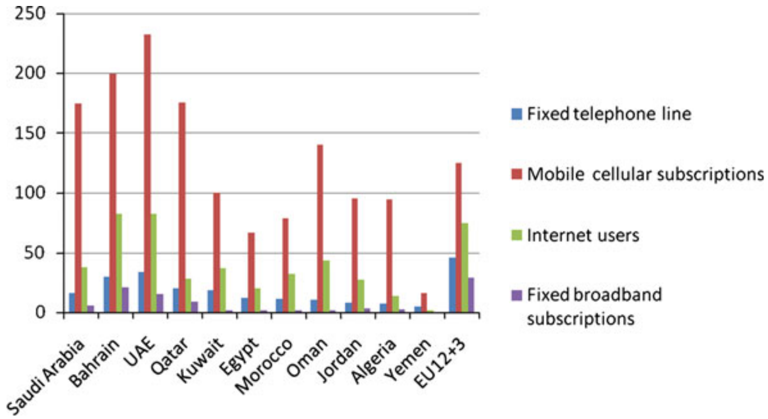


Fig. 5.13 Users of ICT, per 100 people. [*source* World Bank (2010) and UNCTAD (2010). Data are from 2009 or latest available

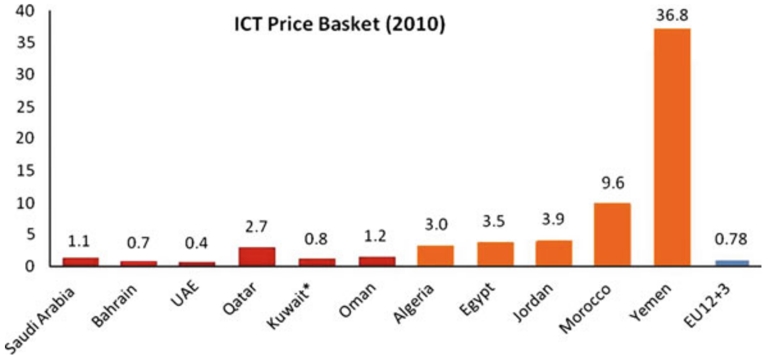
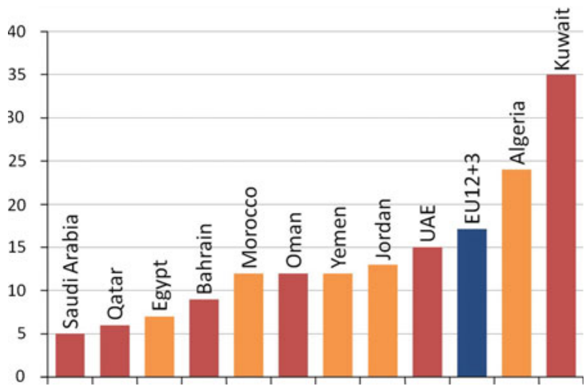


Fig. 5.14 ICT Price Basket. [*source* measuring the Information Society, ITU (2009, 2011)]

launched and rapidly improved the "UAE e-Government Portal", which brings together under one umbrella all public services offered to business people and citizens. The country has advanced from 86th place in the WSIS ranking based on of e-Participation index in 2010, to just 6th place in the 2012 version (National Committee 2012). Qatar and Oman have likewise developed electronic fora for citizens to contact authorities with ideas for improvement, with the promise that all proposals will receive a response (ITU 2012).

Business start-ups and the growth of new enterprises are also very important for enabling innovation. However, red tape often hinders the establishment of new business and increased competition throughout the economy. Figure 5.15 shows the latest available official statistics for the number of days it takes to start up a new business. Here, the GCC countries compare well with the EU average. They also tend to offer less burdensome conditions than their MENA peers, although the

Fig. 5.15 Number of days needed to start a business. [*source* World Bank (2010). Data are from 2008 or latest available]



difference is modest. Kuwait, with its continued opaque business conditions, is an outlier in this respect.

No official statistics are available to offer a comprehensive measurement of barriers to private sector activity. Hence, it is necessary to look at other sources of information to gain an understanding of conditions. The most carefully watched and studied source in this regard is the Global Competitiveness Report, which compiles a league table of countries in a number of dimensions related to economic and business sector competitiveness, based on interviews with business representatives and officials around the world. Needless to say, this information is subjective and tells us more about impressions and views than facts. Notwithstanding the caveats, it is useful to review the report's findings, if for no other reason than that they are observed and taken into account by such a large number of actors, including in the market place.

Figure 5.16a and b show the latest conclusions on the relative weight of different barriers to business activity in a few GCC countries (and also in a few other MENA countries). Note that the figures only indicate the relative weight placed on various hurdles by respondents in each country. Nevertheless, interesting observations can be made.

Kuwait stands out as marked by problems in regard to political process and corruption, whereas Saudi Arabia and Oman reportedly meet with challenges in the labour market. In the wider MENA region, firms in Morocco place relatively greater weight on corruption as an issue, whereas in Algeria the emphasis is on inefficient government and in Yemen on the labour market. Based on these results, Table 5.2 presents parts of the concluding assessment of the Global Competitiveness Report. The position of the GCC countries, to the left, has hugely improved from a few years ago. The GCC is clearly ahead of its MENA peers, shown on the right, in almost every dimension, even though Kuwait is ranked somewhat lower than the other GCC countries (except in macroeconomic stability, where it comes first in the region).

Much of the benchmarking presented in this chapter until this point has focused on performance rather than policy. Figure 5.14 could be seen as an exception, due

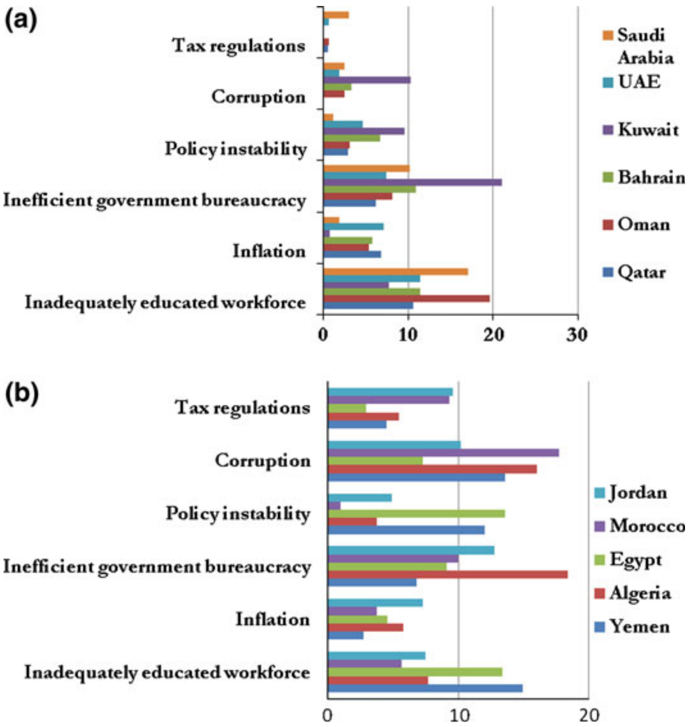


Fig. 5.16 The most problematic factors for doing business (**a**) *source* the Global Competitiveness Report 2011–2012. (**b**) *Source* WEF Global Competitiveness Report 2011–2012

to the pervasiveness of the link between regulatory reform and user prices in IT. While the boundaries are not clear-cut, many other performances could, in principle, be independent (at least in part) of policy. Table 5.3 may be viewed as reflecting policy outcomes rather strongly though, since scientific institutions are generally set up and funded primarily by governments and because public procurement in itself represents a specific policy tool in support of technical progress. This table shows the global rankings of the MENA countries made by the World Economic Forum (with 1 denoting highest performance worldwide). Qatar is ranked the highest in the region on both accounts, with Saudi Arabia second for quality of scientific institutions and the UAE second in procurement. The GCC countries are generally well placed, except for Bahrain in scientific research and Kuwait in public procurement. In almost all cases, the GCC countries and also the broader MENA region perform a lot better in procurement policy than they do in scientific institution quality.

Table 5.2 Competitiveness ranking

	GCC Countries						Other				
Index	Oman	UAE	Qatar	Kuwait	Saudi Arabia	Bahrain	Yemen	Egypt	Jordan	Morocco	Algeria
GCI[a]	32	27	14	34	17	37	138	94	65	73	87
Macroeconomic environment	3	11	5	2	12	45	130	132	97	25	19
Institutions	16	22	14	47	12	17	140	74	45	59	127
Technology readiness	51	30	33	65	43	39	139	95	59	66	120
Financial market development	30	33	19	59	16	14	142	92	65	62	137
Higher education and training	63	33	50	91	36	28	138	107	59	98	101
Business sophistication	40	23	12	62	17	33	134	72	68	80	135
Innovation	47	28	18	84	26	61	142	103	77	80	132
Labour market efficiency	40	28	22	62	50	19	129	141	107	132	137

[a] Global competitiveness index

Source WEF Global Competitiveness Report 2011–2012

Table 5.3 Ranking of MENA countries regarding quality of research institutions and government procurement of advanced technology products

Quality of scientific research institutions		Government procurement of advanced technology products	
	Ranking		Ranking
Qatar	22	**Qatar**	1
Saudi Arabia	37	**United Arab Emirates**	3
Tunisia	38	**Saudi Arabia**	10
United Arab Emirates	45	**Oman**	11
Iran, Islamic Republic	52	Tunisia	14
Oman	57	**Bahrain**	22
Kuwait	75	Jordan	57
Turkey	89	Iran, Islamic Republic	60
Morocco	93	Turkey	62
Algeria	96	Morocco	71
Jordan	98	Egypt	86
Egypt	110	**Kuwait**	90
Bahrain	117	Syria	119
Libya	125	Algeria	123
Syria	127	Libya	126
Lebanon	130	Mauritania	136
Mauritania	137	Lebanon	139

Note marked in bold: GCC countries.
Source WEF Global Competitiveness Report 2010–2011

5.5 Concluding Remarks on Policy

This chapter has benchmarked the performance of the GCC countries versus a combination of peers in the MENA region, a European comparator and, for various indicators, some other selected countries around the world that may provide valuable comparison in the specific case.

On the whole, we found that the GCC countries, having benefitted significantly from oil and gas revenue, have attained a relatively high-income level and have invested, and demonstrated progress, in several areas, including investment in education and ICT use. By contrast, despite the significant increase in resources invested in education, the indications are that the quality of skills continues to lag, also relatively less affluent medium-economy peer countries in the MENA region. Further, their progress in science, technology and innovation has been poor. In some respects, the lag in data probably hides more substantial results in the last few years, for instance, in the case of scientific publications. On the other hand, it appears that the region continues to be confronted with a range of fundamental challenges in this area which still need to be addressed if substantial progress is to be possible.

It should be stressed that the performance measurement in this chapter tells us little about "good" or "bad" when it comes to the merits of individual policies.

Apart from these countries' achievements in attaining competitive prices for ICT use and the international ranking of scientific institutions and procurement policies, much of the analysis reveals rather little on the extent to which policies (rather than other determinants) have led to the observed state of affairs. A range of factors, including the actions undertaken by governments, firms and citizens mingle with the influence of market forces, institutions, culture and mindset in shaping conditions for innovation and a prosperous society.

Chapter 6
Measuring Performance in GCC and Selected MENA Countries: In-Depth Considerations of Implementation

Thomas Andersson and Abdelkader Djeflat

In the previous chapters, we ventured into the rationale for STI policy and a number of issues of relevance for their effectiveness. We further considered methodologies for making international comparisons and how efforts need to be made to draw lessons from international experience relevant to the Middle Eastern context.

In this chapter, we take yet another step in examining what is required for translating lessons from elsewhere, while considering the institutional and policy constraints of the MENA region, particularly for the purpose of benchmarking policies, not merely performance in the knowledge era. This implies that the focus is on features of benchmarking and best practices that can contribute to guiding policies in the GCC countries specifically. These features may come in different shapes and sizes. In several instances we will pay attention to risks of drawing conclusions that may be gravely misleading and point to traps that ought to be avoided when drawing lessons from country comparisons.

6.1 On the Rationale for In-depth Benchmarking

Benchmarking can indeed generate benefits, not least when linked to the search for lessons from best practice as well as other experience that can be useful for identifying and examining opportunities for policy reforms in response to precise

T. Andersson (✉)
Jönköping International Business School, Jönköping University, Jönköping, Sweden
e-mail: thomas.andersson@jibs.hi.se

A. Djeflat
Maghtech Network, Clerse-University of Lille (France), Lille, France
e-mail: Abdelkader.Djeflat@univ-lille1.fr

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_6, © Springer Science+Business Media New York 2013

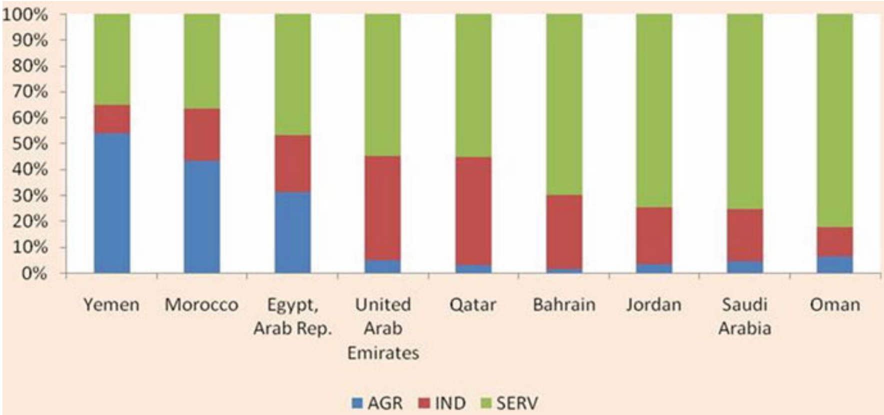


Fig. 6.1 Sectoral breakdown of employment in the GCC Countries, 2010 or latest year available *Source* World Bank (2011)

issues and challenges. It needs to be underlined, however, that this task goes way beyond the mere comparison of performances, as outlined in the previous chapter.

Certain in-depth considerations are important for understanding how to apply benchmarking in such a way that it can contribute to better outcomes. The assessment of STI requires, for instance, consideration to economic structure. The weakness of manufacturing in the GCC countries casts doubt on prospects for generating significant growth in that sector. On the other hand, the service sector—including tourism, finance and trade—is relatively important in the GCC countries, as illustrated by its share of employment (Fig. 6.1). Policymakers should pay attention to the opportunities and barriers impacting on innovation in services specifically.

Beyond gaining insights into what policy reforms to pursue, the most useful of all may in fact be the lessons on how to actually implement policies. The key factor here is the need to engage stakeholders, and to allow for a comprehensive rather than piecemeal approach to policymaking. In the knowledge era, the kinds of decisions and measures that are decisive for raising an economy's performance in STI and economic renewal do not primarily concern what the government can achieve on its own. The task at hand is to enable and inspire broad-based initiative and investment.

As a start, we take a special look at Finland as an individual comparator country. Why Finland? First, it is similar to the GCC states in being a highly successful and relatively small country rich in natural resources—resources it partly used to support a successful process of diversification and industrialisation. The Global Competitiveness Report of 2011/2012 ranked Finland fourth overall. Finland has often been rated as having the highest-quality STI policy framework worldwide. It is the highest-ranked country in Europe in company–university cooperation agreements designed to underpin the innovation system (see Fig. 6.2).

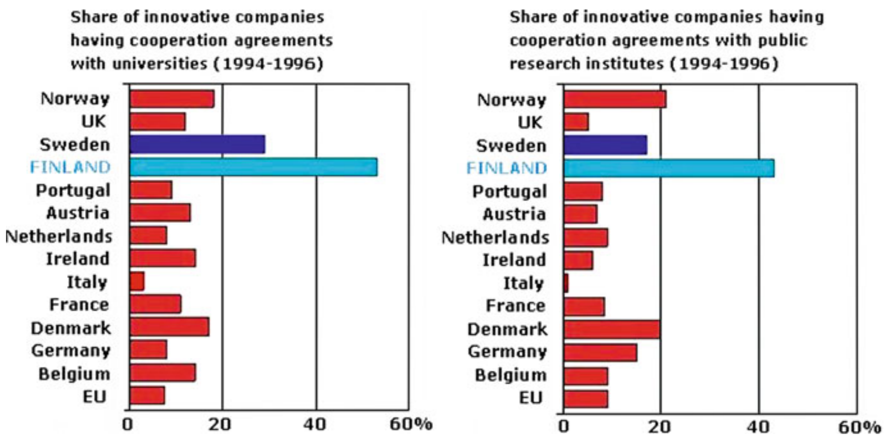


Fig. 6.2 Business–University Cooperation in early stages of innovation *Source* Eurostat, Enterprise DG, 2nd community innovation survey

The choice of Finland also reflects historical considerations. Located in a distant corner of the globe, Finland was so poor and subject to such harsh climatic conditions that an estimated one fourth of the population was lost due to starvation and suffering caused by wars and foreign occupation around the end of the seventeenth century.

Ravaged by foreign occupation and a civil war, Finland has seen more than its fair share of aggression and internal conflict. Its successes came late. It was the loss of some 30 % of its export market basically overnight, as the Soviet Union collapsed, which marked the beginning of the reform process that was to bring STI policy to the highest echelons of the Finnish policy agenda to underpin a swift rise into the ranks of the most competitive, educated and socially advanced countries in the world.

Other characteristics include the ratio of R&D expenditure, one of the highest in Europe, and the extent to which R&D is funded by enterprises. The business component of R&D spending (Fig. 6.3) is among the highest found anywhere, which was not always the case. There has been a gradual buildup, with publicly funded industrial research institutes featuring relatively prominently compared to other European countries. Its model indeed displays a dynamic interplay between the research efforts of the different societal spheres, including incentives that underpin favourable spillover effects from R&D undertaken in large established enterprises to smaller and younger ones.

A variety of factors, listed in Fig. 6.4, spanning apparently diverse areas such as education, R&D, linkages, governance and parliament, can be highlighted as key determinants of the Finnish performance and used as yardsticks for best policy practice (see also Box 6.1). The fundamental reasons behind the Finnish success, however, derive primarily from the country's ability to forge a kind of constructive commitment among all the main stakeholders to place a major emphasis on STI policies and activities.

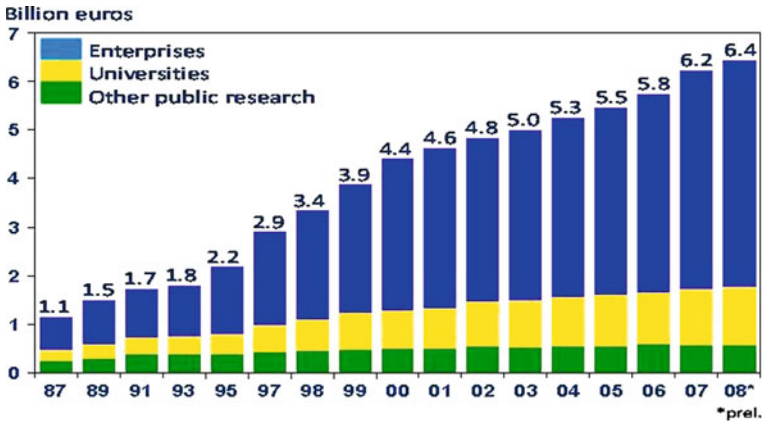


Fig. 6.3 Mix of R&D expenditure in Finland (billion euros) *Source* Statistics Finland and Tekes (2009)

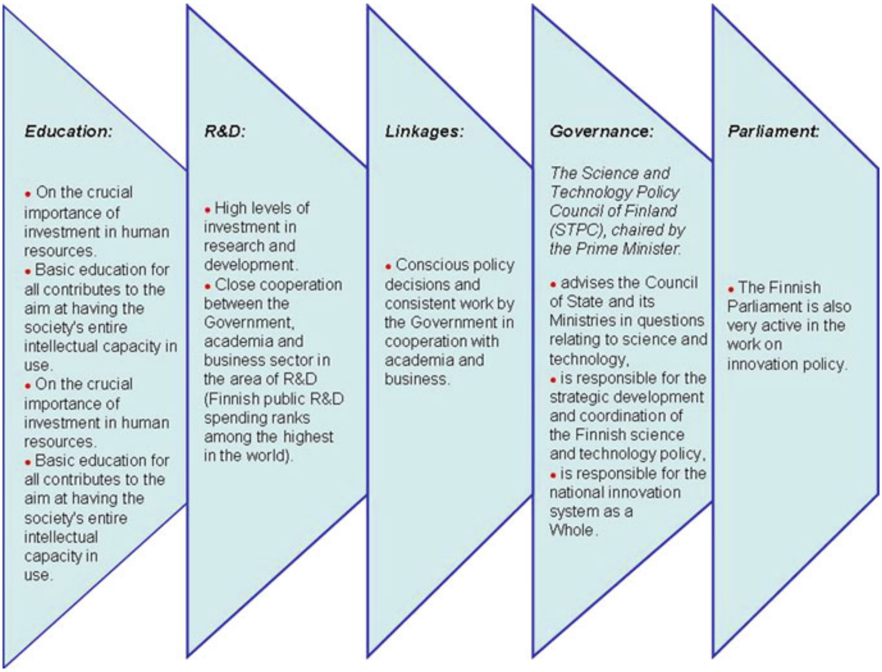


Fig. 6.4 Finland's ingredients for success *Source* Tekes various documents

In this context, it needs to be noted that broad-based support matters critically in this area because success in the overall STI framework requires progress on several fronts. Genuine support and receptiveness for innovation are hampered by contradictory agendas, turf-battles and bureaucratic hurdles. Favourable synergies between different domains are critical. Lack of progress in human resource development, ICT infrastructure or the evolution of active user and consumer communities may make it virtually meaningless to raise investment in R&D.

In the Finnish case, several factors mattered for attaining the required support for reform. The shock of a severe crisis has already been mentioned. The collapse of a prime export market meant that minds had to be focused on finding new markets and ways forward. Another aspect had to do with the genuine commitment and engagement of the highest level of policymaking, as the Prime Minister engaged personally in the new policy design and implementation process. At the same time, a small secretariat was formed to guide the process. A large bureaucracy tends to quickly frame an agenda of its own. In the knowledge era, the coordination that is needed is partly one of dismantling turf, of joining forces in removing barriers, in freeing up resources to invest in people and other intangibles which requires assuming risk, while letting sunset industries give way and not permit them to hinder the rise of what is new.

To what extent these lessons are valid for the GCC countries or the MENA region more broadly may, of course, be debated. The availability of skilled labour, the nature of vested interests, the extent to which building blocks for STI policies are in place, naturally differ from the Finnish case. With regard to governance, however, useful lessons may still be at hand. Observations from other countries that were able to achieve dramatic successes may help illuminate fundamental points.

Ireland, following decades of decline, was at a low point of feared financial meltdown when its newly elected government summoned representatives from different societal spheres to frame a "social contract". On this basis, corporate tax rates were slashed to attract foreign investment and R&D. Labour accepted modest wage increases and agreed to a cessation to aggressive industrial relations that had held the economy hostage to strikes and unrest. Education and social policies also received some support. In the Irish case, the active engagement of labour union leaders was critical for enabling the broad-based reform agenda of the late 1990s. A particular feature was the absence of any major existing industrial sector at the time of the deal, which made it possible to reduce corporate taxes without hurting government revenue. The subsequent spurt in growth was then much helped by the entry of a few large MNEs, initially American and later also Japanese ones (Murphy 2000).

While both these examples underline the importance of broad-based reforms, they also demonstrate that it is far from trivial to forge broader alliances to enable the big "push". When that is not possible, it may well be argued that focus on step-by-step reforms is possible and preferable. Success in STI will, however, still require progress on sufficiently many frontiers, spanning research, innovation, education, enterprise development and entrepreneurship, to create a combined momentum. The key resistance to reform may come from different directions, be it a conservative Ministry of Finance which is squarely fixated on macroeconomic rather than structural factors, or privileged interest groups focused on rent-seeking in an economy loaded with cash from natural resource extraction. Changing the guard is likely to somehow prescribe broad-based awareness that change is needed, as well as of what must be done.

Finland and Ireland had their shocks of the past. Today both those countries meet with their particular struggles of the current era, which may force them to adopt new paths yet again. In the Middle East the Arab Spring, with its underlying demographic reality—framed within a structural and economic context that currently is unable to breed the required new industries and jobs—has arrived with its mighty call for change.

Box 6.1: Finnish National Technology

Finnish National Technology Strategy—Lessons Learnt

1. Why networking?

- It combines the best possible knowledge and competence
- Cross-technological cooperation and internationalisation require networking

2. Why cross-technological cooperation?

- It helps to find new competitive advantages
- It makes the industrial structure more versatile

3. Why long-term commitment?

- It creates the basis for R&D
- It brings forth skills and experts

4. Why innovativeness?

- It speeds up the commercialisation of technologies
- It renews the industrial structure and skills base

5. Why productivity?

- It is the precondition for competitiveness and welfare
- The sound application of technologies increases productivity

6.2 Output Analysis and Performance Benchmarking in STI

This section reviews performance benchmarking by focusing on factors of relevance to output, which represents a relatively common way of assessing the efficiency of innovation systems. In this case, performances are often indicated through metrics and hard measurement. For the analysis to be of true relevance,

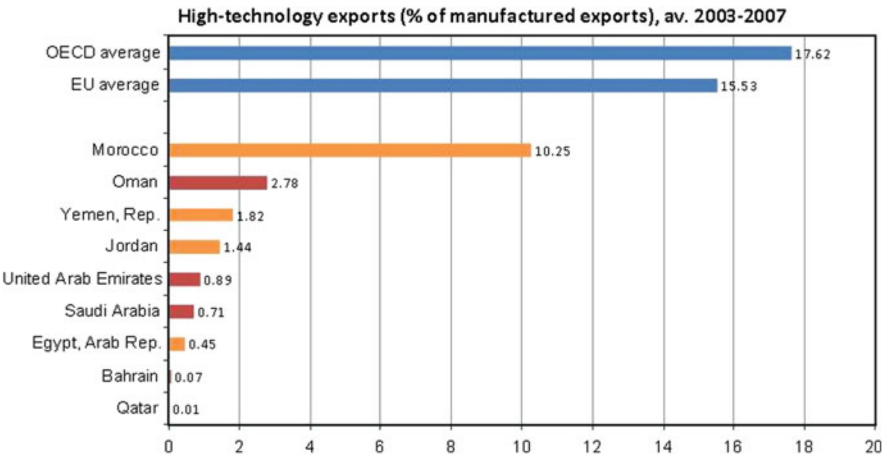


Fig. 6.5 High-tech exports (percentage of manufactured exports), average for 2003–2007 *Source* World Bank (2010)

however, it is essential also to take into account less measurable aspects. Here, we will do so with special attention paid to what is of prime importance for the GCC countries while comparing their performance mainly with other countries across the MENA region.

On this basis, in the following we examine more closely particular output indicators of STI performance: high technology exports, registered patents and foreign direct investment and technology transfers.

6.2.1 High-Technology Exports

High-tech exports not only indicate a country's degree of economic diversification; they have also been extensively used in recent years as a metric for innovative capabilities in developed and developing countries alike. When a manufacturing sector is basically lacking, the application of this measure becomes less relevant. Strikingly, however, World Bank data show distinct weaknesses among GCC countries in this area compared to their regional peers, such as Morocco, and to OECD countries (Fig. 6.5). Here, Oman leads the GCC group, while Qatar and Bahrain lag behind on the 2003–2007 average. Egypt surprisingly also underperforms.

Many countries of the region recently saw increases in the high-tech content of their exports, for instance Morocco and Tunisia (Fig. 6.6). Morocco is outperforming not only its neighbours but also a rising economic power like India. On the other hand, a closer look reveals that medium- and high-technology exports in 2003 were heavily concentrated to: a) lamps, tubes and electronic valves, accounting for 36 % of total exports, b) inorganic chemicals and halogens, mostly

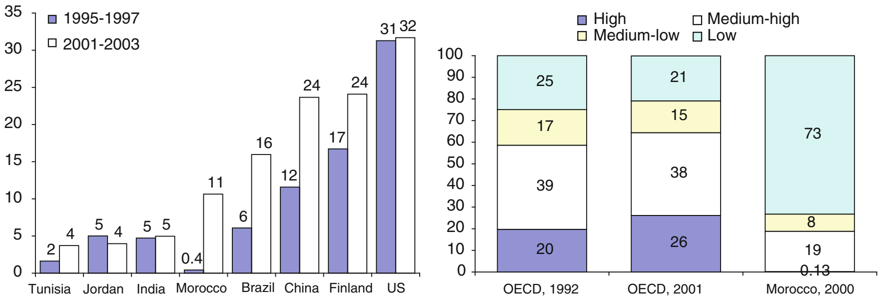
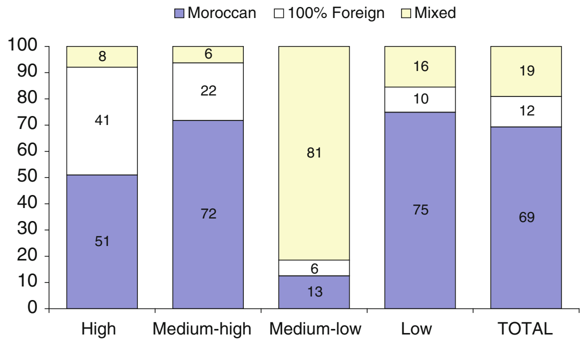


Fig. 6.6 Share of high-tech in total manufacturing exports, averages for 1995–1997 and 2001–2003, and technologyintensity of exports, OECD average and Morocco *Source* World Bank (2005).*Source* Based on data from MENESRSFC (2002)

Fig. 6.7 Technology intensity, by ownership structure, 2000 *Source* Based on data from MENESRSFC (2002)



phosphoric acid, accounting for 31 %; and c) fertilizers (phosphates), accounting for another 22 % (Ministère des Finances 2005).

Using instead the OECD's classification of industry by technology intensity in 2000, low-technology sectors accounted for 73 % of all manufacturing exports, and medium–low technology sectors another 8 %. A set of high-tech export categories,[1] mainly electronic components, accounted for <1 % of all manufacturing exports. Medium–high technology exports (mostly phosphate-based fertilisers and mineral acids) accounted for 19 %, however. Notwithstanding Morocco's not-insignificant medium–high technology exports, its export structure varies markedly from that of the average OECD country, where high and medium–high technology sectors now account for two-thirds of total exports.

In Morocco, all types of company—Moroccan-owned, 100 % foreign-owned and those with mixed ownership—predominantly belong in low-technology sectors (mostly textiles). By contrast, 100 % foreign-owned companies have a higher share of high- and, in particular, medium–high technology exports sectors (Fig. 6.7). Fertiliser is exported entirely by Moroccan businesses, while foreign

[1] See OECD (2003) for an overview of the classification method.

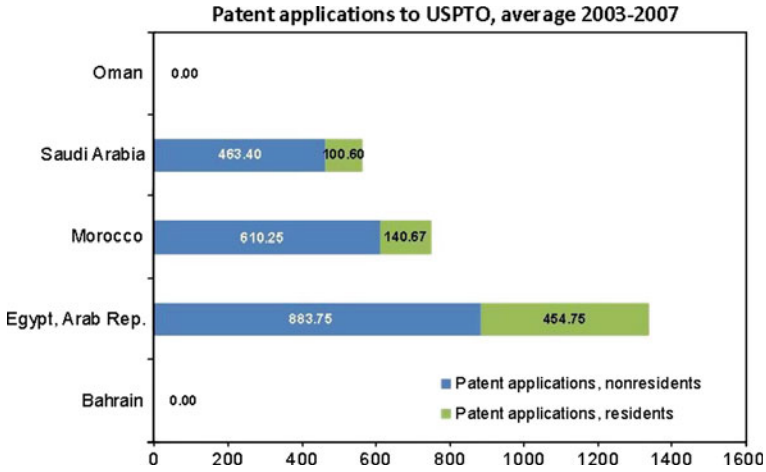


Fig. 6.8 Patent applications to USPTO, average 2003–2007 *Source* World Bank (2010)

companies concentrate on machinery and electric apparatus and equipment (mostly lamps—electronic beams). While entirely foreign companies have higher technology content in their manufacturing exports than Moroccan companies, companies with mixed ownership do not: an estimated 94 % of their exports are in low and medium–low technology sectors.

Such patterns matter in other economies as well. A large share of high-tech exports may thus reflect a strong presence of wholly owned foreign enterprises in relevant parts of the economy, but have little bearing on the properties of domestic industry. On this basis, observations of the aggregate technology content of exports can be seen to provide inadequate information on the technological and innovative capabilities in the MENA region. In-depth analysis of, e.g. sectoral specificities and ownership structures are required to gain a better handle of what drives various kinds of outcomes.

6.2.2 Registered Patents

Patent registrations represent another example of popular STI output metrics. As indicated by Fig. 6.8, the GCC countries have been at a low level in this regard, except Saudi Arabia, where they are heavily concentrated in the oil sector (and primarily associated with the Aramco and Sabic corporations).

Measuring registered patents through conventional indicators gives rise to several questions, notably the structure of patent applications. In Morocco, the bulk of patent holders are individuals (72 %), while institutions and especially enterprises (Fig. 6.9) are poorly represented. By contrast, the balance is generally much different in advanced countries. In France, for example, individuals hold

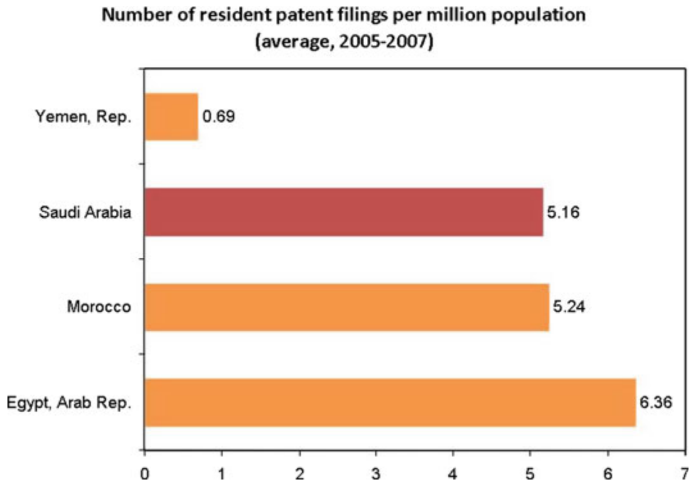


Fig. 6.9 Number of resident patent filings per million population (average, 2005–2007) *Source* WIPO (2010)

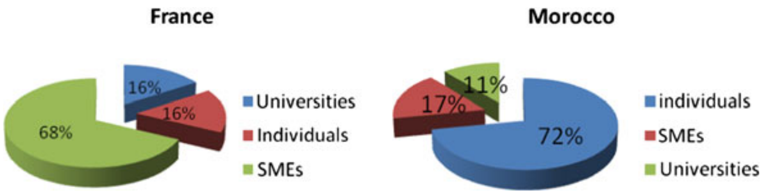


Fig. 6.10 Distribution of patents registered domestically in France (2006) and Morocco (2003) *Source* Djeflat et al. (2008); Andersson et al. (2006)

only some 16 % of patents, while institutions hold 68 % (see Fig. 6.10). This indicates that the institutional base for inventions is rather weak in the Middle East which may reflect a lack of trust between inventors and institutions and disincentives for institutions to value innovation, apart from weaknesses in the intellectual property rights regime.

In the GCC countries the proportion of patents held by individuals is unclear due to lack of data. This aspect needs highlighting due to its importance for institutionalising the invention and innovation processes. In terms of policy, some countries (e.g. Yemen) attribute all inventions to individuals and none to institutions, while others (e.g. Saudi Arabia) have no clear measurement for determining the division.[2]

Nonetheless, in the case of invention in Saudi Arabia, royalties are shared between the inventors, the academic programmes and other beneficiaries for reinvestment in new innovative research. The inventor receives a substantial financial

[2] Data from fieldwork conducted for the INCONET-GCC project.

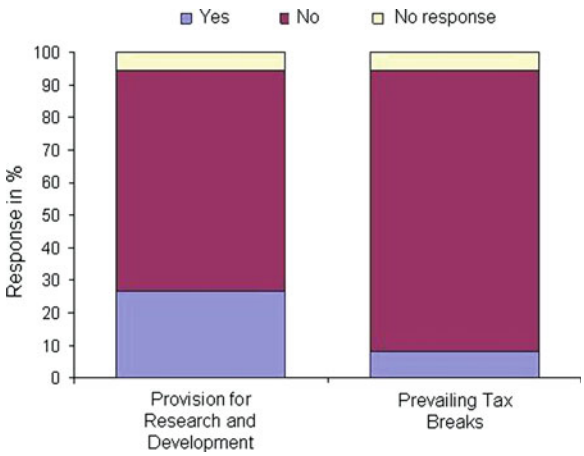


Fig. 6.11 Company awareness of tax breaks and innovation credits *Source* R&D Maroc (2005)

reward and can be awarded a First Class King Abdulaziz Medal. It is highly desirable to strike a balance so as to allow for "win–win" among all parties who contribute with creative ideas and whose support for commercialisation matters.

6.2.2.1 Company Awareness of Local Patent Services and Tax Incentives

Although vibrant innovation dynamics may be found in both large companies and SMEs, and also across basically all sectors, larger firms with greater ability to carry the costs of professional service support are generally bound to fare better in this area. An environment that is responsive to the needs of enterprise development, including physical as well as institutional and "soft" infrastructure, will make the biggest difference to SMEs, however. It will also be important to which extent the landscape of supportive professional business services can develop competences and services that are tailored to what is needed in particular industries and also individual firms (also in regard to finance and marketing, apart from intellectual property rights).

Potentially innovative SMEs are often unaware of building blocks that may be critical to their business prospects, in domestic as well as foreign markets, such as various regulations and public incentive schemes. Figure 6.11 shows that <30 % of firms interviewed in a survey in Morocco knew about prevailing tax breaks (PTR) and less than one-tenth were aware of Provision for Research and Development (PRD) credits in innovative projects.

Similarly, 45 % of Moroccan companies had no knowledge of local patent office services, while 37 % who knew of their existence did not use them (Fig. 6.12). The reasons ranged from complex and bureaucratic local procedures, incompetent personnel, lack of trust in the ability of patent regulations to protect their inventions properly, and also suspicion that the know-how might be given to competitors. Hence, policy meets with the challenge of fostering an improved environment for business services support, including transparency, professionalism and limited transaction costs.

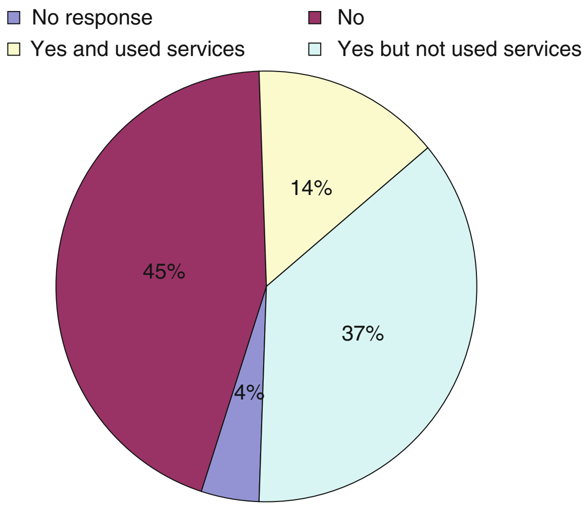


Fig. 6.12 Company awareness and use of local patent office services *Source* R&D Maroc (2005)

Proper communication channels and active communication strategies are part of the process of promoting innovation. This is especially so for SMEs, which often lack the means to undertake appropriate search processes. So-called industrial research institutes have been put in place in many developed countries to support SMEs in this regard. The industrial technical centres *Centres Techniques Industriels* (CTIs) in France, for example, have patent-related communication and support as a key objective.

6.2.2.2 Alternative Modes of Protection and Strategic Issues

Companies may resort to other methods than IPR to protect their innovations, such as those listed in the Oslo Manual: "confidentiality agreements and trade secrecy", "secrecy that is not covered by legal agreements" and "lead-time advantage over competitors". Many innovations are not patented because they are intangible or because a patent would do more harm than good by disclosing valuable information without providing the means to protect exclusive rights. This may be especially so for smaller enterprises and in areas where information on cross-country legal conditions is opaque. These methods are however difficult to investigate due to the lack of information.

While SMEs represent the majority of companies in basically all countries, in developing regions they are particularly badly placed to plan and execute effective IPR strategies. The difficulties of managing the costs of patent applications are part of the picture (Beyhan et al. 2002). Even more importantly, however, such firms suffer disproportionately from the lack of supportive professional services in this area, coupled with weaknesses in the implementation of intellectual property rights. A policy response in this area thus cannot merely promote patent applications. Ways should be sought to ensure that SMEs have access to appropriate competencies capable of providing support in how to navigate in areas relating to intellectual property rights.

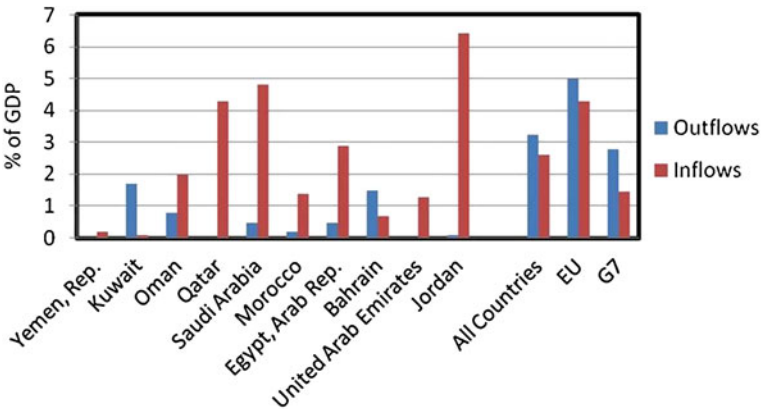


Fig. 6.13 FDI, net outflows and inflows (2012, or latest available) *Source* World Bank (2011)

Patent fillings and registrations hardly tell the whole story on IPR management. We must also address alternative means of protection invention and related incentive systems, and to what extent these circuits reach the vast community of SMEs.

6.2.3 Foreign Direct Investment and TechnologyTransfer

Foreign direct investment (FDI) is often a major and valuable source of technology and creates access to the latest technologies. Several studies have pointed to the benefit of attracting FDI in sectors where research and development activities are at the preliminary stage. For the GCC countries, Fig. 6.13 shows that the FDI flow as a percentage of GDP has increased significantly in recent years except in Bahrain. Jordan receives the highest FDI inflow. In relative terms, GCC countries have been able to surpass the Europe12 + 3 and G7 group.

FDI can be a source of technology transfer and R&D when certain conditions, including the absorptive capacity on the part of host country institutions, are fulfilled. These conditions exist in a number of emerging economies but not throughout the developing world, including GCC countries. Figure 6.14 suggests that Qatar and the UAE perceive that FDI offers high potential to create an inflow of the latest technologies—higher perceived potential even than Finland. Kuwait has a more sceptical attitude and low score.[3]

[3] The difference may not appear very distinct judged from Fig. 6.14. The opinion surveys reported in the World Economic Reports illustrate results based on a scale 1–7 weighted average, obscuring the magnitude of country differences. We will occasionally point this out when referring to these kinds of data which, however, in some cases represent the only available metrics to compare countries in the MENA region.

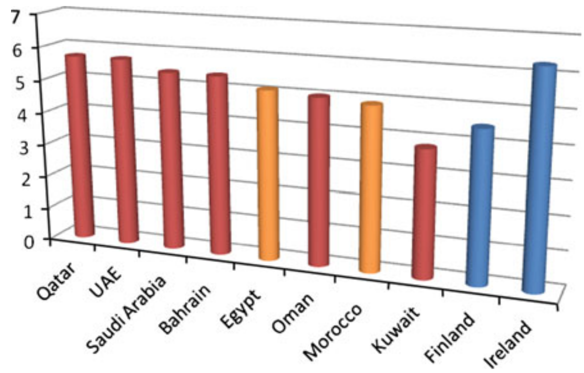


Fig. 6.14 Potential for FDI technology transfer: 2009–2010 *Source* World Economic Forum (2010)

There is, of course, no guarantee that any technology transfer will actually occur in the specific case. Merely requesting MNEs to locate R&D within a particular host country, or to comply with various “performance measurements” in regard to technology transfers, will seldom do the trick. Truly significant transfers will only occur in situations where a genuine “win–win” can be established between foreign investors and local firms, suggesting that transfers might best be achieved by strengthening the capacity of domestic firms. Along these lines, policies aimed at the attraction of—and gaining from—FDI should be designed in tandem with STI policies, as has been advocated in a policy review undertaken on Morocco (Andersson et al. 2006).

Existing conditions, including regulatory and institutional issues, hamper R&D outsourcing by foreign companies, local learning processes and capacity building related to innovation. A certain local mistrust in the capacity or willingness of foreign companies to participate in the development of local S&T capabilities exists among operatives and parts of public opinion. In Morocco, for example, local resistance and sometimes hostility are rooted not in fundamental political, ethnical or religious considerations but essentially in the perception that foreign investment and multinational enterprises have not demonstrated a willingness to contribute to the creation of local research facilities or to outsource research and even simple engineering tasks to local businesses, local universities and research centres.

Nonetheless, examples of impressive leapfrogging processes in the adoption of sophisticated technologies are being seen in some developing countries, for instance through the diffusion of cellular technologies. Not only countries such as India and China have benefited greatly, but even a range of the least developed countries demonstrate significant gains, e.g. Bangladesh and Kenya which are on the way towards joining the ranks of world leaders in financial and payment technology innovation through low-cost mobile applications (UNCTAD 2011).

6.3 Input Analysis and Policy Benchmarking

Input analysis can be said to consider the efforts made by various stakeholders to implement STI. A broad spectrum of indicators can be used and applied. While it is often thought of as reflective of prevailing policy decisions, it is necessary to keep in mind that the scope of inputs by themselves offers little information on the effectiveness and efficiency of processes and results achieved. Despite this obvious limitation, input analysis can contribute with insights that are useful for policy benchmarking.

This section examines selected items in order to highlight limitations and shortcomings as well as some opportunities for improvement in the way input indicators can be used in the GCC countries as well as elsewhere in the MENA region. The aspects considered include absorptive capacity, private sector and company spending on R&D, venture capital, human capital (including issues of unemployment and brain drain), quality and institutions and governance.[4]

6.3.1 Absorptive Capacity

Absorptive capacity has received increasing attention in developing countries in recent years as a key determinant of the extent to which domestic organisations and individuals are able to benefit from external exchanges on terms that can lead to significant innovations.

6.3.1.1 Absorptive Capacity at Company Level

Data from the World Competitiveness Report (Fig. 6.15) suggest that technology absorption at company level is relatively high as perceived by key economic players.[5]

The UAE is highest ranked in this area, scoring the same as the reference country Finland. Three other countries (Qatar, Saudi Arabia and Kuwait) are doing better than their regional peers. Algeria comes out the weakest. This indicates that the potential for absorbing new products and services is relatively high and local demand should not be as much of a handicap as in many other parts of the developing world.

---

[4] It should be noted that no perfect separation line can be drawn between output, input and process indicators. While the elements included here have a marked input side to them, other aspects are also prevalent. This applies, for instance, in the case of absorptive capacity. We deliberately handle this as an input factor, however, in view of its strong influence on supporting or hindering innovation in emerging and developing economies.

[5] Based on survey results, to what extent do businesses in your country absorb new technology? [1 = not at all; 7 = aggressively absorb] | 2009–2010 weighted average.

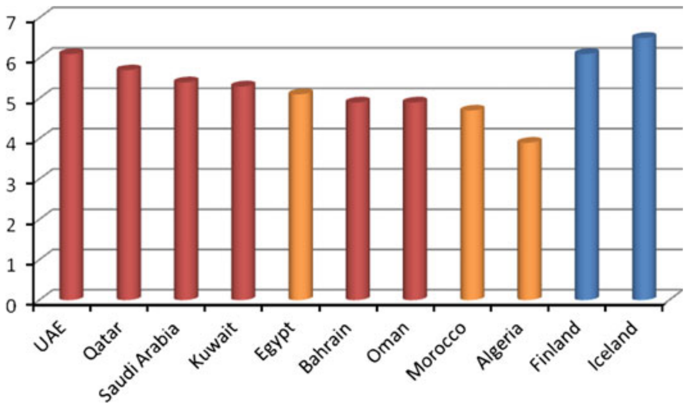


Fig. 6.15 Technology absorption at company level: 2009–2010 (based on a survey: to what extent does foreign direct investment (FDI) bring new technology into your country? [1 = not at all; 7 = FDI is a key source of new technology] weighted average.) *Source* World Economic Forum (2010)

6.3.1.2 Absorptive Capacity of the Research System: Public Funding

An effort has been made in recent years to increase public funding for R&D in the MENA countries, particularly in the Maghreb. However, there are concerns that the actual increase in R&D spending that has taken place largely reflects salary increases in academia (i.e. that existing R&D efforts have become more expensive) rather than additional R&D activity. In Morocco for example, 95 % of the R&D budget is allocated to wages.

While the level of research funding clearly remains insufficient, including in the GCC countries, the effectiveness of the research effort remains a critical issue. A fundamental aspect has to do with the degree to which there is absorptive capacity, i.e. whether allocated input is actually used. A study conducted in Algeria for the Ministry of Industry (Djeflat et al. 2006) found that to be the case for just 28 % of the available funds, as shown in Fig. 6.16.

STI policies in the Middle East region need to address the issue of absorption capacity of research institutions. Ways and means to upgrade that capacity need to be developed in parallel with efforts to increase funding allocations. It is important that greater resources are directed for their intended purposes by researchers and laboratories. To make this possible, institutional obstacles to be removed and appropriate incentives put in place at various levels to support the dynamism of research teams.

Some countries have created an explicit link between input and output factors. In Spain, for instance, a national policy has made the salary increases of faculty dependent on the extent to which they publish in certain scientific journals. On the other hand, such incentives introduce a distortionary element, as behaviours become driven by artificial monetary rewards rather than the scientific merit of achievements. Incentives also serve to strengthen herd mentality.

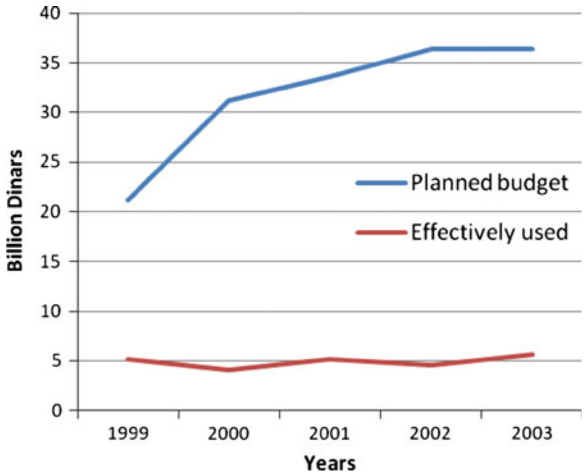


Fig. 6.16 Planned research budget and level of effective absorption in Algeria: 1999–2003 *Source* Djeflat et al. (2008)

Taking account of such influences, some policymakers in the GCC countries have considered introducing reward systems that combine achievements in publishing, patenting, mentoring Ph.D. students and suchlike, and also rewarding successes by allowing researchers to exercise more freedom in how to allocate their time. The pros and cons of output-based incentives as a basis for input allocations need to be weighted in the specific case. As a general rule, however, it is mostly better to allow links between output and input to be fine-tuned at the local or institutional level so as to promote more experimentation and diversity in working out solutions to issues of research efficiency and absorptive capacity.

6.3.2 Private Sector and Company Spending on R&D

One of the key features of a sustainable R&D system is private engagement in spending. Public funding alone is insufficient and is also overly dependent on government finances. As discussed in Chap. 3, there is a natural divide between basic research which is of high societal value but hardly worthwhile for individual companies to invest in, and applied research which is best undertaken in direct association with the core business activities of private companies. In advanced countries, private funding dominates aggregate R&D spending while basic research and academia remain mostly reliant on public funding.

In Chap. 5, we further took note of the huge discrepancy between the significant levels of R&D funding in many developed countries, and the low levels that characterise most of the Middle East. Unfortunately, lack of official data prevents us from extracting more detailed information on the composition of R&D in the latter region. Although we need to be aware of the less reliable, and more indicative, quality of opinion surveys, we will here use some data of that sort to illustrate what the situation appears to look like, based on multiple diverse observations.

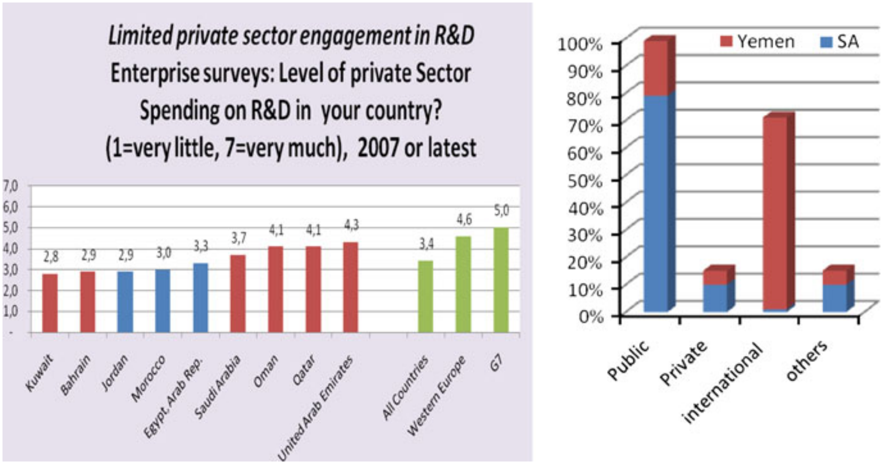


Fig. 6.17 Private engagement in R&D in GCC countries and sources of financing in Saudi Arabia and Yemen: 2010. *Source* World Economic Forum (2010); INCONET-GCC study field survey (2011)

In short, Fig. 6.17 suggests that the engagement of private enterprise in the GCC countries remains relatively weak in comparison to the EU and OECD. Nonetheless, four out of seven GCC countries outscored their regional peers: Saudi Arabia, Oman, Qatar and the UAE. Of Saudi Arabia's R&D for example, it is estimated that 79 % is publicly funded, with private sources accounting for only 10 %. In Yemen international sources fund the bulk of R&D, while private funding reportedly amounts to some 5 % of the total.

Similar unofficial data on private R&D spending (Fig. 6.18) confirm that GCC countries perform poorly relative to countries such as Finland and Sweden (among the top worldwide) but that they are on the whole ahead of their regional peers. Saudi Arabia leads as a result of R&D activities in the oil sector (concentrated mainly in the Aramco and Sabic oil corporations). Kuwait is behind mainly as a result of the dominant position taken by public research institutions. It is evident that much more effort is needed to spur private investment in R&D.

In order to have the desired effect, however, private R&D activity needs to be sustainable and recurrent. An examination of private funding in Morocco shows that most is undertaken on a "one off" basis, i.e. investment occurs in a discrete manner, as immediate opportunities arise (Fig. 6.19). This applies notably to companies with <1,000 employees. In SMEs, which comprise the bulk of productive enterprises, innovation is generally not well integrated as regular activity, and relatively few companies have a research and development project in the pipeline. One-third do engage in innovation as a continuous activity, however.

Larger companies are more engaged in R&D as a continuous activity but those who do are mostly of foreign domicile. Export companies are not more engaged in innovation than other businesses (Andersson et al. 2006). Also, innovation projects

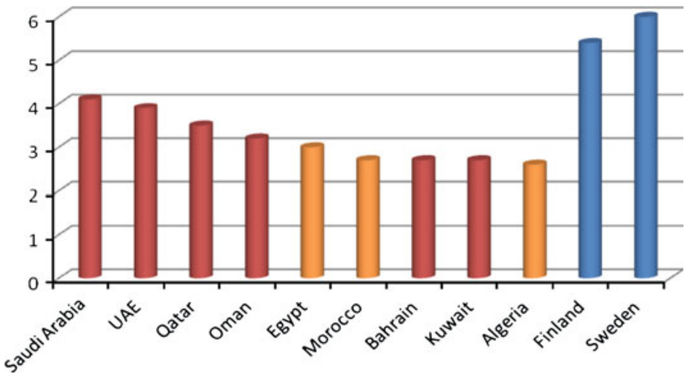


Fig. 6.18 Company spending on R&D: 2009–2010 (based on a survey: to what extent do companies in your country spend on R&D? [1 = do not spend on R&D; 7 = spend heavily on R&D] weighted average) *Source* World Economic Forum (2010)

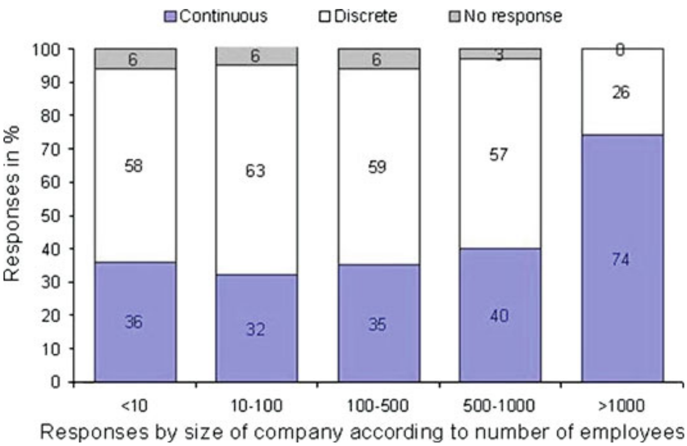


Fig. 6.19 R&D activities by company size: Morocco (per cent of companies stating continuous or discrete investment, or not responding). *Source* R&D Maroc (2005)

are rarely funded from outside the company. Instead, financing is mostly through internal means: 87 % of companies use self-financing, less than half of them (44 %) rely on bank credit, and venture capital plays a small although not insignificant part (10 %).

In terms of policy, it is well documented that OECD countries have enacted a range of incentives and support mechanisms to spur R&D and innovation in the private sector. An interesting example is that of Norway, which has arranged a combination of tax incentives and Research Council interface with SMEs, allowing them to achieve high industrial coverage. Although more evaluations are needed to gauge the eventual results, the indications are that the programme has achieved high "additionality", i.e. enabled a real increase in R&D beyond what the private firms would have invested anyway, in the absence of public support. For some other countries with significant incentives, such as Spain, past evaluations have found low levels of additionality, implying that the public support basically shifted the burden of expenditures from business to taxpayers without much impact in terms of raising R&D levels.

Some emerging and developing countries have started to put in place incentive schemes for promoting R&D and innovation in the private sector (China followed by, e.g., Brazil and South Africa was an early starter). There is clearly a case for the GCC countries, given their financial strength but absence of R&D culture and great need of generating more competitive industries capable of competing internationally despite a relatively high cost structure, to consider what schemes can lead to real results in their particular environment: Appropriate incentives cannot be developed in isolation, however, but need to form part of more broad-based policy packages.

6.3.3 Venture Capital

Private involvement in R&D is mostly a business for larger and already well-established companies. To what extent it can play a role for industrial competitiveness and renewal more broadly much depends on the risk-reducing mechanisms available locally. Venture and seed capital availability is a key element in this respect. In the following, we review what the available statistics tell us on the availability of venture capital in these markets.

6.3.3.1 Availability of Venture Capital

The scarcity of venture capital constitutes one of the obstacles to the growth of young companies in many developing countries. Banks naturally focus on running conventional accounts and allocating credit where risks are lower, which often applies to non-innovative projects. Survey data show that little venture capital is available in the region as a whole. The prevalence of a risk-averse approach to investment with regard to venture capital and technology financing is part of the explanation for the present state of affairs. There is generally an overemphasis on physical assets, a suboptimal allocation of resources and insufficient attention paid to the soft assets and architecture of the knowledge economy.[6]

Nonetheless, three GCC countries (Bahrain Oman and Kuwait) appear rather favourably placed when compared to peer countries from Western Europe (EU12 + 3) (Fig. 6.20). Bahrain's score was similar in 2008 to the G7 average. The 2010–2011 scores (Fig. 6.21) indicate, however, that Qatar has taken the lead

[6] Gulf Organisation for Industrial Consulting and SRI International.

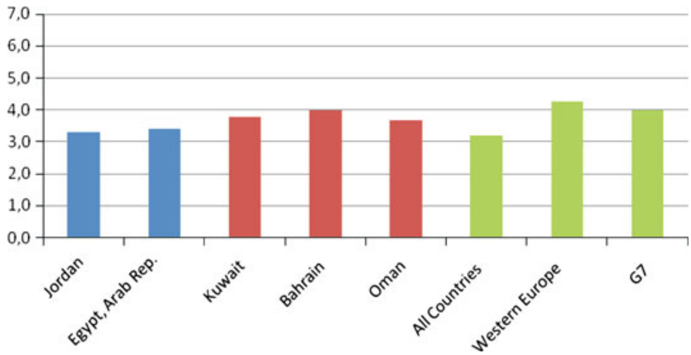


Fig. 6.20 Venture capital availability: 2008 (survey based on the question: availability of venture capital in your country? (1 = very little, 7 = very much).) *Source* World Economic Forum (2009)

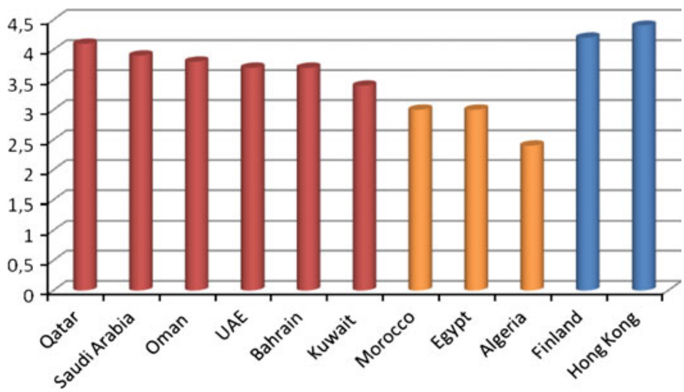


Fig. 6.21 Venture capital availability: 2009–2010 (based on the survey question: In your country, how easy is it for entrepreneurs with innovative but risky projects to find venture capital? [1 = very difficult; 7 = very easy] weighted average.) *Source* World Economic Forum (2010)

and scores almost as well as Finland, while the GCC group is on the whole doing a great deal better than peer countries in the sub-region. When looking at innovation performance, this potential appears to be underexploited by innovative companies and requires better integration in STI policy.

Venture capital data include a variety of items, some of which are remote from what risk capital really means. Looking at venture capital data as a percentage of GDP (Fig. 6.22), Morocco would according to some past calculations appear to perform almost as well as OECD countries and twice as well as Finland. In reality, the Moroccan figures are not comparable to OECD statistics because they include a broader set of financial transactions such as public finance mechanisms to attract FDI and associated technology transfers, mostly of a public nature. This is thus an

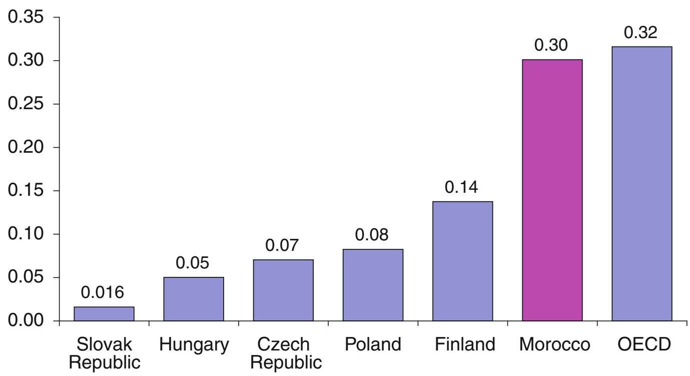


Fig. 6.22 Risk capital as a percentage of GDP, Morocco *Source* OECD (2003); MENESRSFC (2002)

example of a case when statistics blurs an understanding of actual circumstances on the ground.

It is important to be cautious in making comparisons, and drawing conclusions from, the availability of venture capital across the region. Stark contrasts in measurement as well as behaviour arise because of differences in perception of what in fact constitutes venture capital.

6.3.3.2 Venture Capital and Capacity for Innovation

In fact, venture capital is only part of the story. When it comes to start-up activity and the availability of seed and risk capital in new technology-based firms, the established venture capital industry is almost never of much use, but other sources of early stage funding are pivotal. Own funding by innovators and entrepreneurs, a set-up that allows for the presence and active engagement of business angels, the availability of well administrated and smoothly processed sources of public seed funding, and so forth, are more important in that regard.

An effective capacity for innovation is also required. Executive survey data (WEF 2009–2010) indicate that this capacity remains relatively weak in the region (Fig. 6.23). The best performer on paper (Saudi Arabia) is well below a country such as Finland and even farther behind the best performer in the world (which, in the statistical source referred to here, is Germany[7]).

With the exception of Kuwait, the GCC countries appear to outperform their regional peers, including Egypt. Weak capacity for innovation often stems from a

[7] The heterogeneous nature of innovation must be kept in mind. The World Economic Forum ranking of Germany as the leading country reflects the strength of innovation in engineering. Others, such as the Nordic countries or the United States may be ranked more highly in other kinds of measures that put a stronger emphasis on, e.g. innovation in services.

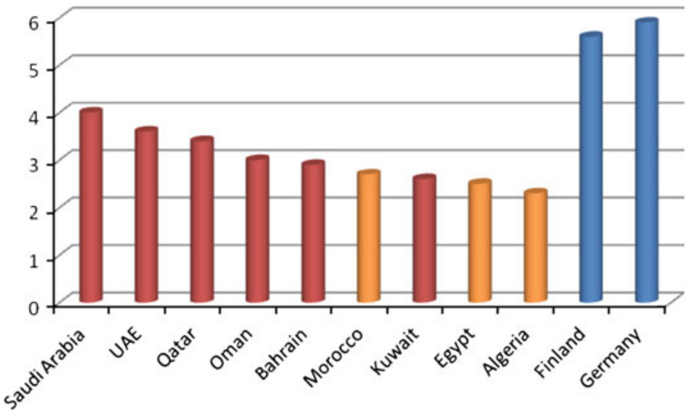
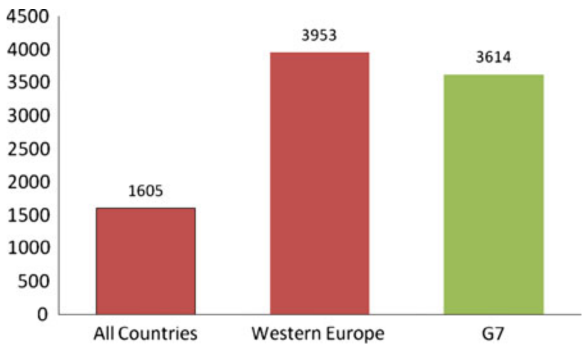


Fig. 6.23 Capacity for innovation: 2009–2010 (based on the survey question: In your country, how do companies obtain technology? [1 = exclusively from licensing or imitating foreign companies; 7 = by conducting formal research and pioneering their own new products and processes] | 2009–2010 weighted average.) *Source* World Economic Forum (2010)

Fig. 6.24 Number of researchers/Mil. People 2006 *Source* World Bank (2010)



lack of self-confidence and trust, which are vital for underpinning constructive collaboration. Psychological barriers are neglected in most studies and require a lot more attention when designing STI policies across the region.

6.3.4 Human Capital

Human capital is important in many respects, ranging from the formation of basic attitudes and skills to the effectiveness of the specific processes enabling observations to be transformed into new ideas that lay the basis for innovation. The quantity as well as the quality of human capital spans multiple areas warranting measurement and analysis: education, on-the-job training, interaction with other entities, etc. We have already seen where GCC countries stand in education and training. Attention should be called to complementary factors, such as the number

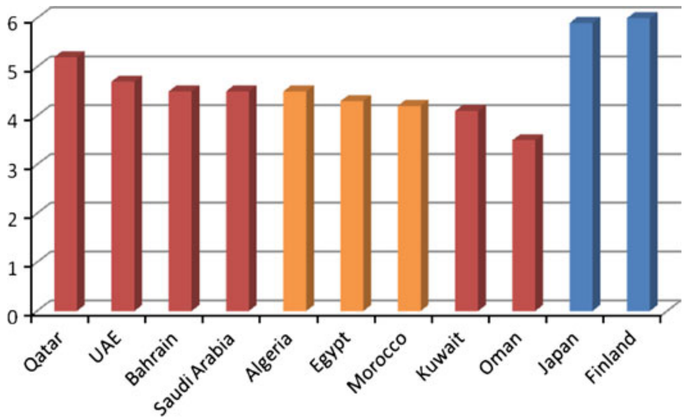


Fig. 6.25 Availability of scientists and engineers 2009–2010 (based on the survey question: to what extent are scientists and engineers available in your country? [1 = not at all; 7 = widely available] weighted average.) *Source* World Economic Forum (2010)

of researchers and their availability, gross tertiary schooling, the rate of graduate unemployment, the weakness of industrial research, the ability of researchers and the capacity to retain qualified scientists through brain gain.

6.3.4.1 Number of Researchers

A large number of researchers in R&D (Fig. 6.24) reflects both high human capital formation and the ability of economies to attract new skills and retain their established competencies.

The high mobility among advanced countries is not a problem but constitutes an advantage, since intensive two-way exchanges in human capital flows enable the enhancement of collaboration, the development of new networks, intensified learning processes and higher productivity. As leading emerging economies, such as India and China (and also many smaller ones), have recently become successful in re-attracting leading talent from the established developed countries, they similarly gain from two-way flows of high-skilled workers, experts and entrepreneurs.

The availability of scientists and engineers in the GCC countries relative to some selected other countries is shown in Fig. 6.25, again estimated based on the mentioned opinion survey (scale between 1 = not available and 7 = highly available). There are particularly stark differences when it comes to expertise in social sciences (World Economic Forum 2010).[8]

[8] Based on responses to the survey question; To what extent are scientists and engineers available in your country? [1 = not at all; 7 = widely available] | 2009–2010 weighted average.

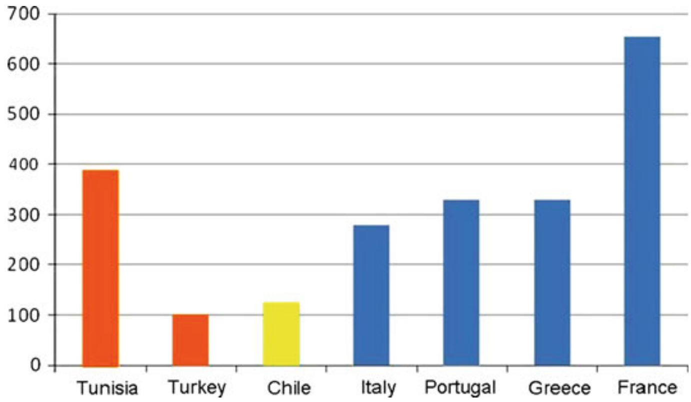


Fig. 6.26 Number of researchers in Tunisia and other selected countries *Source* OECD (2004)

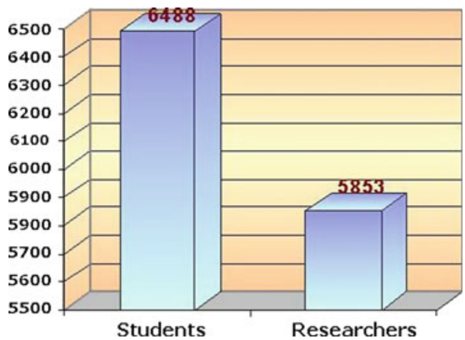


Fig. 6.27 Number of researchers and students with researcher status in Tunisia, 2004 *Source* Djeflat et al. (2008)

The number of researchers per million people remains very low notably in Kuwait and Oman. Four countries (Saudi Arabia Bahrain the UAE and Qatar) are outperforming their regional peers. Although there is now a relatively high share of women in university education, the percentage of women researchers remains particularly low in the lagging countries,[9] at about 15 % in Yemen, 20 % in Oman and 25 % in Saudi Arabia (where it is expected to reach 35 % by 2015).

Yet one must again be careful when comparing data from different countries. Figure 6.26 indicates that Tunisia, for example, is rather well placed when it comes to the number of researchers. It performs better than most Mediterranean countries (and indeed comes second only to France). A close look at the data, though, shows that Tunisia defines "researchers" more broadly than other countries as postgraduate students are included, which creates a misleading impression (Fig. 6.27).

It is important not only to count the number of researchers, but also to take into account to what extent they actually engage in research. One way of doing this is

[9] INCONET-GCC Field survey 2010.

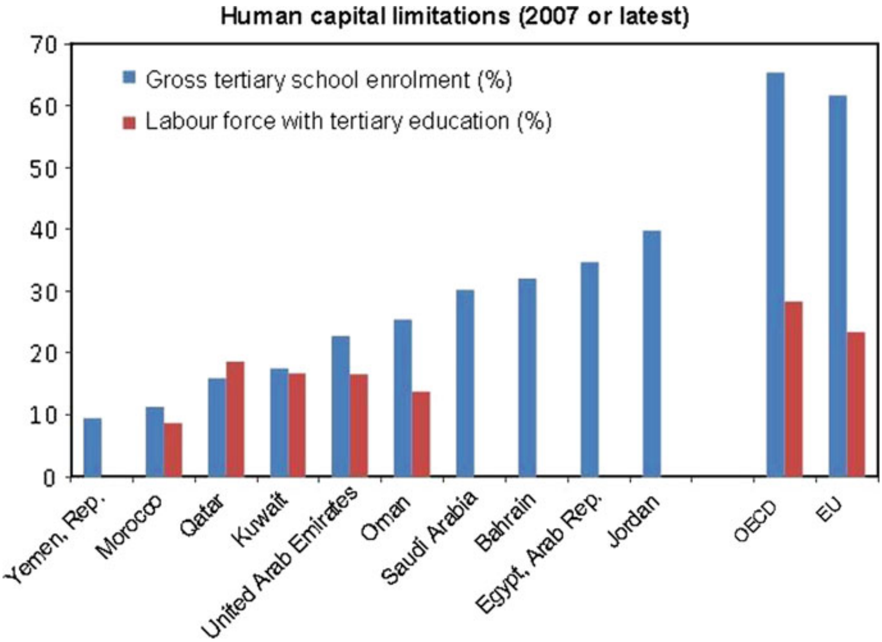


Fig. 6.28 Human capital limitations, gross tertiary enrolment and the share of the labor force with tertiary education *Source* World Bank (2010)

to compare the effective time that researchers devote to academic research. Field surveys in countries of the sub-region indicate that <10 % of time is effectively devoted to research. Full-time equivalent ratios are not always available. A lack of viable data and limited field surveys often lead to rough estimates of this ratio.

6.3.4.2 Gross Tertiary Enrolment

Gross tertiary enrolment is a key issue in the MENAregion and, more specifically, in the GCC countries with regard to their relatively small populations. According to data from the World Bank (2007), shown in Fig. 6.28, the GCC countries not only fall well short of the OECD and EU but also underperform some of their regional peers (Jordan and Egypt), despite great efforts in recent years to increase gross tertiary enrolment. A slow pace of educational system reform is a contributory factor here. Bahrain which has undertaken relatively significant reform efforts when it comes to education, leads the group.

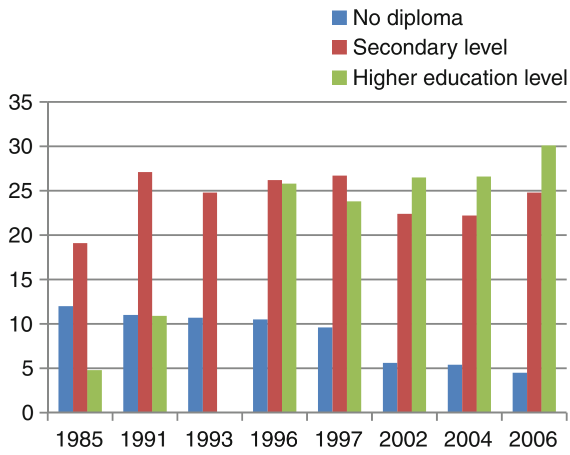


Fig. 6.29 Unemployment rates by educational level, Morocco in per cent, 1985–2006 *Source* Direction de la Statistique, Activité, emploi et chômage, several years (Emperador Badimon 2007)

6.3.4.3 Unemployment of Graduates

In developed countries, university graduates normally face a lower risk of ending up unemployed. In the Middle East the situation is more complex, as discussed in Chap. 2. In a number of countries, graduates encounter critical recruitment problems in the labour market. It is increasingly evident, especially in North Africa, that university and higher education systems often educate students whose job prospects are fairly slim.

A close look at Morocco shows that unemployment is highest among degree holders: twice as high compared to the rate of unemployment among school leavers with primary education (Fig. 6.29). Conditions are similar in Algeria, Tunisia and Egypt, indicating both the inadequacy of the training system and the poor quality of the higher education system's overall output.

6.3.4.4 Weakness of Industrial Research

While the size of the research population is a key element, researchers can be poorly distributed within a country. In developing countries they are often concentrated in universities, while a much greater share is destined for enterprises in the case of advanced countries. Data from a study in South Korea, for example (Fig. 6.30), show that more than 60 % of researchers are employed in companies, while less than one-third work at universities.

6.3.4.5 Brain Drain and Capacity to Retain Competencies

Emigration of tertiary-educated workers represents a major problem in many countries. Data from the World Bank (2010) show the GCC countries with the

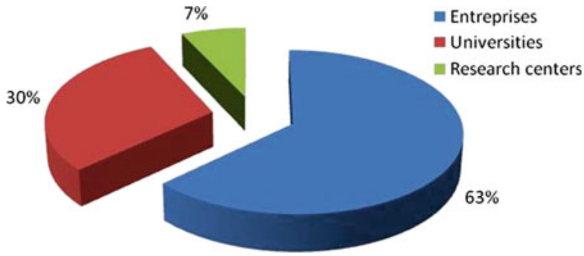


Fig. 6.30 Distribution of researchers per type of institution in South Korea, 2003 *Source* Djeflat et al. (2008)

exception of Kuwait, at a distinctly lower level than their regional peers. A lower level is not necessarily better, as indicated by the much higher levels recorded by the OECD and EU countries on average. Again, it is essential to examine why workers remain at home or move abroad, and whether in- and outflows of expertise are reasonably balanced or not. The levels recorded by Morocco in Fig. 6.31, are indeed indicative of brain drain presenting the country with a serious challenge.

On this basis, the World Competitiveness Report attempts to measure the ability of countries to both attract and retain skilled workers. On this account, the GCC countries clearly outperform their peers in the MENA region (Fig. 6.32).

It is a well-documented fact that the Maghreb (Algeria, Tunisia and Morocco) and Egypt have done poorly in competing for talent. If anything, this situation appears to have worsened in the last year, although official data is still not available for the period following the Arab Spring

Due to their fairly small populations coupled with their availability of significant financial resources, it would appear natural for the GCC countries to attract skills from the outside world, in particular from other Arab countries. Qatar leads in terms of retaining and attracting competencies and is ranked second worldwide, indicating a performance basically on par with Finland. Kuwait, on the other hand, is well behind and scores much below the top-ranked performer, Singapore.

These contrasts demonstrate that success in this area is about more than offering financial resources and filling vacant positions. Skilled workers are often able to choose between alternative destinations and they will inevitably weigh a number of factors that influence their ability to advance their professional career as well as the quality of their private life. The greater their potential for high performance, the greater weight they will place on conditions that will allow them to excel, create real results and allow their families to prosper. At the end of the day, what matters has to do with what motivations are put in place and what gets achieved, not with the number of individuals on the move or spending their time in a particular location.

6.3.5 The Quality Issue

Especially in countries with a previously undeveloped tertiary sector and sizeable populations, such as Sudan, Algeria and Morocco, decision-makers appear to have put an emphasis on quantity at the expense of quality as a way of coping with

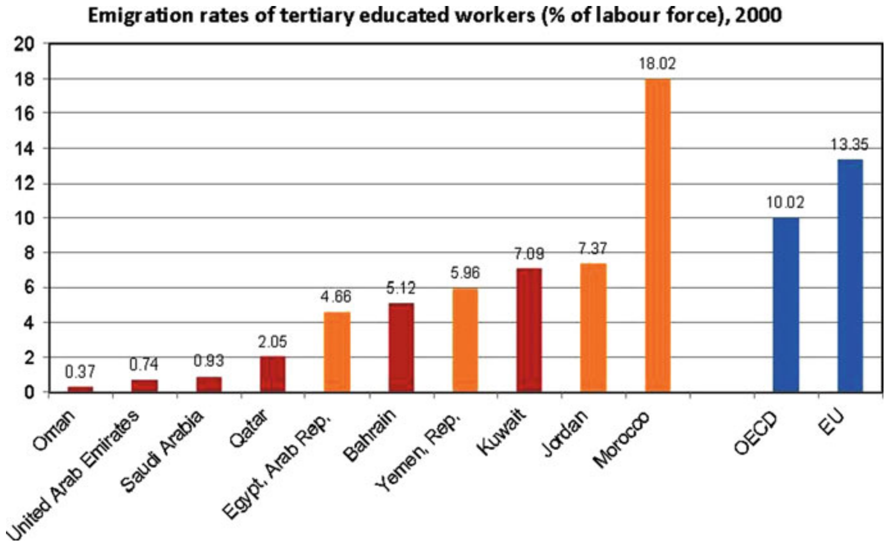
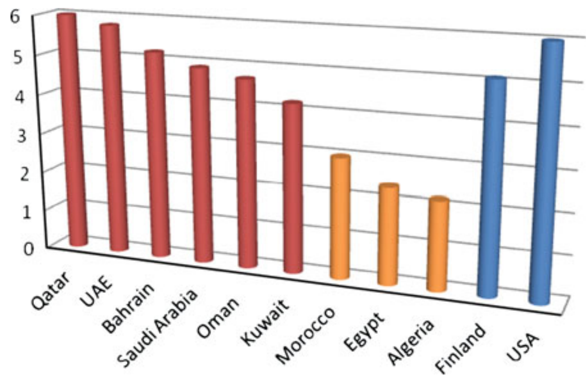


Fig. 6.31 Emigration rates of tertiary-educated workers (percentage of labour force), *Source* World Bank (2010)

Fig. 6.32 Capacity to attract and retain competencies: 2009–2010 (based on responses to the survey question: does your country retain and attract talented people? [1 = no, the best and brightest normally leave to pursue opportunities in other countries; 7 = yes, there are many opportunities for talented people within the country] | weighted average.) *Source* World Economic Forum (2010)



rapidly increasing demand for higher education. This aspect is very relevant for the GCC countries as well although their financial resources coupled with their (in most cases) relatively small size has enabled them to make greater efforts in addressing quality issues.

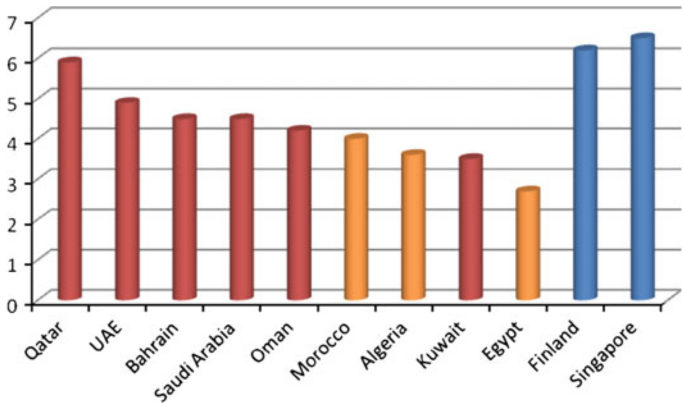


Fig. 6.33 Quality of maths and sciences: 2009–2010 (based on the survey question: how would you assess the quality of math and science education in your country's schools? [1 = poor; 7 = excellent—among the best in the world] weighted average.) *Source* World Economic Forum (2010)

6.3.5.1 Quality of the Education System

Data from the GCC and indeed from the MENA region as a whole show significant progress in education at various levels, including higher education, as seen earlier. The quality of education presents critical issues however. Some of these show up in problems with employability and lack of initiative by graduated students, e.g. with regard to entrepreneurship (cf. Chap. 2). This applies to the GCC countries as well as to the broader MENA region. In maths and science, pinpointed as a weak area in the region as a whole, the GCC countries perform generally better than their regional peers, with Egypt being last (Fig. 6.33). Qatar leads the group with a score quite close to Finland, followed by the UAE, which ranks fourth worldwide—ahead of many countries well advanced in the knowledge economy such as the UK, Austria and Luxembourg (World Economic Forum 2009–2010).

6.3.5.2 Quality of Research Institutions

Performance in research depends not only on the quality of human capital but also on the conditions under which research projects are conducted. Weak research institutions translate into poor performance no matter how competent or brilliant the human element is. It is a fact that researchers in the developing world who perform poorly in their home institutions can substantially improve their research results when recruited to institutions from developed countries: universities, laboratories and the R&D operations of private companies (Fig. 6.34).

This gap in the quality of research institutions is the prime contributory factor behind brain drain, notably in the fields of scientific and technological research where equipment and specific facilities are needed to conduct research

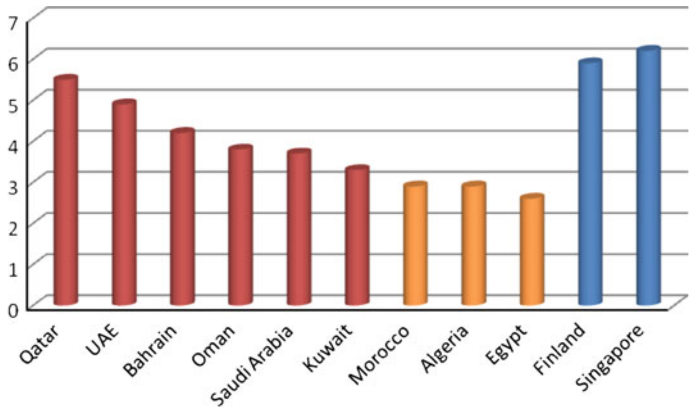
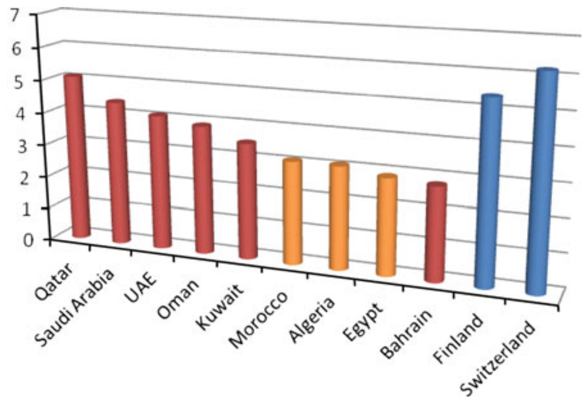


Fig. 6.34 Quality of the educational system, 2008–2009 (Based on the survey question: how well does the educational system in your country meet the needs of a competitive economy? [1 = not well at all; 7 = very well] weighted average.) *Source* World Economic Forum (2010)

Fig. 6.35 Quality of research institutions (2009–2010) (based on the survey question: how would you assess the quality of scientific research institutions in your country? [1 = very poor; 7 = the best in their field internationally] weighted average.) *Source* World Economic Forum (2010)



experiments and projects. Recent figures (2009–2010) show that the quality of research institutions in the GCC countries is higher overall than that of their peer nations, with the exception of Bahrain (Fig. 6.35). Qatar is the highest-ranked, slightly below Finland and with a score twice as high as lowest-ranked Bahrain. However there seems to be a consistency problem when comparing the quality of the education system, where Bahrain is in a better position. This suggests that research institution quality is influenced by other parameters as well, including governance and funding.

6.3.6 Institutions and Governance

The GCC countries largely lack experience of STI output and the traditions associated with a relatively strong industrial sector. Inadequate public awareness of science and technology, insufficient preparedness for knowledge activity and the weak presence of mechanisms for cross-ministerial as well as inter-regional coordination of reforms, investments and scientific efforts, present further obstacles.[10] While financial resources make it possible to take bold initiatives to attract leading foreign research institutions, or invite well-known guest professors and lecturers, there are few checks and balances against making costly mistakes and a lack of mechanisms to ensure quality in delivery.

This final section addresses the importance of addressing governance issues in some key areas: corporate governance, university–industry collaboration, and government procurement of high-tech products and services.

6.3.6.1 Corporate Governance Governance[11]

Ensuring sound rules and practices of governance is critical for STI performance in any country. Again with reference to mainstream indicators, Fig. 6.36 suggests that the GCC countries remain weak on the rule of law, where they are well behind the EU and G7. Nonetheless, they perform better than regional peers such as Morocco and Egypt

While governance in such respects matters for corporate performances, Corporate Governance represents an area that raises important issues in its own right. Corporate Governance can be defined, as the Cadbury Committee put it, “the system by which companies are directed and controlled” (Cadbury 1992). It involves regulatory and market mechanisms, as well as the roles and relationships between a company’s management, its board, its shareholders and other (corporate) stakeholders. Corporate Governance is not only about formal frameworks, however, but is strongly influenced by culture, power relationships, and also the goals by which corporations are governed, as well as the objectives of managers and other actors that are key to their performances.[12]

Corporate governance is judged on the whole to be weak in Arab countries, reflecting the dominant role of family businesses blended with public sector influence. The reasons are both historical and cultural. Tight family bonds have traditionally had a strong bearing on commercial relations. As the public sector has

---

[10] Gulf Organisation for Industrial Consulting and SRI International.

[11] Based on the survey question; How would you characterise corporate governance by investors and boards of directors in your country? [1 = management has little accountability to investors and boards; 7 = investors and boards exert strong supervision of management decisions] | 2009–10 weighted average.

[12] Wikipedia http://en.wikipedia.org/wiki/Corporate_governance. Accessed 29 May 2012.

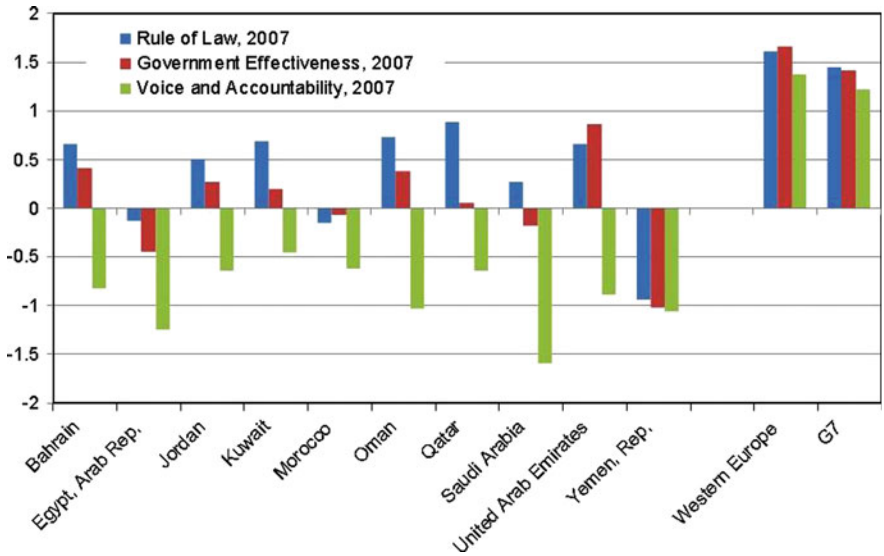


Fig. 6.36 Governance an area of weakness *Source* World Bank (2010)

become dominant, it has shared such practices, while limited attention has been paid to performance, accountability and evaluation, for example in countries such as Egypt and Algeria. According to Fig. 6.37, the GCC countries display, on the whole, a better record in corporate governance than their peers in the wider MENA region, with the exception of Kuwait.

6.3.6.2 Governance of Higher Education

The governance model of higher education is strongly influenced by tradition and limiting government regulations (Hazelkorn 2005). Today, the trend is for granting higher education institutions (HEIs) greater autonomy, while asking their management for higher accountability as well.

A change in the extremely tight control by governments is necessary if universities are to be able to work out their specific local partnerships as well as international strategies, and find innovative ways of carving out and fortifying their own specialisations, be it across disciplines or by way of orientations in other regards, e.g. a research profile, an emphasis on building entrepreneurial capabilities, working out a way of collaborating with surrounding society, and so forth. See Chap. 18 for concrete deliberations on these issues.

Another trend is for private higher education to play a prominent role in expanding the higher education sector as well as in working with it on meeting diversified social needs. On the other hand, private universities can often only play the "second fiddle", due to the financial or other privileges that still tend to accrue

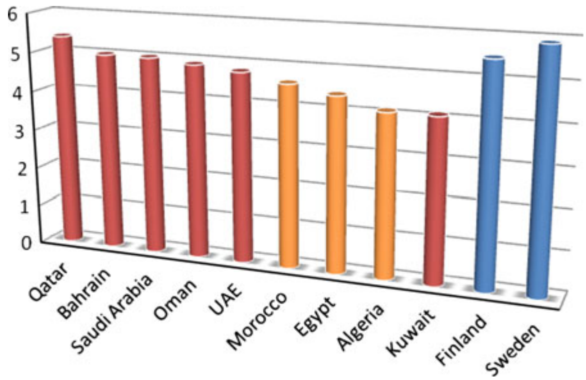


Fig. 6.37 Corporate governance: 2009–2010 (based on the survey question: How would you characterise corporate governance by investors and boards of directors in your country? [1 = management has little accountability to investors and boards; 7 = investors and boards exert strong supervision of management decisions] weighted average.) *Source* World Economic Forum (2010)

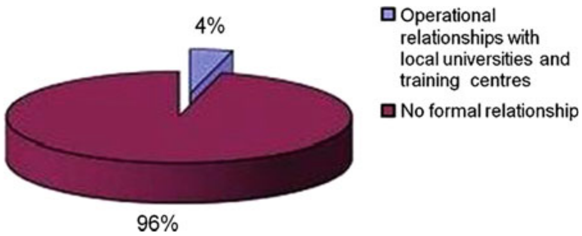
to public universities in the MENA region. There are also real risks that social returns are economised as private education institutions may focus excessively on profit seeking and disenfranchise faculty. They may, for instance, be tempted to recruit students based on ability to pay rather than academic talent. Such student selection will be detrimental to quality, especially in the GCC counties, with few secondary school graduates qualified for college work in English.

With high dependence on tuition, overall university finances are likely to be unstable and unpredictable, making long-term commitments such as tenure and research difficult, if not impossible. Duplication of programmes increases competition for students, threatening admission standards and reducing the range of courses offered. Faculties often complain about students who show little motivation for academic work, cheat in exams, pressure teachers to negotiate grades, etc. Private higher education is nevertheless here to stay, but it is crucial in most countries to work out a better combination of public funding (e.g. of basic research), university autonomy and private initiative and accountability, so as to allow all kinds of institutions to operate responsibly, and also to meet with the conditions that can allow them to influence their own development and actively pursue a specialisation of their own.

6.3.6.3 University–Industry Collaboration

As discussed in Chap. 3, current developments lead universities to work towards closer relations with industry and surrounding society more broadly. Graduate unemployment, along with the limited number of researchers found within productive companies, is largely the result of frustrated ties between training institutions and surrounding society.

Fig. 6.38 Share of companies with formal relations with Universities in Algeria, 2004 *Source* Djeflat et al. (2008)



More generally, Senker (1998) cites three main factors to explain the increase in university interactions with industry: i) the need for universities to look for non-government sources of funds; ii) the need for industry, spurred by competition and shorter time horizons for R&D, to access a broader science base than available in-house; and iii) the push for greater returns from government support for R&D (e.g. via the commercialisation and diffusion of publicly funded research).

Across the OECD, basically all governments are engaged in supporting the establishment of technology transfer and industrial liaison offices at universities, technology incubators, science parks and centres of excellence, all with the goal of increasing efficiency of public R&D spending and diffusing knowledge. Far from all these efforts produce results, for various reasons, including failure to engage the relevant stakeholders, or because complementary enabling conditions are lacking. Among the more controversial but also sometimes most successful initiatives are those that have taken an interdisciplinary approach to address specific outstanding issues. At the same time, there is "herd behaviour" and also overcapacity, with many establishments lacking a niche or edge of their own, and also an overemphasis on certain specific technology clusters (e.g. biomedical and information technologies).

The GCC countries display markedly less activity compared to the developed countries in this area. Qatar leads the group although it remains far behind the chosen reference country, Finland and of course also the world leader, in this case the United States. The GCC states are more active on the whole than their regional peers, however (Fig. 6.38). A survey conducted in Algeria shows that <5 % of SMEs have formal agreements with local universities and training centres (Fig. 6.39). The rest have either sporadic or discontinued relations based often on personal ties or no relations whatsoever (the majority). Egypt and Algeria are the weakest performers.

Recruitment of research personnel represents one of the obstacles, with local enterprises preferring to rely on in-house expertise. The promotion, training and coaching of senior management at HEIs needs to be strengthened, along with the adoption of measures that increase their room for strategic decision making, including with regard to the formation of collaborative linkages with wider society. Mobility of personnel between the relevant societal spheres, spanning executive as well as expert functions, should be encouraged as well.

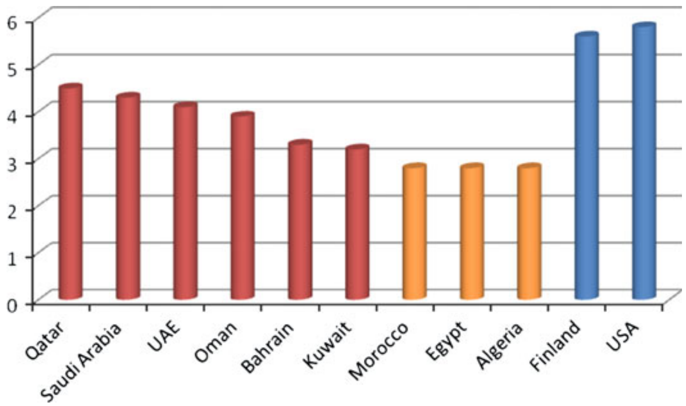


Fig. 6.39 University–industry collaboration in R&D 2009–2010 (based on the survey question; To what extent do business and universities collaborate on R&D in your country? [1 = do not collaborate at all; 7 = collaborate extensively] weighted average.) *Source* World Economic Forum (2010)

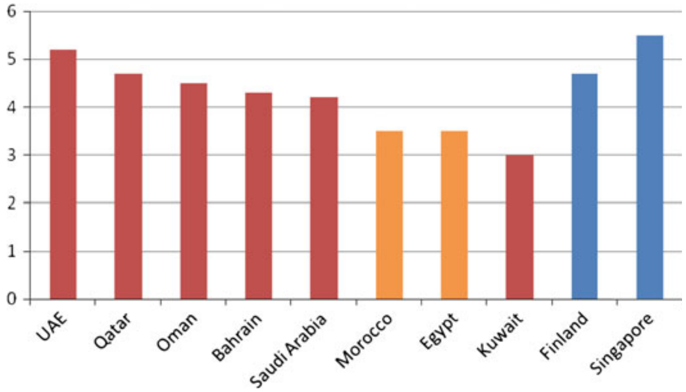


Fig. 6.40 Government procurement of advanced technology products (based on the survey question: do government procurement decisions foster technological innovation in your country? [1 = no, not at all; 7 = yes, extremely effectively] weighted average.) *Source* World Economic Forum (2010)

6.3.6.4 Government Procurement of High-Tech Products

Government procurement of advanced technology may be measured by its capacity to foster technological innovation through the acquisition of new technology products and services (World Economic Forum 2010). A government can articulate demand for new technology by acting as an early user or by formulating policy targets. In this way it can significantly add to the presence of qualified demand for new and improved products and processes, although the impact is often limited by the government's inability to specify sharp and effective incentives through their procurement policies. Figure 6.40 indicates that the situation differs from one country to another. With the exception of Kuwait, the GCC countries are doing generally better than their regional peers. Qatar ranks first both in the group and worldwide, with the same score as Singapore, the world leader in 2010–2011. Both Qatar and the UAE outscore Finland the reference country. However, this needs to be put in context. It may reflect that Finland, given stronger market actors and dynamics in this area, experiences greater demand for innovative and relatively high S&T-content goods irrespective of government action.

Concluding this section, input analysis can help shed insights into issues of critical importance for STI policies. It is imperative not merely to raise input levels in terms of funding or quantities but to improve the nature of processes and the incentives at work. Taking steps to strengthen absorptive capacity for instance may be key to benefiting from imported technology at enterprise level. Similarly, not merely the level but the composition and nature of R&D matters critically, as does the entire set-up for enabling innovation and start-up activity.

6.4 Concluding Remarks

As with any exercise aimed at measuring policy performance, benchmarking and identifying best policy practice need to be pursued with a great deal of care. Benchmarking represents a potentially useful tool to identify weaknesses and needs for reform, and rightly used it can help communicate why policies and institutions must adapt or be changed altogether. On the other hand, wrongly applied, the method may also lead to counter-productive conclusions.

In the opening of this chapter, Finland was identified as a relevant best practice benchmark on policy implementation of STI. Once reliant on natural resources, and also strongly affected by war and aggression, Finland was able to turn a crisis situation into an opportunity as it mustered stakeholders to back a comprehensive STI policy as a basis for developing new markets. Even as replicating the Finnish model would hardly be possible in the context of the MENA region's specificities, there are lessons to be learned. The importance of high-level policy support and of working out means to unite stakeholders behind an enabling role is further underlined.

Countries in the MENA region should go beyond simply assessing their gap in STI performance and policy vis-à-vis peers and advanced countries by undertaking complementary in-depth analysis, for example of the mechanisms at work in shaping output and input relations. In intellectual property rights, for instance, it is recommendable to strengthen support to SMEs to manage these issues as a whole. While R&D-funding matters, it is crucial to tackle absorption issues and transformative capacity. Governance and the quality of institutions and public procurement emerge as key inputs.

Similar policies cannot be expected to render similar results in different environments. For instance, if the successful Asian industrialising countries are used as a benchmark and source of inspiration, which is often the case today given their outstanding performance in recent decades, a number of caveats need to be kept in mind. The entrepreneurial drive and the enabling nature of close economic relationships practiced in Japan, China and the ASEAN countries, along with the presence of domestic factors that influence the effectiveness of policy implementation, account for a context that is quite different from that of the Middle East. It is by definition difficult to benchmark the quality and intensity of immaterial linkages, including the way in which different actors interact and cooperate. Again, STI policies and initiatives that can help improve conditions for job creation, entrepreneurship and SME growth require engagement by multiple actors, and the ability to put in place an environment that is conducive to investment in quality education, and to risk-taking and experimentation.

Subsequent chapters will pay further attention to both policy and performance benchmarking as part of the means to identify ways forward for an STI and knowledge society strategy that can serve the GCC countriesand the MENA region for the future.

Acknowledgments Statistical analysis contributed by Sara Johansson de Silva is gratefully acknowledged.

Part II
Issues, Challenges and Opportunities

Chapter 7
The Relevance of Science and Technology for the Arab Spring and the Key Role of the Knowledge Economy

Abdelkader Djeflat

7.1 Introduction

"In Tunisia, protesters escalated calls for the restoration of the country's suspended constitution. Meanwhile, Egyptians rose in revolt as strikes across the country brought daily life to a halt and toppled the government. In Libya, provincial leaders worked feverishly to strengthen their newly independent republic".[1]

Do you recognise the sequence of events? How about the year? Well, you are probably wrong. The year was actually 1919 (Anderson 2011), when scant technology was available to the then leaders of popular nationalist movements. Though small and modest changes have occurred gradually ever since, one cannot help noticing that the call for change has been present all along, looming in the public consciousness.

Ibn Khaldoun, one of the leading philosophers of the Middle East and noted for his monumental work, of the Muquadima (Brett 1999), is perhaps the individual who best seized this hidden potential for change deeply rooted in the soul of the region's people. It is this potential that has emerged now in reaction to inequality, injustice, oppression and the denial of rights. It is the same force that rose up during colonial times, in Algeria against French rule, in Libya against the Italian occupation, in Egypt against the British. Similar struggles were observed at times in the Persian Gulf, notably in Saudi Arabia, Yemen and Oman.

[1] Taken from the inspirational rhetoric of US President Woodrow Wilson's "Fourteen Points" speech in 1919.

A. Djeflat (✉)
Maghtech Network, Clerse—University of Lille, Lille, France
e-mail: Abdelkader.Djeflat@univ-lille1.fr

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_7,

Popular uprisings were not limited to that period, but the revolts against colonial occupation in the twentieth century were different. In the end, there was the onslaught of an armed opposition. But at its roots, there were also the uprisings of the poor—of the excluded population in both urban and rural areas—that occurred with limited weaponry backing. The then leaders (Omar Mokhtar in Libya, Amirouche in Algeria, Allal Fassi in Morocco and Ferhat Hached in Tunisia) knew that the people had little available technology (few basic weapons and military techniques) to challenge the sophisticated weaponry and geo-political power that confronted them, notably France with the support of several NATO countries, in particular, Italy and Britain. The sheer determination of the people's uprising and the armed resistance, mostly through guerrilla campaigns backed by political activism both nationally and internationally, played a key role in ending the occupation. The Moudjahiddins, the name then given to the freedom fighters, included peasants and farmers, workers in villages and big cities, students, the unemployed, and women.

The demise of colonialism was thus to a great extent brought about by the people. Freed from foreign oppression, the people nurtured high expectations of a bright, peaceful and prosperous future. These were soon to be dashed. The ruling elites and the subsequent regimes that took over spent decades in power with barely any real involvement from the people they were meant to serve and failed to deliver development. Although the old colonial regimes had been replaced, democracy remained conspicuously absent. To paraphrase Elagati (2011), one wonders "… why the cloud of democracy passed over the Arab world without causing rain". The regimes managed to contain discontent, applying harsh repression whenever needed—sometimes through pre-emptive action. Paradoxically, the autocratic rulers imported and made use of modern foreign technology while at the same time denying the people access to science and technology (S&T) for societal development. Hence, for a long time the region made hardly any scientific and technological progress, often blaming foreign powers and companies for its failures in this context.

The political, economic and social aspects of these developments cannot be disentangled. Yet certain patterns exist, and powerful ones too. These have translated into the process of swift social change and political upheaval that are now popularly associated with the Arab Spring. "Ten years after September 11, the streets of Tunis, Cairo, Benghazi, Damascus and the rest of the Arab world have sent a strong signal to the world on the most courageous and determined call for freedom and democracy."[2] One widely perceived aspect of the Arab Spring has been the lack of intellectual leadership. The movement was not orchestrated by established politicians or intellectuals, either inside or outside the region. As internal and external observers have pointed out, the Arab Spring has been a genuine grass-roots movement, albeit one responding to certain triggers.

---

[2] Declaration by the President of the European Union, Herman Van Rompuy, and European Commission President José Manuel Barroso, 10 September 2011.

In the following sections we examine some of the economic, political and social circumstances that created the turmoil. Our aim is to further explore the connection between the different driving forces that led to the present moment. The second section, which forms the heart of the chapter, examines more specifically the role of science, technology, innovation in the build-up of discontent and its subsequent explosion. By way of conclusion, the third section considers how science, technology, innovation and entrepreneurship might now take us forward.

7.2 The Economic and Political Circumstances that Created the Turmoil

Tunisia, Egypt and Libya were at the forefront of the Arab Spring from the start. Syria, Yemen and Bahrain have followed suit. Saudi Arabia and Oman experienced more limited protests. Kuwait, Qatar and the UAE have not witnessed explicit action of the same kind, but the protest wave has demonstrated it can reach and relate to people throughout the region.

While they shared a common call for personal dignity and responsive government, the revolutions in Tunisia, Egypt and Libya reflected divergent political situations, economic grievances and social dynamics, legacies of diverse encounters with modern Europe and decades under unique regimes. Conditions elsewhere across the region naturally differ even more. But again, fundamental driving forces and commonalities create an interrelated web and context for this ongoing movement, which is set to continue on its course. The eventual outcomes may still be quite divergent, depending on the circumstances that shape the underlying influences.

7.2.1 Economic Factors

While emerging economies are in the process of gaining increased influence, the Arab region as a whole, including the GCC countries, is home to a steadily growing demographic of underutilised young people in the midst of sometimes—spectacular infrastructural achievements and record oil revenues.

Unemployment clearly represents one of the key elements in this street revolution. A survey of more than 160 senior executives in the United Arab Emirates (UAE), Saudi Arabia and Qatar[3] found that a widely mentioned contributing factor to the Arab Spring was the need for education and labour reform to address

[3] Post-Arab Spring, Confidence in Middle East Business Climate Remains Steady http://knowledgewhartonarabic.wordpress.com/2011/07/13/post-arab-spring-confidence-in-middle-east-business-climate-remains-steady/.

regional youth unemployment. The World Bank estimates that the MENA region needs to create 40 million additional jobs to accommodate new entrants to the labour market in the next decade, or 4 million jobs per year. This estimate would be even higher if the labour force participation of women were to increase to the levels seen in other regions.[4]

The predominantly young populations of these economies are now mostly well acquainted with the modern information society. "The millions of young people entering adulthood every year have aspirations that need to be taken care of seriously and expeditiously, and the regimes in place right now show little ability to do so".[5] Naturally, the challenge of youth unemployment assumes different dimensions in different countries. The situation in Egypt, which has a population of over 83 million, has regressed dramatically over the last year, while Oman, with only 3.5 million, has performed remarkably well. Still, both these countries face a tough challenge to increase the supply of well-paid jobs appropriate for an increasing mass of well-educated young people.

The young generation has taken a lead role in the Arab Spring. It is not surprising when we know that four in ten of the Mediterranean Arab countries' 180 million citizens are aged between 15 and 34. Of these, 15 % of men and 47 % of women—a group of some 20 million young people—are neither in the educational system nor the job market (Karlson 2011).

In most regions of the world, the duration of unemployment is shorter for youth than for adults, reflecting the natural tendency of young people to move more frequently between jobs (O'Higgins 2003). In some MENA countries, however, youth unemployment appears to be the result of waiting for the right job. Thus, unemployment spells may be longer, especially for educated youth, who may require more time to find a good job match for their skills. Governments have experimented with different approaches to solve the joblessness problem and other youth-related issues, but with mostly limited success.

With young people jobless, climate change and other environmental challenges impacting food prices, the global financial crisis constraining the possibility of working overseas (and remittances sent home) and crony capitalism ensuring wealth is not distributed (except through state handouts), something has to give (Inayatullah 2010). Young people want what everyone does: health, education, housing, clean air and water, opportunities for meaningful employment or income generation, and a better life for their children. Arab governments assume a tight grip on the power structures of their nations but have not been able to provide the outlook for such a future.

Clearly, the traditional regional solution of providing government jobs to young Arabs has reached a limit. But the "free market" economic policies that many

[4] The World Bank News and Broadcast, "World Bank Group Announces up to $6 Billion for Egyptand Tunisia" (May 24, 2011) cited in Youth Population and Employment in the Middle Eastand North Africa: Opportunity or Challenge? Farzaneh Roudi (22 July 2011) p 6.

[5] Fareed Zakaria, "Why it's different this time," Time Magazine (28 February 2011), 18.

regimes followed, without much consideration for the negative impact of these policies on large segments of the population, have not worked either. Many rulers enriched themselves and their political allies through a corruption-ridden process carried out under the labels of privatisation and liberalisation. These schemes led to the formation of oligarchic business networks controlled by the ruling elite, which amassed even greater wealth through the process (Elagati 2011).

7.2.2 Governance, Legitimacy and Accountability

The political dimension constitutes a key element in the Arab Spring, but it is difficult to single out any element from a long list of relevant factors. In our view, however, two critical factors stand out as requiring particular attention within this region: the erosion of old legitimacies and a lack of accountability.

Erosion of old legitimacies. This important factor emerged in the post-war era throughout the world and assumed major proportions in the Arab world. Power bases everywhere are shaped on widely accepted grounds such as democracy and free elections, but numerous alternative bases exist that claim to grant legitimacy of power in the region—and these vary from one country to the other. The most firmly established, and widely present in the GCC countries, is royal descent and royal blood. In countries with republican regimes, often power is based on war legitimacy. Examples include the Neo-Destour Party in Tunisia under President Bourguiba, who refers to himself as the Great Moudjahid (fighter), the FLN in Algeria, which stem from the National Liberation Army (ALN) and the Istiklal Party in Morocco, which militated against the French protectorate. This legitimacy of the warriors lasted for almost half a century but seems to be wearing out among younger generations who have not lived through the struggles and have scant knowledge of them. For example, 80 % of current Algerians were born in the post-colonial era, after the war against the French occupation. "Warrior power has stayed far too long; instead of protecting the weak it has become carnivorous, eating its own children. While it was important in the initial decolonisation process, it is now decrepit. The honour-clan warrior based culture in the Middle East is nearing its end" (Sarkar 2002).

Lack of accountability. Closely allied to self-administered and everlasting legitimacy, lack of accountability developed as an Arab form of governance, leading to frustrations mainly among young Arabs. It also fuelled the rise of *hoggra*—a concept meaning "denial of all rights and being at the mercy of the ruler or any kind of authority".[6] The lack of democratic alternation in power led to some ministers staying in office for years in spite of dismal performance. If a system is to work, it needs to have a mechanism to "hold people accountable if they do not follow the

[6] The notion of *hoggra* was first used in Algeria in the 1990s and led to the first street revolution of October 1998 in many cities and in particular in the capital, Algiers.

rules" (Christensen 2011). Governments have thus contributed to plant the decor for the movement we widely associate with the Arab Spring. The common reality in Arab countries is that youth have not been included in the decision-making process on issues related to them. Hence, they have had little say in the policies affecting their lives, either through a transparent democratic process or through other ways and means. Youth have not yet gained the importance and attention they deserve in the policy-making arena throughout the region.

The Arab Spring sheds new perspectives on the economic and structural factors that contribute to the discontent that must be addressed if there are to be improved prospects for job creation and diversified growth across the region to enable socially acceptable conditions for growing populations.

7.3 The Science, Technology and Innovation Issues Underlying the Arab Spring

The nature of the overriding frameworks for policymaking and governance that have prevailed across the Middle East and North Africa since the colonial era means Middle Eastern countries must be viewed as latecomers in science, technology and innovation (STI)—despite their glorious past in terms of scientific learning and discovery. The region did indeed spearhead many of the prime advances in philosophy, mathematics, medicine, geography and literature about a millennium ago and the pioneers included Al Khawarizmi (whose name was given to logarithms) Ibn Sina, Ibn Batouta and El Farabi. For all their contributions, however, these individuals hold only a diffuse place in the memory, especially in the West.

The current status quo is very different. The Islamic world missed the so-called industrial revolution partly as a result of the scarce attention given to science and technology. Social sciences, literature and the arts fared somewhat better, but the region nevertheless lacks "a reading culture". Today, youth is attuned to short messages. Restoring a mindset for appreciating research and experimentation is thus a significant challenge.

While many countries in the region have modernised rapidly and are making a concerted effort to transition from resource-based to knowledge-based economies, they have also been hampered by weak industrial sector dynamics. In fact, the industrial sector still remains essential in most advanced countries, in spite of the advance of the service sector and what is commonly referred to as the post-industrial era.

In several ways, these factors are interwoven with the weaknesses in S&T, research and innovation. While a competitive industrial sector is largely lacking, there is also a dearth of other mechanisms for translating R&D results into commercial opportunities. Moreover, there is difficulty in achieving requisite size (Kuznetsov 2010) in most fields, including a lack of critical mass in SMEs, the fragmentation of research and higher education system and a lack of exposure to opportunities for innovation and entrepreneurial culture in research and higher education. These problems are of course not unique to this region. The underlying issues are very much the same as those highlighted in the EU "knowledge triangle" discussions of recent years. As discussed in Chap. 3, education, research and societal impact/innovation represent complementary outputs of the landscape we associate with the university sector. That the Middle East and Northern African regions struggle in this domain is clear. We believe that progress needs to be accompanied by complementary output that goes beyond the knowledge triangle and includes civil society, the informal sector and diaspora groups. All these spheres of societal activity need to be mobilised in contributing to the evolving human stock of intelligence and creativity.

7.3.1 The Accumulation of Discontent

The outburst of the Arab Spring in the formerly colonised Maghreb comes as no surprise. Over the years, the euphoria of the post-colonial era has evaporated step by step, giving way to a kind of vacuum that, in the absence of tangible socio-economic progress, could only be filled by discontent. The older generations may to some extent have accepted a lack of progress as the final sacrifice for nation building. Overall they can be said to have borne their pain patiently, though numerous attempts have been made to speak out (almost always resulting in grim crackdowns). Consequently, the fear of dictatorial regimes and a sense of resignation kept building, leading to a sense of despair as most people saw no option of taking any action that could realistically contribute to a real change of course.

Other factors heightened this state of affairs, such as the exclusion of the creative class, the dramatic failure of the education system (particularly higher education), the multi-dimensional crisis of self-confidence, and the side-effects of overly nationalistic attitudes.

7.3.1.1 Exclusion of the Creative Class

The MENA region has creative people and collective intelligence even in advanced technology sectors like electronics, ICT and aerospace. The "creative class" (Florida 2002) exists in the region as past history shows, although not to the same extent as in advanced countries and not of the same type. Richard Florida describes the creative class in the United States as comprising 40 million workers—30 % of the workforce—and breaks it into two broad sections, divided into a "Super-Creative Core" (12 %), who are "fully engaged in the creative process", and so-called "Creative Professionals", essentially knowledge workers.

As can be seen, the existing political system has, in effect, left out most of the social groups that comprise the creative class (Fig. 7.1). Excessive power and decision making concentrated at central government has excluded initiatives in

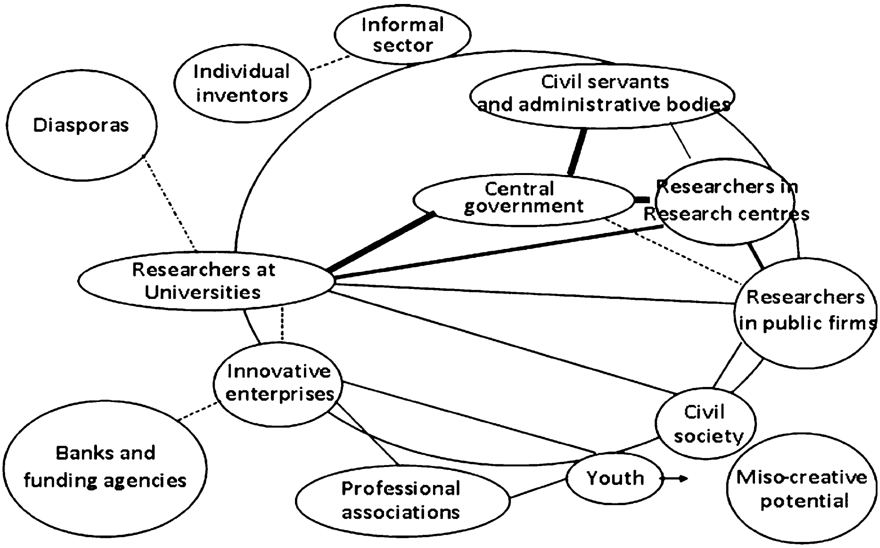


Fig. 7.1 Map of the current creative class in Algeria. *Source* A. Djeflat

other spheres. Even local authorities are not free to initiate novel projects and processes.

Creative people of all kinds—scientists, engineers and technicians—have found themselves marginalised. Often their initiatives for incremental technical changes went at best unrecognised and at worst penalised when implemented. Many professionals and academics were excluded from the decision-making process on technology acquisition and were left aside throughout the industrialisation process of the 1970s. Algeria is a case in point.

An excessive use of turnkey contracts has given technicians, engineers and scientists little room to do the necessary learning (Djeflat 1989) because turnkey contracts often contain stringent restrictive clauses such as the forbidding of undoing the technological package, the restriction on changing the product or process or the obligation to hand back to the supplier of the technology any kind of improvement made by employees and workers. Subsequent learning did take place (internally in the form of tacit knowledge), yet failed to benefit from external and more updated and continuous knowledge flows. Consequently, the "learning capability" to absorb subsequent technology flows did not develop adequately. Indeed, the same turnkey formula was reused later on, with no significant involvement of local capabilities.[7] Decisions were often made haphazardly by bureaucrats in government ministries. The education sector—universities and vocational training institutions—were not involved in any significant way. This prevented the learning sphere from interacting with local industry, resulting in the

[7] Declaration by the Minister of Hydrocarbons and Energy in Algeria, El Watan, 23 June 2011.

loss of numerous opportunities to improve curricula and adapt local training institutions to the needs of local industry. This kind of situation is frequently encountered in MENA countries where the public sector remains dominant.

7.3.1.2 The Failure of University and Higher Education

Oddly enough at a time when science and technology offer greater opportunities than ever to resolve major issues confronting mankind, funding for STI is under pressure in many parts of the world and fewer and fewer young people appear attracted to the subject.

A flurry of university reforms appears not to have resolved the issue. Universities in all Middle East countries, particularly in the Maghreb, have been producing low-calibre graduates who have shown relatively poor performance both in the workplace and in the research sphere (Djeflat 2009b). Chapter 8 provides more insight into these issues.

The public science and research agenda is longer term and puts much more weight on capacity building for its own sake, causing frustration with those impatiently seeking immediate returns. For society as a whole, the result is frustration, lack of credibility and loss of confidence in the public and economic role of the university to effect meaningful transformations.

Universities do not control their budgets, curricula and direction of specialisation. Their lack of autonomy has prevented independent scientific research and hampered universities from taking initiatives, generating new creative ideas and introducing innovations. Instead, they have passively absorbed political orientations and guidelines. As a consequence, they have little ability to connect to their local neighbourhoods, to develop bridges and a sense of relevance. This problem is more acute in the Maghreb countries and Egypt than in the rest of the Mashrek.[8]

Competition within academic circles is often not for the acquisition and production of knowledge, but for acquiring prestige through material gains and social relations. This indirectly leads to a search for holding positions in politics and benefiting from its material gains (Visentin 2005; Djeflat 2009a). Rent-seeking on the part of academics has often strengthened mediocrity and discouraged initiatives in the scientific sphere. It has also hampered university life, particularly research. It takes the form of academics holding permanent tenured positions, not on the basis of academic achievement and excellence but rather on the basis of academic titles and a set of personal strategies and tactics to protect the position. This limits and controls information diffusion and discourages new initiatives and ideas from junior members and promising young doctorate holders. It tends to encourage "clientelism" and a herd mentality (Visentin 2005). Moreover, rent-seeking behaviour contributes to

[8] The six countries of the ESCWA region usually referred to "El Mashrek" are Egypt, Jordan, Iraq, Lebanon, Palestine and Syria.

freezing or even destroying local research competencies, initiatives and capabilities (Djeflat 1999; Carré 2001).

Over the years, dwindling academic standards in the region made access to academic refereed journals internationally difficult and prevented the creation of local ones, even if slight recent improvements have taken place. This led promising scholars to publish in local and national newspapers, where self-censorship and political ambitions tended to reduce their contributions to mere validations of current government policy. In this climate, there was little demand from any direction for reforming and upgrading the status of universities, the media or any of the key societal institutions that are key to competency development.

In recent years, tentative but growing ties have been established between universities and enterprises, though they often rest on personal relations rather than institutionalised programmes. Some countries, including GCC states, have introduced reforms to re-shape scientific research, mostly for improved efficiency. The real impact of these new reforms remains to be seen. Fundamental research, however, vital it might be, contributes to the "ivory tower" image that universities in the Middle East have acquired over the years. The perception is that research is incapable of delivering useful and workable answers to the needs of people and the economy and that investment in research is ultimately a waste of public money. This is why considerable attention needs to be paid to making sure there is sufficient progress in applied research, and in its ability to respond to urgent social and economic needs.

More fundamentally, the salient question nevertheless remains to what extent higher education governance reforms could properly re-integrate universities into National Innovation Systems (NIS). The dominant role of the state, its centralised approach and its lack of a knowledge sharing culture, complicate coordination between the various components of the NIS, rendering goals unattainable (Zawdie 2002). Democratising and empowering the university community is pivotal for enabling a spurt in creativity and innovativeness. Channels for closer collaboration between universities and other key societal spheres must also be developed to allow for more relevant education, more emphasis on soft skills and higher employability of students.

7.3.1.3 Multi-Dimensional STI-Based Crisis of Self-Confidence

A crisis of self-confidence coupled with a lack of self-esteem has been building since many years in a way that has made it form a force of its own in lowering achievements. One of the most visible aspects is its connection to the ongoing "brain drain", a phenomenon through which thousands of academics and experienced professionals have left for foreign institutions each year, with few ever returning for a career back home (Djeflat 2002). In North Africa, and to some extent the Middle East and the GCC states, this crisis has been building for years if not decades for reasons not only of inequality and *hoggra* but of STI-related factors, too.

Bad innovation performance can also result from overly complicated and heavy local procedures, incompetent personnel, lack of trust in their ability to properly protect their inventions and even suspicion that they might be given to competitors as seen earlier. Companies may be driven to resort to other methods for protecting their innovations, such as those listed in the Oslo Manual discussed in Chap. 6. A certain degree of local mistrust in the capacity or willingness of foreign enterprises to participate in the development of local S&T capabilities exists among operatives and sections of public opinion. Mistrust also exists over the capacity of local competencies to meet S&T tasks and requirements. Acceptance of a “made elsewhere” culture has tended to stifle opportunities for developing local capacity. A crisis of confidence also exists in the funding of research and in R&D. Hence, the banking system has very little confidence in the ability of S&T projects holders to convert their ventures into thriving and profitable enterprises.

Similarly, consumers often view domestically manufactured products with some suspicion as regards their quality or viability, often on the grounds of previous bad experience and negative publicity. The crisis of confidence also extends to university-industry relationships (Khalfaoui 1996).

7.3.1.4 The Crisis of Entrepreneurship and SMEs

The Arab world has historically been a powerhouse for commerce and entrepreneurship. Whereas Arabs continue to be perceived by many as effective and shrewd business people, the state of entrepreneurship in the modern era is different. In some countries, many years of state control have fostered resistance to change, whereas gate-keeping and corruption have flourished. The public sector wields a pervasive influence and private sector activity is widely perceived as second-class.

Several studies have highlighted a “crisis of entrepreneurship” in the Arab world, particularly in manufacturing, which has shrunk markedly as domestically-made products have lost out to ready-made and end-of-value-chain products, for instance in the textile and garment industries. The number of jobs in this area has contracted sharply, as has the capacity for new job creation. Torn between modern requirements and local traditions and practices, entrepreneurs typically resort to protection, for instance by recruiting family members as staff. Some 95 % of SMEs are family businesses[9] and obey no code of governance. As a result, very little risk is taken. Similarly, new areas of activity with relatively high levels of knowledge are not taken up and investments remain largely in the traditional sectors.

International experience of previous programmes demonstrates the difficulty of improving conditions for SMEs and entrepreneurship through piecemeal efforts.

---

[9] Ernst and Young (2008) *1st Ernst & Young Family Business Survey*, and figures from the Qatar Financial Centre Authority, cited by the Korn Ferry Institute “Business Leadership in the Arab World” (2012).

SMEs and entrepreneurs are constrained or thwarted not by individual hurdles but by the combined weight of many factors. These may combine limitations in the strategy or skills of the business owner or weaknesses in the business idea and plan, with regulatory and bureaucratic impediments, weaknesses in contractual conditions that hinder orderly payment of invoices, and other conditions that sap an organisation's energy. On the other hand, as discussed in Chap. 3, SMEs and entrepreneurship are vital for innovation, though large companies dominate when it comes to R&D. In fact, the SME sector is critical for broadening the basis for growth—and crucial for job creation. It is essential for society to identify and address the factors that inadvertently exacerbate artificially high transaction costs in the marketplace, in which SMEs find harder to handle than larger organisations with more political clout and bargaining power.

SMEs also encounter inherent difficulties in defining and articulating their competency needs. Vocational training has limited relevance to SMEs, and universities may have difficulty responding to their specific requirements. A key factor is the extent to which conditions will allow for a demand-led evolution of professional service delivery, ranging from ICT applications to marketing, IPRs, financing, design and so forth. Competency-building nodes, networks and brokering services tailored to the needs of special categories of entrepreneurs and firms are critical to the ability of SMEs to bolster their specialisation and ability to compete internationally. Such services may not materialise without the development of public support mechanisms focused on improved matching of service provision to the real needs of enterprises and entrepreneurs.

Learning in action is often the only method available to SMEs. This is often the case in manufacturing, arts and crafts, food, agricultural product refining, fragrances, textiles and embroidery and supportive services. Business in these areas needs to devote attention to renewal of branding and marketing strategies. Domestic and international networks and the exploitation of relevant institutions and events need to be carefully considered. Intellectual property rights matter in some cases but cannot be seen in isolation; they primarily need to be adopted when combined with or made supportive of other components that create features which are difficult or impossible to imitate. Opportunities for pooling resources and marketing strategies among complementary players should further be sought.

It is imperative to improve conditions for knowledge-intensive start-ups specifically. The availability of relevant coaching and mentorship, as well as an environment that offers access to seed and venture capital is vital for this category of potentially high-growth firms. Nowhere in the Middle East is it yet possible to find a truly dynamic environment entailing a combination of seed funding, business angel activity, supportive specialist entrepreneurship networks and constructive brokering functions.

Creativity in business has to do with the generation of new ideas that are converted into economic activity and training that generates creative thinking coupled with a culture of commercialisation. Once a new thought has been developed, it should be validated. Then a prototype offering might be created, the competitive environment assessed, the offering tested, feedback used to refine the offering and a business plan tightly constructed and executed when the new entrepreneur is ready to seek outside investors.

In conclusion, fulfilling the potential contribution of entrepreneurs and small businesses to growth and employment requires a systemic approach that includes:

1. State-of-the-art infrastructure and communication backbone,
2. Availability of relevant support and consulting services,
3. Special community and network environment,
4. Investment opportunities and
5. Constructive cooperation between universities, research institutes and the corporate sector.

Tackling the above effectively requires taking into account the particular properties of the environment in the specific case. Multiple actors and functions are bound to interact in shaping outcomes. The issue is how to mobilise all key players to contribute constructively. In the Middle East, this inevitably includes some actors outside of what we may consider to be the innovation system, as described in Chap. 3 (Fig. 3.9).

7.3.1.5 Side-Effects of Overly Nationalistic Attitudes

Paradoxically, decades of non-democratic rule have produced two seemingly opposite effects. The first is a crisis of confidence between people and rulers; the second is an intensification of nationalistic feeling and attitudes. Needless to say, the stalemate in the Palestinian-Israeli conflict has helped to fuel nationalistic sentiment. People, especially the young, are no longer prepared to see national pride being trampled on and are uneasy at seeing their countries classified in the lower rankings, whatever the indicator might be.[10] Additional frustrations stem from the fact that few best practices are ever drawn from within the region in the eyes of generations who are fed by competition, world contests in all sorts of games and racing. The quest to win and to be among the leaders and champions is perhaps never as vivid as it is in the Arab region, among youth in particular. The last soccer World Cup was interesting in this regard, with a qualifying match for the finals in South Africa almost precipitating the breakdown of diplomatic relations between Algeria[11] and Egypt. The match caused open confrontation between the two countries' youth, both physically in the stadiums and digitally through social networks (Facebook and Twitter). Ahmed Adimi (2010), in a timely

[10] For example, the 2011 innovation index of 125 countries compiled by INSEAD ranked Algeria last in 125th place. http://www.globalinnovationindex.org/gii/main/analysis/rankings.cfm?vno=#CGI.SCRIPT_NAME#.

[11] Algeria in the end won the match, which had to be played in a neutral country, Sudan, following the attack on its national football team in the previous round in Cairo.

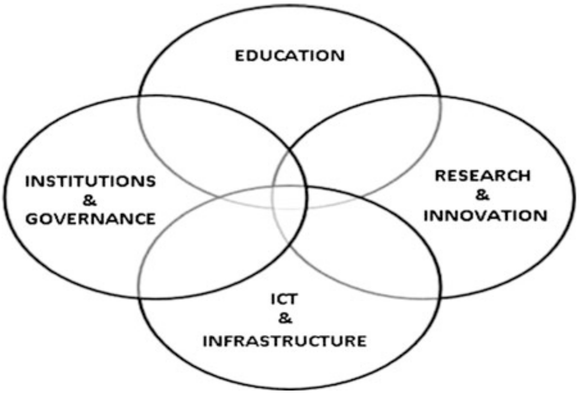


Fig. 7.2 The knowledge economy paradigm: The interconnected pillars of the knowledge economy. *Source* Dahlman and Andersson (2000)

and dramatic book, analysed how these frustrations built up through ICT and media communications, especially television. Some analysts attribute the delayed Arab Spring in Algeria partly to its qualifying for the finals of the World Cup.

7.3.2 Science, Technology and Innovation and the Arab Spring: The Outburst

While everybody has picked up ICT and social media as a key element in the Arab revolution, it is by no means the only facilitating factor; innovation, governance and education have all been at play. In other words, the knowledge economy has played its role in the convulsions. All the major pillars of the original characterisation of the knowledge economy face difficulties of various kinds: education and training, the innovation system, ICT use, properly governed institutions and what later became the business climate (Djeflat 2009b).

A degree of consensus exists that knowledge has become central to the process of wealth creation, growth, competitiveness and development. But there are various ingredients that are likely to make it happen. This paradigm seems to have found relatively high success in the Middle East, including the GCC countries (Aubert and Reiffers 2003; Djeflat 2006). But while ICT appeared to make exceptionally rapid progress, the two pillars of innovation and institutions and governance lagged behind. There was certain scepticism when the knowledge-based project started in the early 2000 that it might be too remote from the needs and immediate preoccupations of the populations and might be regarded as an intellectual exercise reserved for the elite. Quite paradoxically, the resistance soon proved to come from the top of the hierarchy and the political establishment rather than from the grassroots level, where youth embraced the project more readily (Fig. 7.2).

When examining the situation in depth, one cannot help but conclude that rapid progress in these fields has partly contributed to the Arab Spring. Indeed, it is capacity building that enabled young people to engineer what would have been inconceivable few years back: the Arab Spring. Thus the appropriation of the knowledge economy by the young generation had spurred a will to grasp the two other missing pillars—innovation and institutional regime. This window of opportunity, often linked to knowledge-based development, was missed by the political regimes but seized by the so-called "Arab Street".

7.3.2.1 The Role of Information and Communications Technology (ICT)

The advance and spread of ICT has increased the links between individuals and countries. Certainly, the infrastructure and ICT pillar has made strong progress, and this explains how in a relatively short period Middle Eastern countries have ascended the world rankings. The UAE, for example, reached 8.59 in the Economist Intelligence Unit's information infrastructure pillar in 2009—the highest score in the world. This contributed to its excellent score of 6.12 (scale 1–7) in terms of e-readiness for 2009 (Economist Intelligence Unit, 2009). In 2008, mobile subscriptions reached 207.8 lines per 100 people, the second highest score worldwide. The rate of internet use reached 85.7 per 100 people, putting the country in second position worldwide, first in MENA and ahead of the OECD countries (World Economic Forum, 2009). Young people especially are getting wired, becoming interlinked and absorbing new ideas and inspiration wherever they live. The young generation has rapidly absorbed the new concepts and new tools that have popularised ICT use and given new access to knowledge, information, international contacts and networks never envisaged before.

Twitter, Hashtags and Facebook groups played a large part in mobilising protesters, who came from all backgrounds—rich, middle-class and poor—and simply used their mobile phones to organise mass movements. The story of the 2011 Arab revolts in Tunisia, Egypt and Libya is both about how the globalisation of the norms of civic engagement shaped the protesters' aspirations and about how activists used technology to share ideas and tactics (Anderson 2011).

Young people today are used to the options of communicating with people far away, irrespective of their location. They are not merely the first ones to grow up with a phone in their hand; they are also the first to enjoy the tools of messaging and social networking—tools that have become simultaneously available to their peers worldwide.

The engagement of young people has been made possible by the new social media. Many young Arabs assert that Facebook has made peaceful protest possible. Al Jazeera, the Arab cable TV channel, has been instrumental in making daily Arab politics more transparent.[12] Social media have allowed the revolution to not quickly die out since regimes could otherwise have targeted leaders through

[12] Sohail Inayatullah (www.metafuture.org) The Arab Spring: What is Next? New Renaissance Magazine: http://www.ru.org/political-science/the-arab-spring-what-is-next.html.

assassination. As with the overthrow of Slobodan Milosevic by, among others, the youth group outspur, by having no clear leadership, no particular person could be targeted. Social media have made what once would have taken years of careful planning to happen a weekend.

Globalisation via the internet introduced young Arabs to a borderless digital world of communication that they, in a sense, became an intrinsic part of. More than anything, this painfully exposed the societal reality surrounding their physical lives. What ensued may be said to represent the classic "revolution of rising expectations" (see footnote 12). The young, interconnected generation started to observe and disclose the absolute lack of accountability and helped its exposure in the media and public debate. What central governments had failed to organise by way of orderly government institutions capable of ensuring transparency was taken over by the people, who applied social media to examine and expose the untold reality of the societies around them.

This newly found accountability is likely to increase the chances of improving the good governance of knowledge institutions (education, training, R&D, science and technology, ICT, etc.). The path is already being shown by the new forum of bloggers and IT activists who hold their annual events[13] to assess the role of social networks (Wikileaks, Twitter and Facebook) and who intend to monitor the path to democracy.[14]

Other fundamental questions regarding the economic role of ICT include its potential contribution to increased productivity and its facilitation of the roll-out of new goods and services. At the same time, as Chap. 6 discusses, the tremendous diffusion of ICT does not necessarily strengthen SMEs or enable entrepreneurs to start new ventures and succeed in making them grow. Labour market outcomes—and the extent to which new jobs are created—depend on a wealth of factors.

7.3.2.2 The Appropriation of Innovation in the Arab Spring

The term innovation is mostly applied in the commercial sphere, where the difference between an invention and innovation is critically about the latter winning acceptance by customers. Innovation is not only about what generates profit in the marketplace, however; we now commonly speak of innovation in the social field, and civil society, as well. The concept can be applied to politics, too. In Tunisia, the Arab Spring ignited against the backdrop of innovations emerging outside the framework of the ruling political party. This was not the case in Egypt, where the former ruling elite under President Mubarak remains largely intact within the institutions set and protected by the army, making the uprising there more

[13] El Watan, 3 October 2011.

[14] In 2011, this forum was held in Tunisia, after Cairo and Beirut. Seven of these bloggers ran in the Assembly election in Tunisia on 22 October.

reminiscent of a military coup than a people's revolution in spite of the Islamic elected president.[15]

We may apply the concept of "disruptive innovation" in this context.[16] New modes of communication were diffused with staggering speed among the youth masses, a phenomenon in no way unique to the Middle East but seen basically everywhere around the world. In the Middle East, however, the tools for digital communication were to be put to another sort of use. The disruptive innovation process relates both to the content of the messages being circulated (which was openly against the political regimes) and the way the community of young people started to circulate these messages in a way that generally left little clue as to their origin. Amid the danger surrounding them, young people joined a "leaderless" movement. In this sens, they seem to have found a new purpose in life, breaking out of a situation in which they had few other prospects in life other than to leave their homelands. Instead they joined the *harragas*[17] groups or fed extremist movements. They have shown they were capable of "disruptive innovation". We might refer to this as a "revolutionary innovation", meaning an innovation highly radical in nature in which the people embrace new paradigms. This is the prelude to what Moore (1995) calls the "tornado" of adoptions and which indicates that the marketplace has truly adopted the new paradigm.

The Arab Spring saw people in country after country unite to dismantle what were seen as repressive and illegitimate leaders. The main impediments to social change had been everyday life factors rather than social class and political opinions. As already discussed, it is critical to ponder the fundamental questions of what it takes—at various levels—to enable a spurt in science and technology on terms that can enable economic diversification, growth and employment in the Middle East (Fig. 7.3).

Lessons from elsewhere cannot merely be copied in the hope of achieving such results but do provide illuminating input. Technical progress must be accompanied by conditions that allow for the retraining of workers, support for mobility and migration of jobs from contracting to expanding areas. Also, conditions must allow for small companies to grow and for new ones to be created. Human resource development must spur a mindset that makes people more accepting of both success and failure. It must also allow for entrepreneurial ventures not only among individuals who are already established and can trade in real estate with collateral backing, but among young people with an unproven record yet who possess intangible assets that potentially promise the greatest success of all. On this basis,

15 Hugh Roberts—El Watan, 3 October 2011.

16 Disruptive innovation was defined by Christensen and Rosenbloom (1995) as a process "by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves 'up market', eventually displacing established competitors".

17 Wikipedia defines *harragas* as North African migrants who immigrate illegally to Europe or to European-controlled territories in makeshift boats. The name comes from colloquial Algerian Arabic and refers to burning immigration papers if captured. Migrants come from Algeria as well as from Mauretania, Senegal and Tunisia.

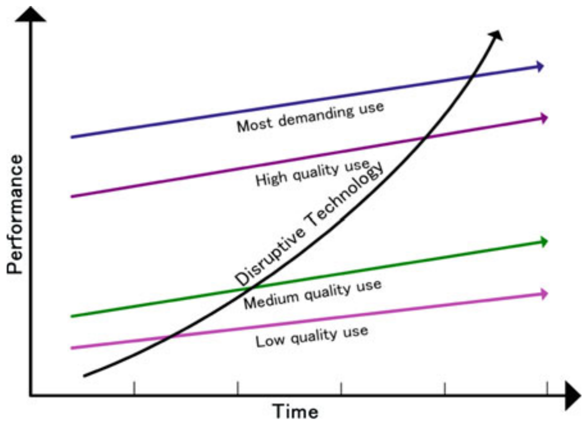


Fig. 7.3 Disruptive innovation. *Source* Christensen and Rosenbloom (1995)

it is essential to create demand for the kind of capacity building that can enable innovation and entrepreneurship of relevance to tackling the MENA region's (and the GCC's) challenges—including youth employment, sustainable growth, inequality and poverty.

A number of precise policy measures then need to be designed in support of that agenda. How to set up priorities in research and development to boost the knowledge-based economy? What is the role of manufacturing, institutions and leaders in shaping S&T innovation systems? What are the implications for the countries of the region, and what are the policy options? What initiatives could be taken at sectoral level, such as health, research, training and innovation, to improve quality of life and meet needs? Finally, what is the role of public procurement in driving innovation in the public sector, bearing in mind that government policies can help foster a better integrated research and social agenda?

7.3.2.3 Education and Training

Education and training have made a significant progress in quantitative terms and the rising role of women in education is notable everywhere in the region. Education and training of young men and women has absorbed a fair chunk of effort and public money over the last decades and governments have felt the need to upgrade the level of public education. While basic education has become compulsory nearly everywhere and reached almost 100 % of school-age children, there are still considerable problems with teachers' abilities and training. Curricula across the region also miss out on promoting soft skills. New topics such as ICT are now introduced early on, but more as a theoretical standalone subject than as a tool that should be mastered and played with and as a way to enhance learning processes overall. There are also challenges of syntax between different languages, for instance in the francophone regions of the Maghreb, where children with Arabic as their mother tongue in many cases receive most education from elementary school upwards in French in an environment where teachers do not understand how to avoid problems with cognitive learning. Such issues underline the continued importance of upgrading efforts to address quality problems throughout the educational system.

Secondary and tertiary education has expanded rapidly as well, although the capacity of tertiary education to accept the growing numbers of young students remains a bottleneck. As previously noted, the problems here arose not as a result of graduate scarcity but because of surpluses that the local market was unable to absorb.

The demands for better quality education and lifelong learning are accompanied by a call for greater flexibility. Traditional jobs are in increasingly short supply, while skills requirements are constantly changing and increasing. Meanwhile, citizens are becoming better informed and better educated, leading them to nurture higher aspirations that be difficult to meet in terms of obtaining a qualified job.

Rising expectations present higher education institutions with stiff challenges. Many have difficulty in offering the high-quality education that is required. Seats of learning across the MENA region have also been slow to establish constructive linkages with surrounding society to foster "employability" and are thus insufficiently exposed to the expectations raised by the modern labour market. This, together with their weaknesses in research, is impeding their ability to introduce education and training content that can help breed innovation and entrepreneurship skills among students. Nevertheless, there is increased awareness of the importance of building stronger analytical capacities, higher awareness and extended scientific and technological capabilities.

Meanwhile, young women are beginning to outnumber their male peers in higher education throughout the MENA region. This is the case in most other parts of the world too. But in the Arab world, higher education serves as a particularly defining entry point for young people in terms of recognition and development opportunities. At the same time, we have noted the presence of mismatch in the interface between the educational systems, labour markets and economic needs. Those who have taken the step of joining private sector employment or attempted a career as entrepreneurs and business owners experience challenges in earning the same returns as in the public sector, though their exposure to new career opportunities is generally much greater in private business than in the public sector.

Achieving better employment outcomes necessitates additional and more diverse avenues for job creation and access to training, including through less formal education. Again for women, who represent the majority of those out of work, it is important that jobs offer flexibility in terms of location, such as remote micro-tasking and outsourcing, so that some can be performed partly at home.

In terms of training, learning for life and learning in the workplace is pivotal both for raising productivity and for enabling companies to hire more and more diverse spectrum of employees in the first place. Success in this respect requires new structures and pedagogy on the part of educational and training instructors.

Technical and vocational education and training (TVET) has traditionally been the poor relation of the education family. There is a widespread unfavourable perception that such programmes are a last resort for students who struggle in compulsory education and lack rudimentary knowledge for further educational advancement (e4e 2011 and World Bank 2008). Status plays a role in choosing education and a profession and the VET programmes continue to score poorly as a preferred choice among young people in MENA countries (e4e 2011). Despite an increased focus and level of investment in such programmes in some countries, most suffer from low quality teaching and institutional weaknesses that hinder them from meeting the needs of labour markets (Dhillon et al. 2009).

The MENA region has seen few pre-service VET programmes to date. There is an opportunity here to work a different scenario. In a knowledge-based economy, TVET's role is in fact rapidly changing. Rather than the dead-end repository of school failure, TVET is increasingly looked towards as a revolving door for skills renewal and requalification. For VET programmes to fulfil their potential in this context there is a need to ensure relevance, a sharp profile (including by building strong connections with industry, especially dynamic SMEs that see the need) and branding.

TVET can also be used to improve radically the prospects of young professionals struggling to establish themselves in the labour market, by bestowing them with valuable practical skills demanded in the labour market's middle level. The programmes offered by the Information Technology Institute (ITI) in Egypt are an example, in this case founded on innovative use of ICT.[18] For success, however, it is important to break the common perception that VET programmes would be a less valuable second-best option, among both students and employers.

Key components for a successful TVET programme include:

- An open and flexible structure, where access does not prevent students from continuing their education, even at formal levels
- A well-defined core set of qualities and focused orientation
- Integration of technical/vocational and general education (introducing more academic subjects in TVET and more practical subjects in general education)
- Effective guidance for students and workers
- Programmes for entrepreneurship and self-employment
- Quality assurance through a well-established national qualification framework, assessment system and data accessibility
- Involvement of economic actors in the planning and evaluation process

7.3.2.4 Institutions and Governance

In the past, the attitude to change among most people across the MENA region obeyed the top-down logic, often due to strong reluctance to delegate and decentralise decision-making. Today, changes seem to have become rooted at the

[18] Affiliated with the Ministry of Communications in 2005, ITI has been operating with its own board of trustees with representatives from a broad range of stakeholders. It specialises in offering state-of-the-art software development skills for graduates and in promoting technology awareness among a broad range of professionals. See further www.iti.gov.eg.

bottom, where there is a strong will to get things moving (although too often in the face of growing discontent, particularly among youth.)

Such desires soon ran into a brick wall, in the form of state institutions, often perceived as bureaucratic, rent seeking, corrupt, etc. What has started gradually attaining a distinct form, and which predated the Arab Spring, has been often expressing discontent, frustrations, opposition to political choice and orientation, but also resistance to injustice in the form of growing, and apparently unjustifiable, inequalities. The notion of "Arab regimes" as a special sort of governance model, alien to the reality and needs of the masses, has never been so strong. Not surprisingly, the constant frustrations with the suffering and humiliation of Arabs through the ordeals of the Israel-Palestinian conflict, has contributed to nourish the sentiments of the Arab Street.

This is even more so as the lack of progress at the world stage in working out a solution has been seen as largely acceptable both to Israel's allies in the West and to the autocratic regimes in the Arab world, especially given the openly hypocritical parallel support of the same Western powers for those military dictatorships across the Arab world. These sentiments have not been specific to the last few years.

The Arab Spring has certainly been able to shake political regimes, and has ultimately precipitated regime change through what appears now to be two major routes—street revolution (Egypt, Tunisia) and armed conflict (Libya and most probably Syria and Yemen). But not all strata of society have embraced change. It was the unemployed youth that initially triggered the Arab Spring, not intellectuals and professionals. The question is how to get multiple sections of society—academics, entrepreneurs, civil servants and women—to embrace change too. In the past, intellectuals who expressed discontent often did so within the system and are known for that as "quadratic intellectuals". Those who openly opposed their regimes in situ faced jail, death or exile.

How to establish, in the minds of policymakers and society as a whole, that science technology and innovation (STI) and knowledge must represent an inherent part of the new paradigm of wealth creation? How to reduce the prevalence of rent-seeking behaviour? An in-depth analysis of Maghreb countries has shown that other vitally important spheres, including universities, have been partly subsumed by the forces of this rent-seeking, impacting negatively on the direction of human effort, the economy and society at large (Djeflat 2009a).

7.4 Conclusion: STI as a New Prospect for the Arab Spring

The Arab Spring has undoubtedly created an irreversible psychological effect that has emboldened young people to take risks, show leadership and start ventures. The young know they can hold their destiny in their own hands. As a young

Tunisian poet, Aboul El Kacem Chabbi[19] wrote prophetically in the 1940s: “If the people one day decide to live [free], destiny will have to obey.” The same young people who took over the streets of the MENA region to fight for democracy have started realising that the lack of immediate and available economic prospects represents a void that must be filled. They have the unique opportunity to create a new generation of creativity and innovation, competing in the global ideas market.

There are now tremendous opportunities for these countries to grow disruptively (Christensen 2011) across the MENA region. Islamic finance, which applies different economic rules to businesses, has started in recent years to become known as a formidable growth factor, spurred by the repeated crises in the global financial system.

The new spirit of positivity ushered in by the wave of change in Arab societies has the potential to promote a new social culture that should help to improve awareness and commitment to the appreciation of knowledge development and use. Innovation can serve as a powerful tool in creating opportunities for growing numbers of young people, as well as in reducing unemployment, driving economic growth and promoting good governance (Nour 2011). The rise of a competitive and attractive science and research community is a necessity for motivating young promising scientists to grow in domestic institutions, and to attract leading scholars from abroad. Most importantly, a shift is required among students, teachers and parents to a mindset that embraces innovation and accepts failure as a stepping stone to success.

Progress is also needed in the enactment of the crucial reforms required for healthy institutions, spanning science, research, innovation and entrepreneurship. The reform of knowledge institutions for this purpose would entail a new and firm commitment to standardised international criteria of adequacy, equity and efficiency. New governments and the new governors of knowledge institutions need not cancel the promising initiatives that begun prior to the revolution in countries such as Egypt, Libya, Syria and Tunisia. But it is crucial that they substantiate their resolve to reform by implementing plans that consider lessons learnt from past experience, as well as from the experiences from other parts of the world, such as East Asia.

These matters are critical in a pending state. In Tunisia, for instance, new initiatives for enhancing the knowledge platform have been strikingly lacking since the old regime fell. The Tunisian government must acknowledge the importance of taking these issues into account. There is a distinct need for action to improve the few positive initiatives that have been taken and to commit to reform and further development. Without such action, there will be no driving force for increased productivity or an expanded economic base for better paid and more rewarding jobs. There will be an inevitable drag on job creation. Structural unemployment will continue to soar, including among the educated.

---

[19] Born in Tozeur in 1909, he died at the age of 25 in Tunis. He wrote an essay entitled “To the Tyrants of the World”, http://fr.wikipedia.org/wiki/Abou_el_Kacem_Chebbi.

One major policy option in view of current limitations in funding is to shift the allocation of resources so as to allow for redistribution away from the present focus on defence and security towards enhancing knowledge institutions and the creation and transfer of knowledge. Such a shift represents the single greatest opportunity in several countries, especially in Egypt, where the military not only retains a disproportionately large share of national income but also holds an iron grip on much of the civilian economy. Another policy option is to encourage private sector involvement in knowledge institutions, and to focus government spending on knowledge institutions that benefit young people and the poor by enhancing their capabilities, upgrading their skills and offering them more education on terms that can increase their entrepreneurship skills, innovative capacity and employability (Nour 2011).

Young Arab entrepreneurs seem less concerned about the immediate consequences of the political tsunami and far more about the long-term structures required for enabling the rise of high-growth start-ups and a sprawling enterprise sector in the Arab world. We should not forget that it is in governments' own interest to support this new wave of innovation. Promoting entrepreneurship and fostering entrepreneurial qualities is key to helping youth create viable jobs and self-employment opportunities. ICT and incubators for ICT enterprises have been known to provide entrepreneurs with the necessary guidance and skills to help nurture and drive the growth of their enterprises. Incubators for digital Arabic content, for example, have shown some promise in the past few years in terms of promoting entrepreneurial endeavours among Arab youth, as have innovation and entrepreneurship competitions. Bearing in mind the structural weaknesses of the industrial sector throughout the region, and the difficulty in building S&T capacity and learning, it is vitally important that new policies fostering product innovation, entrepreneurship and new enterprise are adapted to fuel economic expansion and job creation.

As this chapter has noted, a number of authorities across the region, spanning national governments as well as authorities at the regional level, have adopted aggressive approaches to ensure new spots for their nationals in the labour market. In Abu Dhabi, several state-linked bodies have purged expatriates to free up positions for Emiratis. Algeria has used oil revenues to make seed funds available to young entrepreneurs. Even Oman, which has a relatively small population of expatriate experts, has stepped up its Omanisation policy (nationalisation of the Omani workforce) and sought to replace many foreign experts with locals.

These are, at best, short-term solutions capable of calming some tensions and postponing outbursts of discontent over continued unemployment. The way these shifts are pursued, with immediate cancellation of contracts for often scarce and much-needed categories of skilled workers, is bound to make things worse in the medium to long term. Public and private organisations that have to shed workers with critical skills will become less productive. The private sector, which inevitably must renew itself and expand if employment is to improve, will suffer particularly badly and become less capable of hiring new workers, including locals.[20]

Finally, the promotion of a more favourable environment, institutions and facilities for supporting the creation and transfer of knowledge, would help encourage the return of Arab scholars, experts, professionals and highly skilled migrants able to augment knowledge and reduce the brain drain in Arab countries. An example is Egypt's recently launched Zewail City for Science and Technology. Following its breakdown in the Mubarak era, the project was revived in June 2011 after the revolution. The institution is named in honour of Dr. Ahmed Zewail, winner of the 1999 Nobel Prize in Chemistry (Mohamed Nour 2011), who conceived the project.

Open innovation is directly relevant to Egypt because of its potential benefits for multiple stakeholders. But the Egyptian government, which remains the prime actor in this field, should put other stakeholders at the centre of the scene and define its own success in the light of its ability to mobilise them and catalyse their success. Creativity and the nurture of innovation should start at home and in the classroom. School curricula should be reoriented away from rote memorisation toward problem-solving, exposure to the arts and the integration of ICT tools into classrooms (Mourtada 2010).

The challenge is to build on the ICT revolution and strengthen it by enhancing capacity to build social networks. Social media and technology penetration will lead to more democracy and social justice. "The more Blackberries in a country, the less the economic disparity. The more rural the telecentres, the less is political corruption" (Nour 2011).

Since the Arab uprisings, human rights activists worldwide have championed the power of technology, mainly the web and mobile phones, as tools for democracy and change (Anderson 2011). Demonstrations have also been seen in Spain, Greece and the United States, where the Occupy Wall Street movement shows that the US can also be source of inspiration and models to the rest of the world.

Persian Gulf countries have invested substantially in economic sectors and should now pay more attention to social issues, focusing more closely on policies directed towards youth. The Gulf States have been characterised by high levels of investment in economic, technical and financial assets without much focus on social structures that consider the human aspects of development (Deto 2009).

Decision-making, decentralisation and power sharing are still difficult to affect across the MENA region. The Arab Spring has handed countries in the region an opportunity to lay the foundation for economic growth based on the rule of law,

[20] A recent report by IMF/World Bank encouraged Oman to raise visa fees as a way of making it more expensive and difficult to hire or retain expatriates. Such policy advice is rooted in a common lack of understanding among some multilateral organisations of conditions on the ground.

innovation, equality, human rights and freedom—the ingredients necessary for private sector growth and job creation. The reforms required for this to happen are, however, slow in coming. Young people's need for employment is immediate.[21]

It is, therefore, important to seek the means and communication channels that can help speed reform. In this respect, the current crisis is a double-edged sword. The downturn across the MENA region, coupled with the acute debt crisis in Europe, demonstrates the vulnerability of the economy. Calls from young people for jobs and a say in their futures need to find new means for articulation and new outlets. Forums must be created that can help awaken and channel positive energies in a direction that awakens people to the opportunities that flow from investment in intangibles, the inspiration of STI and new cross-border linkages.

[21] The World Bank News and Broadcast, "World Bank Group Announces up to $6 Billion for Egypt and Tunisia" (May 24, 2011), cited in *Youth Population and Employment in the Middle East and North Africa: Opportunity or Challenge?* Farzaneh Roudi (22 July 2011), p. 6.

Chapter 8
Research, Innovation, Entrepreneurship and the Rentier Culture in the Arab Countries

Omar Bizri

8.1 Introduction

The Arab countries are now home to more than 355 million citizens, just over 5 % of the world's total population. While the average age varies from one country to another, collectively the Arabs constitute one of the world's most youthful populations. Under normal conditions, this would surely count as a blessing. However, for Arab governments with few or no social services, dysfunctional educational systems and inadequate innovation and entrepreneurial capabilities, their young populations are rapidly turning from an onerous burden into a grave menace.

Following independence from colonial rule towards the middle of the twentieth century, Arab states mostly directed their development efforts towards institution and infrastructure building. However, several decades have been lost to the Arab–Israeli conflict, particularly for countries in the immediate vicinity of Palestine. A series of coups in Arab states of the Levant and North Africa, during the 1950s and 1960s ushered in authoritarian regimes whose policies are often blamed for decline on a number of fronts, including education, innovation and entrepreneurship. The path for the GCC countries has been somewhat different. Nevertheless, persistent cultural and socioeconomic traditions, coupled with involvement in efforts to contain Soviet influence during the latter decades of the twentieth century, nourished extremist ideologies, significantly retarding development in education, innovation and entrepreneurship.

O. Bizri (✉)
Former Head of the ESCWA Unit on Science and Technology, International consultant (Lebanon), Beirut, Lebanon
e-mail: omarbizri@gmail.com

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_8,

Vicious cycles are well entrenched throughout the region, with innovative, entrepreneurial and job creation capabilities their principal victims. Popular upheaval in recent times in several Arab countries is but a manifestation of the impasse that many Arab governments have now reached on several fronts, allied to stunted educational, innovative and entrepreneurial capabilities.

This chapter will focus on critical challenges facing the Arab countries, with special emphasis on GCC countries, where several indicators point to less than adequate (and often dismal) performance over the past few decades in crucial fields including education, innovation and entrepreneurship. In particular, reference is made to challenges posed by a rentier culture that pervades many walks of life in the region. Compounded by persistent ethnic, religious and political conflict, this culture considerably undermines research, innovation and entrepreneurship capabilities. While some indications point to change on this as well other scores, there is growing awareness that management of the region's resources, above all its youth, is still below par. Nothing less than radical overhaul of governance procedures, institutional arrangements and infrastructures, and an emphasis on innovation and entrepreneurship, will turn the numerous challenges facing the region into opportunities and long lasting benefits.

8.2 Challenges Confronting the Arab Countries

Many of the challenges that now confront the Arab countries in general and the GCC countries in particular, whether socioeconomic or environmental, are shared with other developing and even some developed countries. However, nowhere are socioeconomic problems such as income inequality and unemployment, and environmental crises such as soil erosion, creeping desertification, water scarcity, more acute than they are in some of the Arab countries. Moreover, whereas developed countries and quite a few developing nations have built research capabilities and made strong progress in mastering technologies required to tackle such threats, the Arab countries are still largely bereft of such means.

The ability of the GCC countries to deal with many of the challenges that confront them today, whether socioeconomic or environmental, is due to their hydrocarbon wealth. However, most of today's challenges are expected to continue further into the future, outlasting hydrocarbon resources. Furthermore, it is likely that many such problems will not go away by simply throwing more cash at them. Indeed, as the following sections attempt to show, a rentier mentality engendered by the proliferation of external rent on the region's natural resources has taken such hold that it would take decades of hard work to reverse its negative impacts on all aspects of life and work, particularly with regard to research, innovation and entrepreneurship.

8.2.1 Arab Economies: Resources, Endowment and Predominant Development Models

The combined gross domestic product (GDP) of the Arab countries amounts to over US$2 trillion in current exchange rate terms.[1] This constitutes around 3.2 % of total global GDP,[2] placing the Arab group of countries among the world's ten largest economies. However, with a population amounting to around 12.3 % of the total for the Arab countries, the Gulf Cooperation Council's (GCC) countries command around 50 % of the Arab countries' total GDP.[3]

The resource-rich Arab countries possess nearly 640 billion barrels of proven crude oil reserves, or around 60 % of proven global reserves. With 31 %, or 265 billion barrels, Saudi Arabia has the lion's share. The same group of countries is also in possession of over 86 trillion standard cubic metres, or 45 %, of the world's proven natural gas reserves (World Economic Forum 2011b).

Considering such immense resources, the GCC economies' heavy dependence on oil and gas revenues comes as no surprise.[4] Thus, oil represents up to 90 % of export earnings and 85–90 % of government revenue in Saudi Arabia, for example (Economist Intelligence Unit 2008). Over the past few decades, several GCC countries' national development plans have stated their main goal as reduced reliance on the domestic natural resource base. However, progress in this direction has been very slow. Overdependence on migrant labour has also been a major concern for GCC governments. Several countries have enacted laws requiring government and private enterprises to increase the proportion of nationals among their staff. However, success seems to have eluded most GCC countries to date. Non-oil Arab economies, on the other hand, have not been able to create employment opportunities to match their (generally high) rates of population growth. In addition, defence expenditures have generally acted as a drain on resources in almost all Arab countries during the recent past, with prospects still looking grim for the immediate future.

---

[1] This figure is based on government or market exchange rates. On this basis the combined GDP of all the Arab countries amounts to US$2,007 billion, with the GCC countriesaccounting for around US$1081.9. The combined GDP based on purchasing power parity is much higher at around US$2,800 billion, according to most recent International Monetary Fund and World Bank data.

[2] GDP figures for the Arab countries, combined, make up a higher percentage, 3.8 % of total global GDP, computed in terms of purchasing power parity in US dollars.

[3] Three GCC countries—Qatar, the United Arab Emirates and Kuwait—are consistently classified among the world's high income nations, while the remaining three GCC states—Bahrain, Oman and Saudi Arabia —are classified as upper-middle-income countries.

[4] There is considerable variation among GCC countries with regard to their dependence on oil and gas resources. Thus, oil accounted for 41.3 % of Oman's nominal GDP in 2010. See the EIU Country Report, August 2011 (ISSN 1462-6667). In Bahrain by contrast, oil revenue was expected to account for 91 % of revenue in 2011–2012. See the EIU Country Report, July 2011 (ISSN 1473-8937).

8.2.2 The Rentier Model and its Consequences

In many ways, what was true in the 1970s and 1980s with regard to sources of power and determinants of economic activity in the Arab countries largely holds true today. Thus, to varying degrees, the GCC and other Arab countries remain firmly anchored to the rentier model in managing their affairs. Arab governments, typically run by individuals who gained power through coups d'état in various guises, or heads of families that assumed power at the inception of statehood, have for decades continued to extract rent from their countries' natural resources[5] and distribute proceeds in a manner ensuring their regimes' perpetuity.

Invoking the concept of rentier economies is not intended here for abstract or theoretical purposes. Nor is it meant to instigate value judgement. Rather, it is meant to provide bases for understanding the manner with which scientific, technological and entrepreneurial capacity might evolve in the shadow of the rentier model. Thus, while it is granted that there is no such thing as an entirely rentier economy and that all economies do include elements of rent of one form or another (Beblawi 1990), it must be acknowledged that economies which are largely dependent upon *external* rent will induce modes of socio-economic activity, in general, and scientific, technological and entrepreneurial activity in particular, differing, more or less sharply, from those prevalent in productive economies.

That the rent exacted by governments in a given country is largely external in origin should not be underestimated.[6] An economy in which rent is largely external would need to involve only a limited number of institutions and individuals in rent generation and collection, while the remaining institutions and individuals would assume functions related to rent distribution and consumption. Thus, optimal strategies for rentier economies would be expected to grant the highest order of priority to technologies and entrepreneurial activities directly related to rent generation and collection, for example oil and gas extraction and transportation in the case of the GCC countries. On the other hand, technologies and entrepreneurial activities dedicated to rent distribution and consumption, which may well include a range of production and service activities, would understandably receive much less attention.

A dominant rentier model raises concerns primarily on two scores. First, the limited durability of sources of rent, e.g. oil and gas resources in the case of the GCC countries, makes it reasonable to assume that most GCC economies, if

---

[5] Rent may also accrue to some states in the region on the basis of their strategic importance for international and regional powers. In such cases it would take the form of international aid and special trade concessions and privileges. International aid, however, is seldom of sufficient volume to give rise to a predominantly rentier economy. Nevertheless, when such aid provides substantial contributions to a country's economy and well-being, rentier practices would be expected to arise.

[6] The situation in these countries is contrasted with that arising in countries where internal rent predominates, automatically presupposing the existence of productive capacities elsewhere in the same economy.

deprived of alternative revenues, would simply go bankrupt. Second,[7] efforts to embrace alternative productive models are constantly hampered because the rentier mentality and culture tend to pervade all aspects of socio-economic activity.

Departures from the rentier model might be expected to arise in response to requirements posed by production and service sectors related to rent dissemination and consumption, especially if they make significant contributions to GDP.[8] It may be supposed that such production sectors could induce a "diluting effect" on rentier practices. However, the impact of production and service sectors along these lines is itself subdued, if not completely nullified, by the fact that operators in such sectors are often public sector entities and investors closely linked, one way or another, to rulers or ruling families—the backbone of the rentier model.

Rentier practices also impact trade and business practices, with nationals taking advantage of positions they have come to occupy, sometimes simply due to the fact they hold citizenship, to collect rent in their own right. Numerous examples exist where production and service activities are undertaken by expatriate individuals and expatriate-run firms paying rent to nationals for using their names as partners or guarantors. Even larger international corporations are not immune to rentier practices, since they also need to operate through local partners who may be adept at navigating hierarchies and bureaucratic hurdles, some of which are put in place solely to preserve the rentier advantage.

It would also appear that rent on natural resources gives rise to second-order rent that pervades many aspects of socio-economic activity, including a wide range of productive and services activities. The impact of the rentier mentality appears to extend, to varying degrees, over many aspects of socioeconomic activity. The work ethic suffers particularly; capacity building in the technological, innovative and entrepreneurial spheres also endures negative consequences.

Non-oil Arab countries may also be said to have embraced versions of the rentier model, albeit to a variable extent. The scale of external rent that some of these countries are able to extract on the basis of regional and international strategic considerations is certainly much less than that generated through oil and gas resources. All the same, internal rent extracted by rulers and their retinues seems to play an important role in shaping entrepreneurial and innovation activities.

Moves away from a rentier mentality and work ethic are slowly taking place in many countries in the region, including the GCC states. At least some of the changes seen must be credited to expatriate businesses eager to maintain advantageous positions in the face of ever stiffening competition. At any rate, cases in

[7] Threats posed by a rentier culture may be considered the more serious since replacing this culture and instituting work ethics attuned to productive models would require years, if not decades or even generations.

[8] Examples of such activities include emerging industries in petrochemicals or pharmaceuticals in Saudi Arabia and other GCC countries.

which national business enterprises, and even government departments, seem to have discarded the rentier mentality and work ethic are often exceptions confirming the rule.

What is of concern to this chapter is the manner in which rentier economies mould demand for scientific, technological and innovative inputs and how national science, technology and innovation (STI) systems might respond through national policies and strategies. Clearly, rentier economies do not make the same demands on national STI systems and entrepreneurship that productive economies do. And while oil and gas revenues give rise to production and services activities associated with rent collection, the demands posed by such activities on national STI systems and entrepreneurial activities may be quite limited and are invariably satisfied by access to external sources of technology, bypassing national STI systems altogether. Arguments in favour of such approaches are all too familiar. Endogenous STI capabilities are judged underdeveloped, inadequate or untrustworthy, while running profitable businesses requires reliable technologies that are in any case readily available on the international market. A vicious cycle sets in as a result, with endogenous capabilities suffering further marginalisation and subsequent underdevelopment.

There is no doubt that, in order to ensure optimal operation, rentier economies do require a host of core and subsidiary technologies as well as innovative and entrepreneurial capacity. However, the widespread rentier mentality sees to it that such technologies are also accessed on the international market through modalities inherent to the rentier model. Thus, in oil-based economies, a well known set of technologies is required to discover new oil reserves and to evaluate their potential, extract and transport their yield through pipelines, or load them into oil tankers. Most of the technologies involved in such processes are mature and proven as well as reliably accessible on the global market. Hence, they are subcontracted and entrusted to partnerships involving overseas operators with little if any involvement by endogenous STI personnel and institutions or endogenous entrepreneurship.

As a result of the prevailing rentier mentality, technologies required for the distribution and utilisation of external rent are also accessed externally, albeit with a somewhat larger share for endogenous enterprises, which are often manned by expatriate labour at almost all levels, with commensurate rent collection for the benefit of dominant local actors. The implications of the rentier model often go beyond outsourcing or subcontracting specific technology-intensive operations, while bypassing endogenous STI institutions. In cultural terms, the rentier model poses insidious threats to governance and acts as an antithesis to dynamic, innovative and risk-taking entrepreneurial activity characterising knowledge economies that governments throughout the region claim as their goals (Beblawi 1990).

The question may be posed as to whether it is possible for continued expansion of production and service sectors, with an enhanced influx of requisite core and subsidiary technologies and support systems, to precipitate radical departure from the predominant rentier model. Based on available information, it seems that only sporadic moves away from this model might materialise in the short- and medium-term. But radical departure from the rentier model would require fundamental transformations in governance systems, as well as an overhaul of entrenched webs of social and economic linkages, neither of which are likely to take place in the foreseeable future. Special initiatives and efforts are needed, with emphasis on local community development, promotion of small- and medium-sized enterprises and featuring contributions by non-governmental organisations, if the region is to change course in this respect.

8.2.2.1 Competitiveness of Arab Economies

The overall competitiveness of Arab economies is captured by the World Economic Forum's (WEF) global competitiveness index (GCI), which is computed on the basis of indicators grouped into 12 categories pertaining to: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labour market efficiency, financial market development, technological readiness, market size, business sophistication and innovation (World Economic Forum 2011b). Table (A.1) in Appendix I presents GCI scores as well as world rankings achieved by 13 Arab countries for which data is available. GCC countries can boast top world rankings in terms of competitiveness, with positions ranging from 14 for Qatar and 37 for Bahrain, among the group of 142 nations for which data is presented in the 2011–2010 WEF report. Tunisia, with a global rank of 40, is just behind the GCC countries. Other Arab countries are ranked at or below the midpoint, with Jordan ranked 71 and Yemen close to the lowest rank at 138.

Figure 8.1 shows the wide variation in GCI performance among these countries. Arab countries achieve maximum values in parameters such as infrastructure, macroeconomic environment, health and primary education and minimal values in higher education and training and financial market development and innovation. There is wide variation in performance on innovation under the GCI categories, reflecting past failures in regional integration and technical cooperation.

8.2.2.2 Private Enterprise in the Arab Countries

The Arab region's strategic position at the crossroad between major land masses and overlooking crucial sea routes has played an important role in shaping its renowned entrepreneurial heritage.

Despite numerous setbacks suffered by Middle Eastern countries over the past centuries as new trading nations invaded the globe, and the non-conduciveness to entrepreneurship of more recent rules and regulations imposed by government, the populace has an unmistakeable flair for free enterprise.

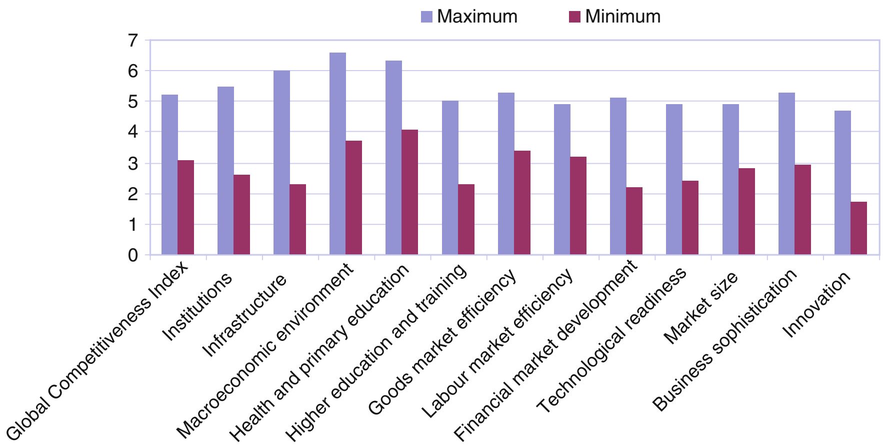


Fig. 8.1 Performance of Arab countries in the global competitiveness index. *Source* World Economic Forum (2010)

At present, the public sector is dominant in almost all Arab countries, though some states are making attempts to promote private enterprise, often with a good deal of apparent energy and media attention. Several countries run programmes in support of small and medium-sized enterprises. Egypt, Jordan and Syria are notable for having created enterprise incubation schemes, some focused on novel technologies including software development. Despite isolated successes, however, the fact that the overall business climate remains less than conducive continues to hamper progress.

Table (A.2) in Appendix I shows a league table of selected Arab countries, with Turkey and Iran included for comparison, based on a set of ten indicators directly related to doing business (see Box 8.1). Arab countries collectively rank lowest in relation to getting credit with view to starting a business. Enforcing contracts comes next, in terms of hindrances posed to business creation, followed by procedures required for starting a business. On the other hand, the Arab countries for which data are presented in the table rank higher in relation to paying taxes. This is probably due to the fact that many GCC countries levy minimal taxes and even exempt a variety of enterprise operations from taxes altogether.

Saudi Arabia stands out among the Arab countries in terms of its world ranking on all indicators, with the remaining GCC members a considerable distance behind. Indeed, Saudi Arabia is ranked ahead of several developed countries on a variety of indicators including property registration, which goes to explain its high ranking as 11th worldwide for ease of doing business.

Box 8.1: Ease of Doing Business Indicators

Ease of Doing Business Indicators Used in Ranking Countries

In order to rank countries around the world in terms of ease of doing business, the International Financial Corporation (IFC) and the World Bank (WB) developed the following indicators:

- Starting a business
- Dealing with construction permit
- Registering property
- Getting credit
- Protecting investors
- Paying taxes
- Trading across borders
- Enforcing contracts
- Closing a business

While data are not available for quite a few countries around the world, 17 Arab countries are listed by these two institutions. See Table (A.2) in Annex I.

In terms of ease of doing business, it is possible to classify the Arab countries into three categories. The first includes all GCC countries, together with Tunisia. Here, the global rankings range between 11 for Saudi Arabia and 74 for Kuwait (Tunisia in 55th place is higher ranked than Kuwait). Next come Egypt, Yemen, Jordan, Lebanon and Morocco, with rankings ranging from 94 for Egypt and 114 for Morocco. At the bottom of the list come Palestine, Algeria, Syria and Iraq, with rankings ranging from 135 for Palestine and 166 for Iraq. There is clearly a good deal to be done in terms of improved legislation and regulatory arrangements in all of the Arab countries, with the need for improvement greatest in non-GCC Arab countries if we take the rankings at face value.

8.2.3 Poverty and Unemployment in the Arab Countries

For a variety of reasons, including lack of transparency, deeply rooted aversion to research in the social sciences and inadequate arrangements for the collection, compilation and analysis of statistical data, information on poverty, unemployment and income inequality is extremely hard to come by in most Arab countries and, when available, tends to be unreliable, outdated or both.[9] Figures quoted by many

[9] Reports by international organisations consistently lack up-to-date figures on all three parameters in most Arab countries. Most recent data included on poverty and unemployment in the database established by the World Bank's Knowledge Assessment Methodology date back to

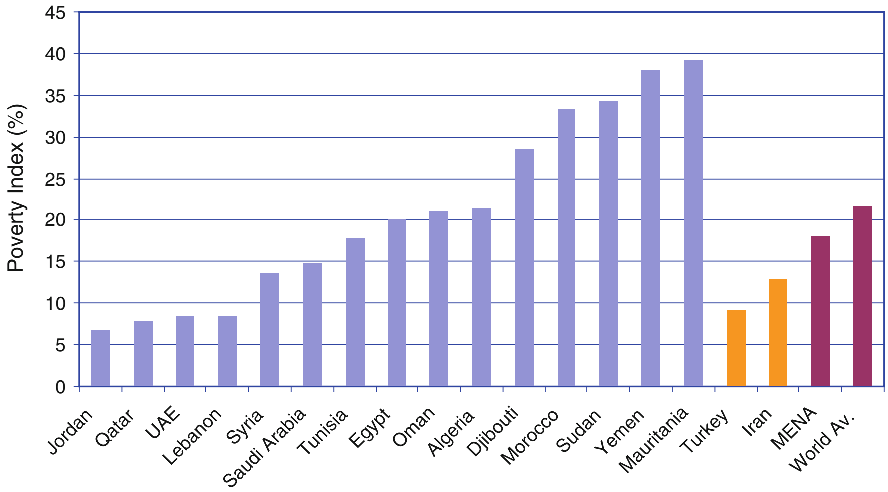


Fig. 8.2 Poverty index values—selected countries. *Source* World bank, KAM database (August 2011)

international reports on the Arab region routinely rely on official sources, which invariably paint a far rosier picture of much sadder realities.

8.2.3.1 Poverty

Insofar as poverty is concerned, the Arab countries are a highly heterogeneous group. Recent figures on the incidence of multidimensional poverty indicate that, while falling below 7 % in the United Arab Emirates and Tunisia, for example, the rate rises to more than 14 % in Iraq, 28 % in Morocco, 29 % in Djibouti, 52 % in Yemen and 81 % in Somalia (UNDP 2010). Figure 8.2 indicates that in at least eight Arab countries, the poverty index fell below the world's average, according to latest available figures, in 2005. It may well be argued that more recent figures would paint a darker picture, particularly with regard to the situation in countries such as the Sudan, Egypt, Somalia and Syria.

In addition, the fact that a considerable number of Arab countries show relatively high figures in the multidimensional poverty index is cause for particular concern. Considerable segments of the population in Morocco, Mauritania, the Comoros, Djibouti, Iraq, Palestine and Yemen are at risk of multidimensional poverty.

(Footnote 9 continued)
the year 2007. Though the database includes data on nearly 140 countries figures, only 13 of the 22 Arab countries are included. The Human Development Report, published annually by the United Nations Development Programme (UNDP), routinely addresses a poverty, unemployment and inequality but invariably lacks figures on poverty or income inequality in a large proportion of Arab, and particularly GCC, countries.

According to the multidimensional poverty approach,[10] a considerable proportion of these countries' populations are also at risk of at least one severe deprivation relating to one of three principal dimensions: education, health and living standards. The list of countries with considerable populations in that situation includes the more populous Arab countries: Egypt, Yemen, Morocco and Syria. At least two of these countries, namely Syria and Iraq, were considered as having made significant strides towards self-sufficiency in agricultural production, as having implemented widespread industrialisation programmes and having enacted a series of educational reforms bringing education to the masses in both urban and rural areas.

While information on poverty in the GCC countries is lacking, it may be assumed that the populations of GCC states are least affected, compared to other Arab countries. This is not to say, however, that poverty is totally absent in the GCC countries. As a rule, statistical data released by government authorities tend to depict a conservative, even ambiguous, picture of national poverty. In Saudi Arabia, for instance, the government estimates that around 1.6 % of the total Saudi population lives in extreme poverty.[11] Unofficial figures, on the other hand, vary considerably. On the conservative side, the percentage of impoverished Saudis is put at around 10 % of the country's native population, while less conservative estimates suggest the proportion of impoverished Saudis is much higher at around 20 %. Based on the more conservative estimate, approximately 100,000 families have to subsist on less than US$10 per day and cannot rent even the most modest accommodation.[12]

Across the world, poverty is rightly associated with a host of social ills. However, in the Arab countries, the dangers of poverty are further compounded by ethnic, sectarian and political differences. While some of these dangers might be alleviated in the short term, through charitable interventions by private as well as government institutions, long-term action based on employment creation would certainly be far more beneficial. Box 8.2 provides further information on measures undertaken to combat poverty in Saudi Arabia.

---

[10] The United Nations Development Programme's Human Development Report for the year 2010 introduced the Multidimensional Poverty Index (MPI), acknowledging the multifaceted nature of poverty, which extends beyond inadequate income to include poor health and nutrition, low levels of education and skills, inadequate living standards, bad housing conditions, social exclusion and lack of participation. The MPI identifies deprivations across the same three dimensions as the Human Development Index (HDI), namely health, education and living standards, as reflected in ten indicators, each with equal weight within its dimension. The ten indicators taken up in computing the MPI relate to: nutrition, child mortality, years of schooling and children enrolled, as well as standard-of-living indicators measuring lack of electricity, clean drinking water, adequate sanitation, use of "dirty" cooking fuels (such as dung, wood or charcoal) and having a home with a dirt floor, and lack of ownership of a car, truck or similar motorised vehicle and ownership of at most one of the following assets: bicycle, motorcycle, radio, refrigerator, telephone or television.

[11] This may be contrasted with official statements indicating that government is committed to a plan cutting Saudi Arabia's poverty rate to 2.2 % by 2020.

[12] Rent even in the most modest locations averages around $4,200 per year. This clearly puts housing beyond the means of impoverished and low-paid Saudis.

Box 8.2: Poverty in Saudi Arabia

Poverty in Saudi Arabia

Poverty is now recognised as a national issue and standing problem in Saudi Arabia. Urban quarters and townships in the country's northern and southern regions are reported to suffer from limited access to basic services, including schooling and healthcare.[13]

Work on a "National Strategy for Combating Poverty" is reported as having started, but the steps hitherto implemented by the government may be described as broadly palliative. Thus, government provides around 1.5 million Saudis, particularly unemployed single or divorced women and the sick and elderly, with a monthly allowance amounting to around US$200. Free housing was made available to families of low means in the district visited by the king in 2002. In addition, a team of specialists was assembled to undertake research on poverty throughout Saudi Arabia, identifying causes and proposing measures.

During the latter half of the past decade a national charity was established, to which the government has donated the equivalent of around US$80 million annually. This fund is designed to support needy populations, providing job training and small interest-free business loans. However, there have been warnings that practices adopted by the fund might deepen an ingrained culture of charitable donations while doing little to empower the poor and reduce their dependence on handouts.

With a view to alleviating this problem, a "General Authority for Housing" with a budget of around US$2.7 billion was established in 2007. Furthermore, Saudi Arabia's current 5-year plan, covering the years 2010–2014, envisages the construction of 1 million housing units to meet a large portion of the demand for homes throughout the country.

8.2.3.2 Unemployment

Figure 8.3 presents a view of unemployment in several Arab countries with corresponding data for Turkey and Iran, as well as average values for countries in the Middle East and North Africa (MENA) and for all the world's countries, included for comparison. The data clearly indicate a grave situation for Arab countries such as Mauritania, Tunisia, Algeria and Jordan, which appear to have unemployment higher than the MENA and world averages.

---

[13] The last official census in Saudi Arabia was conducted in 2004 and put the national Saudi population at 16.5 million. See: http://www.saudigazette.com.sa/index.cfm?method=home.regcon&contentID=2010042069914.

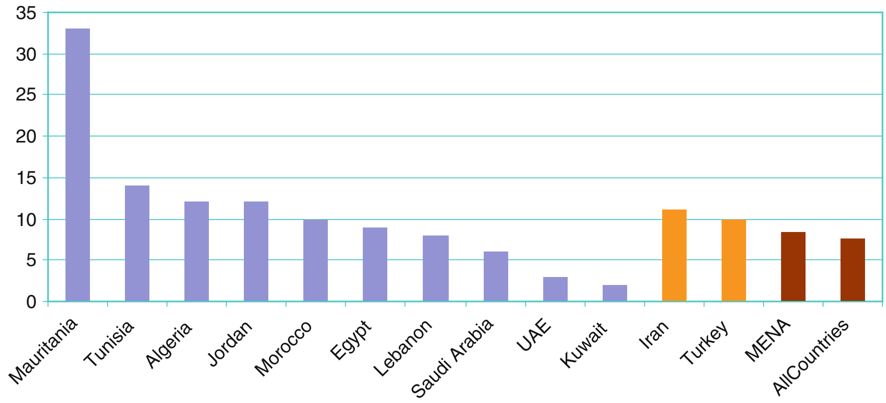


Fig. 8.3 Unemployment rates in percent of total labour force. *Source* World bank, KAM database (August 2011)

Fig. 8.4 Unemployment in Egypt 2000–2008. *Source* ILO unemployment database (accessed August 2011)

Figure 8.4 provides a snapshot of unemployment in Egypt, the Arab world's most populous country, indicating that unemployment rose by more than 44 % in 2000–2005 and decreased between 2005 and 2008. It is also noteworthy that unemployment figures for Egypt indicate that the vast majority of the unemployed, among both men and women, are first-time job seekers.

Press reports indicate that backward migration from the GCC countries, precipitated by the financial crisis in 2008, has impacted professionals and other classes of workers from Egypt as well as several other Arab countries, such as Syria, Lebanon, Iraq, Sudan and Yemen. It is also quite likely that unemployment could only have increased in the aftermath popular revolts in the region.

8.3 Education in the Arab Countries: Achievements and Persistent Challenges

As indicated in the introduction to this chapter, Arabs are one of the world's most youthful peoples. Average age is lowest, around 18 years, in Yemen, Somalia, Mauritania and the Gaza Strip, and highest, in the early 1930s, in countries such as the United Arab Emirates, Bahrain and Qatar.[14]

Another indicator of youthfulness is the proportion of people younger than 14 in Arab countries. More than 112 million of Arab citizens are below the age of 14. The richer GCC countries account for 10.5 % of this total. Much higher proportions of this age group are found in countries like Somalia (44.7 %), the Gaza Strip (43.9 %) and Yemen (43 %).

Positive developments in education and vocational training have in fact taken place in a number of Arab countries. Examples include the overhaul of Jordan's education system and the creation of campuses of renowned world-class universities in some GCC countries. However, such progress appear to have been confined to countries with smaller populations. In addition, the persistence of outdated curricula and teaching methods in the majority of countries with large youth populations does not augur well for the future.

The fact that some Arab countries have declared themselves in favour of establishing knowledge economies and information societies presents their educational systems with even more onerous challenges, including utilising modern media, establishing quality standards, implementing long-distance learning and lifelong educational and training programmes. Thus, while many of the challenges facing Arab educational systems are often portrayed as due to a dearth of new technology inputs such as computers and networking systems, other deeper-rooted problems (including poor infrastructures, mediocre management and educational content lacking relevance to national socio-economic development and market needs) deserve far greater attention.

None of the above should be taken as negating or belittling the achievements for which Arab educational systems can indeed draw credit for in the last few decades. Collective adult literacy rates for males and females in Arab countries increased from around 55 and 25 %, respectively in 1980–1982 and 62 %, respectively in 2005. Progress has also been made in primary level enrolment rates, see Box 8.3.

[14] Available population statistics for the GCC countries do not differentiate nationals from expatriates. Hence, the above figures may be biased towards higher age groups, with the average age of GCC populations actually being lower, and the proportion of the population younger than 14 higher, than actually reported.

Box 8.3: Primary School Enrolment

Net Primary School Enrolment Rates

Enhancing enrolment in basic education[15] is a first step that a country should take towards creating its knowledge capital. A principal goal of basic education is to impart a range of intellectual skills and inculcate a set of social values and attitudes, leading to eventual knowledge capital formation. With the aim of examining quantitative as well as qualitative aspects related to this process, a relatively recent report (Salama 2009) attempted a survey of various types of knowledge offered to children during their basic education. On the quantitative side, statistics on net primary school enrolment rates show that only four Arab countries approach the saturation point, estimated at 95 % and above. Eight more countries had enrolment rates of between 80 % and 94 %, while six others (Djibouti, Mauritania, Oman, Palestine, Yemen and Saudi Arabia) fell below this range, with the first showing an enrolment rate in basic education of <40 %. Notably, only two countries, Bahrain and Tunisia, appear to have attained the saturation point for female enrolment.

Gross male and female enrolment ratios in all levels and types of secondary schooling increased from an average of about 57 % and 38 % in 1980 to 70 % and 65 %, respectively by 2006. Similar rises were also seen in tertiary enrolment. While overall enrolment in tertiary education was <5 % in 1980, the average for the Arab countries had risen to 18 % for males and 29 % for females by 2005. Nevertheless, more than 60 million of Arab populations, two-thirds of them women, remain illiterate and some 9 million school-age children are out of school, mostly in countries that have failed to tackle the literacy challenge. In addition, most Arab educational systems continue to exhibit limited openness to novel advances in various fields of knowledge. This may often be truer of public, rather than private educational institutions, but it may be noted that educating the great majority of Arab children and youth is essentially a task for the former, i.e. government-run and supported institutions.

It is also difficult to see how some of the larger Arab countries planning to build knowledge economies and information societies could succeed in their quests while the rate of upper secondary school enrolment is <55 %.[16]

Other disparities in efforts to build human capital may be due to basic educational content and time allocated to various subjects. It appears that basic education in most Arab countries allocates less time than the global average to

[15] A period of at least 9 years, generally designed for children aged between 6 and 15, is commonly referred to as "basic education".

[16] The corresponding percentage exceeds 80 % in industrialised developed nations and the countries of Central Asia.

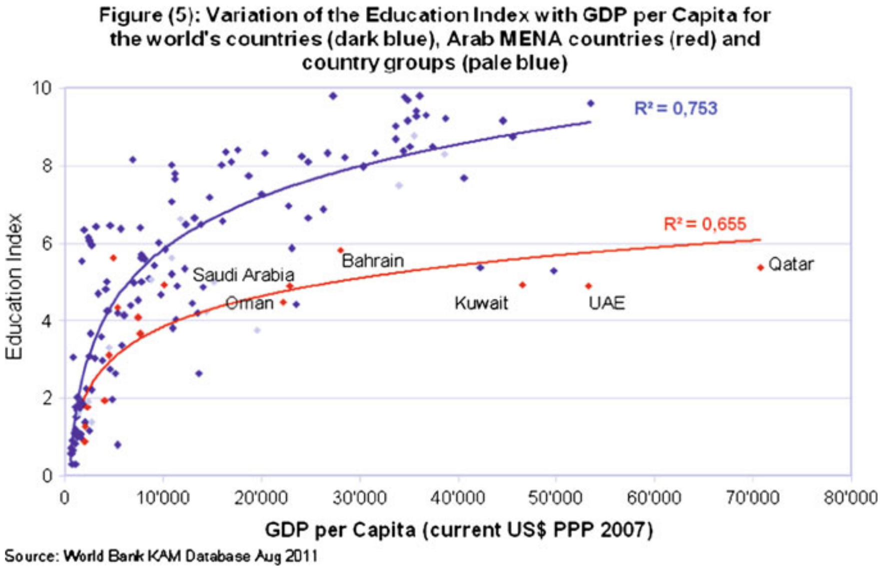


Fig. 8.5 Variation of the education Index with GDP per Capita. *Source* World Bank, KAM database (August 2011)

teaching pupils their mother tongue (26 % of total time allocated to all instruction, as opposed to 30 % globally). In addition, a much higher proportion of time than the global average (around 5 %) is assigned to religious studies. The average proportion of time allocated to these studies in the Arab countries is around 12 %. However, several countries by far exceed this average figure, with the quota for religious instruction reaching 28 % in Saudi Arabia, 20 % in Yemen, 18 % in Sudan and 17 % in Oman.

The trend line, in dark blue, depicts EI variation against with GDP per capita, while the second, in red, illustrates the same trend for the Arab countries.[17] The fact that the trend line for the Arab countries is below the rest of the world clearly indicates that Arab states are expected to perform at considerably higher levels on the basis of the resources they have at their command. In addition, it is also apparent that while the EI values for some of the less prosperous Arab countries (indicated by red diamonds in this figure) aggregate closer to the trend line for countries around the world, those for all GCC countries fall significantly lower than the same trend line. In other words, the higher GDP per capita figures for the

[17] Confidence in trend lines such as those presented in Fig. 8.5 is generally expressed by the value of a variable (R^2), which may be computed on the basis of standard statistical methods. R^2 values corresponding to trend lines are embedded within the figure. The value of R^2 for the trend line describing variation of the Education with GDP per capita for the world's countries is close to 0.75, reflecting a high degree of confidence in the correlation. At 0.66, the R^2 value for the trend lines describing the corresponding relationship for the Arab countriessignifies reasonable confidence.

GCC countries do not seem to have reflected positively on the performance of their educational systems.

Detailed consideration of the quality of education in the Arab countries, delivery methods and performance assessment modalities is beyond the scope of this chapter. However, a review of the available literature provides little solace. Arab countries for which data is available seemingly lag behind most other countries on the basis of international initiatives aimed at comparative assessment of national achievements in education. Notable among such initiatives is the Programme for International student Assessment (PISA), launched by the Organisation for Economic Cooperation and Development (OECD).[18] The PISA programme is designed to monitor fourth and eighth grade students' achievements in reading, mathematics and science. The results of the latest exercise, conducted in 2009, are presented in Figure 8.6.

These results include scores for the four Arab countries taking part—Dubai, (UAE), Jordan, Qatar and Tunisia—as well as average OECD country scores. The figures clearly show that, with the possible exception of Dubai, the scores attained by students from these Arab countries in the 2009 assessment cycle are below the OECD average.[19]

Figure 8.7 summarises information from a programme run by the National Centre for Educational Statistics to evaluate "Trends in International Mathematics and Science Study (TIMSS)".[20] Figure 8.7 presents the results of an evaluation of mathematical and scientific abilities attained by eighth grade students in schools from several Arab, including five GCC countries.

The results show that:

- most of the Arab countries reviewed underperform the average for all participating countries[21];
- students in the GCC countries underachieve academically compared to their peers in other Arab countries.

[18] "Programme for International Student Assessment (PISA) 2009 Results: What Students Know and Can Do. Student Performance in Reading, Mathematics and Science , Vol. I", ISBN: 978-92-64-09145-0, downloaded from http://browse.oecdbookshop.org/oecd/pdfs/free/9810071e.pdf. August 2011.

[19] It may be noted here that although the OECD comprises some of the world's richer countries it also includes quite a few other countries in which per capita incomes are on a par with some Arab countries.

[20] "Trends in International Mathematics and Science Study (TIMSS)"; The National Centre for Education Statistics. See Highlights from 2007 TIMSS, downloaded from: http://nces.ed.gov/pubs2009/2009001.pdf. August 2011.

[21] Arab countriesunderperform the average scores for all countries taking part in the assessment cycles reported by Figs. 8.6 and 8.7. They heavily underperform top scorers, such as South Korea, Finland and Shanghai (China), in PISA tests. Pupils participating from schools in these locations scored 536, 539 and 556, respectively with regard to overall reading skills, 541, 546 and 600, respectively in mathematics, and 554, 538 and 575 in science.

In short, while notable in some respects, achievements attained over the past few decades by educational systems in most of the Arab countries were inadequate for meeting past challenges. Should things continue along similar paths, they will be even less capable of handling the challenges of the future. Piecemeal reforms are likely to be of little value when what is really needed is a radical overhaul of educational and vocational training systems, promotion of life-long learning, through programmes for continuous learning as well as through tackling cultural practices that marginalise reading as a means of self-edification.

8.4 Research and Innovation in the Arab Countries

Science and research in the Arab countries of the Middle East and North Africa has long lagged behind that undertaken in developed and even many developing countries around the world.[22] While individual scientists from the region have made significant contributions to human knowledge through research undertaken in the developed countries of the West, the region's publication and citation indicators describe a situation that is far less than satisfactory. It would certainly be oversimplifying things to assume that the backwardness of scientific research in the region is due to a single cause, or indeed a limited number of causes, but a good deal of the blame must be borne by development models adopted by the Arab countries. In all these countries, almost total reliance upon imported technologies, with minimal intervention by national cadres, is the rule rather than the exception.

8.4.1 Arab Science, Technology and Innovation Policies

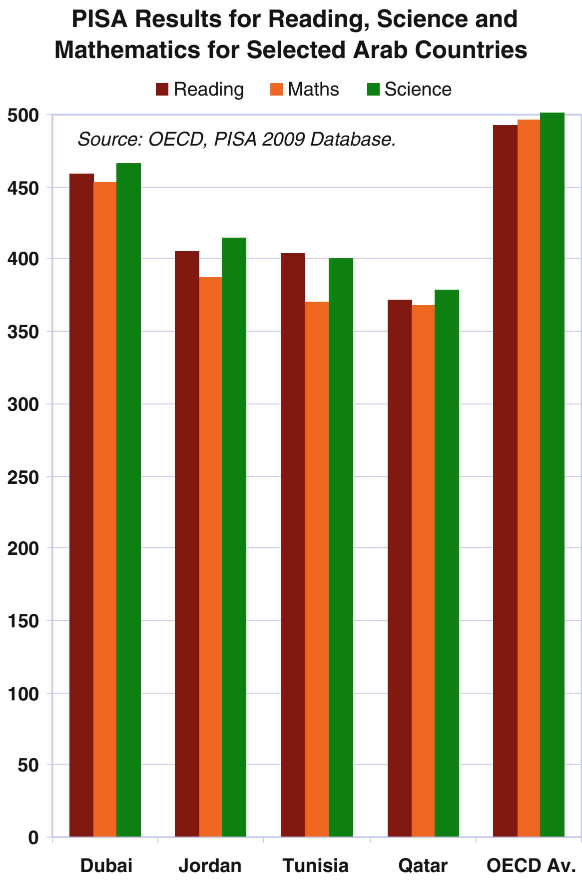
National development policies formulated by most Arab countries during the latter part of the last century dedicated much greater attention to socio-economic development and national institution building in education and research. More recently, several Arab governments[23] formulated science, technology and innovation (STI) strategies, emphasising issues such as national security, competitiveness and optimal utilisation of natural resources, as well as capacity building in

---

[22] As recently indicated, for example, by the Nobel Laureate A. Zewail in the "Global Research Report, Exploring the Changing Landscape of Arabian, Persian and Turkish Research", J. Adams et al., February 2011. Thomson Reuters Science. ISBN: 1–904431–27–5.

[23] Few Arab countries, notably Lebanon and Saudi Arabia, have formulated comprehensive STI strategies, mostly during the first few years of the twenty-first century. Others have simply carried over traditional science and technology strategies drawn up during the 1970s and 1980s. On the other hand, all Arab countries formulated information and communications technology strategies in 2003–2005.

Fig. 8.6 PISA academic results



information and communications technologies.[24] The exploration of possibilities made available by promising discoveries in fields such as new materials, particularly nanotechnology, is also highlighted in several Arab STI strategy documents. Similar attention is accorded to biotechnology and genetic engineering, underscoring applications in agriculture and medicine. New and renewable sources of energy, along with water resources, have also received a good deal of attention. Here, the focus has been on solar energy use in desalination, particularly in the GCC countries. The development of more effective desalination technology has been a common priority for the region for many years, and a regional research facility was set up in Oman in 1996. However, progress apparently remains below potential, leading to repeated calls for new and more innovative initiatives in several GCC countries.

[24] For the most part, information and communications technology strategies formulated by some Arab countries are essentially carbon copies of policy handouts by international organisations, with limited attention to national and local particularities.

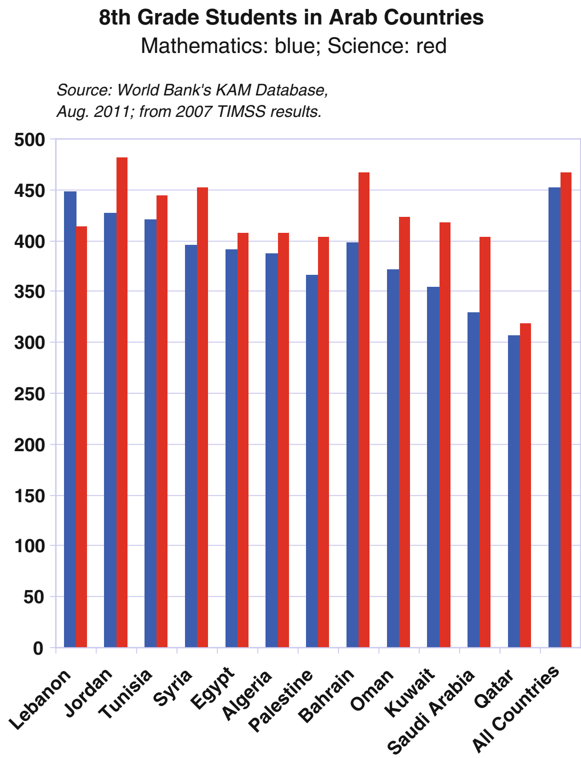


Fig. 8.7 Results in mathematics and science

Countries including Algeria, Egypt, Sudan, Morocco and Yemen have underlined agriculture and animal husbandry as priority areas for the application of science, technology and innovation inputs. Related issues of common concern include agricultural production combating desertification, water pollution and, in countries with coastal regions, protection of the marine environment. The Marine Biotechnology Research and Business Park Oman was recently established with support from UNESCO and European venture capital associations. A separate Animal and Plant Genetic Research Centre is also under way in Oman, with the aim of building research capacity while engaging stakeholders in reviewing resources and usage opportunities.

Several Arab countries, including Egypt, Lebanon and Tunisia, are focusing special attention on medical and pharmaceutical research.

Strategies formulated by Egypt, as well as a few other Arab countries, address the importance of space technologies, highlighting applications such as remote sensing in monitoring environmental pollution, desertification and agricultural production. Several strategy documents underline inter-institutional and international cooperation. In the case of countries with significant numbers of scientists and technologists working abroad, such as Egypt, Lebanon, Jordan, Syria and Iraq, networking with migrant S&T communities also receives special emphasis.

While the Arab countries generally appear comprehensive in their treatment of desired outcomes, limited attempts are made with regard to the adoption of novel modalities, including new institutional entities such as technology and innovation parks, regulatory arrangements and schemes for seed and venture capital funding to support new knowledge-based enterprises and enable effective links between scientific and technological capacity building, innovation and entrepreneurship. Saudi Arabia's strategy stands out by calling for the establishment of institutional entities specialising in S&T forecasting and policy formulation.

Oman has introduced two categories of research grants. While the first targets building research capacity to address road transport safety issues, reflecting concern over the high rate of road casualties in the country, the second is aimed at combating the Dubas Bug, which is a hard-to-combat insect that plagues palm trees and does much damage to the agricultural sector, is another example. These efforts are also noteworthy in that they aim to build research capacity to help broaden perspectives and induce industry to think beyond traditional means. Grants within the first category emphasise better understanding of socio-cultural factors that lead to unsafe traffic behaviour, rather than merely addressing technical aspects such as the construction of roads or vehicle equipment. Grants within the second category address biological control in agricultural production and encourage environmentally sustainable solutions for pest control as opposed to chemicals and pesticides.

Some areas of universal importance are only weakly present, if at all, in the current research plans of several Arab countries. Research in the humanities and social sciences is, for instance, under-represented compared to the rest of the world. Despite the region's rich ethnic diversity, this deficit includes anthropology and sociology. Technical research relevant to engineering and manufacturing is also underdeveloped. Nevertheless, efforts are being made to remedy the situation in countries such as Saudi Arabia. International and some regional oil companies are pursuing active research programmes in support of oil and gas exploration, though on a very limited scale relative to the value of their production. Equally limited are efforts directed at laying down bases for cross-sectoral linkages and synergies in support of entrepreneurial spin-offs. Moreover, little effort is made to address sustainability, while efforts by Oman and the UAE to broaden research efforts around enhanced oil recovery, rendering extraction activities more effective and also more environmentally friendly, have progressed slowly thus far.

Even when S&T strategies appear to be well designed and conceived, with a sharp focus on national needs and priorities, obstacles invariably arise on implementation, resulting in frequent failures to meet projected goals. Some such failures may well be explained by overoptimistic goals and unrealistic expectations, as well as by international factors beyond the control of national governments. For the most part, however, they are due to inadequacies inherent in established systems of governance permeating national S&T institutions.

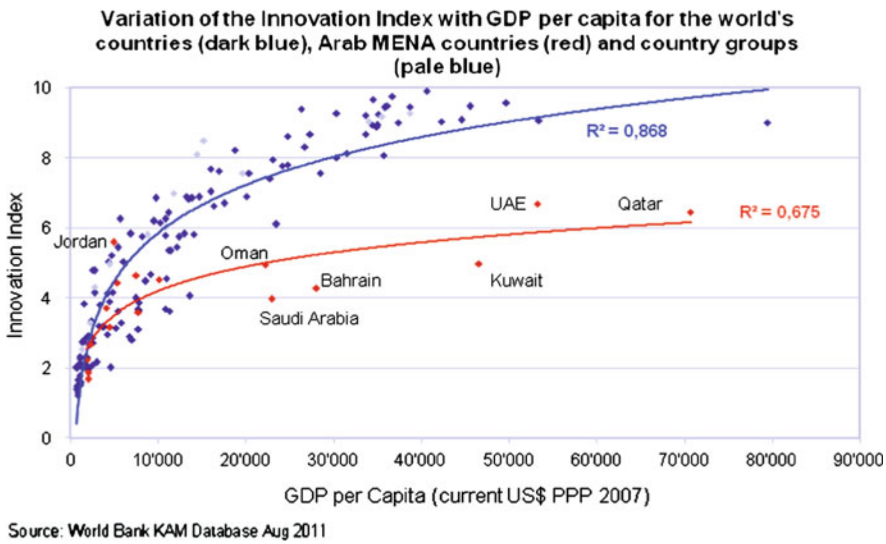


Fig. 8.8 International innovation indices in comparison

8.4.2 Research Spending and Innovative Output

Available statistics indicate that Arab countries consistently allocate meagre resources to R&D activity, lagging behind both in terms of manpower and in expenditure as a percentage of GDP. Table (A.3) in Appendix I indicates that with the exception of Tunisia and Morocco (reported as spending 1 % and 0.66 % respectively of their GDP on R&D), expenditure in other countries is far below par, falling as low as 0.07 % in Algeria, for example, while the world average stands at around 0.9 %.[25] Available statistics on researcher numbers in the Arab countries, dating back to 2006, are cause for further concern when compared to neighbouring countries such as Turkey and Iran, which have roughly 43,000 and 88,000 researchers respectively. The picture may have changed in selected countries during the past few years, however. Saudi Arabia has launched a relatively ambitious initiative involving expenditure of around US$2.1 billion on R&D in the next few years; it is also building a number of research centres. Collectively, though, the Arab countries allocate insufficient resources to research.

Low resource allocation to R&D activity, unimpressive research output in terms of patents and papers published in technical and scientific journals, and poor overall performance in innovation activity, are all characteristic for the Arab countries. Figure 8.8 charts variation of the World Bank Knowledge Assessment

[25] Data is available and only regarding to eight Arab countries. This underscores the need for better arrangements for data collection on R&D activity.

Methodology's (KAM) Innovation IndexIndex[26] with per capita GDP. While countries around the world are represented as blue diamonds and trend line, the Arab countries are represented by red diamonds and trend line. That Arab countries, and particularly GCC states, are underperforming in relation to these variables is immediately apparent.[27]

Most of the science and technology policy documents produced by Arab countries in the past two decades have pledged increased R&D expenditures. However, it is not likely that such increases, once realised, could lead to immediate improvement in innovative performance due to time needed to establish research facilities, train additional researchers and establish effective linkages with other actors in priority disciplines of interest. Such prerequisites may lie behind the situation presented by Figure 8.8. Radical improvements in innovative performance would also be conditional on the creation of much stronger links to application sectors.

8.4.3 Focus and Impact of Research Activity

A number of Arab universities and research centres, for example, in Egypt, Saudi Arabia, Tunisia and Morocco, have been known to undertake scientific research in accordance with international standards, enjoying citation levels comparable to their counterparts in other developing countries.

With regard to the fields of scientific research most frequently addressed by researchers in the region, a recent survey by Thomson Reuters Scientific (TRS) of publications produced by Arab countries in the Middle East, Turkey and Iran[28] stated that engineering and agricultural sciences were fields in which Arab scientists contributed their largest world share of publications in international journals in 2005–2009. Publications by Arab scientists in the agricultural sciences have also risen, with growth ranking among the top five highest in recent global output of research papers. The fields of clinical medicine, chemistry mathematics, computer science and—especially—microbiology also exhibited substantial growth since the previous 5-year period. Although research output in the social

[26] The KAM Innovation Index is the simple average of the normalised scores on three variables: total royalty payments and receipts, patent applications granted by the United States Patents and Trademarks Office, and scientific and technical journal articles.

[27] Values of the correlation coefficient R^2, which measures the degree of confidence that might be placed in the trend lines depicting change in the Innovation index with GDP per capita, stand at around 0.87 and 0.68 for all the world's countries and the Arab countriesrespectively. Such values normally prompt reasonable–good confidence. The lower R^2 value shown for the Arab countries is due to the wider spread of values for the Innovation Index computed for these countries, relative to respective values of GDP per capita.

[28] "Global Research Report, Exploring the Changing Landscape of Arabian, Persian and Turkish Research", J. Adams et al.; February 2011. Thomson Reuters Science. ISBN: 1–904431–27–5.

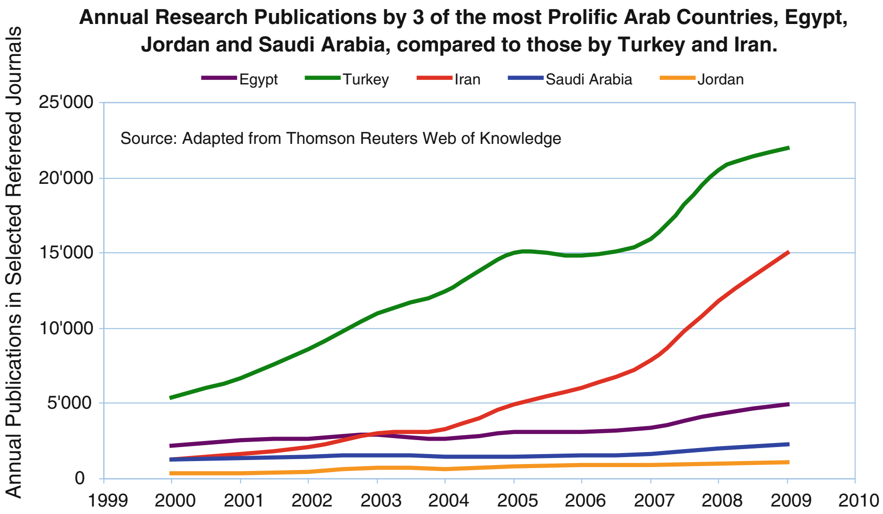


Fig. 8.9 Research publications comparisons

sciences still occupies the lowest ranks relative to any of the other research fields addressed by Arab researchers, publications in the social sciences exhibited the highest rate of growth in the Arab countries of the Middle East. However, it may be noted that publications in the social sciences started from a comparatively low starting point.

Several universities in the region publish their own journals featuring research papers contributed by their own staff as well as researchers from other universities.[29] Here, engineering, agriculture and medicine are common fields; only a small proportion of journals specialise in the social sciences. A small minority of articles are published in refereed international journals. Contributors from Arab universities, in Egypt, Jordan and Saudi Arabia appear to have made a larger proportion of publications in refereed journals abroad than researchers in other Arab countries.[30] The above-mentioned report indicates that, despite the low rate of publications in various scientific disciplines by contributors in the region, many countries have witnessed considerable growth over the past decade. Figure 8.9 presents a summary of selected TRS findings, demonstrating that Turkey and Iran

---

[29] Thus, respondents in a recent UNESCO survey indicated that at least 116 scientific journals were published in Iraq monthly, quarterly or annually. The same questionnaire also indicated that some Iraqi researchers were also regular contributors to academic reviews published in neighbouring countries such as Egypt and Jordan. UNESCO, 2010.

[30] Several universities in Egypt, including Cairo, Alexandria and Ein Shams, and universities in Saudi Arabia such as King Saud University and King Abdul Aziz City for Science and Technology are regular contributors to prestigious international journals.

led all other countries in the region in terms of the number of publications produced as well as the rate of growth of publication activity in 2000–2009.

Indeed, Turkey's share of world output increased almost threefold from 0.7 % in 2000 to 1.9 % in 2009. Iran's share grew at an even higher rate, from less than 0.2 % to 1.3 % during the same decade. In comparison, Egypt, Saudi Arabia and Jordan, which led all other Arab countries in terms of research publications in refereed international journals, displayed a much flatter trajectory throughout. Nevertheless, all three countries have increased the numbers of their refereed publications during the decade covered by the survey, with Jordan in fact doubling its output.[31] Forecasts indicate further progression, given announcements of intended increases in higher education and research investment in all three countries.

The TRS survey shows that even research publications by institutions in less prolific Arab countries of the Middle East have increased since 2000 and since continued on an upward path. The countries that produced the least number of publications exhibited substantial output growth. Thus, Iraq, Qatar and Yemen more than doubled their (admittedly miniscule) share of world output between 2000 and 2009, indicating their potential in future scientific research activity. However, the United Arab Emirates, Kuwait and Lebanon achieved the highest rates of growth within the group of less prolific Arab countries.

In short, while an upward trend in scientific publications is a healthy indicator shared by almost all countries covered by the TRS survey, there is a long way to go before these nations reach the publication levels of even their closest neighbours. Turkey and Iran, for instance, produced around 22,000 and 15,000 papers respectively in 2009. Enhancing the scientific output is contingent upon a number of factors, including an increase in researcher numbers and resources as well as the removal of regulatory contradictions. Thus, while many universities in the Arab countries impose scientific publications as an essential condition for promoting faculty staff, faculty members are frequently overloaded with teaching duties, leaving them little time to conduct quality research. On the other hand, faculty members in some countries often welcome extra teaching duties as a source of much-needed supplementary income.

Greater investment in higher education and research is seldom immediately translated into world-class research with high impact. Time is invariably needed to train new generations of researchers and to establish research schools. Some time will also elapse before the quality of research activity achieves recognition, thereby ensuring networking and cooperation possibilities, which may in turn drive quality and impact further upwards. In practical terms, this means that at least a decade may go by before research in the Arab countries has the kind of

[31] As for scientific impact, citation rates have increased significantly for Egypt, Saudi Arabia and Jordan compared to the early 1990s. Figure 8.10 quotes publication rates tracked in 5 year overlapping periods since 1990.

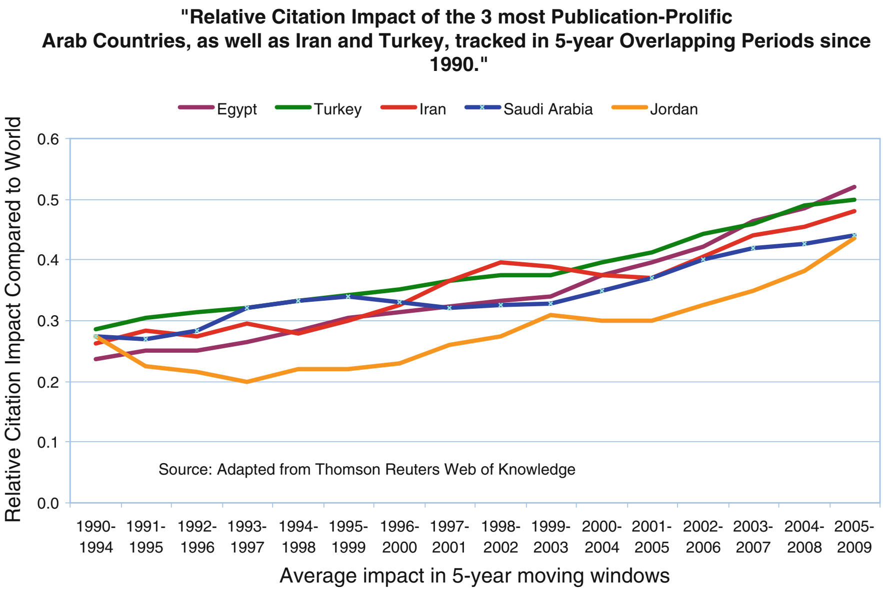


Fig. 8.10 Citation impact—publication-Prolific Arab countries Arab countries

impact achieved by other countries in the region, such as Iran and Turkey (Fig. 8.10).

8.4.4 Patenting Activity by the Arab Countries

Inventions registered with United States and European patent offices are generally regarded as a measure of innovative activity at national level.

According to this benchmark, patenting activity by the Arab countries is miniscule by international standards. Residents of Arab countries have been granted a mere 937 patents since the late 1970s, compared to a worldwide total of around 4.3 million patents (USPTO 2011).

Figure 8.11 shows, however, that patenting activity appears to be picking up, with Saudi Arabia leading the field and Kuwait and Egypt in second and third position.[32] A preliminary review of Saudi—held patents indicates a predominance of oil, water and health technologies.

[32] Figure 8.11 is based on data from a United States Patents and Trademarks Office (USPTO) report downloaded in October 2011 from: http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_utl.pdf.

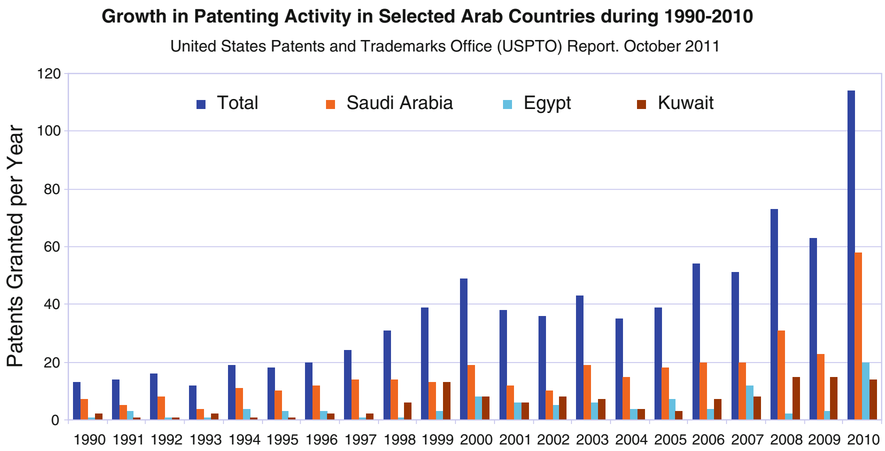


Fig. 8.11 Patenting activity growth. *Source* USPTO (October 2011)

8.5 Information and Communications Technology (ICT) and the Arabic Language

The importance of access to information and communications technology (ICT) in enhancing development, scientific research, innovation and entrepreneurship is now widely recognised. The history of ICT dissemination is instructive, particularly with regard to the need for rendering ICT applications more accessible to the widest possible range of users. Thus, personal computers (PCs) were initially welcomed as a miracle tool in many Arab countries. However, due to inadequate training and limited efforts at Arabising key applications, PCs often ended up as little more than status symbols or at best as glorified typewriters. However, this state of affairs has been changing, over the past decade, mainly due to growth in internet utilisation in the Arab countries.

Recent statistics[33] indicate that internet users in the Arab countries increased more than 30-fold, from around 2.5 million in 2000 up to over 77 million in 2011. Annual growth rates in latecomer countries such as Algeria, Morocco, Sudan, Syria and Yemen often exceeded 100 %. The total number of internet users in the Arab countries is now in excess of 3 % of all internet users worldwide and roughly 21.7 % of combined Arab country populations.[34] The GCC countries have 18.7 million internet users, equivalent to about 23 % of all internet users in the Arab region.[35]

---

[33] Internet World Stats. Downloaded in August 2011, http://www.internetworldstats.com/stats5.htm.

[34] This is nevertheless smaller than the world average, estimated at over 30 %.

[35] This is despite the fact that inhabitants of these countries make up only around 13 % of the total Arab population. The anomaly may be explained by the fact that many GCC inhabitants are expatriate workers with high rates of internet access and utilisation.

The presence of the Arabic language on the internet grew around 2,500 % in 2000–2011, the highest growth of the ten top online languages and higher even than Chinese (some 1,480 % during the same period). However, use of the internet by Arab populations is still low compared to the top ten online languages (see Table (A.4) in Appendix I). In effect, just over 3 % out of a total of over 2 billion internet users reside in Arab countries. This indicates a lower than average use of the internet given the fact that Arabic-speaking countries make up some 5 % of the world's population.

In addition, available evidence on Arabic content on the web obtained through search engines reveals a preoccupation with religious, traditional and recreational issues. Only a small number of websites possess content dedicated to socioeconomic development needs, including education, scientific research, health care, social issues, the environment and enterprise promotion (Arab Thought Foundation 2010). As things stand today, e-government, e-learning, e-health and e-commerce applications are still at an embryonic stage of development in most Arab countries (see Box 8.4).[36] Only very few websites are dedicated to topics targeting research and innovation communities. Even university websites generally suffer a variety of shortcomings in terms of design as well as content.

Limited progress in utilising the above applications is largely due to the inability of ICT devices to handle Arabic digital content compared to European languages (especially English). This is especially the case with regard to applications that require ontological and semantic content analysis and intelligent interaction between humans and machines.

Since it would be impractical for the many millions of potential internet users in the Arab countries to master the English language, there is an urgent need for more intelligent systems to allow better handling of Arabic language by ICT devices. More powerful computers and progress in artificial intelligence would help improve things to a certain extent. However, since some of the limitations on the ability of ICT devices to handle Arabic are due to the manner in which this language is written and spoken across the Arab world, there is urgent need to reform the language itself. In particular, radical change is required in the manner with which Arabic is written in order to facilitate a variety of novel applications widely enjoyed by European languages. This is a particularly onerous task, as it would need to be implemented through cooperation among a variety of institutions in all Arab countries, involving intensive research and radical overhaul of educational curricula and instruction methods. Failure to perfect more powerful hardware and software devices and achieve language reform is likely to deprive Arab populations from the full range of ICT benefits.

[36] E-government and e-commerce applications have been reported as having made progress during the past decade in the GCC countries. See the Regional Profile of the Information Society in Western Asia, published by ESCWA; E/ESCWA/ICTD/2009/12; 25 September 2009.

Box 8.4: Arabic ICT

Arabic Language and Information and Communications Technology

Due to its limited use in association with ICT devices and the internet in particular, especially in education and scientific research, problems facing the Arabic language in this context have not been adequately assessed. Some of these problems are related to the manner with which Arabic is generally written and spoken. This category of problems has been responsible for inadequate character and speech recognition systems. Their resolution may be addressed only through long-term linguistic and educational reform. More important, albeit related to the above issues in several respects, are problems due to the lack of reliable systems for morphological and semantic analysis. This has severely hindered the development of adequate systems for machine processing of Arabic text; including spelling and grammar checking systems as well as machine translation.

Thus it is expected that problems currently faced by Arabic in conjunction with ICT will be aggravated with the advent of future generations of search engines and related applications unless long-term linguistic and educational reform can be undertaken.

Indeed, it may not be possible to utilise the full benefits of e-commerce, e-government and e-learning applications in Arabic, thereby sidelining the large majority of Arab populations. A large proportion of Arab people are younger than 30. Most have been schooled in Arabic and, therefore, lack the proficiency to effectively access educational, research and business resources in other languages. The fact that only a limited number of Arabic speakers are able to access the internet, primarily using English or other European languages, will likely lead to further alienation and inequality rather than aid development.

In short, without far better software tools than are currently available for ontological, semantic and grammatical analysis leading to improved machine translation and comprehension of written and spoken Arabic, the chances that this language would be a useful medium for knowledge creation and dissemination in conjunction with future generations of Internet technologies are minimal.

Upgrading Arabic digital content would benefit greatly from enlightened national and regional policies armed with suitable incentives and aimed at enhancing infrastructures and achieving further reductions in access costs. Promotion of content that is more relevant to socio-economic development would also go a long way towards enhancing ICT benefits.

With the internet gaining new ground in the region, the threat of wider access to even more superficial material is greater than ever. Integrated and wide-ranging approaches are greatly needed to address a variety of inherent and related weaknesses in school systems and curricula. Necessary measures include the promotion of creative and in-depth analytical abilities. Attempting to replace a reading rather than a predominantly verbal culture is also a key issue requiring focused and long-term attention. It is only through nurturing such abilities that the Arab countries may utilise the internet as a tool in knowledge assimilation, adaptation, dissemination and creation.

8.6 Conclusions

Building capabilities in research, innovation and entrepreneurship requires a good deal more than importing and embedding disembodied technology inputs within isolated sectors of the economy. A host of framework conditions must be put in place to guarantee effective dissemination, utilisation and further development of new knowledge. Sound government policies are crucial for institution and infrastructure building aimed at encouraging technological innovation and ensuring effective knowledge dissemination, including utilisation in both public and private enterprises.

With many wealthy countries in their midst and youthful populations, the Arab world would ideally stand a good chance of establishing innovative and competitive knowledge economies. Yet, young people, especially in the larger Arab countries, continue to suffer the effects of substandard educational systems. Indeed, it would be no exaggeration if blame for many of the ills suffered by Arab societies were to be laid at the doorsteps of Arab educational systems.

Research and innovation systems throughout the Arab world face serious challenges. Research institutions in many Arab countries remain under-funded and have management procedures ill-suited to their innate nature and objectives as they have to conform to a rentier culture with attendant bureaucratic hurdles and contradictions.

Almost all national policies extol the value of human capital. However, brain drain continues to developed countries, depriving the region of its elite educators, researchers and entrepreneurs and rendering systematic reform efforts doubly difficult. Initiatives aimed at linking to S&T diaspora have been launched but have little to show as yet in terms of tangible benefits.

The past decade has seen the birth of several notable initiatives aimed at promoting research, innovation and entrepreneurship in the region. Several Arab countries, particularly in North Africa, have established technology parks and incubation schemes, some with effective links to well-established entities in the developed world, mostly in Europe.[37]

Work is in progress on several national initiatives aimed at enhancing higher education and research in the GCC countries. Saudi Arabia, for example, is in the process of setting up King Abdullah University of Science and Technology (KAUST), a colossal institution of higher education and research. Abu Dhabi is building Masdar City, a global first that will aim to promote new and renewable energy technologies and related enterprises. For several years now, Qatar Foundation in Doha has partnered with a host of high-calibre universities and research institutions from the United States in setting up colleges of medicine, business studies and associated research facilities, creating a magnet for students, researchers and entrepreneurs from the region and beyond. In 2005 Oman set up a Research Council that has developed and launched a range of policy initiatives, including an open research grant programme, directed research grant programmes, and a research centres programme.

Yet, it takes far more than all of the above to retrieve a semblance of the golden era when science, innovation and entrepreneurship provided the mainstay of the region's civilisations. Radical departure from an entrenched rentier mentality is a principal prerequisite. Putting limits on the practice of subcontracting knowledge creation, utilisation and dissemination required for critical development activities to overseas entities is another—and one that should not be interpreted as a call for insularity in today's patently globalised and interlinked world. On the contrary, the need has never been greater for Arab countries to foster far more international collaboration in research, innovation and entrepreneurship. What this chapter calls for is future policies that involve stakeholders and target populations insofar as is possible in knowledge creation, dissemination and utilisation, emphasising investment in the region's youth. Without progress in this field, the region may be doomed to decades of further upheaval and arrested development.

Sharper international competition, recurrent financial instability and a host of environmental problems make it essential for all countries to succeed in applying science, technology and innovation, dedicating both human and financial resources to address critical social and economic challenges. The grip of the rentier culture across the Arab countries is holding back many such efforts, however, and is additionally responsible for the limited returns from many of the initiatives that are launched. The fundamental problem is one of attitudes focused on investment in tangible assets and securing the kind of gains that carry little risk, such as acquiring land and new construction. The language and reading mindset also promotes superficial inquiry and quick fixes. A short-sighted consumption culture

[37] Several GCC countrieshave established links with higher education and research institutions in the United States, Australia and Europe. Qatar and the United Arab Emirates now host overseas campuses for several renowned universities from Australia, France and the United States.

is rampant, with an explosion in the number of luxury villas, cars and grandiose real estate projects.

Given the nature of science, technology and innovation, where risks are inevitably considerable and full returns take a long time to materialise, fresh strategies must be designed and implemented. These must emphasise concerted action by policymakers, the business sector, educational institutions, non-governmental organisations and the general public. They must be designed with a view to demonstrating concrete and clearly visible gains for Arab economies on the basis of science, research and innovation. Awareness-raising campaigns should be embedded in such strategies with a view to galvanising policymaking and decision-making towards investment in new knowledge as bases for future development at all levels—nationally, in public as and private sector institutions, and across Arab societies. Patience and long-term vision must be combined with astutely selected quick-win initiatives. The latter might take the form of entrepreneurial and job creating measures based on science, technology and innovation inputs. Coupled with improved conditions for enterprise creation, including seed funding for business start-ups and enterprise incubation, such initiatives could usher in an entirely new environment throughout.

All this points to the need for comprehensive strategies aimed at securing more ambitious novel science, technology and innovation capabilities targeting all Arab populations, especially young people. Governments must provide more funding for science, technology and innovation while building enabling conditions for innovative enterprises and civil society institutions. Ground-breaking alliances must be forged, both within and among the Arab countries, with the aim of strengthening educational and training programmes and shaping new and more innovative learning facilities. Here, incentives should be tailored to transforming societies where education has thus far produced mediocre outcomes. As a critical ingredient, more dynamic cross-boundary networks must be set up to promote intangible investment and new industries.

Good governance is a prerequisite for achieving these objectives. However, as events during the past decades have amply shown, good governance in the region is never attained with governments alone in the driving seat. Other influential stakeholders must undertake essential tasks, setting out directions for conditions that can allow for a more dynamic economic development, while also ensuring that it is equitable and sustainable. Countries may also benefit from external collaboration, and a wider regional movement, in this regard. These are tasks that reinvented and empowered regional organisations should play, shifting blame away from the usual suspects and launching initiatives to promote learning and catalyse and inspire joint action by countries across the region.

Cross-regional collaboration, such as the INCONET-GCC project between the EU and the GCC countries for capacity building in research and innovation, can also contribute on this score. However, project leadership must always be home-grown. Research and innovation strategies are never a subject for remote control. Only endogenous efforts can reach the roots of what will eventually work in the

Arab countries, identify and implement tools that can raise general awareness, challenge mediocrity and complacency, and put social and institutional establishments on their toes and encourage them to establish the conditions required for success in developing and utilising new knowledge as a basis for economic renewal and development.

Chapter 9
S&T Innovation Systems: The Role of Manufacturing, Institutions and Leaders

Eoin O'Sullivan

9.1 Introduction

This chapter offers reflections on best practices in science and technology (S&T) policy. In particular, the focus is on policy issues related to the effective translation of new S&T ideas into an industrial context that creates jobs and generates value for the national economy. Observations are based on analysis of recent trends in S&T policy relating to manufacturing research, as well as on experiences and insights from a range of S&T initiatives, R&D agencies and policy studies in several countries.

The chapter underlines the reality that effective translation of S&T opportunities into industry requires careful attention to the interfaces between the actors that generate new scientific knowledge, technology applications and industrial users. It also highlights the fact that the variety of institutions and organisations involved in this process requires S&T policies that acknowledge the 'innovation system' nature of this process.

In particular, the chapter aims to highlight some issues and themes that are too often neglected in the S&T innovation systems policy discourse—issues that may have important implications for how policymakers endeavour to design and develop their national innovation systems, in particular, the roles of:

- Manufacturing (and manufacturing R&D) in the process of S&T-based innovation
- Intermediate R&D organisations in translating emerging S&T ideas into industrial contexts—and the critical importance of configuring the institutional

E. O'Sullivan (✉)
Department of Engineering, University of Cambridge, Cambridge, United Kingdom
e-mail: eo252@cam.ac.uk]

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_9,

missions, functions and capabilities of these organisations to the structure, maturity and needs of the national innovation system
- R&D institutional leaders in configuring their organisations to suit the national innovation system—and the key skills and experiences that enable these institutions to be effective.

9.2 S&T Policy: Innovation and the Manufacturing "Industrial Commons"

Recent years have seen increasing interest in manufacturing among many international policymakers, not only because manufacturing is an important source of jobs and economic value, but because manufacturing can play a vital role in the process of innovation itself (O'Sullivan 2011).

Building or maintaining a healthy local industrial system is a sensitive matter. Offshoring production operations may increase operating efficiency but result in a range of unforeseen consequences (Tassey 2010; Pisano 2009; PCAST 2004). The number of local suppliers of materials, engineered components and production technologies may decline. It may become more difficult to attract or retain human capital with process engineering expertise, manufacturing know-how or leadership skills. And important infrastructure (for example, prototype, test bed or pilot-manufacturing facilities) around the manufacturing cluster may decline or disappear entirely.

Not only does this process result in a loss of jobs and economic activity within a region, but it also damages the so-called "industrial commons" (Pisano 2009; Grove 2010)—a shared set of industrial capabilities drawn upon by a range of companies within a local industrial system. This damage also has the potential to reduce critical interactions between elements of the industrial innovation system, for example interactions between product development, next-generation production technology R&D and process engineering activities. These interactions can be a vital source of new ideas and innovation in the development of next-generation products. Furthermore, because novel emerging technologies developed in the science base often rely on existing elements of the industrial commons of more mature sectors (for instance, fabrication expertise and test beds), this in turn risks reducing an economy's capacity to be involved in the important new S&T-based industries of the future.

Innovation and manufacturing do not occur in isolation, but possess interdependencies and feedback processes that make the journey from S&T research to manufacturing highly nonlinear. S&T policymakers in many countries are increasingly aware of the interdependencies of S&T research and manufacturing and are therefore focusing on the interface between manufacturing industry users and the science and engineering research base (O'Sullivan 2011; Abele and

Reinhart 2011; PCAST 2011; Teknikföretagen 2009). In particular, increased attention is being paid to ensuring that policies and programmes addressing manufacturing challenges are better coupled to scientific discovery and technology development, thereby ensuring that national industries can rapidly translate S&T-based innovations into processes, production technologies and products.

In this context, many S&T policymakers are looking again at their investments in high-profile emerging technologies such as nanotechnology and biotechnology, realising that the potential of these novel technologies to create economic, social and environmental benefits will require new, advanced manufacturing capabilities built on innovations within the manufacturing research base (NSTC 2008; O'Sullivan 2011). A particular issue highlighted in a range of international policy documents is the "scale-up" challenges of translating novel materials (notably biotech- or nanotech-based materials) from the research laboratory into real-world manufacturing environments. Significant attention is being paid in many countries to the potential for enhancing the productivity and competitiveness of national manufacturing enterprises through "faster, better, cheaper" methods for incorporating advances in novel materials into new processes and products.

In summary, manufacturing research—with its expertise in production technology and process engineering, integration engineering skills, industrial system insights and real-world manufacturing industry problem-solving experience—may represent a critical translational mechanism for turning novel (scientific-discovery-based) technological innovation into new high value industries.

9.3 S&T Policy: The Industrial Innovation Ecosystem

Over the last quarter of a century or more, many innovation experts and S&T policymakers have increasingly adopted systems perspectives (Freeman 1987; Lundvall 1992; Edquist 1997) to understand the evolution of innovation and technology developments in terms of a complex set of interactions and relationships between systems made up of institutions and a range of organisations, including: the R&D labs of major corporations, small technology-based firms, universities, national labs and intermediate research and technology organisations.

For many of the reasons discussed above, increasing attention is being paid to policies addressing the R&D manufacturing "ecosystem", where scientific discovery, new technology platforms, industrial design, process engineering innovation, etc., all benefit from interaction with manufacturing operations. There is a growing sense that regional innovation systems that contain strong S&T universities, intermediate R&D centres and manufacturing operations have a competitive edge (PCAST 2004). This dynamic, system-dependent nature of technological emergence and innovation is also partly reflected in attention being paid by S&T policymakers to industrial innovation gaps—areas of underinvestment in public-good R&D investment that address challenges at the interfaces of scientific discovery, innovation and manufacturing (for example, early-stage technology development, prototype testing and scale-up and pilot production systems) (Hauser 2010; Kota 2010; PCAST 2011).

In particular, there is a growing sense that an effective national innovation system must not only promote efficient R&D processes but also the efficient diffusion and assimilation of new technologies (Tassey 2010)—and that this efficiency depends to a significant degree on the configuration and functions of the innovation system and partnerships between R&D organisations therein. A number of countries have paid considerable attention in recent years to analysing the role of intermediate research and technology organisations—R&D centres and institutes that sit between traditional university research departments and industrial technology development operations (Lal 2007; Hauser 2010; Arnold 2007; Albors-Garrigos 2010).

9.4 S&T Policy and Intermediate R&D Institutions

Interest in intermediate research and technology organisations is driven by a number of factors including: the reduction in basic research performed by the industrial sector, in particular the virtual disappearance of the great industrial research labs of the twentieth century (for example, Bell Laboratories); and an urgency to increase the efficiency of R&D translation in the face of growing global competition and accelerating technology development cycles (Pisano 2010).

Recent policy studies have analysed a range of university-private sector research partnership models, research and technology organisations and 'technology innovation centres' (PCAST 2008; Hauser 2010). These studies highlight the significant variety of organisational models (and even diversity of activities within models) with different capabilities, functions and activity focus across the innovation spectrum (from applied science to technology development, demonstration and integration). The studies emphasise that there is no ideal model for an intermediate research and technology organisation. Indeed, many of the models reflect the industrial innovation systems to which they belong: their functions and missions—even the scale and scope of their activities—having co-evolved to complement the R&D activities and strengths of local universities, regional (often sector-specific) industrial clusters, and the priorities of national R&D funding agencies and government ministries. This broader innovation systems context should, therefore, be a prime consideration when exploring any opportunities to transfer or adapt particular organisational models, or particular S&T research practices and programmes.

Nevertheless, despite the sheer variety of models and their innovation system context dependency, there is significant consensus on the potential value of intermediate research organisations in supporting the efficient translation and diffusion of new S&T knowledge from the university research base into industry—in particular through the provision of infrastructure (for example, test beds, prototyping facilities, pilot manufacturing equipment, etcetera), engineering skills, production technologies and know-how to address industrial innovation challenges that are beyond the capacity of individual firms to tackle alone (Hauser 2010; Tassey 2010). Intermediate research organisations help to reduce the risks and uncertainties that companies face when it comes to adopting new technology platforms. They can also potentially reduce technology development cycles and give local innovation systems a collective competitive advantage within the global economy. Company access to this infrastructure, the creation of opportunities to engage and interact through contract R&D or public–private collaborative R&D programmes and the existence of scope to demonstrate novel technologies to potential investors and users all help to translate and diffuse new technologies, processes and capabilities throughout the innovation system.

The following sub-sections briefly describe five very different models to illustrate the variety of functions, missions and capabilities of different institutions and, in particular, to highlight the innovation system *context-specific* nature of the models:

- Engineering Research Centres (USA). Centres for Science, Engineering & Technology (Ireland)
- Fraunhofer Institutes (Germany)
- Industry/University Cooperative Research Centres (USA)
- Metropolitan Industrial Research Institutes (Japan)

9.4.1 Engineering Research Centres (USA)

The US National Science Foundation's Engineering Research Centres programme was launched in 1985. Since then, ERCs have pioneered and refined many effective practices in university-industry engagement and collaborative R&D (ERC Association).

This centre model is university-based, has a finite lifetime (up to 10 years) and addresses multidisciplinary engineering systems challenges that have the "potential to spawn whole new industries or to radically transform the product lines, processing technologies, or service delivery methodologies of current industries" (NSF 2009). ERCs provide an environment in which university researchers can work in close cooperation with industrial partners to address engineering system challenges that are of significant scale, complexity.

This centre model places particular emphasis on translating research results into new products and services, addressing barriers between different stages of invention and innovation. The ERC programme places particular importance on the *translational* nature of the research agenda. ERCs are required to have a strategic plan, based on the 3-Plane Chart (illustrated in Fig. 9.1) that identifies critical paths from developing new insights from fundamental knowledge through to the innovation of transformative engineering systems. ERC research plans are

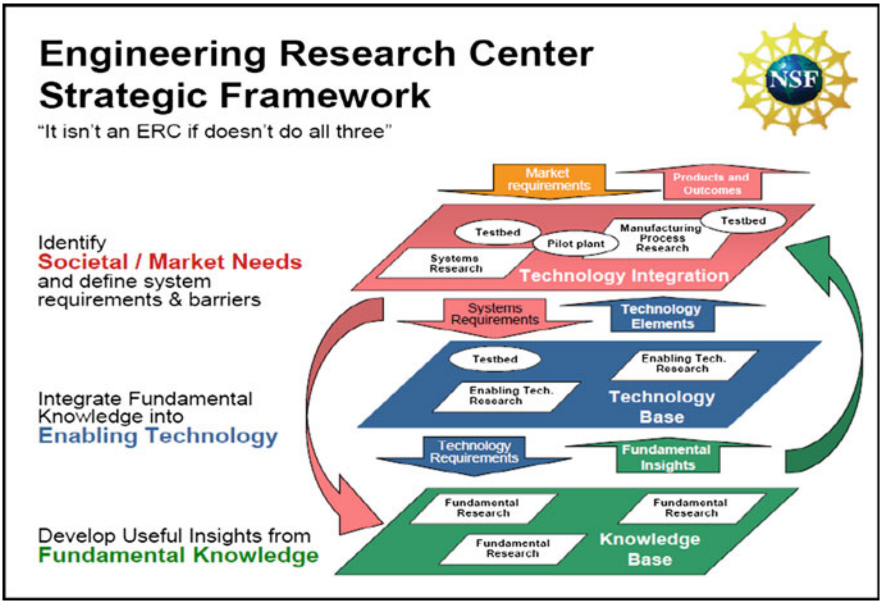


Fig. 9.1 ERC strategic "3-Planes" framework. *Source* NSF (2009)

carefully scrutinised to ensure they have a strategy to address any barriers between fundamental knowledge, enabling technology and systems-level research activities.

9.4.2 Centres for Science, Engineering and Technology (Ireland)

The Centres for Science, Engineering and Technology (CSET) programme of Science Foundation Ireland (SFI) was modelled in part on the ERCs, but with careful modifications to address the characteristics and maturity of the Irish industrial innovation system.

When SFI was founded in 2001, its mission was to establish a research capability in key strategic areas underpinning Ireland's economic development, in particular ICT and biotechnology—industrial sectors in which Ireland already had a strong base and reputation in manufacturing. At that time the Irish economy was heavily reliant on low-cost hi-tech manufacturing (in particular on the operations of international software, microelectronics and pharmaceutical corporations) and was facing increasingly strong competition as a manufacturing location from emerging economies. SFI was an important part of the Irish government's efforts to move its manufacturing economy up the value chain to a knowledge economy driven by research and innovation. One of SFI's earliest programmes (and its main initiative directly connecting universities and industry research) was the CSET programme (Crawley 2006). Although modelled partly on the NSF ERCs, the CSETs faced distinct challenges and imperatives. In particular, Irish universities had traditionally been mainly teaching institutions and industrial activity had been dominated by the manufacturing operations of multinational corporations, with little or no research based in Ireland.

The CSET programme, therefore, actively encouraged the training of PhD scientists and engineers in areas of S&T relevant to Ireland's manufacturing base. It also stressed engagement with the local activities of high-tech corporations *and* their research headquarters. Research agendas related to technology platforms that also mattered to domestic small- and medium-sized enterprises were particularly valued. The CSET programme placed special value on industrial cost share in the form of industrial researchers and integration engineers working on a collective research agenda and based on the CSET campus. The approach enhanced awareness, interaction and knowledge exchange, thus strengthening the innovation capacity of Ireland's manufacturing base. The centres have since proven to be significant attractors of industrial research activities. Senior officials from international companies have cited the potential to engage with specific CSETs as a major attraction factor for locating new research facilities in Ireland.

9.4.3 Fraunhofer Institutes (Germany)

In contrast to the time-limited, university-based, challenge-driven nature of the centre programmes described above, the German Fraunhofer Institutes are permanent institutions charged with conducting applied research designed to strengthen the innovative capacity of German industry—especially in sectors where Germany is traditionally strong. Fraunhofer Institutes also have a translational mission associated with researching, developing and demonstrating new technologies emerging from the science base. They also work with industry partners on transferring new technologies into the market, engaging in both pre-competitive and contract research (Arnold 2007; Lal 2007; Mina 2009; Hauser 2010).

The Fraunhofer funding model is significantly different from the models described above. Instead of building on a core university research grant, Fraunhofer Institutes get just one-third of their funding from the federal government. The institutes are expected to generate the second third of their funding from industry and the final third from competitive public research programmes. The availability of R&D funding from state governments to pursue regional economic innovation agendas is an important factor in making this model work.

One distinguishing characteristic of the German S&T research ecosystem (which helps the Fraunhofer model work) is the extent to which engineering and technology-related university departments (in particular mechanical engineering and production technology) engage in significant levels of industrial problem-solving contract research themselves. Many engineering professors will typically have considerable industrial experience, and their graduate students have high levels of industrial engagement. Furthermore, the directors of engineering-related Fraunhofer Institutes are often also directors of a local university-based research institute. All of these factors enhance the linkages, interactions and levels of understanding between Fraunhofer Institutes and local universities, helping to connect university research to a broader network of industrial actors and research challenges as well as facilitating the operationalisation of more fundamental academic S&T research into industry-relevant processes and technologies and its translation into real-world production systems.

9.4.4 NSF Industry/University Cooperative Research Centres (USA)

Although the US has fewer intermediate institutions (cf Fraunhofer Institutes), many of its university-based research centres reach out to industry in a very substantial way.[1] Another US National Science Foundation intermediate centre model is the Industry/University Cooperative Research Centers (I/UCRC) programme. This university-based centre model addresses major problems of relevance to industry, but the industrial partners play a greater role in shaping (and funding) the multidisciplinary research agenda. The collective nature of financial support by partner firms ensures a focus on research that is of interest to multiple companies. Research projects are funded primarily by industry members—typically in a ratio of approximately 3:1 (industry to NSF investment). Industry plays a significant management role at the centres, in particular through advisory boards of representatives from partner firms. Advisory board members are involved in the oversight of research projects and also vote on matters of centre policy and research strategy (Gray 1998).

The value proposition of I/UCRC membership for companies includes: industry networking, industry-driven R&D projects, access to intellectual property developed during membership, access to prepublication technical papers and access to cutting-edge facilities and researcher know-how. Some manufacturing-related I/UCRCs offer value to their industrial partners by validating high-impact emerging technologies and cultivating inter-firm alliances through interaction on collaborative test beds (Gray 1998).

For many manufacturing-related centres in particular, interactions with industry partner companies often extend beyond the corporate R&D labs. Industrial advisory board members, for example, may be managers in a manufacturing or engineering department. Given the potential impact of research across the value chain, centres often cultivate many points of contact across different departments

[1] For a schematic representation of the two contrasting industrial innovation systems, see Furman (2002).

of partner firms to promote research relevance and effective dissemination of information on activities and findings.

9.4.5 Metropolitan Industrial Research Institutes (Japan)

In Japan, universities play a somewhat different role within the industrial innovation 'ecosystem' compared to some other major economies. Traditionally, Japanese universities have engaged in relatively little industrial problem-solving research and have had fewer substantial engagements with manufacturing corporations. Until the 1990s, there was very little interaction between universities and industry, and relatively low levels of private sector funding for university-based research (NRC 2009). Much of the applied science research and technology development research was concentrated to Japan's National Institute of Advanced Industrial Science and Technology, whose mission is to integrate scientific and engineering knowledge to promote innovation, strengthen the competitiveness of Japanese industry, create new industries and address research areas of critical socio-economic need.

Within the context of Japan's distinct national innovation ecosystem, metropolitan (or prefectural) industrial research institutes have evolved, run by municipal or regional governments. These play a somewhat different role to the intermediate centre models described above (Kitagawa 2007). In particular, they carry out significant levels of relatively low-cost problem-solving R&D for small- and medium-sized manufacturing enterprises. They also provide services such as testing and fabrication and materials characterisation to small companies in order to enhance product quality and technological capabilities. Some centres also endeavour to help smaller companies extend networks to other companies, suppliers and Original Equipment Manufacturers (OEMs) and increasingly to local universities. These institutes play a crucial role in the Japanese industrial innovation ecosystem. Their activities are typically shaped in response to industrial configurations and needs of local sectors. For example, the agenda of the Tokyo Industrial Research Institute (TIRI) is significantly shaped by the materials processing-related innovation needs of small engineering suppliers to the automotive firms in the Tokyo metropolitan area. This phenomenon, in turn, is shaped by the R&D strategies and practices of the leading Japanese automotive corporations.

In summary, the institutions described above are only a small sample of the different models of intermediate R&D organisations. Again, there is no one *ideal* model for an intermediate research and technology organisation. The effectiveness of individual models is highly dependent on their local context. The missions, functions and strengths of their R&D organisations are often legacies of, for example, historical approaches to higher education, traditionally dominant industry sectors, special strengths in science and engineering or even levels of government investment in S&T research for military, space or health technologies.

9.5 S&T Policy and R&D Institutional Leaders

People are one of the key factors behind successful S&T organisations in the innovation ecosystem—in particular S&T leaders with the experience, skills and perspective to tailor their organisation's activities, functions and engagements for an optimal fit within the innovation system and to reconfigure their organisation's structures, operations and strategies to enhance the R&D efficiency and impact both of their own organisation and of the system as a whole. The most carefully designed S&T policies or R&D institution models may make no impact on innovation systems at all if the right people cannot be found to implement the policies or run the key institutions.

Many successful international intermediate R&D organisations (of the type described in Sect. 9.4 above) have individuals with significant industrial experience within their senior management team. Such individuals often have broad industrial career experience within a range of R&D, production and strategic management roles. Many intermediate research institutes emphasise the contribution of such individuals to the research agenda, in particular by providing: insights into industrial practice and culture; a network of real-world industry contacts; and operational and management experience that can be invaluable in running complex, multi-project, multi-partner R&D endeavours. The high level of trust that such individuals bring to engagements with industry partners is highly valuable as it often facilitates more substantial, strategic and long-term collaborations with industry.

Competent S&T leaders play a particularly important role in addressing the S&T manufacturing agenda (as outlined in Sect. 9.2). In the field of manufacturing engineering research, they can help align S&T research activities with the manufacturing innovation agenda and link university research communities with the manufacturing "industrial commons". Universities in several countries, most notably Germany, have many engineering research leaders with significant depth and breadth of industrial experience—not only in mechanical engineering and production technology research, but often across a broad range of manufacturing, management and strategic roles. Research leaders with this type of industrial experience can make a significant contribution to addressing complex manufacturing user challenges. In Germany, most professors of "production technology" have had significant industrial career experience (Altan 1996, 2003). Indeed, for several German universities, this is the most common career path route for senior mechanical and manufacturing engineering research academics. Directors of production technology and related fields at Fraunhofer Institutes are generally professors and/or directors of research institutes at the local university. In the US, the number of engineering research professors with significant industry careers is smaller, but it is striking how many successful university-industry research centres have directors with industrial experience. Research leaders with significant and broad manufacturing industrial experience can also be found embedded in US universities with titles such as "professor of practice" or "industrial engagement director" (Etzkowitz 2007).

The industrial experience of S&T institution leaders can make a valuable impact in a number of ways. For example:

- Senior ex-industry leaders who were well known in their research field and industry sector are typically well connected across important firms and—critically—they are trusted to appreciate the priorities, culture and innovation needs of those firms. This trust can make a significant difference in convincing companies to engage in research partnerships or invest in contract research with an institute.
- Experience across the manufacturing value chain (that is, in a research lab, business unit, production facility and suchlike) can make leaders better placed to understand the interdependencies of S&T research and manufacturing and can connect the institute's R&D agenda with evolving manufacturing innovation needs. Such leaders are well placed to configure their institute's model—its activities, agenda and linkages—to fit best within the local innovation system.
- S&T leaders with industrial experience tend to have acquired pivotal industrial management skills, experiences and systems-thinking approaches which can be invaluable in running large complex research institutes with a diverse set of partners and clients. Those qualities, skills and experiences that have allowed purely academic researchers to hold senior university positions do not necessarily translate into being able to direct major research institutes.

In summary, an important success factor for many intermediate R&D institutions, in terms of making an impact on the national S&T-based innovation system, is the quality, experience and leadership skills of the senior management team—often leaders with extensive industrial experience who command the respect of university academics, industry researchers and other senior managers.

9.6 Summary and Conclusions

The variation and complexity of the structures and dynamics of national innovation systems, as outlined above, makes benchmarking S&T policies extremely challenging. It is difficult to design benchmarking metrics that appropriately characterise the innovative capacity of an innovation system (that is, measures that fully account for the efficiency with which novel S&T ideas are translated into an industrial context in ways that effectively support the competitiveness of local industry, capture value and create jobs for the national economy).

Although many economies which generate significant wealth from S&T-based industries do, typically, have high levels of, for example, R&D investment, S&T publication outputs and patents per capita, they also have complex and diverse industrial innovation institutions, advanced S&T management and innovation leadership skills and a strong manufacturing industrial commons that have developed over many years. If the ultimate goal of many S&T policies is the advancement of industrial competitiveness and economic prosperity, then it is important to take a holistic industrial innovation systems approach to S&T policy and programme design.

This chapter has argued that S&T policymakers should be fully cognisant of the interdependence of science and technology R&D and manufacturing. The efficiency of the industrial innovation ecosystem may be enhanced by the alignment and synchronisation of S&T policies with economic policies and high-tech industry development strategies. Furthermore, without a healthy industrial commons a nation's capacity to innovate and capture value from new S&T ideas may be inhibited.

The efficiency of a national innovation system depends on more than just the level of R&D investment (or the portfolio of spending across the innovation spectrum from scientific discovery to product development). It is also important that the organisations within the innovation system have appropriate configurations, capabilities and linkages. In particular, intermediate translational research and technology organisations which bridge the gap between public research and industry may play a critical role. The effectiveness of international models of intermediate institutions is highly dependent on the configuration of the national innovation system and national industrial structures. This systems context needs to be fully understood before any particular institutional model is adopted or adapted by another country.

Furthermore, in many cases a critical characteristic of successful intermediate R&D institution is the quality, experience and leadership skills of the senior management team. Their importance emanates not least from their position as leaders with extensive industrial experience who command the respect and trust of academics, industrialists and policymakers alike. Such individuals are hard to find, but can be invaluable in helping to create linkages across the S&T innovation system and in configuring (and continuing to reconfigure) the priorities, strategies and activities of their institutions to optimise their effectiveness within the local innovation system. The best S&T policies, institution models and R&D portfolios will count for nothing if they lack the right people to implement, direct and manage them.

In conclusion, despite the complexity of modern industrial innovation systems, extraordinary opportunities exist for those countries currently engaged in growing new S&T-based innovation systems. In particular, there is considerable potential to align and synchronise S&T policies with economic policies and high-tech industrial development strategies, and to benefit from the lessons learnt from the international S&T policy experiments of other nations (while taking care to adapt them to suit the local context and to build on national competitive advantages). These opportunities offer the potential to accelerate the rise of knowledge-based industries and build diversified competitive economies that leverage investments in the national S&T base to create jobs and generate value for the economy.

Chapter 10
Innovation in the Public Sector: Experiences in E-Procurement and University Research

Andrea Prat and Erina Ytsma

10.1 Introduction

Organisations must adapt to new conditions. In particular, they must transform themselves in order to take advantage of technological change. This principle is well accepted in corporate settings, and the public sector is also moving in this direction.

This chapter considers three examples of such a transformation in the public sector. The first relates to public procurement; the set of procedures that public bodies use to purchase goods and services from the private sector. As we will see, ICT allows public bodies to use procurement mechanisms that achieve economies of scale and greater flexibility.

The second example concerns how to fund and incentivise research in public higher education systems. It indicates how international comparisons of scientific output measures can shed light on the variation in productivity of different national research funding systems.

Finally, we present and discuss a methodology for identifying research strengths and synergies among countries that was developed by Andrea Prat and Erina Ytsma at the London School of Economics. The methodology involves using bibliometric data to calculate the sums of total-cites-weighted publications produced by single authors or collaborations between authors affiliated with the same country, as well as the sums of total-cites-weighted publications produced by collaborations between authors affiliated with different countries. By calculating and comparing these measures of research intensity and collaboration strength for

A. Prat (✉) · E. Ytsma
London School of Economics, London, United Kingdom
e-mail: A.Prat@lse.ac.uk

E. Ytsma
e-mail: E.G.Ytsma@lse.ac.uk

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_10, © Springer Science+Business Media New York 2013

different countries and regions, research fields and years, the methodology can reveal research fields, centres and co-authorship linkages that show a relatively strong performance or have been growing rapidly or shrinking recently.

On this basis, we will make a number of observations on the actual evolution of S&T collaboration, both within the GCC and with other parts of the world. These observational patterns may be used to inform policies geared towards stimulating research and research collaboration.

10.2 Public Procurement

The scale of public procurement is often underestimated. The total amount spent by public bodies on goods and services purchased from the private sector is between 5 and 10 % of GDP for most developed countries. According to Audet (2002), it equates to 7.1 % of global GDP.

Some of the products procured are unique in nature, such as bridges, roads, airports and so forth. Others—such as computers, cars and telephony services—are standard, mass-produced goods and services. While the border between these two categories is somewhat subjective, a good approximation for the average country is that spending is equally split between the two categories.

Traditionally, the purchasing agency is faced with three dilemmas.[1] The first is the classic trade-off between decentralisation and centralisation. By making procurement decisions at a higher level, the government can achieve economies of scale, both in terms of market power vis-à-vis suppliers and through avoidance of cost duplication. However, centralisation also reduces flexibility. The central agency is less aware of the needs of the various units and incurs all kinds of delays and additional costs due to the need to communicate up and down the hierarchy.

The second dilemma relates to the trade-off between quality and cost. A standardised price-centred procedure pits bidders against each other, and can save governments large amounts of money. But such a procedure necessarily combines different product specifications in the same category, thus conferring an advantage on suppliers of low-quality goods. The alternative is a less structured, more subjective procedure. But this leads to higher cost because of an increased need for administrative resources and reduced competition among suppliers.

Third, the government can select the degree of monitoring in the process. Individual purchasing managers may lack the motivation, skills and (sometimes) personal integrity to optimise the procurement process. By creating a set of strict reporting requirements and detailed procedures, the government can try to channel purchasing managers' efforts in a productive direction. However, this typically adds complexity to the process and reduces its speed and flexibility. It may also lower the morale of the people involved, making them even less motivated.

[1] See Dimitri et al. (2006) for an overview of the economic analysis of procurement.

Public procurement has traditionally identified solutions in terms of these three trade-offs. A classic mechanism involves a centralised, rule-bound, cost-centred system. If well designed, this solution delivers low prices through the exploitation of market power and the avoidance of duplicate costs. However, such a system is also cumbersome and inflexible, and it adds large administrative costs. Most importantly, benchmarking its performance is difficult. If only one agency buys a certain good, how do we know whether it is getting the best quality at the lowest price? If procurement is organised centrally, only one public body commissions work, thus foreclosing the possibility of value-for-money comparisons across bodies.

In the other extreme solution, purchasing decisions are delegated to local units. The key advantage is flexibility. But, as seen above, this flexibility comes at the price of cost duplication and lack of market power. The solution also exacerbates the trade-off between monitoring and speed. If the government wants to institute a system of controls on local units, it creates delays and red tape.

Recently, however, a new system has begun to emerge that relaxes the traditional constraints of public procurement. For the purpose of this note, we will refer to it as *optional e-procurement*. More information about it is available in Bandiera et al. (2009).

This system, which combines elements of centralisation and decentralisation, operates as follows. A central procurement agency runs the tender process. However, the goods are not bought by the agency directly but advertised on a catalogue. Public bodies choose between buying from the catalogue and running their own tender process.

To be concrete, let us consider the purchase of printers. In the first step, the central agency issues a request for tender for 10,000 laser printers with certain specifications. The award is made not only on the basis of price but possibly also depends on points assigned on the basis of other features. The winning supplier commits to providing at most 10,000 printers with the agreed specifications in a period of x months (typically six).

In the second step, the printers are advertised in an online catalogue. The price is the one agreed with the supplier (possibly minus an agreed quantity discount) and applies to all public bodies. If a public body is interested it can buy it directly from the catalogue. However, the public body can also decide to source printers elsewhere, either because it is looking for a better specification or because it thinks it can get a better price. In this case it will run its own tender process. The agreement between the central agency and the supplier expires when either 10,000 printers have been sold or the time limit has been reached.

What are in theory the advantages of optional e-procurement? This mechanism combines the benefits of centralisation while avoiding its costs. As the central agency runs the tender process, it has market power and can potentially avoid duplication costs. However, the purchasing decision is still in the hands of users, who can decide that they prefer some other specification. This creates a powerful benchmark both for the central agency, which will not sell many units unless it obtains good quality at low prices, and for the local purchasing managers, who must now justify their actions if they choose to buy more expensive goods not included in the catalogue. In a sense, optional e-procurement could create competition between the central agency and the local purchasing managers in finding the best deals.

While the advantages of the new system are clear in theory, do they materialise in practice? An answer to this question can be found in Bandiera et al. (2009).

In the late 1990s, the Italian government launched a programme to reduce public expenditure on goods and services. A key component was the creation of a central procurement agency, Consip, to coordinate the procurement of commonly purchased goods and services. After initial pilots in 2000, Consip signed 70 agreements for more than 40 product categories up to the end of 2005. Total purchases from the Consip catalogue in that period amounted to €14 billion (that is, 12 % of total procurement expenditures in 2005). The value of purchases of the same products and services from other sources was €26 billion or 22 % of total procurement expenditures in 2005. Thus, the value of Consip purchases accounted for a third of the total procurement value of the offered products.

We analysed data on procurement purchases of generic goods compiled by a sample of Italian public bodies between 2000 and 2005. The data were collected in a survey designed and implemented by the Italian Statistical Agency (ISTAT) in three rounds, administered yearly between 2003 and 2005. Our study covers a broad range of generic goods, such as office supplies and furniture, computers, and utilities. Sample goods were chosen on the basis of three criteria: (i) Comparability—homogeneous goods whose price depends on a few observable characteristics, (ii) Diffusion—goods that are purchased by most public bodies, and (iii) Relevance—goods that account for a sizeable share of the budget for most public bodies.

The survey was sent to the office clerk responsible for receiving, paying and filing invoices in each public body. The respondent was asked to report the unit price, date of purchase, quantity purchased, and several characteristics of each good. For durable goods, such as PCs, the manager was asked to report each purchase made in the 5 years before the survey. For nondurable goods and for services, for instance phone subscriptions, the manager was asked to report information on the last purchase only. Data were collected from over 208 public bodies.

In the analysis, we have exploited two key sources of variation. First, we observed the same public body purchasing several goods at several points in time. Second, we observed the same good being purchased both when a Consip agreement is active and when it is not. We were thus able to estimate the average price paid by each public body when buying on the open market, and the decision to buy from Consip when Consip agreements were active.

Three rules define our working sample. First, as the identification relies on intra-public-body variation, we have included in the analysis only public bodies for which we obtained data on at least ten purchases. Second, to maintain comparability across public bodies, we have excluded goods that are purchased exclusively by a few public bodies. Finally, we have eliminated price outliers by dropping the bottom and top percentile of the price distribution of each good. Our final sample contains 6,068 observations on purchases of 21 goods by 208 public bodies over the 2000–2005 period. On average, 52 % of purchases were made when a Consip agreement was active and 48 % when there was no active agreement.

The 21 goods were: car rental, photocopier rental, laptop computer, desktop computer, office desk, office chair, landline subscription, projector, switch network, cable network, heating diesel, motor oil, lunch voucher, refuse bin, paper, mobile phone subscription, MS office software, printer, server, car purchase, fax machine.

In each category, all the relevant characteristics of the good are identified. For instance, for a relatively simple good such as paper, the data include: brand, producer, type (natural or recycled), format (A3, A4, letter), colour indicator, delivery mode (to premises, at street level, warehouse collection), duration (months), delivery delay indicator, payment due date (days), sustainable forest indicator, low chlorine content indicator, weight (grams per square metre).

The empirical strategy for estimating the price savings generated by Consip consisted of regressing the logarithm of the price paid for a particular good by a certain public body on all the characteristics of the good, on time of purchase, on quantity and on a dummy variable indicating whether the good was purchased independently or through Consip. The coefficient of the dummy measured the percentage difference in the average price in Consip and outside Consip.

The estimated value for the coefficient was 0.276, indicating that savings totalled approximately 27 % of the purchase price. Consip-purchased goods represent approximately 2.5 % of Italian GDP, implying a potential annual saving of around €10 billion.

Note that the cost of running Consip is limited (160 people are employed in the procurement department). Moreover, additional savings from reduced litigation and administrative costs cannot be quantified with these data.

While the optional e-procurement mechanism appears to work well in Europe, is it applicable to other countries? Given the importance of public procurement for technological advancement in the GCC countries (as documented in Chaps. 5 and 6) it is both interesting and highly relevant to study the efficacy and efficiency of the public procurement process in these countries. Experimenting with e-procurement programs could cast light on the efficiency of procurement procedures in the GCC countries as well as provide a means to improve it. The efficacy of government procurement in advancing research and education can be studied by comparing international measures of scientific output relative to government spending on research and education, as discussed in the next section. Section 10.4 presents a method that uses bibliometric data to create maps and derive measures of research intensity and research collaboration strength within and across countries, research fields and years that could be used to identify research centres and fields that may benefit most from government funding.

10.3 University Research

Tertiary education is widely perceived to be a key determinant in the well-being and economic success of a nation or geographic region. In particular, there is extensive evidence that research activities performed within universities generate positive spillover into other economic activities. Krueger and Lindahl (2001) analyse the cross-country evidence for this spillover effect, while Aghion et al. (2009) analyse the intra-country evidence.

For this reason, university research in most countries is heavily subsidised by the government. With the possible exception of the United States, public agencies are typically the dominant source of funds for academic research. A natural question to ask is then how we can optimise the research performance of publicly funded universities.

For comparability, it is useful to focus on a group of relatively homogenous countries: the largest EU nations. They all share a predominantly public tertiary education system, characterised by a mix of old and new institutions. Bandiera and Prat (2010) perform a simple international comparison exercise, for each country calculating (1) the annual public spending on tertiary education, and (2) the number of "excellent" scientific publications. The latter is based on a bibliometric methodology suggested by King (2004), who selected the 1 % of publications in every discipline with the largest impact factor. The ratio between (1) and (2) yields a measure of the cost per excellent publication, which can be seen as a rough indicator of cost-effectiveness.

As Fig. 10.1 shows, there is great variability between the European countries. The bulk of European countries spend between €4 and €7 million per excellent publication. The UK is the clear outlier, with just over €2 million per publication. Greece and Portugal are the least efficient spenders.

Europe's four largest countries—France, Germany, Italy and the UK—have similar levels of per capita spending. France and Germany spend just over €200 per person, while Italy and the UK are just below that level. However, the UK produces twice as many publications as each of the other countries with approximately the same amount of money.

The UK stands out from the rest of Europe on an institutional dimension. Since 1992, it has operated a unique research funding model whereby the Higher Education Funding Council for England (HEFCE) allocates research funds—about €1.4 billion per year for research—in a transparent, stable and meritocratic manner.

Every academic department undergoes a rigorous Research Assessment Exercise (known as Research Excellence Framework since 2010/11). Departments within a discipline are ranked on the basis of observable scientific production. This ranking determines the share of funding attributed to that department.

Universities generally have control over their human resources policies and can hire, promote and reward academic staff autonomously. There is no national competition requirement and salaries are mainly decided at the local level. The combination of a competitive resource allocation system and a high degree of autonomy creates the conditions for healthy competition among universities to attract, retain and reward successful researchers.

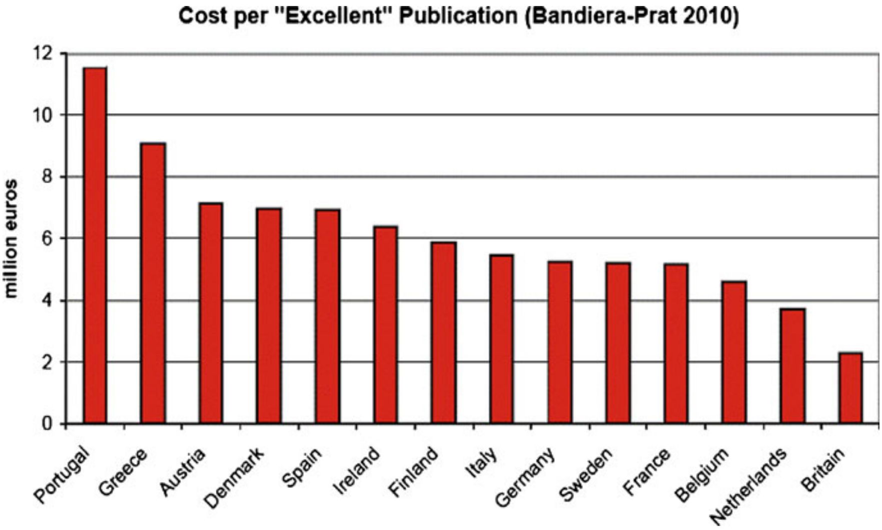


Fig. 10.1 Cost per "Excellent" publication. *Source* Bandiera-Prat (2010)

Table 10.1 Change in university students numbers from 1995 to 2004

Country	Increase in %
Bahrain	140.1
Kuwait	33.3
Oman	409.8
Qatar	19.0
Saudi Arabia	145.4
UAE (2003)	387.0

Source World Bank (2010)

The link between autonomy and meritocracy has been analysed more systematically by Aghion et al. (2009). Their study, based on cross-country evidence from Europe as well as cross-state evidence from the United States (for public universities only), indicates that both university autonomy and competitive funding have a positive effect on research productivity, and that there are positive interactions between the two factors. The GCC countries constitute an interesting experiment in tertiary education. Their growth rate in student numbers has been extremely strong, as illustrated in Table 10.1. For comparison, in the same period, the number of students in France and the UK grew by 4.2 % and 23.9 %, respectively.

The individual GCC countries are experimenting with different routes to develop their university systems, with some trying to develop a national system from scratch while others are inviting established foreign institutions to open sister schools in the Gulf. To our knowledge, there does not exist any systematic analysis of the different approaches, how they compare to European and North American experiences, or how the GCC countries could work out their own "best practice" to suit their uniquely evolving environment. Mapping and analysing the research strengths and co-authorship relations of the GCC countries using bibliometric data may guide the targeting of incentive programmes for research and research collaboration in an effective and efficient way.

10.4 New Tools: Bibliometric Analysis of Research Networks

In the following we present and discuss our recently developed methodology to map research collaboration networks using bibliometric data. Through this method, we are able to examine the evolution and current topology of research networks between the research communities in different countries. This analysis can be applied to help disclose important trends in the evolution of the science community within various countries, its international links, its performance and potential and so forth. In turn, the insights from this analysis may help prioritise targets for policy support, thus for instance increasing the efficiency of research funding programmes as well as initiatives geared towards aiding the formation of an effective research collaboration network between the GCC and other regions.

More specifically, creating and evaluating research network maps can help to assess the current strength of research and research collaboration of the GCC countries across various research fields. It can also identify research areas in which collaboration between the GCC countries and other regions is particularly strong already. Moreover, this methodology can to help discern the research areas with the most momentum as well as those that are losing ground.

By mapping and evaluating the research networks of the biggest research areas in the GCC (as measured by the number of publications), as well as research priority areas identified by GCC stakeholders themselves, we thus aim to help compile a list of relevant research priorities with the highest potential for growth and fruitful collaboration between the GCC countries and other parts of the world.

10.4.1 Background of Bibliometric Analysis

The mapping method we have developed borrows from roughly three lines of research. The first is the literature on co-authorship networks comprising descriptive empirical studies (studying and classifying the topology of research networks across research fields and time), including theoretical work geared towards constructing models of network formation and simulation attempts to match the evolution and topology of real-world research networks. Important papers in this line of research are Barabási et al. (2002), Newman (2004), Goyal et al. (2006), Fafchamps et al. (2010) and Goyal and Van der Leij (2011). Watts (2004) provides a nice overview of the study of networks across disciplines.

The second strand of research from which we draw is the vast informational science literature on research collaboration networks and the study of scientific domains that proposes various methods of mapping and evaluating collaboration networks using bibliometric and additional—usually web-based—data (Cf. Heimeriks et al. (2003); Moya-Anegón et al. (2004); Leydesdorff and Rafols (2009); De Bellis (2009) for a nice overview). The standard research area categorisation in this literature appears to be Thomson Reuter's ISI subject categorisation and we employ it for our bibliometric analysis accordingly.

Finally, our work relates to that of others who use bibliographic databases to assess research strength in parts of the world and across research fields, most notably the bibliometric study of South-East Asia by Peter Haddawy (2010) and the Global Research Report on Africa by Adams et al. (2010). Haddawy uses Elsevier's Scopus as bibliometric input database, while the latter draws on the ISI Web of Science database. Given that the ISI database employs the subject categorisation that appears to be the standard in biblio- and scientometric research, we use it as principal database for our analysis, but complement it with data from Scopus where ISI is lacking—as further outlined in the next section.

10.4.2 Method

The basic idea behind mapping research networks is to visualise research collaborations by plotting researchers/research centres/countries as nodes and connecting nodes that have collaborated with an edge (line). We base our maps of research networks on publications included in the ISI web of science database, supplemented by information from Elsevier Scopus, and we focus solely on collaboration manifested as co-authorship. Because we aim to visualise and evaluate the research network of the GCC in relation to Europe and the rest of the world, we take the six GCC countries and Yemen, Europe, the US (together with Canada, Australia and New Zealand), the six other INCONET project clusters[2] and the rest of the world as nodes in the network and represent a co-authorship between any of these nodes by a line connecting them.

We follow a number of steps when creating a research network map. First, we download from the ISI and Scopus databases an overview of scientific publications by authors of which at least one was affiliated with an institution in the GCC or Yemen at the time of publication. We refine the overview by ISI category or more

[2] These projects are CAAST-Net (Coordination and Advancement of sub-Saharan Africa-EU Science & Technology Cooperation Network), IncoNet EECA (S&T International Cooperation Network for Eastern European and Central Asian Countries), EULARINET (European Union – Latin American Research and Innovation NETworks), MIRA (Mediterranean Innovation and Research Coordination Action), SEA-EU-NET (Facilitating the Bi-Regional EU-ASEAN Science and Technology Dialog) and WBC-INCO.NET (Western Balkan Countries INCO-NET), (European Commission, 2011).

specific research topic, depending on the scope of the map to be created. Next, we replace authors by the country of their research affiliation to generate an affiliations-by-publication matrix. Because the author affiliation entries listed by ISI are far less complete than those listed by Scopus, we supplement ISI affiliations with ones from Scopus for all matching publications, where publications are matched on title.

The affiliations-by-publication matrix is used to construct a network matrix in which the entry in row (i) and column (j) gives the total number of co-authorships between authors affiliated with country (group) (i) and authors affiliated with country (group) (j), weighted by adjusted "total cites" of the sources of the respective publications. The total cites metric is taken from Thomson Reuters Journal Citation Reports (JCR) 2009 and 2010,[3] which publish the total number of citations of a journal in the JCR year. The JCR does not include all sources appearing in the ISI publication database and we therefore construct an adjusted total cites metric where every source not listed in the JCR is awarded a total cite of 1. Because a disproportionately large share of (publications in) conference proceedings are missing from the Journal Citation Reports, and because conference proceedings account for a larger share of publications in some fields (most notably electrical and mechanical engineering, telecommunications and computer sciences) than others, the missing JCR publication sources causes the total cites weight given to publications to be biased both within and across fields. The aforementioned adjustment made to the total cites metric only partially corrects for this bias, and future research is geared towards improving this.

Finally, we use the network matrix to plot the corresponding research network map using UCINET.[4] Figures 10.2 and 10.3 are examples of research network maps generated in this fashion. In these network maps, the size of a node representing a particular country (group) depends on the number of publications its affiliated authors published in the given time span, weighted by adjusted total cites of the corresponding publication sources. Similarly, the thickness of a link between two nodes represents the number of co-authored publications by authors affiliated with the two connected countries (groups), again weighted by corresponding adjusted total cites. In Fig. 10.2 for instance, it is clear from comparing the sizes of nodes in the map that the total weighted number of publications by authors affiliated with Saudi Arabia exceeds that of authors affiliated with Qatar in

[3] We used data from JCR 2009 for our analysis of the top-20 research areas of the GCC and Yemen and data from the JCR 2010 for our analysis of the evolution of research fields and the research strength and collaboration in the GCC Research Priority Areas. The JCR 2010 had not been published when we did the former analysis. The adjusted total cites metrics that we construct using data from these JCRs however appear highly correlated.

[4] The network matrix used for mapping the network ignores any co-authorship links amongst and within countries outside of the GCC and Yemen. These co-authorships represent only a small subset of the total co-authorships between and within countries outside of the GCC and Yemen due to the way in which publications are selected (based on affiliation with the GCC and Yemen) and are therefore uninformative.

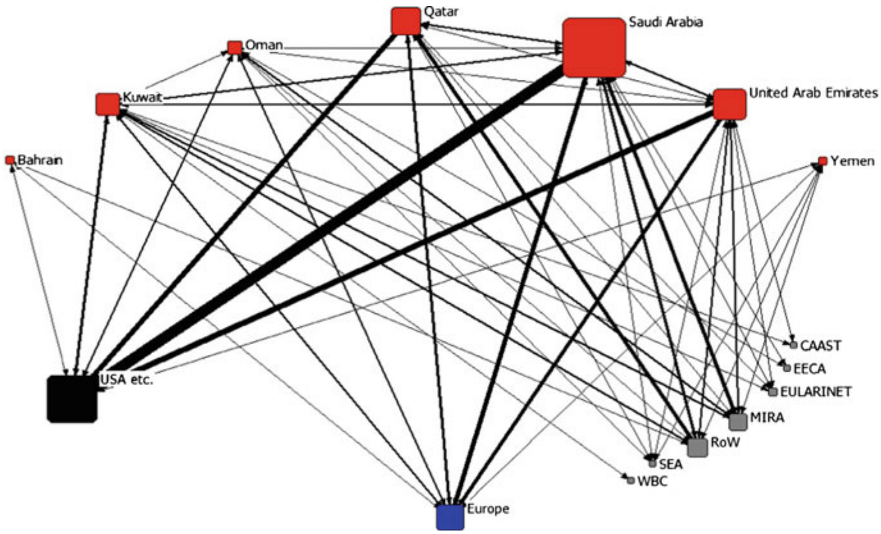


Fig. 10.2 Co-authorship network in the field of Engineering (Electrical & Electronic) over the period 2007–2010, weighted by adjusted total cites. *Source* The authors, based on data from ISI, Scopus and JCR 2010

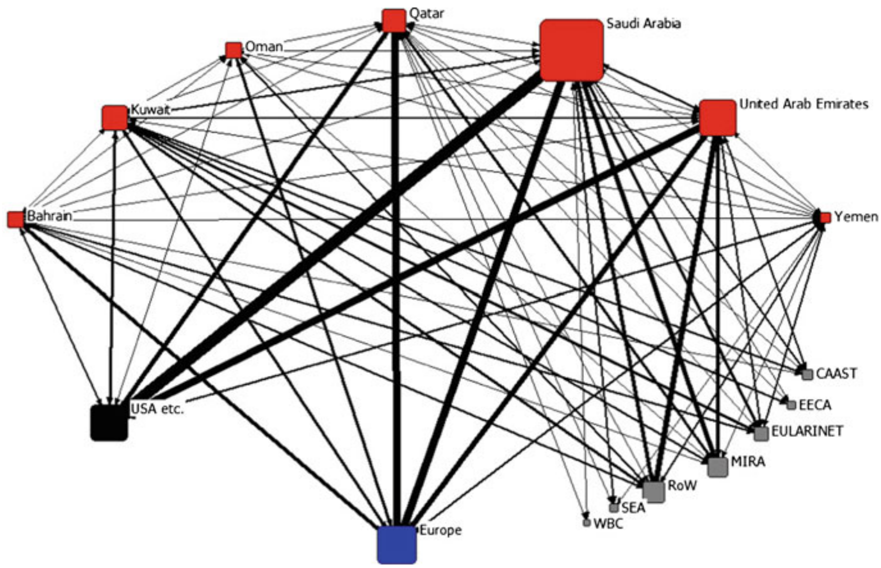


Fig. 10.3 Co-authorship network in the field of Medicine (General & Internal) over the period 2007–2010, weighted by adjusted total cites. *Source* The authors, based on data from ISI, Scopus and JCR 2010

the respective field and time period. Comparison between the thickness of lines in the same figure shows that the total weighted number of publications on which Saudi authors collaborated with authors from the US exceeds the weighted number of publications on which UAE authors collaborated with US authors.

10.4.3 Network Maps of the Top-20 Research Fields of the GCC and Yemen

Using the method outlined above, we have generated co-authorship network maps for the 20 most important (as measured by the total number of publications in the last 5 years) research areas of the GCC and Yemen. These maps yield a number of interesting insights into the research network of the GCC and Yemen that we will briefly discuss below. Figures 10.2 and 10.3 depict the co-authorship networks in the top two areas Engineering (Electrical & Electronic) and Medicine (General & Internal), respectively.

Figure 10.4 shows the number of publications weighted by adjusted total cites (based on JCR 2009) in the period 2007–2010 of the GCC and Yemen in their top ten research fields. The research fields are ordered by size (measured by total number of publications by authors affiliated with the GCC), with size decreasing when going from left to right in the figure. The front seven rows of bars depict the weighted number of publications of the individual GCC countries and Yemen. The rear four bars represent the weighted number of publications on which scholars affiliated with the GCC collaborated with scholars affiliated with Europe, the US (together with Canada, Australia and New Zealand), MIRA or other GCC countries, respectively.

The first observation of interest relates to the relative sizes of the top twenty research areas. The top two research areas are relatively much bigger than the other research areas in the top-20, with the total number of publications by GCC-affiliated authors in the largest research area of the GCC (Engineering (Electrical & Electronic)) being almost twice the number of publications in the third largest research area of the GCC (Mathematics (Applied)).

Second, the research network maps show that substantial cooperation takes place in most research fields between the GCC and Yemen and the US, Europe, MIRA or other parts of the world. In most fields, the US is the biggest partner, but in Engineering (Chemical) and Biochemistry & Molecular Biology it is Europe, and in Material Science (Multidisciplinary) and Computer Science (Interdisciplinary Applications) it is MIRA. For Mathematics (Applied), Pharmacology & Pharmacy, Computer Science (Theory & Methods), Environmental Sciences, Physics (Applied) and Mechanics the US, Europe and MIRA (and/or other parts of the world) are equally strong co-authorship partners. Co-authorship links amongst the GCC and Yemen are generally few and weak, especially compared to the number and strength of links with non-GCC countries. However, Medicine (General & Internal) is an exception to this rule (Cf. Fig. 10.3).

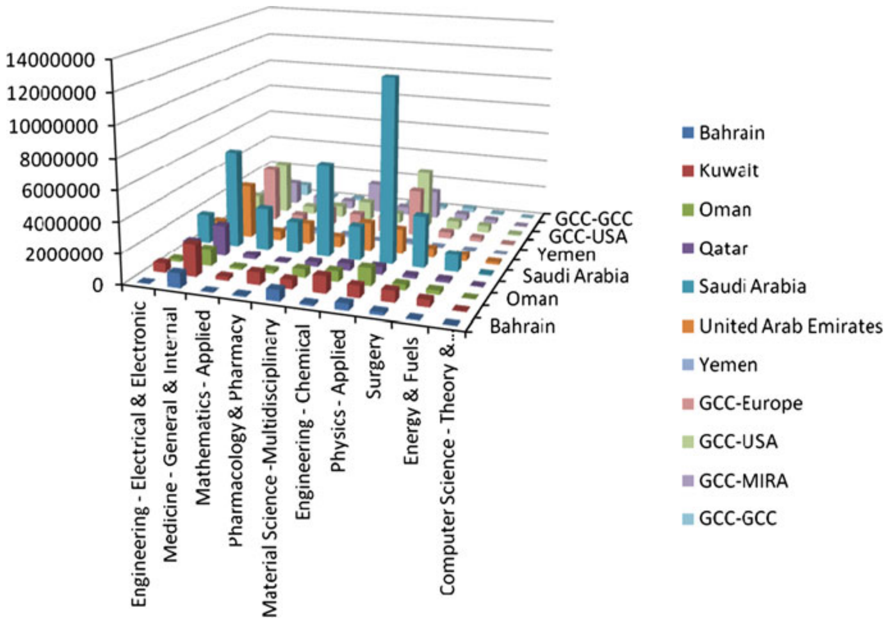


Fig. 10.4 Number of publications in the period 2007–2010 by research area and country for the top-10 research areas of the GCC and Yemen, weighted by adjusted total cites. *Source* The authors, based on data from ISI, Scopus and JCR 2010

Finally, the maps allow us to evaluate the relative research strength of the GCC countries across research fields. Generally speaking, Saudi Arabia has the most (and the most influential) publications (Cf. Fig. 10.2), except in Computer Science (Theory & Methods), where the UAE is the biggest player. In Engineering (Chemical), Pharmacology & Pharmacy, Engineering (Mechanical) and Biochemistry & Molecular Biology the UAE are almost as big as Saudi Arabia, while in Telecommunications Qatar is nearly as important a player as Saudi Arabia. Kuwait and, to a lesser extent, Oman are usually mid-size players—their greatest strengths are in the fields of Engineering and Environmental Sciences. Bahrain and Yemen are generally the smallest and least well-connected nodes among the GCC, with Bahrain being entirely unconnected in Engineering (Mechanical) and Chemistry (Multidisciplinary), and Yemen in Mechanics.

10.4.4 Evolution and Research Priority Areas

In a first bid to assess the evolution of research strength and collaboration in the GCC, we have mapped the research network of the GCC and Yemen in the two top fields Engineering (Electrical & Electronic) and Medicine (General & Internal) separately for the years 2007 through 2010. The corresponding number of

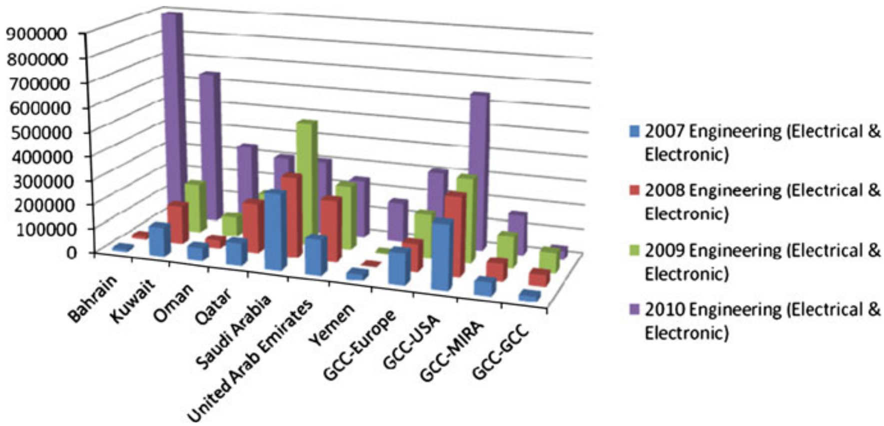


Fig. 10.5 Number of publications in engineering (electrical & electronic) by country and year, weighted by adjusted total cites. *Source* The authors, based on data from ISI, Scopus and JCR 2010

publications by country or collaboration and year, weighted by adjusted total cites based on JCR 2010 are depicted in Figs. 10.5 and 10.6, respectively.

In the field of Engineering (Electrical & Electronic) there appears to be an upward trend in the number of publications. Kuwait, Oman and Qatar have increased their research output in the field roughly throughout the period, while the output of Bahrain and Yemen has jumped up in 2010. Saudi Arabia and the UAE were on an upward path from 2007 to 2009, but in 2010 their output fell to below its 2008 level. Collaborations have been on the rise too, with a strong increase in output produced by collaborations between the GCC and the US, and a slightly weaker increase in output from cooperation between the GCC and Europe and the GCC and MIRA. The only exception to this rule is the output produced by collaborations amongst the GCC and Yemen; although the output produced by such collaborations rose from 2007 to 2009, it fell back to below its 2008 level in 2010.

The pattern is less clear in the field of Medicine (General & Internal). Here, the output of almost all countries and collaborations jumped down in 2010, with only Bahrain being on a consistently upward path. Oman's output is on the rise from 2008 onwards, while Saudi Arabia's output increased until 2009 only. Kuwait and the UAE have been on a downward trajectory from 2008 onwards. The output produced by collaborations between the GCC and Europe, the US and MIRA increased until 2009, but fell considerably in 2010. The pattern of output produced by collaborations amongst the GCC and Yemen is more erratic, with a sharp increase in 2008.

Finally, to gauge the viability and potential of growth and increased collaboration in areas that the GCC and Europe have identified as being of particular interest, we have analysed the output and network in four GCC Research Priority Areas (Flesia 2011). Identified by the stakeholders from the GCC and Yemen and

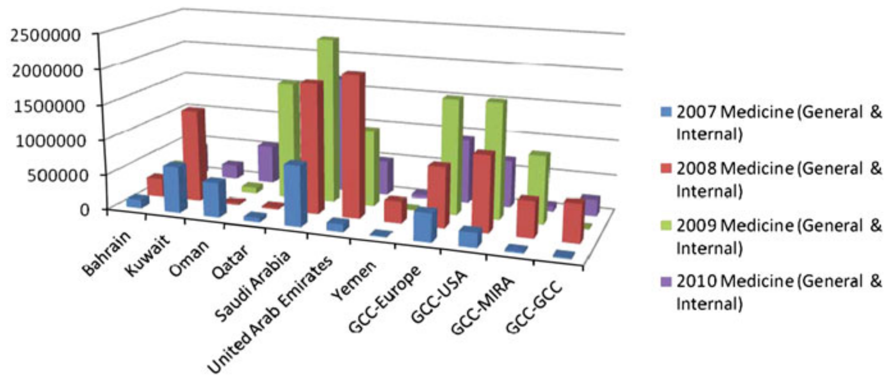


Fig. 10.6 Number of publications in medicine (general & internal) by country and year, weighted by adjusted total cites. *Source* The authors, based on data from ISI, Scopus and JCR 2010

Europe in the INCONET-GCC project, these are: Health, Energy (Security), ICT and Environment, Water & Climate (including Marine, Agriculture and Food).

Figure 10.7 depicts the number of publications in the GCC Research Priority areas[5] weighted by adjusted total cites based on JCR 2010, by country and collaboration. Note that, because these areas differ in scope considerably—with Health and Environment, Water & Climate being much broader areas than Energy (Security) and ICT—a meaningful comparison of research strength across these areas is difficult.

We therefore focus on comparisons across countries and collaborations within the priority areas. The pattern of relative research strength of the GCC countries that is observed in the Top-20 fields resounds in the data on the priority areas: Saudi Arabia produces the greatest output in all priority areas, followed by the UAE, then Kuwait, Oman and Qatar. Bahrain and Yemen are the smallest players across the board, with neither producing any output in the ICT area.

As for output produced by collaborations, those between the GCC and Europe reigns supreme in Health, followed by collaborations between the GCC and the US and between the GCC and MIRA. In the priority area Environment, Water & Climate, collaborations between the GCC and the US and the GCC and Europe produce almost equal amounts of output, with the latter lagging by only a small

[5] Based on the descriptions of the GCC Priority Areas in Flesia (2011), we have taken “Health” to comprise publications in the ISI subject categories Biotechnology Applied Microbiology, Biochemistry Molecular Biology, Endocrinology Metabolism, Pathology and Genetics Heredity. “Energy(Security)” comprises publications that are classified under ISI subject category Energy Fuels, while “ICT” comprises search results for the topic “Information and Communication Technology” in the ISI Web of Science database. The priority area “Environment, Water & Climate” is taken to comprise publications in the ISI subject categories Environmental Sciences, Water Resources, Marine Freshwater Biology, Agriculture Dairy Animal Science, Agronomy and Fisheries.

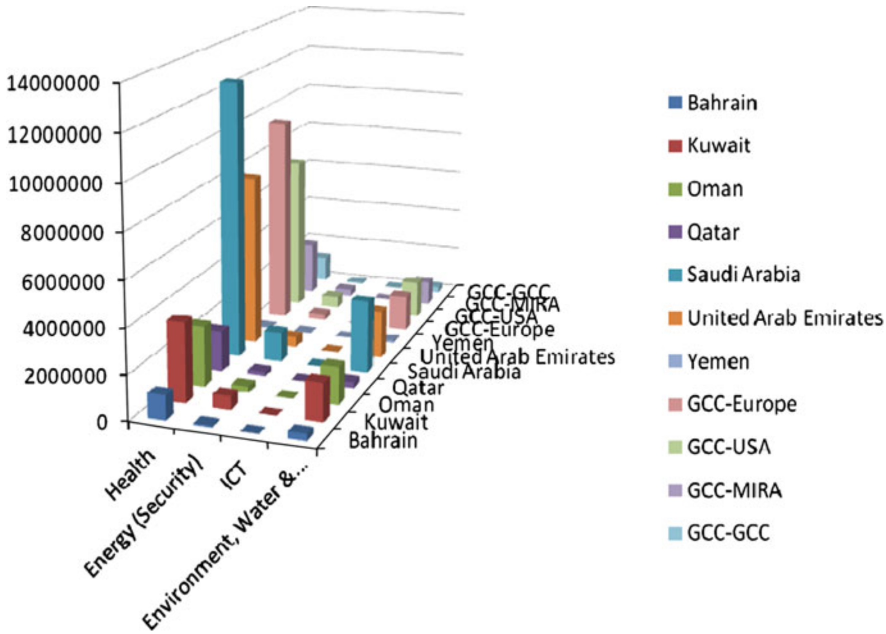


Fig. 10.7 Number of publications in the GCC research priority areas by country and collaboration, weighted by adjusted total cites. *Source* The authors, based on data from ISI, Scopus and JCR 2010

amount, while the output level of GCC-MIRA collaborations is about two-thirds that of GCC-US collaborations. In Energy (Security) GCC-US partnerships produce almost twice as much output as collaborations between the GCC and MIRA and those between the GCC and Europe, with GCC-MIRA collaborations producing slightly more than GCC-Europe partnerships. The output produced by collaborations amongst the GCC and Yemen is much smaller across the board than that of other partnerships between the GCC and Europe, the US or MIRA.

10.5 Concluding Remarks

The GCC countries are in the process of expanding their higher education systems and raising the quality of their research and its relevance to society. It is not obvious how governments can best help induce a favourable development in this regard. Universities cannot meaningfully be regulated or prescribed to achieve excellence in any top-down or uniform manner. Any successful strategy needs to embed a strong element of autonomy with appropriate room for local initiative so that all institutions can attempt to improve in the direction that works best for them. On the other hand, public support and incentives are critical for spurring progress.

Against this backdrop, this chapter has highlighted the importance of public procurement practices in fuelling improved performances in a range of industries. It also indicates the potential importance of applying public procurement principles as a tool for public authorities in the GCC countries to reform their research funding and help spur an intensive pursuit of strengthening science and research performance in a manner that can be consistent with local adaptation and diversification.

Collaborations between local and international researchers may be of central importance for furthering a knowledge-based economy in any part of the world. Hence, there is a need for networking tools that are sound and effective in analysing and stimulating the build-up of research capacity. One of the initial steps towards increased research capacity should be a careful review and examination of existing scientific output in the GCC countries and international linkages.

To this end the London School of Economics has developed a method for mapping research networks using bibliometric data and performed an exploratory analysis of the research collaboration network of the GCC and Yemen. We find that there is substantial research collaboration between the GCC and Yemen and the US, Europe and MIRA, with the US the biggest research partner in most fields. In contrast, collaborations amongst the GCC and Yemen are generally few and weak. In the field of Engineering (Electrical & Electronic) there appears to be an upward trend in research output, both from individual GCC countries and Yemen as well as from collaborations with the US, Europe and MIRA, but there is no such consistent rise in the field of Medicine (General & Internal).

An exploratory analysis of the research strength and collaboration in the GCC Research Priority Areas (Flesia 2011) finds that collaborations between the GCC and Europe produce a higher output level than those between the GCC and the US in the Health area, and the output level of these partnerships is almost the same in the area Environment, Water and Climate.

On this basis, it is worth underlining that we witness the combination of some rapidly growing research linkages between GCC countries and other parts of the world, but the research collaboration within the region remains virtually stagnant. Further work should be undertaken to explore the policy implications and opportunities for collaboration between the GCC countries and other areas of the world in science and research. Whereas a continued intensification with other regions can be expected, the question is what prevents the development of local research networks, what the consequences are, and what action is merited to address the current situation.

Acknowledgments The authors would like to thank participants of the conference on "Best Practice in S&T Policies EU-MENA Countries", Muscat, December 2010, as well as participants of the INCONET-GCC meeting in Venice, November 2011, for their useful comments.

Chapter 11
New Perspectives on Health Issues, Research and Innovation

Kazem Behbehani and Peter F. Beales

In the swift transition from traditional to modern lifestyles, health-conscious societies with good governance have contributed to an immense improvement in the quality of life of their populations. In contrast to the West, however, where populations are ageing, the Middle East is characterised by a young, growing and technology-savvy demographic. This heralds a promise of continued improvement in health status, with better health system design and management. However, new diseases such as lifestyle-related obesity are beginning to take their toll. Bold steps are required to develop a health-conscious, knowledge-based society, centred on the prevention of disease and the promotion of good health and well-being, in support of improved quality of life and economic development in the Middle East.

11.1 GCC Demographics

The profound demographic and social changes that have transformed the six-nation Gulf Cooperation Council (GCC) region (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates) are set to continue over the next decade. The GCC has one of the fastest-growing populations in the world, forecast to rise by one-third to 53 million people by 2020. The vast majority will be under 25 years of age. This rapidly growing and relatively youthful demographic presents serious challenges as well as major opportunities.

K. Behbehani (✉) · P. F. Beales
Dasman Diabetes Institute, Kuwait City, Kuwait
e-mail: kazem.behbehani@gmail.com

P. F. Beales
e-mail: p_beales@yahoo.com

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_11,

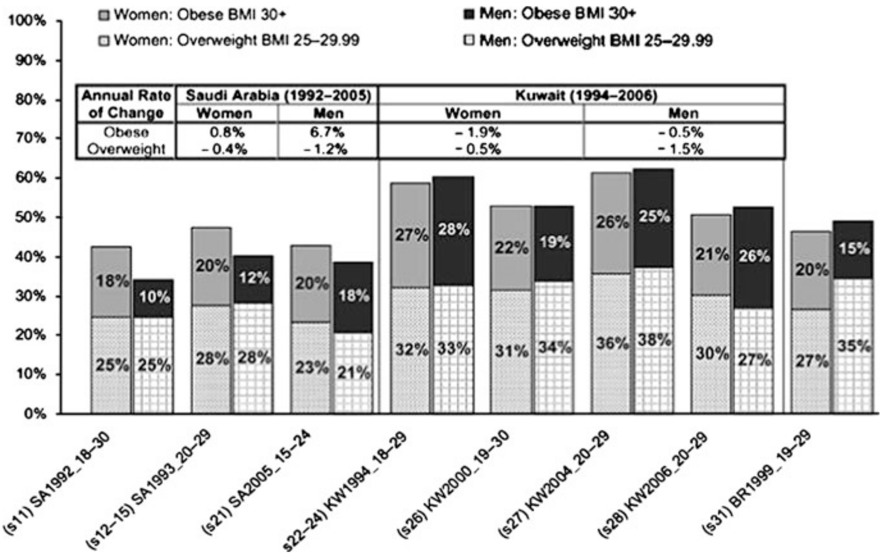


Fig. 11.1 Prevalence, trends and annual rate of change of overweight and obesity among young adults (16–30 years old) in the Gulf States *Source* Ng et al. (2011)

Notwithstanding disparities between countries, the overall health improvement has been impressive. Life expectancy rose from 60.5 years in 1978 to 73 years in 2004. Infant mortality fell from 69 deaths per 1,000 live births to 18 in the same period.

11.1.1 The GCC Health Challenges

Among GCC nationals, the prevalence of Type 2 diabetes and obesity is unusually high relative to the rest of the world. The obesity rate for GCC nationals stands at 40 %, one of the highest in the world. The health complications of both diabetes and obesity will correlate with much higher medical costs in the coming years (Figs. 11.1, 11.2, 11.3).

The hospital sector is modernising to cope with the newly emerging situation and some countries are investing more resources in primary care. However, this will not be sufficient unless there are major changes. The private health sector needs to be encouraged, while the health care industry as a whole must be well regulated (Hediger et al. 2007) (Table 11.1).

The total health expenditure for diabetes (in US dollars) in the MENA Region for 2010 was $5.6 billion, with an increase estimated at $11.4 billon in 2030.

Internationally, the health sector is growing rapidly, a trend that offers substantive development and employment opportunities. One of the global effects of higher medical costs is an increase in medical tourism by patients in search of

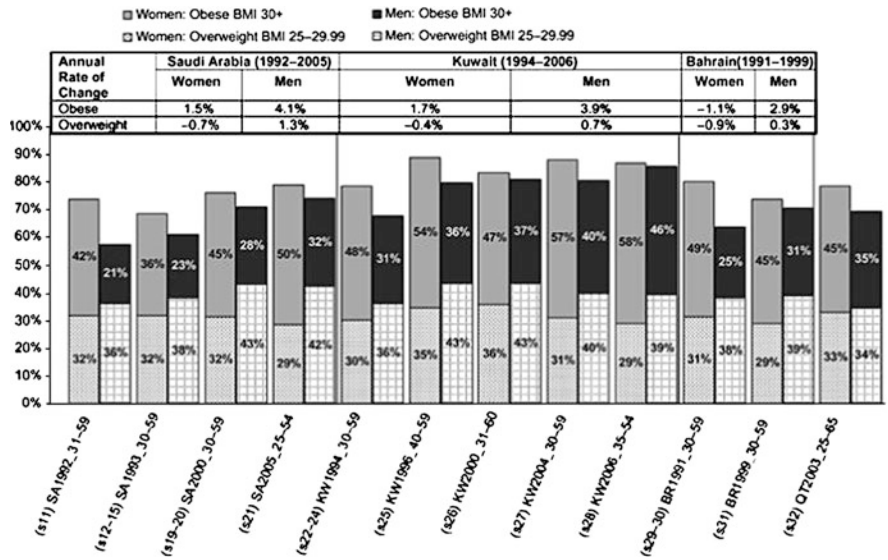


Fig. 11.2 Prevalence, trends and annual rate of change of overweight and obesity among adults (30–60 years old) in the Gulf States *Source* Ng et al. (2011)

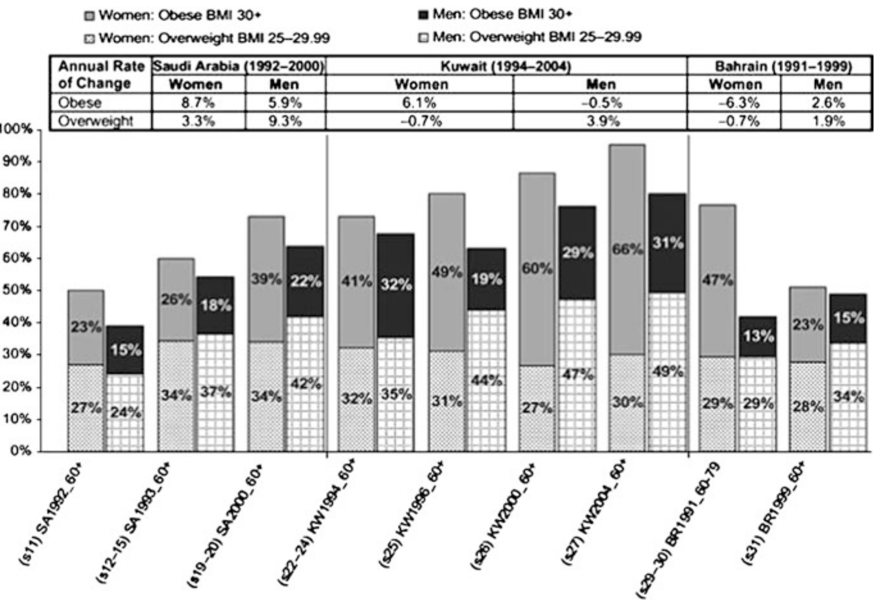


Fig. 11.3 Prevalence, trends and annual rates of change of overweight and obesity among older adults (≥60 years old) in the Gulf States *Source* Ng et al. (2011)

Table 11.1 Health expenditures for diabetes (USD) in billions

	2010 (in billion)	2030 (in billion)
MENA	5.6	11.4
Africa	1.4	2.0
Europe	105.5	124.6
North America and Caribbean	214.2	288.7
South and Central America	8.1	13.2
South–East Asia	3.1	5.3
Western Pacific	38.2	44.8

Source International Diabetes Federation (2010)

countries providing medical services at a much lower cost. However, in the case of the Middle East, medical tourism often takes on a different perspective in that patients go in search of what is considered better or more comprehensive care. Through pilot projects, Kuwait is seeking not only to connect health facilities electronically and develop a citizen-centred approach to health care, but also to raise the standard of care and to offer more services, thereby reducing the need for patients to leave the country for medical attention and providing a system that can better cope with the rising epidemic of chronic diseases. These projects are also supporting the professional development of young Kuwaitis to provide better employment opportunities in the country's health sector.

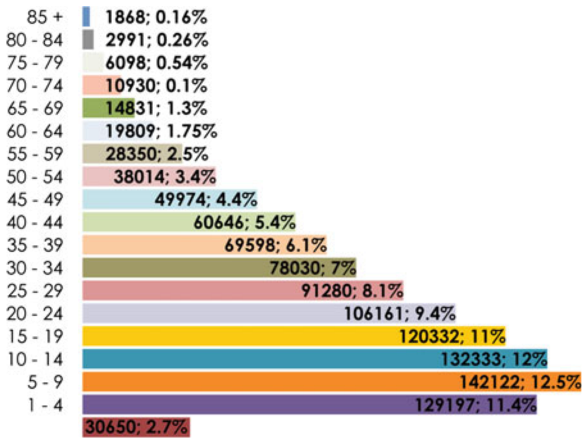
11.1.2 Kuwait Population and Health Challenges

The population of Kuwait was estimated at 3,582,054 on 31 December 2010, according to the Central Statistical Office (Health Kuwait 2010). The number of Kuwaiti nationals was 1,148,363, representing 32 % of the total population (Fig. 11.4).

From the January to March 2011 Quarterly Report, the proportion of Kuwaitis under the age of 20 years in Kuwait was 49.6 % of the total Kuwaiti population and 40 % of Kuwaiti nationals are under the age of 15. By 2025–2030, Kuwait nationals in the 0–14-year-age cohort (with the lowest rates of health care services utilisation) are expected to decrease from 40 % to 29 % of the total national population, while the over-45 age cohort (with the highest rates of health care services utilisation) will represent at least 26 %, up from the current 13.8 % (Fig. 11.5).

There is a steady increase in the prevalence of chronic diseases, in particular diabetes, cancer and coronary heart disease. In addition, non-communicable disease risk factors are alarmingly high—especially obesity, dyslipidemia and physical inactivity. Multiple factors, on a background of an underlying genetic susceptibility, have led to diabetes becoming more prevalent in Kuwait. These include rapid urbanisation, rising per capita income changes, nutritional habits and less physical activity, which in turn have led to high obesity rates among the population.

Fig. 11.4 Total Kuwaiti population by age group (mid-year 2010) *Source* Health Kuwait (2010)



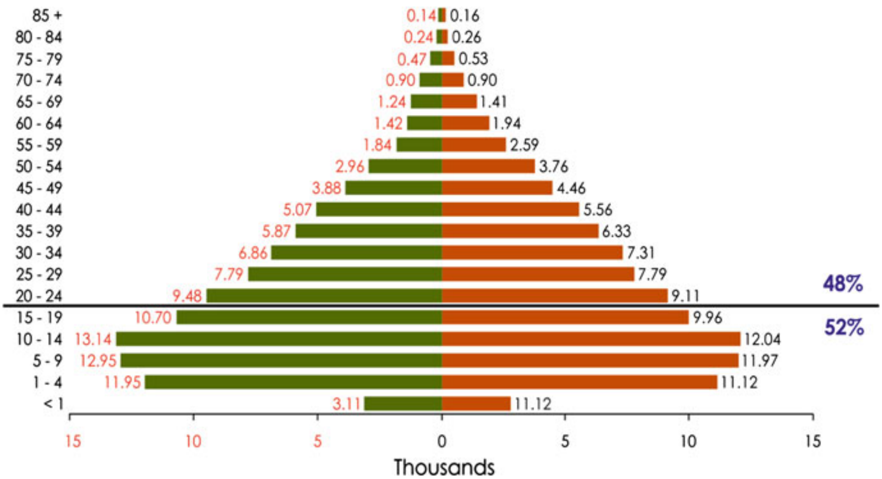


Fig. 11.5 Age of distribution of Kuwaiti population (2009). *Source* Health Kuwait (2009), Health and Vital Statistics Division: Department of Statistics Medical Records, Ministry of Health, State of Kuwait

11.1.3 Obesity and Diabetes in Kuwait

Obesity and diabetes are twin epidemics that the government of Kuwait has identified as major public health issues. A recent study of 2,280 Kuwaiti individuals demonstrated that the prevalence of diabetes was 18.1 %, obesity 47.5 %, overweight 80.4 % and metabolic syndrome 36.2 % (Ibrahim Al-Rashdan and Yousef Al Nesef 2010) (Fig. 11.6).

Similarly, in a cross-sectional study of 740 adult diabetic patients (Kuwaiti and non-Kuwaiti) from five out of 94 primary health care centres (PHCs) in Kuwait,

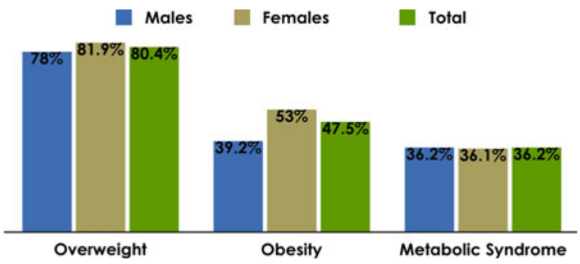


Fig. 11.6 Prevalence of overweight, obesity and metabolic syndrome (adult Kuwaiti population, random sample study) *Source* Al-Rashdan and Al-Nesef (2010)

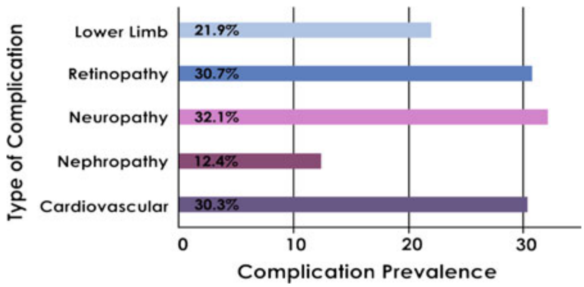


Fig. 11.7 Complications found in diabetic patients from five kuwait primary health care centres *Source* El-Shazly et al. (2010)

more than 61 % had already one or more chronic diabetes mellitus complications (Fig. 11.7).

Life expectancy in Kuwait is 76 years for men and 80 years for women. However, diabetes and obesity can reduce longevity by 13 years and 5–20, respectively (Olshansky et al. 2005).

The problem of childhood obesity in Kuwait will be of great concern in the future. A recent study showed that the overall prevalence of overweight and obese Kuwaiti children aged 10–14 years was an alarming 30.7 % and 14.6 %, respectively (Bayoumi et al. 2009). Furthermore, in a large survey of 128,918 children aged 6–18 years, the prevalence of type 2 diabetes was 34,9 per 100,000 (Moussa et al. 2008). This confirms the emerging public health problem of type 2 diabetes in children and adolescents, requiring efforts to address prevention strategies in youth and among parents.

11.2 The Kuwait Constitution

Kuwait's constitution is excellent in its guarantee of health care for its citizens and the protection of its youth and elderly populations in articles 10, 11 and 15.

Article 10 (Youth protection): The state cares for the young and protects them from exploitation and from moral, physical and spiritual neglect.

Article 11 (Old age protection): The state ensures aid for citizens in old age, sickness or inability to work. It also provides them with services of social security, social aid and medical care.

Article 15 (Health care): The state cares for public health and for means of prevention and treatment of diseases and epidemics.

11.3 Health Research and Innovation

Health research is multidimensional and may be categorised into biomedical, clinical, population and public health research. Recently a number of initiatives for research capacity building including a new health research and innovative strategy transcending traditional domains have been undertaken. The core objective is to establish priority goals and actions to achieve a long-term vision of health research and innovation in Kuwait, underpinning the important role of education. Research capacity building should ensure appropriate dissemination to maximise impact.

Health education, on the other hand, is the process of educating people about wellness and promoting good health. Education mainly motivates people to boost their living conditions, to develop their knowledge about healthy lifestyles and to become responsible members of a more health-conscious society. The focus is to create a health action plan to deal with the current challenge of obesity and diabetes. The emphasis is on training and education, and providing validated information to people in the risk of obtaining diabetes as well as to those with the disease and their carers. The latter include doctors, nurses, a range of allied health professionals and public health medical and health service managers. By deploying a range of different methods and learning experiences, an appropriate mix of competent professionals will be developed to support the health services.

Learning and teaching are provided through an ambitious 3-year programme that provides continuous professional development to those involved in the provision and management of diabetes healthcare in Kuwait and establishes knowledge transfer expertise in primary care service delivery. It aims to ensure that the postgraduate certification course in diabetes care and education is consistent with the educational needs of the professionals in Kuwait’s health care system. The ultimate goal is intellectual capacity building, knowledge sharing and the development of the clinical skills needed for the efficient delivery of health services. The Kuwait Education Programme was launched in September 2011. Eighty-seven candidates enrolled in the first batch to take the four educational modules of diabetes care, leadership, clinical skills and training of trainers. The plan is eventually to enrol and graduate 500 health workers.

Despite admirable achievements in socioeconomic development, health status and the provision of, and access to, public services, Kuwait is facing many challenges in the twenty-first century that may impinge on public health unless serious and systematic steps are introduced as soon as possible.

Public health has been defined as “the science and art of preventing disease, prolonging life and promoting health through the organised efforts and informed choices of society, organisations, public and private, communities and individuals” (Wanless Report 2004). The basis of disease prevention is sound public health policies and practices on the part of government, industry, the private sector and the general public and a knowledge-based society with a voice that can be heard. The individual, the family and the community collectively must be responsible for their own health, the environment in which they live and the attitudes and behaviour of the inhabitants with regards to health and welfare. Empowerment the general public to actively participate in its own health, as part of its contribution to civil society, is important in the development of health-knowledge-based society.

11.3.1 Science, Technology and Innovation System

The evolution of a science, technology and innovation system enables several entities to work in partnership and collaboration. These include government bodies, private businesses, media, public associations and others. Fully deployed, a science, technology and innovation system can help achieve the ultimate objective of developing preventative therapeutic strategies to control obesity and diabetes and their associated complications. The most innovative, state-of-the-art, scientific and technological tools can be used to decipher the pathophysiology and identify and characterise biochemical factors of obesity and diabetes and associated complications, with the perspective of developing effective diagnostic and therapeutic strategies.

11.3.2 Information and Communication Technology

Kuwait is one of the most advanced technological markets among the member countries of the GCC. Growth in broadband subscribers has been strong, although numbers are still very low. The government hopes to drive ICT development with its broadband access initiative.

Despite the global economic downturn, Kuwait is striving for a continued eProject implementation by various state organisations. At the end of 2010, the Kuwait Ministry of Education announced the launch of a new technology Infrastructure Project aimed at increasing information technology use in schools. This has been billed as just one of the first in a series of planned projects to raise the standard of school information technology systems. Dasman’s School Health Initiative seeks to link to this project, thereby mobilising and strengthening health promotion and education activities. One of the main focuses will be on dietary and hygienic practices that cause disease, such as a sedentary lifestyle. Another related project announced by the education ministry is the establishment of a cloud-computing centre to serve students and teachers.

11.3.3 Linkages, Partnerships and Collaboration Enhances Research Capacity Building

There is little doubt that establishing linkages, and building partnerships and collaboration, enhances research capacity building so that the country benefits from the best of both worlds. In Kuwait, agreements have been established with major international organisations and internationally renowned academic institutions for collaboration on multiple programmes and projects.

Developing skills and building confidence at an individual, team and organisational level is critical. Organising discovery courses has helped develop skills in the education field and the training of health care professionals from the primary health care sector, and has also offered opportunities for postgraduate certification and higher qualifications such as MSc degrees. This form of information transfer and knowledge acquisition through a variety of mechanisms including workshops, web-based discussion forums, flexible learning packages and participation in research is greatly enhancing capacity at the primary health care level, where a major opportunity exists for improved management of chronic diseases such as diabetes and obesity before they result in cardiovascular complications (Albert and Mickan 2002). Thus, the philosophy is to transfer knowledge to, and develop skills in, primary health care professionals (who are the main health care providers in the country and who would also be able to deliver community-based measures to prevent disease complications).

Kuwait's Clinical Skills Centre is accredited internationally by the American Heart Associations as one of its international training centres. It is an educational and training centre for health care professionals, health care students and selected patients and represents another technology-based approach to developing skills. It uses simulation and other state-of-the-art medical technologies such as robotic mannequins to create real-life experiences to enhance participants' skills and abilities to ensure increased patient safety. The Kuwait Clinical Skills Centre is one of the few in the world that has introduced teaching for certain patients in important medical skills, giving the patients more independence and improving their quality of life. Among the skills taught are correct methods for injecting insulin, and blood glucose monitoring. The Clinical Skills Centre also serves the community in Kuwait by training and providing first aid and safety courses to the public. The emphasis at this stage is on schoolteachers.

The advancement of information technology in health care promotion and education could also be part of the Clinical Skills Centre's educational courses. The centre could be used to train health care providers and students in many different topics that involve technology and communication in health care. The centre could host various technology projects to help advance the health care system.

11.3.4 Cell Therapy for Diabetes

The need for an innovative diabetes cell therapy programme in Kuwait and the other Gulf Cooperation Council states is apparent due to the high prevalence of diabetes and related secondary complications, and the individual and national financial burden that this is causing.

In Kuwait, a strategic plan of "Cell Therapy for Diabetes" that includes "islet transplantation" and stem cell therapy is being developed. The plan is based on current knowledge and available information from internationally renowned centres in this field of cell therapy and its prime objective is to decrease insulin dependency in diabetics and to prevent diabetes-related secondary complications through successful islet transplantation and stem cell therapy procedures.

11.3.5 Innovative Genomic Research

Kuwait has established a state-of-the-art Genome Centre for innovative research to develop preventive and therapeutic strategies to control obesity, diabetes and their associated complications. As gene-environment interactions are implicated as major components in the aetiology of obesity, diabetes and their associated complications, it is essential to characterise them, and develop innovative scientific and technological platforms that help to decipher the risk factors and the pathophysiology. The Genome Centre provides the necessary infrastructure for investigating the principal genetic and environmental risk factors that confer population susceptibility on common public health challenges including obesity and diabetes and for using the resulting knowledge for large-scale population screening.

11.3.6 eHealth

An innovative method to promote a healthy lifestyle and healthy environment is to make use of the population's competence as regards technology and techniques, and use these skills in ICT for health purposes, namely eHealth.

Kuwait has made progress in following the eHealth strategies endorsed by the World Health Organisation (WHO), utilising eHealth for best practice, policy coordination and technical support for health care delivery, service improvement, information to citizens, capacity building and surveillance. In hospitals where eHealth strategies have been deployed, interoperable electronic health records have led to improved patient safety, enhanced physician efficiency and reduced medical errors. eHealth strategies also help health care professionals by providing immediate access to timely, comprehensive patient data. They also foster administrative efficiency and facilitate the communication of data between different health care professionals, general practitioners and specialists.

Agreements have recently been reached with well-known institutions to develop an electronic health network aimed at integrating electronic health records within the primary and secondary health services. This collaborative programme has three core components: (a) capacity building through training and development of staff, (b) effective and safe treatment of patients through real-time integration of clinical and administrative information services for disease management, audit and governance and (c) scientific advances through a lively engagement with the international research community.

Furthermore, this innovative network embeds education, informatics and quality improvement at the heart of health care transformation. In 2011 the system was deployed on a pilot basis in the Capital Region and configured in 22 PHCs with the required communication links and connectivity—the first initiative of its kind in Kuwait. In addition, the training of health care professionals has begun in how to use the clinical informatics platform to better coordinate and improve chronic conditions. An important addition has been the creation of national clinical standards and guidelines for non-communicable diseases in collaboration with the Ministry of Health and Faculty of Medicine at Kuwait University. These standards and guidelines provide clinicians, patients and researchers with the components of optimal diabetes care, general treatment goals and tools to evaluate the quality of care provided. By the end of 2011, all PHCs in Kuwait will have electronic connectivity. This will enable physicians to view electronic patient records anywhere in the country, as required.

11.3.7 eLearning

The use of electronic resources for medical topics by healthy individuals and patients is a form of consumer health informatics. This could contribute to the development of a health-knowledge-based society through eLearning. The WHO (2006) defines eLearning as "the use of any electronic technology and media in support of learning".

eLearning may be used not only to develop a knowledge-based society targeting all age groups, but also to promote health awareness and healthy lifestyles. An important aspect of eLearning is that content can be tailored to target different audiences, thereby providing an opportunity to convey health information to children, young people, adults and the elderly. This information may be delivered in the form of interactive eLearning modules or short clips using communication tools such as educational videos, compact discs, online websites, online forums and games.

Schoolchildren who run a high risk of developing widespread health conditions such as obesity are an appropriate target when it comes to rolling out knowledge to promote awareness. An effective school health programme can be one of the most cost-effective investments a nation can make to simultaneously improve education and health. School health programmes are a strategic means to prevent health risks among youth and to engage the education sector in efforts to change the educational, social and economic conditions that affect risk.

The introduction of interactive eLearning modules on health issues and specific diseases into the school curriculum has three key benefits. It teaches the value and use of computer technologies; it provides practice in using computers; and for the very first time it allows health to become a valid school subject. This is possible today because teachers are not required to teach content for which they are not trained, their role instead becoming one of mentor and discussion moderator. It is the eLearning programme that provides what the student needs to know about the subject. The health information is fully validated and the programme contains self-assessment and self-evaluation instruments. However, it does provoke discussions among the students about what they have learnt, and here the teacher's role is to moderate the discussion and keep it confined to the health content of the eLearning programme.

There are many advantages to eLearning, the foremost being that the students can learn at their own pace. We know that children learn at different rates. In a classroom setting, slower children are often left behind, while faster children are held back in favour of the majority. eLearning technology ensures that the slower learners are not left out and are not under pressure, and that the faster learners do not get bored. Other advantages are that the content can be rapidly and cost-effectively updated, the programme can be localised to suit any language and cultural issues, and health issues that have never before been taught in school can now be addressed in the drive to develop a health-knowledge-based society.

Besides eLearning experiences in the classroom (computer laboratory), school field trips can ensure that students learn about the benefits of physical activity and of leading a healthy lifestyle, the value of nutritional counselling and the need to spread awareness of the importance of a healthy diet.

11.3.8 mHealth Initiative

The objective of using mobile communication systems (mobile health—mHealth) is to support innovation, research and education as a means of empowering the population to take better care of their own health. Expanding the use of ICT will enable more people to be accessed more efficiently. People increasingly use mobile phones to communicate, making it logical and innovative to harness this technology for the better management and prevention of chronic diseases, to provide support to patients and to educate people in preventive health care and how to take care of their families and friends.

Kuwait launched a partnership with one of the top national telecom companies in July 2011 to develop a mHealth model, suitable for global replication, focused on education and raising health awareness. The intention is to impact behavioural and lifestyle change to reduce disease risk factors such as obesity and lack of exercise, and to promote the prevention of diabetes and other prevalent diseases. Studies have shown that an unprecedented opportunity exists to fulfil the promise of mHealth. Dynamic collaboration between interested parties (including government ministries and departments, multilateral organisations and the private sector) will be essential to sustain and possibly accelerate the momentum so far achieved and to fully exploit the potential of mHealth applications.

There is an urgent need to encourage people in Kuwait and the Gulf region to adopt healthy living. The added focus therefore is to involve them in taking the necessary action to adopt a healthier lifestyle. The youth of today are especially adept and knowledgeable in the use of new technologies and consequently can be targeted through the use of mobile phones and newly emerging communication instruments to access eLearning.

11.3.9 Children's Health Magazine

As part of building a knowledge-based society another innovative approach is to provide, on a regular basis, a children's magazine devoted to health. In Kuwait a magazine on these lines is being developed to address different health conditions and their prevention. It is aimed at the younger generation with a view to modifying and changing behaviour towards a healthier lifestyle. It will be published as interactive stories and activities, on paper and electronically.

11.4 Kuwait Diabetes Resource Centre

The Kuwait Diabetes Resource Centre was launched in July 2011 to serve selected communities in Kuwait by means of a call centre acting as a personalised health education resource for the general public. It is intended to benefit people with diabetes and their health care providers by providing information and support on diabetes and its related conditions and complications. The team is composed of trained medical information specialists who are also health care providers dedicated to assisting and supporting patients. The service is publicly available via multiple channels, including live phone consultations on working days, response to email inquiries and provision of up-to-date and accurate information on diabetes.

A standard operating procedures manual has been provided and a comprehensive training programme designed for staff at the centre. Also, a large bank of frequently asked questions on diabetes has been created, and detailed guidelines developed on how to respond to more complex questions. In addition to educational materials and a monthly newsletter, outreach education classes have been regularly offered to people with and without diabetes in the community.

11.5 Geographic Information Systems for Health

A geographical information system (GIS) that is used to collect, collate and analyse data and information on mortality, disease burden and risk factor trends can provide the necessary information to develop health policies, plans and programmes. A GIS helps to answer questions and solve problems by looking at data in a way that is quickly understood and easily shared. Furthermore, GIS technology can be integrated into any information system framework.

GIS is the merging of cartography and database technology. It is an integrated collection of computer software and data that allows us to view, understand, question, interpret and visualise data in many ways that reveal relationships, patterns and trends in the form of maps, reports and charts. It is of considerable benefit for mapping emerging epidemics of non-communicable diseases and analysing their social, economic, behavioural and political determinants. These form the guidance on which to develop the policy, programmatic, legislative and financial measures that are needed to support and monitor the prevention and control of non-communicable diseases. The database may be expanded in the future to handle new information on subjects such as health services coverage, related costs, economic burden and other issues, in the face of globalisation and coping with increasingly new technological and competitive advantages.

11.6 Conclusion

Diabetes has become widespread and is now recognised as a public health concern for Kuwait and its neighbouring GCC countries. There lies a vast potential value for these countries from interest in programmes that incorporate well-managed health care systems and support research and training of health care providers. Further investments in education for the prevention of obesity and diabetes and its associated complications would, in the long term, be of considerable humanitarian and economic benefit.

As a step towards the implementation of a vision for enhanced health care in its public domain, Kuwait is using innovative approaches and technologies to further implement new ways towards the transformation of public health and educational initiatives. In particular, Kuwait is committed to delivering newly developed information and communication-based technologies that involve the creation of eNetworks, such as the electronic health (eHealth) network and the mobile health (mHealth) communication system, both which are powerful tools for distributing information within the Kuwaiti public. The eHealth network has focused on educating and training health care providers, as well as offering resources to children through the eLearning programme and the Diabetes Resource Centre. Both these avenues provide the Kuwaiti public with better training and educational experiences, allowing for the benefit of using modern technological approaches to gain valuable experience and skills. In addition the eLearning approach targets the youth, embarking on the multiple efforts to create and nurture a passion for learning, creativity, technology and innovation in the future generations of Kuwaitis, serving as an investment of time, money and expertise. These approaches have involved collaboration with internal governmental entities, as well as external collaborations, which in turn have fostered the early stages in the development of a more health-conscience culture in Kuwait.

Kuwait is building a model that other countries could use as a working template for transforming health care and developing a comprehensive approach to dealing with chronic diseases. Using well-managed and well-designed systems, citizens have the added advantage of centred health care, as well as the educational growth that is necessary for the long-term sustainability of a healthier society. In addition more emphasis on research, training and innovation will provide a foundation for building a health-knowledge-based society better equipped to face the challenges involved in striving for excellence in health care.

Acknowledgments This chapter was authored by Kazem Behbehani and Peter F. Beales of the Dasman Diabetes Institute, Kuwait, who acknowledge the valuable contributions of staff of the Dasman Diabetes Institute.

Chapter 12
A Research and Development Framework for Sustainable Development in the GCC Countries

Thomas Andersson and John D. Liu

12.1 Introduction

The critical challenges posed by the GCC countries today very much include the task of moving towards a sustainable development process. Sustainable development is generally understood to represent the combined achievement of a society when it comes to economic efficiency, social responsibility and the management of the physical environment. Originally set out by the Brundtland Report (1987), the notion of sustainability holds that a society must manage all those three interrelated dimensions to achieve prosperous development in the long term. Put differently, if we fail with one of these, we will eventually fail with all.

One may argue that the economic and social situations of the GCC countries are under reasonable control, at least compared to their peers in the MENA region. In fact, the GCC countries are among the shining stars of our time when it comes to macroeconomic performance, as indicated by a healthy trade balance, government finances largely under control and rapidly enhanced purchasing power. With regard to social development, these countries display robust records in student enrolment and a range of public services. Crime is down and many had considerable success in building a safe society, especially in the light of lack of stability in the wider region, along with the vulnerable position they started from a few decades ago. That said, all the GCC countries face severe challenges in the economic and social spheres, not least in terms of their ability to create well-paid productive jobs outside the oil and gas industry and the public sector, and also in regard to health and wellness.

T. Andersson (✉)
Jönköping University, Jönköping, Sweden
e-mail: thomas.andersson@jibs.hj.se

J. D. Liu
Environmental Education Media Project (EEMP), IUCN, Beijing, China
e-mail: johnliu@eempc.org

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_12, © Springer Science+Business Media New York 2013

In this chapter, however, the focus is on the environmental issues confronting the Middle East and the wider region (though some observations are offered, particularly towards the end of the chapter, on the integrated challenge of ensuring sustainable development across all three dimensions).

It can be stated from the outset that the Middle East performs very poorly in regard to environmental management—worse, in fact, than in the other aspects of sustainable development. For instance, the GCC countries have an extremely large carbon footprint with CO_2 emissions of almost 27 tonnes per capita (see Fig. 12.1). In comparison, the EU's footprint is currently less than 8 tonnes per capita.

The six GCC countries all fall in the estimated total top 25 for per capita CO_2 emissions. They comprise just 0.6 % of the world population but contribute about 2.4 % of estimated total greenhouse gas emissions (Reiche 2009). Furthermore, the GCC countries, like the wider Arab region, perform badly in managing their precious water resources. Having lost virtually all its natural hydrological functions, the entire region suffers from ongoing severe land degradation and soil erosion problems, while paying a high economic cost for assuring access to artificial water sources for everyday needs and priority projects, notably from desalination of sea water. Meanwhile, some countries are experiencing a major threat to vital coastal areas from rising sea levels. Other outstanding issues include air pollution, urban congestion and waste management.

The environmental challenges facing the region are interlinked. For instance, desertification, loss of biodiversity and a deteriorating hydrological capacity for water retention go hand-in-hand; pressures from livestock counts cause overgrazing, loss of vegetation, loss of water and declining productivity in agriculture, while waste dumping releases methane which adds to global warming and causes other deleterious ecological impacts. Quite simply, the region faces an overriding need to put in place a framework for consistent management of the environment and embark on a journey towards a green society and economy.

In the following, we reflect on the need for improved measurement of trends and patterns of relevance to sustainable development. The link to STI, and how to turn environmental problems into a source of opportunity, then comes into focus. Possibilities of halting and reversing the ongoing degradation of ecosystems and the living environment are given special attention in this context. We will examine a specific country, Oman, in some greater depth when describing elements of the current situation. Proposing specific strategies for formulating policy responses, we will emphasise the importance of linking advances in STI to broader community engagement and opening up for constructive civil society initiatives, as crucial and complementary components of a broader policy response.

In this chapter, following this introduction, Sect. 12.2 elaborates further on the concept of sustainable development, particularly with regard to the environment and the notion of a green society. In Sect. 12.3, we reflect on the development and use of appropriate indicators. Various aspects of environmental decay across the Middle East are discussed in Sect. 12.4. In Sect. 12.5, we examine the potential contributions of STI in this field. In Sect. 12.6, we introduce some particular opportunities to green the Middle East through a combined research and popular movement effort. The last section concludes with observations on ways for R&D and innovation to help achieve a genuinely sustainable development in the Middle East.

12.2 The Environmental Agenda: Definitions and Measurement

There are numerous definitions of sustainable development. One of the most often used is that proposed by the Brundtland Report (World Commission on Environment and Development 1987):

> *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

Economically, this implies maximising income while maintaining a constant or increasing stock of capital. Socioculturally, it means maintaining the stability of social and cultural systems. Ecologically, it may be interpreted as maintaining the resilience and robustness of biological and physical resources.

Sustainable development is important to the prevention of poverty, social injustice, violence, state failure, migration and so forth. At the same time, furthering sustainable development requires institutional changes that can allow for more efficient utilisation of physical and human capital, while also mobilising greater investment and technical progress in support of long-term prosperity. Sustainable development is "a dynamic process of change" made consistent with present and future needs.

Economic, environmental and social components are referred to as "the triple bottom line" of sustainable development. Maurice Strong (1993) offers a definition that runs beyond the triple bottom line and enlists the change process of the political, institutional and technological order, and the relationship between the developing and more developed countries. Sustainable development is intended to achieve economic prosperity, environmental quality and social justice.

According to Ashford (2007), sustainable development defies a simplistic definition. Rather, it is a multidimensional concept characterising development that seeks to:

- Meet needs and avoid adverse effects of industrialisation within and among nations and on subsequent generations.
- Provide an adequate and fair distribution of essential goods and services.
- Provide for good health, safety and a physical environment without serious inefficiencies or injustices.
- Provide for fair working conditions/occupational health and safety.
- Provide for fair and meaningful employment.
- Provide for adequate and fair purchasing power.

- Expand the potential for a nation's self-reliance, innovation and participation in the global economy on terms that do not harm society and the environment.
- Engage individuals in society to realise their human potential.

Most current frameworks put a strong emphasis on people and their perceptions and aspirations. Incentives and motivations for people to take the environment into account represent a key component of any strategy to ensure sustainable development. The vision of a "green economy"—one that improves human well being and social equity while reducing environmental risks and ecological scarcities—aims to reflect this matter (UNEP 2011). In this context, "conservation" of nature and "development" must be made complementary for sustainability to be achieved.

When moving beyond the notion of broad objectives, the precise means and tools for achieving sustainable development become contentious. Speaking of the importance of all possible virtues is fine, but real solutions require the ability to handle hard trade-offs and manage scarce resources. The theory of resource dependence, for instance, emphasises that no organisation is self-sufficient. To develop, organisations depend on external sources. This kind of framework suggests that resources must be pooled and also exchanged in order for effective and efficient solutions to be obtained. International trade and investment in a competitive market economy allows for specialisation and mutual benefits. This does not in any way preclude that benefits can also be attained from capturing synergies between actors that collaborate when win–win can thereby be achieved. Others argue, however, that critical learning processes will be put in motion by focusing on self-sufficiency. The proponents of zero-emission solutions suggest that closed systems, which put up high objectives to prevent any negative impact on the environment whatsoever, drive innovation and can lead to dramatic improvements in human behaviour and social outcomes.

A traditional economics perspective typically views environmental degradation as a direct result of so-called "market" or "policy imperfections". The lack of well-defined property rights, for instance, and the presence of external effects (impacts that fail to be priced and taken into accounts by markets) are prime causes of undesirable outcomes in this regard. This explains the tragedy of the "commons" such as the oceans and the atmosphere, which are polluted or degraded by individual actors reaping benefits for themselves without taking into consideration the aggregate outcome of everyone's behaviour, and thus neglecting the renewal of vital resources. On the basis of this framework, environmental mismanagement results not from international economic exchanges per se, but because of negative externalities from the resulting production and transport activities. Regulatory and market conditions that allow for the internalisation of negative impacts would account for the best situation, while self-sufficiency stands out as limiting and inefficient.

The widely accepted application of this sort of framework around the world has, however, failed to result in any common successful practice to define and combat the presence of environmental mismanagement, as will be returned to below. There are several possible explanations. One may be that the fundamental driving forces causing environmental decay are so strong, and the governance set-up in most countries so weak and poorly organised towards achieving what is good for society collectively, that the presence of conceptual frameworks basically does not matter. Another may be that it is so difficult to identify, measure and disclose market and policy imperfections that this theoretical framework is deemed irrelevant. A third is that people's values and beliefs exert such a strong impact on their behaviour, while there is also such a strong presence of indirect and mutually interlinked interdependencies between different factors (including those linking the environmental and societal spheres), that the mainstream policy frameworks must be complemented by additional approaches to develop real responses to the prevailing issues.

12.3 Indicators

To get a handle on how to manage environmental resources we need proper *tools* to evaluate the state of sustainable development, including how to identify and communicate the nature and role of factors that give rise to mismanagement, as well as the importance of taking action. Problems are ignored in part because the dominant mainstream and widely applied indicators for economic development of our time basically omit any measure of how we treat the environmental and ecological assets that form the very basis for our economy and for society as a whole. As a consequence, many countries would appear to raise their performance when in reality they are undercutting the basis for future prosperity. Often this would concern not only themselves but also the prospects of other countries since the impacts or environmental degradation tend to spread across national borders.

Some of the difficulties emanate from the multifaceted nature of the challenge at hand. Environmental goods and services are not easily defined. Technical solutions and innovations that can help bring about more environmentally friendly production or product and service use can occur in basically any industrial sector or sphere of society. Classical measurement challenges also apply, such as how to value the quality of a service or an experience, how to discount the well being of future generations, how to measure indirect effects when degradation in individual areas cannot be viewed in isolation but add up to cause much larger and partly irreversible aggregate effects with possible repercussions on essentially all human beings and economic activities, and how to evaluate risks and the loss of options for the future.

The influences of human interference with natural systems are further interwoven with the continuous change caused by a multitude of divergent factors. Merely taking note of factual variations, for instance in temperatures one direction or the other, does not take us very far. Likewise, understanding to what degree various actions in themselves invoke destructive pressures on environmental assets is no longer sufficient, but there is also the question whether the combined influences of multiple impacts give rise to serious aggregated risks. Due to the resilience of natural ecosystems, buffer mechanisms, threshold effects and the risk of irreversible outcomes, it is virtually impossible to predict what damage will be inflicted over time and how costly it will be. Needless to say, all human behaviour and economic activity is associated with uncertainties. As the scale of human impact continues to grow and we alter the way that a myriad of local ecosystems perform, however, it becomes essential to take into account the ultimate consequences for the interrelated living ecosystems of our planet.

In order to gauge the seriousness of the situation and stake out ways forward, more needs to be done to put in place and make use of indicators that are capable of reflecting that complexity. Such indicators must also be part of the frameworks for continuous monitoring of detrimental impacts as well as help support in-depth analysis of particularly risky developments. This applies in principle to all countries, individually and collectively, in part reflecting the need of improving our understanding of cross-border spillovers and processes.

The literature is rich with many indicators that can be used to measure various kinds of environmental impacts. Normally, each indicator comes with a standard template that has its own set of criteria, which is useful for comparison and information exchange purposes. Traditionally, selecting indicators for a particular construct entails that a set of criteria be developed to align with a country or institution's priorities. In the modern information era, however, it is not sufficient to address environmental management as an intra-government affair. Scientific validity constitutes a basic criterion for selecting indicators, particularly when using mathematical means in aggregating indicators into indices. It is also a primary requirement when evaluating causal models. Distinguishing between normal cycles and movement from or towards a sustainable state is, for instance, often greatly important given the reference to long-term developments, and reflecting the need of generating interest in and building respect for indicators that can serve as early warning signals to disclose unfavourable trends along with their underlying causes. Further, in response to the recommendations made by social psychologists, and also our present understanding of the way public opinion, media and policymaking work, the indicators should be possible to aggregate in such a way that a small set of ultimate measures can be distilled and allow for highly visible interpretation and communication.

Beyond such considerations, putting in place a framework that is conducive to effective and development-oriented governance in this area requires the engagement of pivotal stakeholders. The criteria should thus be meaningful not only to scientists and decision makers but to users much more broadly. This implies they must be relevant and easy to grasp. Criteria should support an understanding of the extent to which stipulated targets for environmental policies are relevant, whether policies are on track to fulfil them, how different stakeholders contribute to progress, and who or what bears the costs of deficiencies or failure. Finally, indicators must be cost-effective—though not to the point of risking inaccurate assessment, or leaving out what is essential. Costs can be mitigated through establishing means of information sharing.

Even as indicators for sustainability are abundant in the literature they represent a disorderly pot of options and, given the absence of clear objectives for their usage, they risk leading to outright misleading interpretations. A coordinated effort is required to nail down an orderly coverage and methodology for critical measurement of what needs to be observed and examined. Caveats in measurement and errors associated with each indicator should also be clearly communicated.

The availability and quality of information on what is at stake, along with the distribution of costs and benefits between different social groups, as well as between generations, is a sticking point. Due to political economy aspects, hazards are likely to weigh heavily on those that are less well informed, whereas resistance to taking preventive action may result from high concentration of the required costs. Government regulations or other kinds of mandatory requirements are mostly needed in the region today if any action is to be taken, because there is a lack of civil society and the private sector is unengaged in responding to environmental challenges. Bottom-up awareness and engagement are required, however, if there is to be any real change. Indicators and associated research work should facilitate the process and help build demand for the kind of decision making that aims to achieve those outcomes that serve the overall good of society, rather than satisfies particularly vocal vested interests.

The concepts of the "green society" and "smart city" have gained attention in recent years. They may be understood as means to gather policy makers, professionals and the public around a common vision. The objective is to establish a society or local environment that can be conducive to harnessing the strengths and attractions that we associate with a green, healthy and responsible lifestyle. Achieving that, however, means working out, communicating and applying particular objectives and measures for how to fulfil them. Cutting CO_2 emissions, improving air quality, recycling water, introducing noise-free communication and car-free city centres are on the agenda in many parts of the world (Adams 2006; Blewitt 2008). Zero emissions are an example of an objective which is easy to measure and which can help spur efforts in its support. On the other hand, such a target may in some areas be viewed as unattainable and more balanced ones may be preferable. On a related note, Barcelona now reportedly has the highest density of solar panels in Europe. While attaining such goals may trigger action, meaningful measurement requires more. The Smart Cities initiative of the European Union and the Asian Green Cities Index, for example, use a combination of quantitative targets and benchmarking to present cities with an instrument to measure and score points for action on CO_2 emissions.

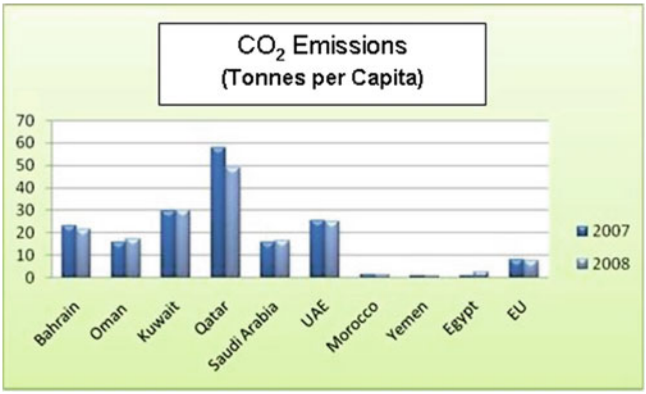
Developing new and better environmental performance measurement indicators that are informative and can support an enhanced performance by individual countries as well as the world as a whole will clearly require improved international cooperation. In addition, the continued advance of ICT and the explosion in digitally available scientific data bring virtually limitless opportunities to generate and combine different kinds of data to identify and examine complex processes of societal and environmental change. Through virtual interconnected labs, for instance, interdisciplinary and intercultural teams of researchers along with representatives of business and local communities are increasingly able to participate in evolving kinds of research collaboration and experimentation using diverse data and addressing issues of common concern in real time (European Commission 2011).

Taking part in this journey, however, will require investment in new infrastructure, education, training and capacity building on the part of both researchers and local communities. This very much applies across the Middle East, whose research institutions so far display only weakly developed networks of cross-border research collaboration, particularly within the region itself as seen in Chap. 10. The absence of broad-based engagement likewise hampered critical reflection what could be done differently in the environmental field. With the precise issues varying between different parts of the world, the MENA region and the GCC countries now has a real option to take advantage of the new opportunities under way in research collaboration, including by having their own specific environmental challenges represented in those agendas. In this way, new perspectives can be gained on how to get to grips with what is driving them and how they can be turned into motivations for inspiration to realise a sustainable and more prosperous future.

12.4 A Dire Situation

Some of the pressing environmental issues of our time include climate change, biodiversity, energy, water and waste management, and urban congestion and development. The combined impact of the many sources of environmental pressure builds a scenario of serious and potentially catastrophic outcomes. Alarming data are coming in from multiple sources: the Arctic icecap is melting, coral reefs are dying, fisheries are seeing the apparent disappearance of entire species, ancient forests are lost, biodiversity is being reduced, deserts are encroaching, freshwater is under stress, agricultural productivity is challenged by the loss of natural fertility, there is fierce competition for fertile land use from biofuels and urbanisation, and food security is under pressure.

Different parts of the world contribute differently to the overall problems, and countries are also clearly affected in a disproportionate way. Adding to the complications is the fact that the outcomes we see today, and can expect in the future, are the result of aggregate pressures built up over an extended period of time. Because many of the countries that are developed today contributed much more to the impacts in their previous phases, developing countries tend to argue that the historical record should be taken into account when deciding who is responsible for what—and who should pay what to sort out the mess.



Source: World Bank (2012).

Fig. 12.1 CO_2 emissions. *Source* World Bank (2012)

Figure 12.1 provides a comparison of CO_2 emissions (World Bank 2012),[1] portraying one aspect of national carbon footprints. As can be seen, the GCC countries have higher CO_2 emissions compared to other less developed MENA countries and compared to the EU average. They are also growing rapidly. Oman's CO_2 emissions, for instance, have doubled in the last 10 years. Meanwhile, emissions of methane, which contribute strongly to the greenhouse effect, are among the highest in the world. At the global level, most developed countries are now in the process of taking some action to reduce their CO_2 emissions. The GCC counties have not yet signalled much preparedness to do so, however, though several view energy management as part of their core skill and some initiatives to invest in renewable energy are under way.

With regard to water stress, the GCC countries appear more aware and keen to address their poor environmental record. Several of the GCC countries, along with a large number of MENA states, are among the driest in the world. Still, natural access to water has been badly handled in the modern era, as evidenced by the ongoing depletion or pollution of groundwater. Table 12.1 provides an overview of available freshwater stocks in selected countries and a future prognosis, illustrating that the problem is set to gradually worsen across the region. Like energy use, water consumption is heavily subsidised, creating serious overuse and distortions in resource allocation. Governments throughout the region currently spend between 20 and 30 % of their total budgets on this sector (Tolba 2008), with a sizable chunk on seawater desalination.

The main consumer of water in this part of the world is the agricultural sector, whose productivity in this regard is among the lowest globally. Massive

[1] The emissions include carbon dioxide produced during consumption of solid, liquid and gas fuels and gas flaring (World Bank, World Development Indicators: http://data.worldbank.org/indicator/EN.ATM.CO2E.PC).

Table 12.1 Annual per capita freshwater availability in cubic metres

	Country	2010	2015	2025
GCC	Bahrain	139	120	89
	Kuwait	<100	<100	<100
	Oman	450	450	410
	Qatar	<100	<100	68
	Saudi Arabia	320	250	113
	UAE	<300	<200	176
Other MENA	Egypt	750	600	550
	Morocco			590
	Yemen	250	200	152

Source Mostafa K et al. (2008)

application of chemical pesticides and fertilisers causes serious groundwater contamination and salinity. Since ineffective agriculture consumes precious water resources, the sector is undermining its own future. Meanwhile, the costly and ineffective food chain accounts, including production, storage, distribution, discharge, etc., account for a sizable part of the region's high level of energy use (Abouleish 2008).

Over the past 5 years, the MENA region has seen substantial price rises on food products, partly reflecting international trends but also strongly influenced by domestic or regional factors. The latter have been particularly important in the GCC countries, as well as in Algeria, Tunisia and a few other nations (Ianchovichina et al. 2012). Inefficiencies in logistics create severe bottlenecks and exacerbate the consequences of price variation. Coupled with a largely ineffective and polluting agricultural sector, these factors underline the vulnerability of the Middle East to global shocks in food markets.

Likewise, depletion of natural habitat involving a rapid extinction of significant numbers of species is ongoing, though there is a lack of basic data and information in the MENA countries both on the ecosystems and the degradation they are suffering. The marine sector has also been affected by overfishing and pollution. Oman benefits from pristine waters that offer opportunities both in terms of preserving rich sea life and in harnessing economic and social gains. Yet the fisheries industry, which employs some 7 % of the workforce, reportedly accounts for less than 1 % of GDP. A few prestigious hotel complexes and other projects have put focus on ecotourism around marine attractions such as dolphins, sea turtles and coral reefs. But in the Arabian Peninsula and the southern and eastern end of the Mediterranean, success in the cultivation of high value-added services based on marine resources has been patchy. Initiatives are few and knowledge is often lacking in how to award precious ecosystems proper recognition and protection so as to ensure an interface with human society that can be sustainable for the long term.

Across the Middle East, there is a lack of awareness and action to take care of and manage the rising amount of waste. Even basic functions such as the collection of heavy metals, plastics or other substances that are damaging to nature and human health are mostly lacking, not to mention separation and recycling of household garbage. Similarly, few efforts can be seen to diminish wasteful energy use in offices. Another serious nexus of issues concerns the congestion, air pollution, noise and safety problems that accompany the uncontrolled expansion of road traffic in and around the major cities. In the absence of public transport, everyone and anyone views a private car as a necessity and indispensible token of social prestige. Some families acquire not one but two, three or even more cars. People revel in the freedom to move around at will and they are happy to make sacrifices to upgrade to a newer model. Lifestyles in the cities are increasingly marked by automobile culture, while the traditional meeting places, where people walk and gather for informal conversations, are on the retreat.

Trends of this kind have implications for culture and societal institutions and contribute to health and wellness problems. Related to this subject, young people in the Middle East today face risks to their physical and mental health that differ from those experienced by past generations. Adolescents in this part of the world, as in other emerging and developing regions, are in the process of acquiring many of the unhealthy habits their counterparts in developed countries have already grown used to. The rising problems include hazards caused by drug and alcohol abuse, adverse eating habits associated with the spread of fast food and soft drinks, and insufficient physical movement. As a consequence, the seeds of obesity-related diseases such as diabetes, cardiovascular complaints and cancers are now planted in early childhood. There is also evidence of a systematic increase in mental disorders among the young. According to Blum et al. (2012), some 70 % of premature adult deaths worldwide are related to behaviours begun in teenage years.

Even though adolescents constitute a very significant proportion of the population in the Middle East, health and social investment programmes virtually ignore them. At the same time, a significant part of the problem is related to changes in food intake and physical activity that occur at an even earlier stage—changes that in some cases are even passed from unknowing pregnant mothers to their unborn (see further below and also Chap. 11).

It is hard to measure a country's precise performance in regard to environmental management and the associated social and economic issues. However, Table 12.2 indicates the severity of the situation in the GCC countries. Conditions show no sign of improvement relative to the wider MENA region and are far behind advanced countries.

Addressing inefficiencies and the negative environmental side-effects of economic growth will require massive investment and development work. Letting the problems continue unabated will, on the other hand, lead to rising costs. Conversely, addressing the problems can be turned into an opportunity, e.g. to achieve: enhanced competitiveness in a range of industries; the rise of new services; abating and reversing negative social trends; and the creation of new jobs.

A number of questions require reflection in this context:

- How can the GCC countries craft strategies that are effective in propelling green considerations into a driving force for the development of key sectors such as energy, water and waste management?

Table 12.2 Environmental performance index (international ranking)

Country	Ranking
France	6
Sweden	9
Malaysia	25
Egypt	60
UAE	77
Saudi Arabia	82
Qatar	100
Morocco	105
Oman	110
Kuwait	126
Yemen	127

Source Yale University (2012)

- How can the GCC countries reconcile their dependency on oil and gas resources with increased environmental concerns and the adoption of a green economy?
- Which particular areas represent opportunities for the GCC countries to attain competitive advantages through environmentally and socially friendly growth?
- What are the relationships between environmental management and the other aspects of sustainable development across the GCC countries?
- How can the GCC countries design and implement a collaborative policy in response to the environmental needs and economic and societal goals of the region?
- Do the GCC countries have the capacity and motivation to take advantage of present and future advances in science, technology and innovation to support the rise of a green economy and sustainable development more broadly?

12.5 STI Policies in Support of Sustainable Development

Given the increasing pressures on the global environment inherent in an expanding world population and the advance of major emerging economies (including rising consumption in highly populous countries such as China, India, Indonesia and Brazil), environmental resources are under growing pressure. The intensive debate we have seen on global warming in the last few years foreshadows the difficulty in telling from where the affirmative action to halt these trends will come. Strongly divergent sovereign interests and continued disagreement over the seriousness of the situation mean countries are facing great difficulties in agreeing how to address the most serious environmental threats of our time.

Taking action to counter environmental damage generally gives rise to immediate costs, whereas the benefits build more on a long-term outlook. Corporate social responsibility schemes may serve as an entry point for firms to taking actions that go beyond their immediate short-term benefit. Many such programs are still of limited significance, however, and it appears their success is dependent on a range of conditions (Ioannou and Serafeim, 2010). Empirical evidence further shows that firms subjected to sharpening competitive pressures may become more short-term oriented. The liberalisation of the energy sector across the United States and many European countries has, for instance, been accompanied by stark reductions in R&D, with the exception of a few companies which have enjoyed greater market dominance and maintained a stronger emphasis on attaining l ong-term strategic advantages. For such reasons, market forces will most likely fail to respond unless the exhortations to address environmental degradation have sufficient clout.

Having said that, the available evidence suggests we are all subjected to growing risks of tremendous repercussions for our own future and that of generations to come. As affirmative rectifying actions are lacking and major impacts on the global environment continue to mount, all indications point towards a continuously worsening of serious environmental issues. Meanwhile, the potential of collecting, processing and distributing scientific information will continue to rise. The scope and nature of the human impact on the global environment as well as on local communities will thus inevitably become better researched, communicated and understood. For these reasons, and also because people's concern with such issues tends to rise with higher income levels, we can expect market forces to reflect growing demands for protecting the environment. Although we cannot foresee the precise mechanisms, businesses as well as governments around the world can be anticipated to come under increasing pressure to get into sync with the limitations of nature.

Looking ahead, countries that find themselves "behind" on their environmental record will thus both experience a disproportionate degradation of their living conditions and suffer the prospect of higher transition costs to achieve catch-up in order to avoid being stuck with sunset technologies and industries. For those that are in the forefront, and have already relatively competitive goods and services in this respect, there will be opportunities to capture new markets and market shares, and thus to accumulate financial as well as socioeconomic gains. It is in that process the early development of "green" technologies and practices moves away from being seen as a "cost" to becoming a source of "benefit" in achieving a competitive edge.

One particular aspect, that has confounded both experts and policy-makers, concerns what impact can be expected from the adoption of a green economy on job creation. Naturally, contradictory forces are at hand. Environmental standards that force polluting industries, including fossil fuel production, to downsize may cause a direct immediate reduction in the number employed by those industries (Morriss et al. 2010). On the other hand, improving the efficiency of oil extraction (so-called "enhanced oil recovery") can enable the industry both to expand and reduce pollution. A key question is further how to open up opportunities for new environmentally friendly business development in and around the hydrocarbon sector.

It is already recognised that "green industries" represent a significant source of growth as well as jobs in a number of national economies. Because environmental services tend to be both skill- and labour-intensive, positive direct as well as indirect effects generally accumulate as demands picks up. A management effort aimed at achieving stronger environmental outcomes tends to be beneficial for corporate performances and industrial competitiveness more broadly. This may occur through an increased general awareness of quality and customer satisfaction in a particular organisation. Although various studies have had difficulty in demonstrating any general favourable impact of environmentally friendly corporate behaviour on business performance, recent studies have demonstrated a strong positive effect when a longer term assessment, in the range of 15 years, is carried out (Eccles et al. 2011).

The mechanisms at work to enable restructuring again matter crucially, however. At the aggregate level, barriers to shifting resources and reskilling workers impede the shift away from less economically efficient and more environmentally degrading industries and activities to those that are more favourable. The greater the rigidity, the longer it will take before positive impacts are realised (Babiker and Eckaus 2007).

The adoption of those technologies and practices that are the most efficient or the least wasteful at any particular point in time represents only part of the picture. Imposing predefined technologies on researchers and companies could even counter the drive for responding to new issues as they arise and for trying out new solutions. This is particularly important where culture tends to counter the development of multiple experiments to discover new solutions, including trying out the best technologies.

Ultimately, it is a question of what driving forces and mechanisms are in place to develop as well as accept and adopt entirely new solutions so as to enable a shift away from wasteful or polluting methods and sources of energy production and consumption to those that result in more favourable outcomes. Making progress in that direction requires a combination of, and compatibility between, top-down and bottom-up initiatives. As a part of the solution, governments need to deploy effective carrots, as well as sticks, to push and pull actors in a desirable direction. Steps must be taken to remove, or at least neutralise, the soothing impact of public subsidies, as in the areas of energy and water use. On the other hand, there is the need of taking measures to build general awareness of what is at stake, along with confidence what can be done to change course. It is imperative that engaged communities can evolve, consisting of concerned individuals, professionals, researchers, innovators and entrepreneurs, and be engaged in working out constructive counter-measures.

How to open up for experiments to form a natural part of the set-up working out new solutions, rather than relying on meticulous planning, deserves attention. Previous studies have demonstrated the value of experimental applied research undertaken on a broadened geographical base (David 2009). From the literature on corporate R&D, and notably on the advantages of joint research ventures, it is known that the involvement of teams from more than one company weakens the

Source: Declerck (2005).

Fig. 12.2 Examples of areas in which new ICT applications have the potential to create real value *Source* Declerck (2005)

resistance of research managers to abandon projects emanating from their own laboratories. The development of joint research ventures between public research agencies in different countries can likewise pave the way for greater openness to the ideas of others, including experimentation with and serious testing of new research results irrespective of where they originate from.

ICT applications carry the potential to generate new solutions to critical problems in various areas (see Fig. 12.2). Again, however, the key to success is not the technology per se, but how its development and use can be pulled by insights into the real issues and associated ideas how they might be resolved. Urban development and transport, where the adoption of solutions that are capable of taking environmental externalities into account require broad-based organisational change and a revamping of current systems, is a case in point. Whereas social and cultural factors call for a high degree of personalisation, there is huge scope for greener, safer and more intelligent distribution and traffic. Smart application of sensors may, for instance, enable adaptation of driving behaviour and traffic flows in real time, along with radical improvement in planning, efficiency, use of time and safety.

There are may other example of potentially important niches that could help generate a distinct edge for this part of the world in technical progress and application to counter prime local as well as global environmental challenges. The capture and transformation of solar energy to achieve path-breaking solutions for cooling would, for instance, complement mainstream research efforts in Western countries to advance renewable energy. The scale of the potential opportunity is demonstrated by the very high amount of energy used throughout the region for air conditioning during the hot season. Combined with solar energy captured and appropriately stored and released to support such cooling, traditional skills and natural construction and shading practices can be used to lower temperatures.

Success in that respect is likely to require that niches of "excellence" can be established, in which a pool of local and connected international scientists are able to engage in relevant research agendas, of the kind that is both inspired by the outstanding issues and capable of generating first-rate research results. Important building blocks for that to happen include the presence of fully competitive research infrastructure and adequate sources of funding for scientific research, established networks with other leading universities in the particular area of specialisation, and so forth. In that environment, there must however also be technicians and entrepreneurs, linked to industry, as well as the conditions required for startup activity, organisations specialised in seed funding, networks of business angels and a diversity of required professional service providers, apt to facilitating and realising the rise of new products and services capable of responding to burning local issues while also attaining competitiveness in world markets.

Examples of attempts to achieve such niches in sustainable development include: the push on solar energy by Abu Dhabi in its new Masdar city development; research and the renewal of health practices to tackle the increase in diabetes in Kuwait; Islamic financial banking in Bahrain; and the effort to spearhead research and training to underpin enhanced oil recovery in Oman and Abu Dhabi. None of these have been able to build a comprehensive effort, however. In several instances, significant resources have been devoted to the premises or the infrastructure, whereas funding for research and also appropriate working conditions for researchers have been lacking.

As for research policies, Qatar Foundation and the Research Council in Oman have allocated funding for research and innovation related to sustainable development agendas specifically. Oman has prepared for a combined research and action project in support of sustainable development through a series of studies and workshop activities. The plan is to link research to openings for action on critical issues in various areas, including water and waste management, energy, urban development, agriculture, transport and logistics, biodiversity and ecotourism. After the council board had decided to launch the project and the plan had been devised, however, the implementation was delayed several years primarily due to difficulties to attract the required human resources and organise a functional team.

New initiatives in education (primarily higher education to date), have been launched in selected sites with a view to achieving a critical mass of researchers and professional expertise. Examples include the Education City in Qatar and KAUST in Saudi Arabia. For such projects, a prime challenge is how to go beyond mainstream routine to spur genuine inspiration and effort to build unique capacity in research and innovation. To date, few institutions across the Middle East have tried to break new ground by shaping educational programmes with a specialisation in green or sustainable development. On the other hand, this dimension has been accorded strong attention with regard to the establishment of science and technology (S&T) parks or cities. This is both as part of the objective to shape a hospitable local development capable of attracting first rate international talent and a creative workforce and as part of the proposed focus of specialisation considered as facilitatory to the rise of a diversified modern industrial sector.

Experience from other parts of the world suggests that critical success factors in this endeavour are:

- Sharp and favourable conditions motivating specialisation based on existing or potential strengths and ways of working, that may not merely be of a sectoral nature;
- Targeted efforts to secure tenants with genuine ambition to long-term investment in a real edge of research and innovation, not merely in the copying of efforts elsewhere;
- Public investment in infrastructure and private-led expertise in management;
- Professional management of the S&T company and the securing of the balance between key stakeholder spheres must be secured;
- Governance and incentive models that enable a focus on customers' needs and a development-oriented approach, meaning that the management of the S&T Park does not merely backtrack to renting out space.

12.6 The Prospect of Greening the Middle East

While there is no shortage in projects that invested in massive new buildings and real estate, new efforts need to be made on substantive aspects. Other kinds of ground-breaking initiatives are conceivable in the years ahead. The establishment of the Botanical Gardens in Oman has mapped and housed 1,200 plant species from around the country within naturalistic habitat displays. The associated data compilation is to lay the basis for new developments in germination, propagation of pest control, etc. Meanwhile, a publically funded centre on Biodiversity and Genetic Plant Research has been allocated startup funding of some €140 million, while another initiative that focuses on marine biotechnology, aimed at combining basic research with innovation and the incubation of startups and new products, has been launched through private initiative and offset funding.

Meanwhile, community efforts to harness the local environment have been ongoing for years. One example is the proposal to establish an association for reforestation of areas around Salalah, Dhofar (Oman). A precious deciduous forest thrives at the tip of the Arabian Peninsula where it stretches out in the Arabian Sea thanks to a natural dense cloud formation that occurs during summer. The phenomenon approximately doubles water availability compared to what is available as plain rainfall (Hildebrandt et al. 2007). About 80 % of the green area has been lost in the last 40 years, however, due to a combination of factors including overgrazing and excessive water consumption putting pressure on aquifers. Sultan Qaboos bin-Said said decades ago that counteraction had to be taken to preserve the area. A "grazing animals depopulation project" pursued in 2004 and 2005, which included public purchases of camels, succeeded in reducing the number of animals by some 40 % (Shammas 2007). There was no effective learning and communication policy, however, and when the programme terminated the number of animals soon recovered.

The development in Salalah serves to illustrate the rapid degradation of coastal aquifers and groundwater, loss of biomass, desertification and land erosion that already embraced most of the Middle East since many years. In Salalah, researchers have demonstrated the need for coordinated and comprehensive actions if the remaining green area is to be saved. The requirements include changes in irrigation systems, revived control of overgrazing and also tree planting to increase fogwater interception and use of biomass to strengthen the hydrogeological system and recover the groundwater.

The effort to embark on a major restoration scheme in Salalah thus far met with lukewarm support from government officials, highlighting the hurdles for a constructive civil society movement to prompt decisive action. While programmes of this sort require national backup and support, local leadership and engagement is necessary since the ultimate outcome will depend on the buy-in of the individuals and organisations on the ground. It is, therefore, important to put emphasis on a public communications and incentives schemes. Efforts should also be made to muster required buy-in and support from relevant stakeholders, including various authorities and parts of government that could otherwise block the process. SMS campaigns can form part of a broader communication package, for the purpose of reaching out to the local population as effectively as possible.

Other related activities should also be developed, to help strengthen the supply of nutrients, hinder pollution, and restore fundamental hydrological and ecological functions. The application of natural fertilizers could in effect drastically diminish the extensive use of destructive chemicals which presently contaminates the ground water. The development of so-called biological bricks, which could be produced in collaboration with countries in the tropics, represents one option in that regard (see Box 12.1). Meanwhile, deployment of the so-called Groasis Technology, a Dutch methodology that allows for the planting and growth of trees or vegetables at very low cost and without irrigation even in areas where precipitation levels are minimal, can be deployed with low maintenance costs in the 1st year and after that year with basically zero service support.[2]

Large-scale eco-restoration of this sort is no utopia but has been implemented in selected places since several years. Ethiopia, Jordan and Rwanda are examples of other developing countries that already have extensive experience of such programmes and with documented benefits as a result. Having said this, the introduction of an appropriate scheme for greening an entire region in the Middle East would represent a pioneering effort that should be accompanied by a comprehensive research and evaluation agenda. It will be important to allow for effective tailoring to local conditions with gradual adjustment and fine-tuning as the project evolves to ensure maximum engagement and benefit for the local

[2] The Groasis Technology (GT) offers water savings of some 90 % in the 1st year compared to mainstream planting methods. The components of this biomimicry planting technology consist of: (1) improving the soil with mycorrhizae; (2) leaving the capillary structure intact; (3) using plants with the right primary roots; (4) the use of the “waterboxx” and, if necessary when planting on rocks, (5) the use of the capillary drill. See www.groasis.com.

population. The effort should also include systematic learning to lay the basis for future scaling of the programme. Continuous monitoring of soil moisture, temperature, relative humidity, wind speed, rainfall, carbon flux and photosynthesis, may be maintained on an experimental site and be compared with a control site where no amendment has been attempted. Perennial indigenous and endemic crop varieties could be revived and an uptake in productivity engineered for products such as dates, figs and citrus and nut crops. Part of the task would also be to examine whether it is possible to revive rain-fed agriculture in arid regions and what type of changes might be possible to hydrological infiltration and retention through additions of organic matter and vegetation.

Given the high value of fertile land today, greening what have turned into currently unused and basically freely available pastry lands not only promises to generate substantive environmental and social benefits; it can also create massive financial returns as life and water functions resume and the land attains commercial value again. Once the land can begin to support crops, new businesses and jobs would be generated at high pace. Successes in this regard would serve as an example to others and could help pave the way for similar schemes elsewhere. A similarly yet dormant movement in Sohar, in the northeast of Oman, along with highly engaged individuals pushing for action to improve environmental practices in Jebel Akhdar in inland Oman, could be expected to follow suit—provided a Salalah scheme can show the way. The same applies to other parts of the region.

Box 12.1: On Bio-Bricks and the Potential Oman-Rwanda Link

On Biological Bricks and the Potential Oman-Rwanda Link

It is proposed that rich natural fertilizers could be obtained through a collaborative venture between Oman and Rwanda. The establishment of a fertilizer-producing unit would offer new employment opportunities on the Rwandan side, giving farmers an incentive to halt destructive slash-and-burn land clearance. The replacement of such wasteful practices by exports of biomaterial turned into fertilizer could meanwhile help to underpin an agenda of greening landscapes throughout the MENA region, resulting in a sharp improvement in land and water management, a reduction in net CO_2 emissions and huge increases in land values.

Background: Observation of arid and hyper-arid areas shows that current vegetation cover and accumulated organic matter is often vastly lower than the natural evolutionary climax. This situation, which can be attributed to the historical trend to prioritise productivity over function, has led to disastrous reductions in ecological function and, ironically, to a reduction in productivity. The reduction of vegetative cover and accumulated organic matter has massively lowered the infiltration and retention of rainfall, decreased soil fertility, threatened rare and vital biodiversity, and massively contributed to climate disruption and desertification. The Biological Bricks concept is based on replacing lost organic matter and studying the resulting impact on hydrological regulation, fertility and biodiversity. If, as expected, this shows it is possible to rapidly regenerate healthier conditions in arid or hyper-arid regions then this intervention could be massively scaled up to actively and positively address many of the region's problems.

Observation of high biomass-producing areas in the humid tropics shows that primitive slash-and-burn agriculture is still widely employed. The destruction of the natural vegetative cover in these areas is devastating to the fragile soils and the natural infiltration and retention of the vast amounts of water these regions receive. The agricultural productivity of employing these primitive methods is negligible and leads to food insecurity and further damage. The Biological Bricks concept envisions replacing primitive agriculture in humid tropical areas with community-owned and operated optimised organic soil creation factories. This would provide employment, income and high quality natural fertilizer to these regions. The plan sees investment from arid and hyper-arid regions capitalising on the development of this industry in exchange for a percentage of the materials produced being exported to replace lost organic matter in these regions.

The concept of linking humid tropical areas (supplying organic matter) with arid or hyper-arid regions (investing in infrastructure and utilising the organic matter), carries the potential of solving problems in both, in ways that cannot be realised by each region in isolation. Success in this regard could have massive implications for the Middle East, Africa and worldwide. Assuming that the premise is correct and proof of concept trials turn out a success this method could in principle be replicated throughout the world to help mitigate and adapt to climate change, protect biodiversity and combat desertification. A sea change in attitudes could follow. By creating jobs and addressing some or our most serious challenges through physical work, humanity could potentially move away from enrichment by impoverishing the Earth and enable vast numbers of people to share a stronger platform for development.

Source: Envisioning a Pathway to Sustainability, seminar at the Cultural Club, Muscat, Oman, by Prof. John D. Liu, Senior Research Fellow at the International Union for the Conservation of Nature (IUCN), 21 January 2012.

12.7 Concluding Remarks

The ecological and environmental assets demonstrate a poor state of affairs in the MENA region, including the relatively wealthy GCC countries. The countries' carbon footprints and record in water management and land use leave room for massive improvement, partly reflecting a general lack of awareness along with distortive public subsidies that encourage waste. Given the limitations in human resources and general ignorance among the public, education and awareness building are a must for laying the basis for change. Correspondingly, the significant negative impacts on the environment and ecological systems of the Middle East represent an opportunity for improvement. In order to turn the tide, there is a case for putting research, technical progress, innovation and entrepreneurship to work in identifying and piloting new solutions in areas where the countries and peoples of the region could both address outstanding issues and leverage an edge for development.

A comprehensive strategy is warranted to enable success. An effective R&D and innovation policy designed to address the grand challenges of our time (such as climate, energy, water, food, etc.) must display certain focus and allow for critical mass in capacity building (see further Chap. 13). At the same time, it should link to education and contribute to broad-based innovation, experimentation and economy-wide strive for improvement. It will benefit from drawing upon a variety of instruments and mechanisms to create the necessary knowledge infrastructure (human capital, science and engineering capabilities) and encourage private sector participation wherever appropriate.

The chapter has highlighted various initiatives potentially capable of driving change. However, the heavy marketing of certain institutions and agendas, such as the effort to develop renewable energy in the new city of Masdar, have thus far not been matched by complementary essential awareness and community building. Pivotal schemes are being delayed by bureaucratic hurdles, red tape, lack of collaboration between officials and relevant authorities and difficulties in finding and attracting the human resources and competencies that would be required to sustain the operation of these projects.

Continued desertification, erosion, rising sea water, loss of biodiversity and depletion of marine life present the Middle East and North Africa with serious threats. Conversely, these can be turned into opportunities. The cost of greening landscapes through a combination of established methods and new innovative solutions, while testing and learning how to build broad-based community support, could open up for massive societal and environmental gains. To conclude, a host of development activities could be activated by responding to the outstanding environmental and societal issues, making use of research and innovation in the process. As part of the picture, large numbers of new jobs could be generated outside of hydrocarbons and the public sector, neither of which can resolve the employment issues facing the region today.

Acknowledgments Previous contributions to the Interim-GCC project that were taken on board as building blocks for parts of Sects. 12.2, 12.3 and 12.5 were provided by Costas Kiparissides, Department of Chemical Engineering, Aristotle University of Thessaloniki and Centre for Research and Technology Hellas, Thessaloniki, Greece. Qammar Abbas, IKED, provided valuable assistance in collecting data.

Part III
Science, Technology, Innovation and Entrepreneurship: Leveraging International Cooperation

Chapter 13
Research Priorities and Their Impact on the National Innovation System

Cristina Flesia

13.1 Introduction

The GCC countries are facing a concerted challenge when it comes to shifting from oil-based to knowledge-based societies that can stimulate economic growth and new, high-quality employment opportunities. The ability to achieve scientific excellence while also establishing linkages to innovative activities is greatly important in that context. Research-based innovation is directly relevant to business innovation and to the ability of companies to establish and renew themselves in the rapidly evolving markets that generate the highest value added. It is not possible to rely squarely on imports of research results from elsewhere.

The ability to innovate, as well as to excel in research, is heavily dependent on human resources. Education and training must be able to draw upon science and research but also on social capital in other respects. A well-functioning NIS (see Chap. 3) needs to incorporate well functioning linkages in this regard, which can be drawn upon and also further leverage strengths that are unique to the country or region concerned.

In the GCC countries, despite the presence of ample financial resources, the absence of a fully developed attractive environment for science and research blends with the lack of critical mass in human resources attuned to a scientific environment. Thus far the GCC countries have tended to concentrate their science and research activities in a few institutions specialising in limited fields. At the same time, there is often a lack of strategy in which niches to adopt, and how to cover a broad-based development of a knowledge-based economy. Rebalancing this situation has been subject to rather slow-moving and complex top-down government decision-making, which also has brought other constraints with a

C. Flesia (✉)
University of Ferrara, Ferrara, Italy
e-mail: cflesia@gmail.com

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_13,

bearing on scientific and technological development. Against this backdrop, it is greatly important for the GCC countries to adopt a comprehensive strategy for determining research priorities, and how those can best support innovation, growth, and job creation.

13.2 Policy Instruments

Policy frameworks devised to support capacity building in research and innovation need to include several components. These include: undertaking institutional reforms to create a stimulating and conducive environment for research and innovation; allocating public funding in support of science and research, particularly basic research; promoting incentives to stimulate research and development; attracting foreign capital and talents in research and innovation, and enabling them to establish or deepen their activities in the country; and relevant public sector activities, including procurement, regulation and infrastructure investment.

The oft-cited international examples of governments that have been able to establish functional R&D systems over a limited timeframe (as in the case of South Korea, best known for its successful innovation-induced industrialisation experience) do not really correspond to the GCC's parameters in terms of human capital and demographics. Attaining a critical mass of local talent, for instance, is a not-inconsiderable factor but the very basis for any further sustainable investment in research and innovation.

International transfers of technology and knowledge to the local environment is likewise essential. Special action may be justified to increase the local value-added component within cross-border supply chains. One way may be to promote strategically valuable research infrastructure. Other means may include raising the quality of human resource capabilities, favouring mobility or promoting entrepreneurship.

The GCC has very few technology-intensive exports today and the region's advance towards the knowledge economy has thus far been mainly about services. In these countries, however, a research and development framework capable of achieving the capacity building that is required or the future must to some degree encompass high-tech manufacturing as well.

The transition towards a global economy based on the acquisition and application of knowledge as the driving force for new processes, businesses and industries requires a continuous strengthening of work force skills. There is a need, therefore of both strengthening the research community's linkages with tertiary education, and of supporting the development of practically oriented capabilities, including through vocational training.

International research partnerships and collaboration between industry and academia matter for resolving real-life engineering problems through scientific and technological research. Developing a research system with high academic standards further requires the presence of multidisciplinary and internationally oriented academic institutions open to researchers' mobility and international contexts and capable of attracting national and international talents. Collaborative R&D environments of this kind give graduates greater scope for learning, honing their competencies and skills and concretising their innovative ideas (Bachellerie 2010).

A sustainable innovative scientific and technical development requires a deep scientific culture, implying a thorough experience of cooperation within a productive scientific and technical environment. It is not possible to build a teamwork culture, research and development visibility at national and international level and the motivation to develop strong capacity in fundamental and applied research without long-term collaboration with international research institutions and multidisciplinary networks.

Particular problems emanate from the slow-moving nature of institutions; the lack of infrastructure; and the strength of top-down governance, which leaves limited room for local initiative and bottom-up specialisation processes. Such factors must be addressed as a requirement for enabling the development of competitive research activities.

One way to accelerate the transformation into a world-class research and innovation system is to make more effective use of internationalisation strategies. World-class research institutions have effective and well-established international collaborative networks that enable them to attract the most talented people, to implement state-of-the-art research locally and to train students in a competitive international context. An appropriate blend of international and local researchers and faculty members may be accessed through: (a) the number of international collaborative programmes, (b) the multidisciplinary aspects of international collaborative programmes, and (c) the degree to which there is active collaboration in research implementation between the international and local partners.

13.3 Towards Prioritising Research

The creation of a more effective knowledge-based system is critically related to the presence of a beneficial scientific environment, conducive to innovative activities and to driving the development of strong capacity in fundamental and applied research.

A high priority in virtually all regions of the world is to identify the most competitive/promising areas in S&T—areas in which countries stand the best chance of achieving genuine competitiveness. Only top-class science will benefit markedly from international linkages, and the conditions for creativity in research usually require the development of beneficial regional as well as international collaboration.

National authorities have a role to play in providing mechanisms to engage stakeholders and institutions in defining a science and technology innovation programme based on a number of strategic choices. Such programmes should have high social and economic relevance to regional characteristics and be able to promote the region's competitiveness and sustainable development. This requires critical research and technological advances over the medium to long term.

The choice of research priorities is a complex and delicate subject. The methodology for selecting the most promising R&D fields has to include key areas evaluated in terms of implementation of science and technology innovation (STI) policy decisions, which are essential in achieving a competitive advantage for any country. Processes for setting national research strategies have to be carefully evaluated as a function of both the impact of the research priorities on the regional economy and of the relevance of the innovation system outputs to the international research framework.

Within the GCC, given the importance of actual or potential cross-border collaboration, it is also important to create and evaluate research framework priorities with a view to: (i) help assess the current strengths of research collaboration between GCC institutions across research fields; (ii) identify research areas in which collaboration between the GCC and international partners is already strong, and; (iii) ascertain the research areas with the greatest positive momentum in cross-border collaboration by tracking the evolution of existing research networks.

In the following, we present a list of research priorities that has emerged from a collaborative effort involving researchers and other actors in Middle Eastern countries and the EU over the past 2 years. The list aims to be relevant for the policy task still facing most of the region, namely hammering out such priorities in practice. It has also been developed for the purpose of being conducive to innovation in a local as well as global context.[1] That said, the task of finally concluding and implementing priorities of the greatest use to the GCC countries needs to be addressed through their own frameworks and processes capable of engaging key stakeholders.

Two steps have been applied in the selection of promising research fields presented hereafter. These are the identification of:

1. *Research priority areas*. General fields of common interest, based on the guidelines of international programmes and the main national research strategic plans of GCC states.
2. *Research priority subjects*. More specific research topics, selected within the priority areas and as a function of mapping existing research interests, primary bilateral cooperation lines and stakeholder communities.

To promote national competitiveness and sustainable economic growth, national research funding bodies need to define an STI framework programme based on strategically important R & D issues with high social and economic relevance. Some of these R&D issues are widespread across the region, while others relate more specifically to a particular country's characteristics and needs.

[1] The list of research priorities presented here draws on the WP2-INCONET-GCC project.

When selecting research priority areas, the national R&D programmes of the different GCC countries must be carefully taken into account and linked to the main international priorities and research efforts. It is for the GCC countries themselves to carry out the eventual analysis, spanning their individual as well as their collaborative priorities. Here, we discuss aspects of the process for priority selection.

Some shared national interests (besides setting international R & D priorities) among the GCC countries include: promoting cooperation between GCC countries so as to achieve both appropriate complementarities and specialisation across the region; working together in facilitating joint research activities between stakeholders from academia, research institutes, industry and the public sector, collaborating on a wider regional base; and establishing a common S & T common framework in the region linked to international efforts. The above can be greatly important for forging stronger synergies between the innovation systems and economic progress of the GCC countries in years to come.

13.4 Proposed Research Priorities

Within general research fields, the prioritisation of research subjects often follows patterns derived from three perspectives: social needs, academic disciplines and industrial development. Multidisciplinary aspects are likewise of significant interest more or less universally, suggesting the involvement of a large number of researchers and stakeholders and favouring the implementation of a range of innovation outputs.

In discussing proposed priorities for research, we here start out by applying mainstream classification frameworks.[2] The main areas are grouped as:

- Environment, water and climate (including marine, agriculture and food)
- Health
- Energy
- Information and communication technology

Main aspects in each of these are expounded in the following sections. It should be noted, however, that certain additional research areas deserve emphasis because of their importance horizontally. Research and applications in biotechnology and nanotechnology have for instance become an integral part of R & D activities in many fields (e.g., life science, agro-industry, chemical industry, energy, environment, etc.). Capacity building in these fields is thus of transversal importance.

[2] The rationale for the international S & T priorities classification presented here draws partially on the European directives of the 7th Framework Programme.

Social science capabilities are likewise fundamental to any effective innovation framework and are more or less universally included in the research priorities of virtually any country.

13.4.1 Environment, Water and Climate (Including Marine, Agriculture and Food)

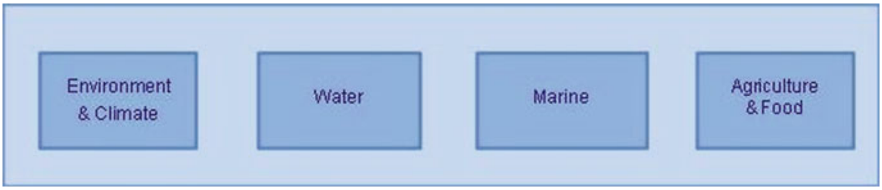
The international research agenda puts considerable emphasis on sustainable management of the natural and human environment and its resources. Interactions between the biosphere, ecosystems and human activities attract major attention. New technologies, tools and services are being developed in order to address global environmental issues in an integrated way.

Research on adaptation to climate change, including desertification, is potentially important for the GCC countries. This includes environmental monitoring and remediation for pollution control and resource optimisation, and tools for risk analysis. The GCC is also addressing food security, waste and water management.

The economic and scientific potential of aquatic environments (principally marine but also including fresh-water) has yet to be fully explored. Extreme or specific environmental conditions (e.g. in temperature, pressure, salt content, pH and chemical composition) and the enormous biodiversity of aquatic ecosystems offer multiple opportunities for bio-prospecting, exploitation and the use of microbes (e.g. cyanobacteria and fungi), plants (micro- and macro-algae) and animals (e.g. fish, molluscs and sponges) and their physiological performance and genes. There is potential for new products and industrial applications (e.g. in bio-processing, biomass, bio-energy, bio-materials, pharmaceuticals and aquaculture) and beyond.

Natural resources including fuels, mineral resources, water, air, soil and biomass are facing higher demand and intensification of use. Greater efforts are therefore necessary to fully valorise their potential and avoid growth ruptures while mitigating unsustainable pressures on the environment. New innovative solutions are essential for the necessary transition towards a more resource-efficient and circular economy. Specific objectives are to reduce input, maximise resource productivity and minimise waste from processing along the value chain, to re-use, recycle and recover valuable materials, and to exploit alternative solutions that take account of the potential for services.

Environment, Water and Climate include a wide range of issues and can be divided into four broad categories:



1. Environment and climate

- Climate change and desertification
- Environmental pollution
- Sustainable development, risk assessment and regulation

2. Water

- Water management
- Wastewater recycling
- Desalination
- Groundwater

3. Marine

- Marine environment and ecosystems
- Coastal management
- Pollution risk assessment

4. Agriculture and food

- Agriculture biotechnology and bio-saline agriculture
- Fishery genetics/biotechnology
- Food security, food industry and optimised animal health production
- Food production and diversification of production.

13.4.2 Health

In health, the GCC attaches priority to improving public health and raising the competitiveness and innovative capacity of health-related industries as a way of addressing global health issues, including emerging epidemics. Countries emphasise translational research (translation of basic discoveries into clinical applications, including scientific validation of experimental results), the development and validation of new therapies, methods for health promotion and prevention, diagnostic tools and medical technologies, and sustainable and efficient health-care systems.

The GCC countries place a special focus on infectious disease diagnostics, diabetes management, sensory impairment, chronic inflammatory disease and health technology assessments. We foresee a major effort to apply new technologies for achieving better diagnosis and treatment, and to push for preclinical or clinical development.

The main priority subjects in the context of health can be summarised as:

1. Genetics

- Stem cells
- Rare diseases
- Genomic screening
- Bio-banks
- Neurogenetics

2. Nanomedicine

- Nanomedicine for diagnosis
- Nano-delivery systems providing a significant therapeutic payload
- Therapy
- Basic research

3. Diabetes

- Diabetes therapy and prevention
- Obesity
- Liver diseases
- Genetic immunology

4. Disease detection

- Bio-markers
- Medical and pharmaceutical biotechnology.

13.5 Energy

Twenty-first century energy policy objectives at the global level are driven by the need to counter global warning, promote sustainable development and ensure a secure energy supply. As major energy producers, the GCC countries naturally have other objectives. At present, the bulk of research is directed to raising the effectiveness of energy exploration, production and diffusion. Much of the research in this context takes place in collaboration between the multinational oil companies that operate in the region and the state-controlled public oil companies that constitute their major regional partners. Future development trajectories in this sector include energy security issues related to the sustainability of the economic and industrial development of the region and the rise of local energy needs to support desalination, coupled with the need to meet the international demand for oil and gas. Enhanced oil recovery, overall production and diffusion efficiency and energy use for water desalination feature are among the main strategic issues addressed by the GCC countries. Meanwhile growing attempts are being made to address climate change, the strain on energy resources, and the development of renewable energy sources.

When it comes to greenhouse gas reduction and Carbon Capture and Storage techniques (CCS), the main priorities are improving model predictions of the behaviour of injected CO_2 and demonstrating technologies and protocols for successfully implementing and validating long-term safe storage of sequestered CO_2. Research, development and demonstration efforts are also directed to the potential of active and passive heating and cooling from renewable energy sources. The aim is to achieve substantial cost reductions, increase efficiencies, further reduce environmental impacts and optimise the use of technology in different regional conditions in which sufficient economic and technical potential can be identified.

Harnessing the vast potential for final and primary energy consumption savings and improvements in energy efficiency requires research into validating and demonstrating new concepts, and optimising proven and new concepts and technologies for buildings, transport, services and industry. Innovative R&D addressing specific components or technologies must support large-scale actions. A key aim is the optimisation of the local community energy system, balancing a significant reduction in energy demand with the most affordable and sustainable supply solution, including the use of new fuels in dedicated fleets.

In energy, research priority subjects in the GCC countries can be grouped into four broad categories:

1. Greenhouse gas reduction

- Novel technologies for carbon capture and storage
- Natural gas—new processes based on natural gas

2. Non-fossil sources for energy generation

- Solar thermal, photovoltaic, geothermal
- Fuel cells (solid oxide)

3. Conventional energy generation

- Petrochemical
- Petroleum refining
- Enhanced oil recovery
- Sustainable chemistry (i.e., chemical intermediates, commodities and advanced polymers)

4. Energy efficiency

- Energy storage and development of tools for energy system analysis
- Smart grids and electricity networks for future
- Green buildings and efficient energy use in buildings
- Efficient oil/gas production
- Clean combustion
- Impact on water efficiency.

13.6 Information and Communication Technology

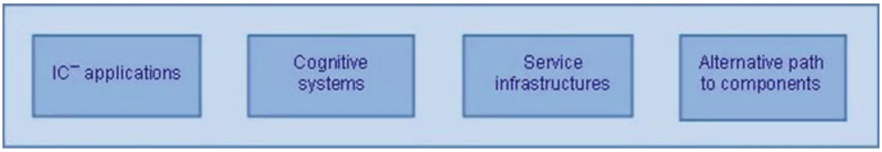
Information and communication technology (ICT) sits at the very core of the knowledge-based society. International initiatives and activities will continue to strengthen the scientific and technology base and help to drive and stimulate product, service and process innovation and creativity.

Current trends are leading to miniaturisation via the application and further evolution of nanotechnology and nanosystems to provide an integrated ambient intelligence environment for the future. New opportunities are arising from novel technology paths, in particular those that make ICT systems more context-aware, personalised and better able to learn and adapt from observations and experience.

Major opportunities will also emerge from new ways of using and applying ICT for digital content management, sustainable health, safer mobility, energy efficiency and the environment, and independent living and inclusion.

Alternative approaches to component and systems development—including nanoelectronics, enhanced chip functionality integration and the use of new materials in photonics—will drive a large part of the technological development. The focus is on further miniaturisation and increased performance in electronic and photonic components and the integration of functionalities like sensing, actuating and communicating in micro and nano systems.

The rise of pervasive and trusted network and service infrastructures, capable of fundamental functionality with regard to authentication, security, privacy and accountability in novel internet applications, will require further development of appropriate tools and platforms. Investments in soft ware and human capital will, for instance, be needed for the development of digital content in multiple languages, and for enabling individuals, small companies, local communities and other sections of civil society to engage in bringing to light the kind of services that fit their particular needs and context. Main research areas with regard to ICT include:



1. Pervasive and trusted network and service infrastructures and more specifically:

- Future networks
- Cloud computing, internet of services and advanced software engineering
- Internet -connected objects
- Trustworthy ICT
- Networked media and search systems
- Future internet research and experimentation

2. Cognitive systems:

- SME initiative on digital content and languages
- Language technologies
- Digital preservation
- Intelligent information management

3. Alternative path to components and systems and more specifically:

- Advanced nanoelectronic components
- Smart components and smart systems integration
- New paradigms for embedded systems, monitoring and control towards complex systems engineering
- Computing systems
- Core and disruptive photonic technologies
- Flexible, organic and large area electronics and photonics

4. ICT applications

- ICT for health, ageing well, inclusion and governance
- ICT for a lower carbon economy
- ICT for manufacturing and factories of the future
- ICT for learning and access to cultural resources.

13.6.1 Additional Research Areas

Three additional fields can be noted as areas that may not at this stage qualify as main priorities for the whole region, but which are of primary interest for some countries in the Gulf hinterland. These fields are partially covered by other areas or transversal issues.

- Aerospace
- Transport
- Material.

13.6.1.1 Aerospace

Internationally this sector is viewed as strategically important as it provides a stimulus to innovation and growth in the economy. In contrast to some Western economies, the GCC countries assume a leading role not as industrial producers or developers, but as main service providers. The rapid evolution in the industry makes it critical to extend the geographical reach while tackling serious environmental and congestion issues. In some of the GCC development priorities include space-based sensors and/or services for natural disaster prevention. Research in this field also supports other research priorities, while various multidisciplinary topics can greatly benefit from an aerospace dimension.

Opportunities for the development of new services integrating detection and monitoring technologies apply with regard to:

- Water quality, groundwater
- Oil spills
- Meteorological and biological information
- Living marine resources
- Marine biogeochemical and marine biology
- Water quality monitoring and pollution control
- Sea level rise and coastal erosion.

13.6.1.2 Transport

Transport systems play a key role in the transportation of people and goods at local, regional, national and international level. They make up an essential aspect of logistics networks and matter greatly for the internal and external connectedness of any country, along with the terms for economic growth and prospects for long-term prosperity. The current tide of development within the GCC countries is much centred on managing the rapidly expanding car traffic. There is however a wider need of managing a range of new technological and organisational developments, including in support of more effective intermodal solutions and more intelligent systems marked by diverse functionality, green features and a high degree of personalisation.

Transport is a shared concern among GCC countries, but emphasis varies from country to country. Several of them have initiated particular efforts pertaining to safety, innovative control systems for operating and managing existing transport networks and plans for public transport. The transport issues are greatly important for achieving a more amenable urban development.

Transportation priorities include:

- Safe transport
- Information provision
- Road pricing
- Traffic control
- Transport fuels—environmental issues
- Planning issues—land use-transportation interactions
- Public transport—sustainable city development.

13.6.1.3 Materials

Although there is an increasing emphasis on applications, longer term research in key enabling technologies is seen as a crucial driver of innovation in the areas of nanotechnology, materials and advanced manufacturing. Research in these fields can help support competitiveness in a range of industries, through additions of add-on know-how that is decisive for new applications at the crossroads between different technologies and disciplines. As with transport, the GCC countries take a general interest in R&D relating to materials science.

The following issues are addressed in the context of specific challenges:

- Nanoscience and nanotechnology for sustainable energy production
- Environment and remediation
- Nanomedicine and safety
- Materials—innovative materials for advanced applications.

13.7 Concluding Remarks

In the GCC countries, the shift from an oil-based to a knowledge-based society will require the establishment of high-quality research infrastructures and activities. While financial resources are available, the inspiration and attraction of required human capital requires the presence of agile, multidisciplinary and internationally oriented academic institutions. It is necessary to create an environment that is conducive to mobility among researchers and access to the international context.

This chapter has reviewed key areas in STI systems and discussed possible research priorities, drawing on the international context while considering relevant local factors. The resulting observations should be viewed as input to local governance processes. Furthermore, selected research priority areas and topics will have to be refined, updated and evaluated constantly, not least with a view to their regional and international impact.

In terms of establishing an efficient research framework and associated NIS, which is in sync with the GCC region's particular needs, the impact of a traditional scheme of bilateral cooperation on some focused area can be compared to the benefits of a broader multi-country collaborative network around R&D activities. While bilateral cooperation may be effective in developing narrow technical capacities that lead to useful performance benchmarking (e.g. the number of patents or scientific publications), international cooperation via larger networks may be more conducive to long-term capacity building and for structuring research in promising directions. Given a lack of critical mass in local talents, broader networks can help build larger pools of ideas and personal contacts, enable a more multidisciplinary approach, and may facilitate the mobility and the exchange of students, researchers and scientists. In the case of the GCC countries, a multi-country collaboration framework can also help enable more productive collaboration within this group of countries themselves, facilitating cross-border synergies in their NIS and a pooling of resources for investing in facilities, infrastructures, research funding and commercialisation schemes.

Acknowledgments This chapter has been authored by Cristina Flesia. Input was provided by various colleagues of the INCONET-GCC project.

Chapter 14
ICT Convergence and Europe's Digital Agenda 2010–2020

Sylviane Toporkoff

14.1 Introduction

Information and communications technology (ICT)[1] has made a formidable contribution to economies around the world in recent decades. The initial impact was visible on the production side, but the focus has increasingly shifted to the user side. ICT has led to new and improved products, new industries, new companies, higher productivity, organisational change and new dynamics within both private companies and governments.

Several new phenomena are now in the process of changing the role and impact of ICT. Among these, convergence[2] will enable ICT users to access a range of services through multiple interlinked devices. Its significance will be comparable with that of other major breakthroughs, such as those stemming from cloud computing and open source (which will be examined in more detail below).

More than anything else, however, the role of ICT and its future effects on the economy and society is critically dependent on non-technological factors. ICT's advance is interwoven with education, human capital formation and the broader societal mindset. The way in which ICT interacts with human capital matters

[1] ICT include computer hardware, software and services, a host of telecommunications functions such as wired (or "wireline"), wireless, satellite products and so on.

[2] While there is no universal definition of convergence, it is generally understood to mean the ability of different networks to carry similar kinds of services (for example, voice-over-internet-protocol (IP) or over circuit-switched networks, video-over-cable television or asynchronous digital subscriber line (ADSL) or, alternatively, the ability to provide a range of services over a single network, such as the so-called "triple play".

S. Toporkoff (✉)
Paris University and Items International, Paris, France
e-mail: stoporkoff@itemsint.com

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_14,

greatly for technological readiness, for investment in technological infrastructure investments and R&D, and for ICT-related innovation.

The link between ICT and innovation deserves special attention. The new tools that ICT provides create many opportunities for different approaches. They also continually challenge our established methods of working and learning in virtually all countries—for experts and generalists alike and in both urban and rural areas.

For the emerging new technologies to continue to empower individuals, enrich societies and foster relevant R&D and innovation, it is essential that society can accommodate the required accompanying changes. Governments' role in addressing the outstanding issues is pivotal, although governments cannot and must not handle these questions in isolation. A number of measures are required to ensure that networks are secure and reliable—and these measures must retain the trust of individuals, businesses and governments.

Harnessing the benefits of ICT requires the creation of an environment that allows for stronger combined development and use of new applications—and the broad dissemination thereof to government agencies and the private sector (from large corporations to the vast community of small- and medium-sized enterprises).

These developments affect virtually all countries, with impact intensifying according to a country's level of development. This is because the opportunities created by ICT and the impediments to realising them weigh increasingly heavily with the development process. The GCC countries thus stand to be strongly affected, while other countries across the Middle East will be drawn into this orbit at varying speeds.

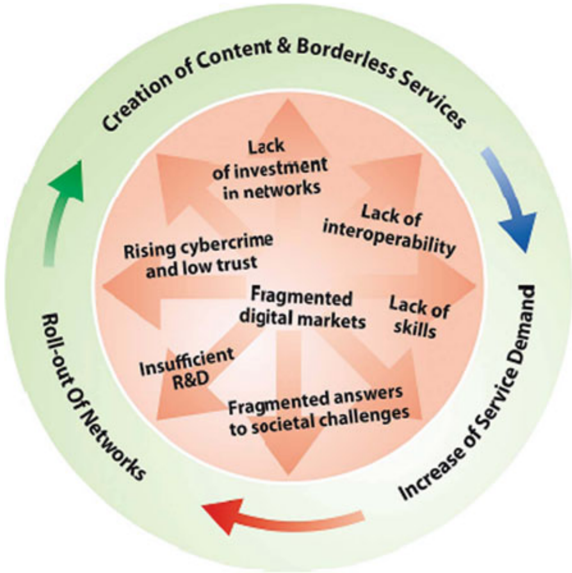
Already as of today, the GCC countries have made concerted efforts in the ICT arena. In some respects, several of them have joined the ranks of world leaders. Mobile penetration in Qatar and the UAE, for instance, is among the highest in the world. There is extensive direct engagement by government through infrastructure investment, for instance in fixed and mobile high-performance networks, as well as in e-government services and regulatory reforms.

On the other hand, there is a lack of effective cross-border collaboration among GCC member states, and also in regard to the wider Middle East, in this area as well as more generally in regard to science, technology and innovation.

Given the integration under way among GCC economies (including the establishment of a common market) and consistent growth in the region's IT usage, it would appear natural for GCC states to join forces in undertaking some joint policies and investments and IT project coordination across both sectoral and national boundaries. In many instances, common initiatives will simply be more effective in developing a digital economy and society compared to unilateral action. Broadband networks, access policies or roaming charges can serve as examples. As this chapter will show, the European Commission has launched a major collaborative effort, "Europe's Digital Agenda 2010–2020", that can offer the GCC countries opportunities if they organise themselves to take advantage.

Fulfilling the potential of ICT, especially in the stages ahead, will require the active involvement of local, national and regional actors from all parts of society—including government, business, civil society groups across all sorts of sectors

Fig. 14.1 Virtuous cycle of the digital economy. *Source* European commission (2010)



(from health and education to transport and energy), thinkers and, above all, doers. The task calls for an effective dialogue, which can allow for exchange of experience and mutual learning between complementary competencies. There is a need to shape a strong and effective digital cooperation strategy that engages all key parties (Fig. 14.1).

This chapter presents observations on the advance of the GCC countries with regard to ICT and then reviews how convergence drives change. It offers reflections on Europe's Digital Agenda and discusses the openings for international cooperation in research and related aspects, along with the implications for the development of trustworthy network services in the rapidly evolving communications field. Finally, it reflects on how to enable new alliances and collaboration through a common vision of the digital future.

14.2 ICT and the GCC

The GCC countries are experiencing some of the most rapid ICT growth in the world, especially with regard to the diffusion of mobile telephony. They have already undertaken a series of large transformation projects in both the public and private sectors that have helped boost the advance and use of ICT.

A range of new measures is also under consideration, spanning legislation, regulatory and infrastructure development, business engagement and investment, and the application of new technologies by institutions through their daily activities. Several GCC states have initiated the development of high-performance higher education and research networks to connect institutions more effectively with the outer world. However, innovative capacity to help generate the development of new industries and higher value-added well-paid jobs is limited.

Market research by World Information Technology and Services Alliance (WITSA 2009) projected an increase of 8–10 % in IT spending in GCC countries by 2012, and further an accelerating trend in ICT investment by GCC states in the period up to 2015. Some countries are more ambitious, or advanced, than others. In absolute terms, Saudi Arabia naturally invests more than the others, accounting for some 50 % of total GCC ICT spending.[3] Next is the UAE, which invests the most relative to the size of its economy and accounts for 25 % of the GCC total in this area, in part reflecting a national effort to promote private sector activity. For all the GCC countries, however, improved coordination and collaboration across the borders could reduce costs, increase efficiency and offset the risk of costly mistakes.

Every GCC country needs to take further steps towards economic diversification generally and towards becoming a genuinely knowledge-based economy (Booz & Co 2009). More than anything else, this will require the appropriate investment in local talent development. Given its role in bringing together people with diverse skills and experience, and in diffusing information and opportunities to the wider community (especially young people), ICT has to be a primary focus of that effort. For that to happen, a comprehensive cyberspace strategy is needed—for the GCC countries individually and for the region as a whole.

When it comes to substantive ICT work and initiatives, intra-GCC cooperation is currently poor. One reason could be the heterogeneity of the region. And yet, the differences between GCC states do not appear wider than those in Europe. Another factor may relate to fear of domination by, or dependency on, others. The degree of cooperation most likely depends on mindset and political choice. At any rate, there are ways to combine market openings and efficiency-enhancing collaboration with enhancement of each participating country's profile. The Digital Agenda for Europe, further discussed below, may serve as a source of inspiration. It encourages a European ICT strategy approach in order to achieve sustainable growth.

14.3 Digital Convergence

ICT convergence brings the world together in a way that very few could have imagined just a few years back, let alone one or two generations ago. Convergence can be characterised in different ways but is certainly no longer empty of meaning; or, as has been said:

[3] According to the Kuwait Financial Center, market expenditures in Saudi Arabia are expected to reach $90 billion by 2012.

Table 14.1 Developing Viable Business Models with Convergence

Multiple service provision under different network infrastructures

Infrastructure	Voice	Data	Video
Copper line	PSTN	DSL, FTTP	VOD, IPTV
Cable	Some	Cable modem	Analogue, DTV
Mobile	Analogue, 2G, 3G	2.5 G, 3G	DVB-H, others
Fixed wireless	Some (VoIP)	Proprietary, 3G, WiMax, LMDS, MMDS	DVB
Powerline communications	VoIP	BPL	VOD, DVB, IPTV

DSL Digital Subscriber Line, *FTTP* Fibre to the premise, *VOD* Video on Demand, *IPTV* Internet Protocol TV, *DVB* Digital Video Broadcasting, *2G* Second generation mobile service, *3G* Third generation mobile service, *BPL* Broadband over Power Line. *Source* Telecommunications Management Group, 2011

> Convergence is no longer a buzzword used by people who want to stir up the ICT landscape. It is real and starts to happen in nearly all ICT-related fields. It ranges from rather simple convergence cases like fixed-mobile telephone services to much more complex cases involving digital content, networks, services and devices. The emerging "Triple Play" shows where the future could be going (Stollenmayer, 2008).

Convergence is accelerating as existing networks are modified (e.g., upgrading telephone networks to offer ADSL, alteration of electric power networks to offer broadband services, and the modification of cable networks to offer interactive services). Convergence is also possible with wireless broadband technologies. As a result, different network infrastructures provide a plethora of services (Table 14.1). Cable television providers offer consumers voice, internet access, and broadcast services over the same network as one bundled package and for one monthly price. Likewise, a mobile service provider may be able to offer a subscriber data and video services, as well as voice services, and digital television (DTV) providers are coming forward with interactive services.

Convergence has in part been made possible by digitalisation, which allows different types of content (audio, video, text) to be stored in the same format and delivered through a wide variety of technologies (computers, mobile phones, televisions, etc.). Two broad definitions of convergence exist, depending on whether technological and media aspects or content are being referred to. The definitions are shaped to some extent by the context in which they are offered.

Technological convergence refers to the trend whereby a set of technologies initially with distinct functionalities evolves towards technologies that overlap. It occurs when multiple products come together to form one product with the advantages of all of them—e.g. your computer as purveyor of voice as well as text and graphics; and cell phones that provide text and graphics as well as voice.

Media convergence refers to the removal of entry barriers across the IT, telecoms, media and consumer electronics industries, creating one large "converged" industry.

The fundamental building blocks determining the way convergence will take us forward have to do with technology, accessibility and relevant content. The key technological factors are the development of networks and new devices.

For accessibility, the quality of services, regulation and cost are essential. The better the accessibility, the greater the number of people who will become active users. Thus, the ability of vendors to offer high accessibility becomes a key competitive factor.

The same applies to content. Through convergence, content enables and will also be a driver (including through mobile devices) of enhancement of services such as entertainment services, payment services and security centres. This will provide numerous opportunities for the development and wide diffusion of new services in health, education, tourism and other sectors—with major implications for local development and job creation.

The changes brought about by convergence are bound to be universal and global. Increasingly, they will affect virtually all countries, all kinds of organisations and people everywhere.

Going further than convergence, cloud computing is now on the rise. Cloud computing has been an information technology buzzword for several years, reflecting fundamental developments in how to make use of new technological opportunities. Now it is going mainstream. As with convergence, the definition of cloud computing varies. In essence, however, it is about putting more of your material out there, in what is emerging as common space apt for exploiting synergies, and less on an isolated PC or bundle of servers.[4] Data are stored on server farms generally located in the country of the service provider. Again, the rise of cloud computing reflects a number of coinciding trends that all involve the evolution of the Internet and its potential to magnify as well as simplify the way we use computers and extend their capabilities.

Defined that way, virtually everybody in the business now views cloud computing as the key to the future of ICT. Cloud computing offers opportunities for all, as it provides answers to what IT always needs: the ways and means to increase capacity or add capabilities on the fly without investing in new infrastructure or licensing new software (open source). Cloud computing extends IT's existing capabilities in real time over the internet.

On this basis, cloud computing is on the way to enhancing virtually all applications, including business, health, education, green IT and others. It heightens the benefits of the digital network to our societies and economies. It empowers individuals and businesses. Most governments across the OECD (including in Europe, the US, Canada, Japan, South Korea and Australia, among others) have evaluated and put into effect plans and policies to pave the way for solid implementation. That said, outstanding challenges are nevertheless frustrating present-day applications, such as issues arising from security and identity management.

In a sense, convergence, cloud computing and open source are the result of rapid technical progress, occurring in different and yet inter-related fields that are

[4] A stricter definition might be the logical computational resources (data, software) made accessible via a computer network (through WAN or the internet, etc.), rather than from a local computer. Data are stored on server farms generally located in the country of the service provider.

coming together and enabling a host of new combined applications. At the same time, competencies and organisational issues are the key to harnessing the benefits involved. Public and private spheres worldwide are engaged in a tremendous effort to meld these individual new technologies to achieve an unprecedented advance in services to end-users. There are no single-bullet solutions. Also, multiple trials have taken place to extend ICT to other industrial fields, including green convergence, smart screens, next-generation broadcasting and media, mobile convergence networks and other ICT convergence applications and services. These attempts have all taken place under the label of ICT convergence.

In these circumstances, a region—just as an individual firm or organisation—needs to be able to plug into the broader regional or international networks of resource flows and exchanges. At the same time, the region also needs to prioritise the kind of infrastructure, networks and content developments that can help to strengthen its unique niche of specialisation and excellence. Both will be required to generate economies of scale, capture synergies and enable effective learning processes.

To date, the European Union has made the most ambitious effort of any group of countries to engage in research collaboration, applying to multiple levels, and with joint efforts around ICT as one of the prime springboards for realising new opportunities more broadly. The EU and GCC share distinct similarities. Both are communities of nation states that can benefit from working together to shape common markets. As we have seen, however, there is a stark difference in the extent to which the two regions have developed internal linkages, with the GCC countries increasingly connecting outward but not among each other Again, ICT can serve as a bridge builder and leverage factor for more extensive knowledge exchanges, including to overcome the fragmentation of the GCC countries. Broad-based inter-regional collaboration, involving joint work on the issues and opportunities arising from convergence spanning research projects, innovation, commercialisation, enterprise development and job creation, can contribute to enhanced connectivity and synergies within the GCC region as well.

14.4 Digital Agenda for Europe 2010–2020: An Opportunity for Cooperation

ICT is shifting away from being an "interesting issue" to a hugely important factor for economic and societal development, with policy ramifications that cut across national and sectoral boundaries. Hence, coordination is required across these boundaries. In Europe, the coordinating policy institutions are in the process of deploying the Digital Agenda, Europe's strategy for achieving a flourishing digital economy by 2020.

The Digital Agenda outlines a number of measures that need to be taken in order to develop the digital economy and society. Given the scope of the technical and organisational implications, there will most probably be a profound impact on how we access the internet, how we do business and how we build and protect our families and communities.

In March 2010, the Vice President of the European Commission and European Digital Agenda Commissioner, Neelie Kroes, sought to spur progress by calling for the active involvement of national, regional and local actors from all parts of society: government and business, citizens' groups in multiple sectors—from health and education to transport and energy—thinkers and, above all, doers. The task also requires effective international dialogue that allows the exchange of experience and mutual learning from each other on these issues. There is a need to shape a strong and effective digital cooperation strategy that engages all key parties.

At present, the European Union is not actually a union when it comes to the digital universe. The EU is potentially ultimately borderless, but its manifestations and development are influenced by an institutional maze that in effect creates 27 different digital economies. Where this leads to fragmentation and costly duplication, development capacity is constrained and consumers are losing out.

Today, however, a digital single market is about to become a reality for cross-border e-commerce, European services and digital content, with potentially massive benefits as a result (EITO 2010). Music downloads and access to music services are cases in point. Consumers often cannot find, or do not have access to, legal services and/or offers. This lack of supply may lead them to download illegally. One of our main goals is to enable people to purchase music online legally from another EU country just as easily as they would from a music shop in the physical world. This would generate new business opportunities for the creative and music industries and give consumers legal access to a wider range of music or films online. A series of different actions is proposed.

To open up access to legal online content, the European Commission has set itself an agenda that moves towards simplifying copyright clearance, management and cross-border licensing (Fig. 14.2).

Actions in this area include making electronic payments and invoicing easier, simplifying online dispute resolution and reviewing the EU data protection regulatory framework.

The Commission is also seeking to keep the Digital Agenda on track by establishing:

- A commissioners' group to ensure effective policy coordination
- A high-level group to work with member states
- Regular dialogue with European parliaments

As for specific deliverables, an annual scoreboard will be published each May. Meanwhile, a Digital Assembly will be held in June each year to look at what has been achieved and to examine whether there is a need to adjust the efforts to meet

Fig. 14.2 "Every European digital" *Source* Global Forum/Shaping the Future, WDC November 2010, Digital Agenda for Europe

new challenges. This process will take the shape of a dialogue involving member states, EU institutions, civil society and industry.[5]

The Commission has further committed itself to: promote the internationalisation of internet governance and global cooperation to maintain the stability of the internet on the basis of the multi-stakeholder model; support the continuation of the Internet Governance Forum beyond 2010; work with third countries to improve international trade conditions for digital goods and services, including with regard to intellectual property rights; and seek a mandate to update international agreements in line with technological progress or, where appropriate, propose new instruments (http://ec.europa.eu/information_society/digital-agenda/index_en.htm).

14.5 Related Factors

Realising the Digital Agenda, for the EU and for other regions, and fulfilling its potential, will hinge on a number of related factors. Some of these have to do with the availability of sufficient resources or infrastructure. Others will relate to the ability of stakeholders to discern and realise opportunities of various kinds. Of some particular interest in this context are the opportunities raised by open source.

Open source promises benefits including lower cost, better quality, higher reliability, more flexibility and an end to the predatory practices of individual vendors who will now be less likely to trap their partners and customers by dependency on specific technologies or services. This is because open source provides the opportunity for multiple non-incumbent and non-conventional organisations, people and talents to interact and create new and unexpected outcomes.

[5] The first Digital Assembly took place on 16 and 17 June 2011.

Open source can be helpful to varying degrees with all the different applications of the digital society, including e-Government, e-education, e-Health, e-transportation, e-environment, green IT, etc.

Despite its potential, and the drive of many individual people to engage, experience shows that open source does not take off by itself. In particular, many emerging economies invest massively in encouraging the established ICT industry leaders to contribute their latest technology and software, and in training a wide range of officials. The goal for these economies is to leapfrog into the information society. While achieving rapid results in a number of respects, this strategy has the tendency to lead to an emphasis on business as usual, on routine applications, and on dependency on the established international industry, rather than to foster new innovative local competencies and firms.

In this context, open source can be highly important, not only as a means of reducing vendor dependency and improving the bargaining power of local players, but for introducing a “can-do” mindset and promoting innovation and the ability to integrate new kinds of tools. Lack of domestic experience and expertise is still often put forward as an impediment and reason to wait. Examples from various regions demonstrate that the difficulties can be overcome. Brazil, for instance, has made significant progress and cut costs by overtly pushing open source. For several reasons, collaboration between networks of researches in different regions, such as the EU and the GCC, could also start initiating new thinking and demonstrating new openings in this respect.

Open source may indeed represent a practically useful hook for working out new means for productive regional collaboration, particularly among GCC countries. This is because all actors are in a learning mood, which is a constant feature of open source. Open source can be of special interest to the GCC, together with the EU, as a vehicle for building new relations between actors that are genuinely keen to share information and engage in mutual learning processes.

14.6 Issues Requiring Action

The Digital Agenda (European Commission 2010b), in conjunction with the Europe 2020 Strategy, aims to:

> …Deliver sustainable economic and social benefits from a digital single market based on fast and ultra-fast Internet and interoperable applications.

However, the progress of different actions will strongly depend on their ability to overcome a number of specific issues. The most important of these are described below.

14.6.1 Increasing Trust

Public attitudes are crucial to the kind of progress that is possible with regard to the information society. Here, trust is now one of the critical factors. For example, 88 % of EU eShoppers reportedly feel a lack of trust today (Reding 2010).[6]

This kind of sentiment is no coincidence. Issues relating to security, integrity, authentication and the like present real issues in the information era. Conspicuous threats such as spam, malicious software, online fraud, identity threat and so on, unsettle consumers and dog efforts to promote the online economy.

The Digital Agenda offers a new avenue towards developing a range of practical solutions to counter these threats. Appropriate responses to cyber attacks and the adoption of tougher rules on personal data protection must be coordinated within Europe as well as beyond. This agenda is important for fulfilling the potential of IT services broadly, and developing the solutions that are required offers a range of business opportunities of its own.

14.6.2 Developing Ultra-High Speed and Wireless Broadband

The scope for progress is dependent on basic capacity, which in turn needs to be put in place by governments (though private business and individuals need to generate the lion's share of innovations and practical applications themselves). Europe has made great progress in the first generation of broadband and mobile take-up, basically leading the world in this area, but is clearly falling behind on the new challenges, such as ultra-high-speed and wireless broadband. This is a great concern because major benefits await the leaders in these areas, especially when it comes to front-runner applications.

New services such as high-definition television or videoconferencing require much faster Internet access than is generally available in Europe. Higher speeds are needed to match world leaders like South Korea and Japan. By 2013, all EU citizens should have access to a basic internet connection. In ten years time, everyone should have access to speeds of 30 Mbps or more and half of Europe's households should have access to speeds of 100 Mbps or more.

The Digital Agenda aims to turn this ambition into reality, for instance by stimulating investment and developing a comprehensive radio spectrum plan.

---

[6] From the speech by Viviane Reding, Vice-President of the European Commission responsible for Justice, Fundamental Rights and Citizenship, entitled *Building Citizen's Rights into the Single Market*, delivered at the 2nd Consumer Rights Forum 2010, Brussels, on 2 June 2010, http://ec.europa.eu/commission_2010-2014/reding/pdf/speeches/consumers_en.pdf.

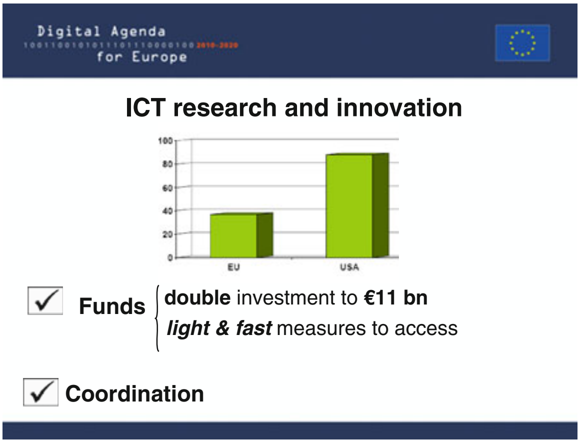


Fig. 14.3 Total ICT R&D Spending (in billion €), 2007. *Source* Eurostat and IPTS-JRC

14.6.3 Investing

The EU is under-investing in ICT research and development, as seen in Fig. 14.3. EU investment in ICT research is currently less than half of the amount being spent by the US.

World class infrastructure and adequate funding are required to attract the best minds to research in this field. Concrete steps that have been recommended to reach the 3 % target on R&D expenditures tend to focus on practical actions to channel more private sector investment into ICT research and innovation.

The Digital Agenda seeks to maintain Europe's competitive edge through increased coordination of and focus on Europe's fragmented efforts.

The first necessity is to ensure that adequate funding is available and accessible. The following steps have been proposed and should help lead forward:

- Leveraging more private investment through the strategic use of pre-commercial procurement and public–private partnerships, by using structural funds
- Adopting measures for "light and fast" access to EU research funds in ICT, making them more attractive notably to SMEs and young researchers
- Second necessity of coordination—to improve the ability of actors to collaborate in making use of the funds, for instance by reinforcing the coordination and pooling of resources with industry

14.6.4 Increasing Regular Use of the Internet

The European strategy aims to raise regular Internet use from 60–75 %, and from 41–60 % for disadvantaged people by 2015 (150 million Europeans have never used the internet!).

The Digital Agenda also aims to help people acquire the skills they need to use the internet proficiently. This will both improve the basic digital literacy of all EU citizens and address professional skills shortages, helping Europeans to participate fully in the digital society, fill jobs in a dynamic tech sector and promote employment growth throughout the economy.

For people already using ICT skills and working in the technology sector, the Digital Agenda will help identify and recognise the competencies of IT practitioners through an EU-wide certificate for e-skills based on the Europass CV classification (a common and agreed tool across Europe).

14.6.5 Developing Education

ICT has become a great force for transforming social, economic and political life globally. It has the potential to aid economic growth and improve social conditions.

For this to happen, it is important to create the appropriate infrastructures, offer reasonable connection costs and develop all citizens' computer literacy and numerical skills.

There is a strong link between modernising a country and the education required to raise the level of IT literacy within the working population.

14.6.6 Developing e-Government Services

eGovernment services have to be led by the ambition to be really interesting to citizens and businesses. At present, 38 % of citizens use online services; the target is to raise this figure to 50 % (with more than half of those returning filled-in forms online). Member states need to agree on a list of publicly available cross-border services by 2011. These services must be available in all member states no later than 2015.

14.6.7 Developing Health Care

Health care is also an important part of digital services; investing more in eHealth can dramatically improve the range and quality of care available. Telemedicine and portable devices can offer a revolution in patient freedom of movement while saving everyone money.

By 2015, the Digital Agenda wants to provide Europeans with secure access to their online medical health records, not just at home but also when they are travelling anywhere in the EU. This would facilitate the work of doctors and enable patients to get the best help if they are seeing a doctor at home or in another EU country.

14.6.8 Developing Media Labs

Media labs can play a catalytic and essential role in fulfilling the potential of the Digital Society. They are laboratories of architecture and planning devoted to research projects at the convergence of design, multimedia and technology.

Media labs have been widely popularised since the 1990 s by business and technology publications such as *Wired* and *Red Herring* for a series of practical inventions in the fields of wireless networks, field sensing, Web browsers and the World Wide Web.

More recently they have focused on design and technologies that address social causes. One Laptop per Child (OLPC) was one of the notable research projects that grew out of the MIT Media Lab.

Media labs help both technologically savvy and technologically challenged researchers with their creation of powerful computerised experiments. Created specifically for the Windows environment, media labs combine smart experimental design features with the capabilities of today's powerful multimedia PC technology.

Media labs allow an abundance of stimuli from basic and fully-formatted Word documents, HTML and PowerPoint presentations to be transferred to multimedia files such as audio, video and image files—either alone or in combination. Examples include:

- The CUBE in Issy-les-Moulineaux, France
- The Media Lab Helsinki and many others in Europe
- Developing smart cities and regions through living labs centred on media and content, i.e. media labs.

Following significant support from the European Commission, living labs have proved to be an effective way to close the gap between innovative R&D and market take-up and to make the innovation process more efficient.

Networks such as the European Network of Living Labs (ENoLL) and projects like Apollon, a Commission-funded initiative to benchmark and share best practice across European living labs have, in turn, helped to mainstream this new and important means of innovating.

14.6.9 Developing S&T Parks

The development of science and technology (S&T) parks and, in some instances, specialised ICT parks can help to establish a critical mass of competencies and resources in a particular area. Such parks may make it possible to enhance the technological skills and knowledge access of a particular region and lay the basis both for attracting a more mature technology industry and for creating technology-intensive start-up companies. Hence, the parks contribute to the overall development of ICT in their regions.

ICT parks enable the creation of a dynamic environment in which local talents can be attracted, retained, incubated, cultivated and shared. They should operate along the full ICT value chain, from ideation to commercialisation. They need also to be integrated with the wider economic forces in their countries, including government, industry and educational institutions.

S&T and ICT parks can be laboratories of good practice for GCC countries and a source of efficient implementation cooperation between the EU and GCC.

14.7 Concluding Remarks

ICT has already achieved an information revolution, both at the global level and in many individual countries worldwide. The continuing advance of ICT will continue to have a dramatic impact on growth, jobs and prosperity.

According to one study, for every job lost because of the internet, another 2.6 jobs were created. Especially SMEs enjoy plenty of opportunities to achieve greater reach and stronger productivity growth (McKinsey Global Institute 2011). The GCC countries are among those investing for the future in this area and primed to take advantage of the opportunities that arise. Economic integration partly spurred by more effective ICT cooperation can further leverage the potential benefits to the GCC's maturing common market of 30 million potential customers. However, hurdles do exist. There is a distinct need for the GCC countries to embark on practically useful collaboration projects, of a nature that can help identify and demonstrate avenues for achieving success in capturing opportunities to generate new products, enterprises and jobs.

New horizons evolving due to convergence and cloud computing offer a rich array of opportunities for countries all around the world, while cutting across traditional sectoral as well as national boundaries. For the GCC, the key will be an ability to engage in new cooperation and partnerships. This must be predicated on an IT approach that is conducive to new applications in areas such as e-health, e-education, green IT, etc.

Like their EU counterparts, the GCC countries are heterogeneous yet represent a wider community that stands to benefit from further pooling of resources and common strategic initiatives (both at intra-GCC level and through collaborative projects with the EU). The mix of rapidly evolving opportunities and challenges emerging through convergence and cloud computing should be built upon to inspire new and stronger research networks and projects across national and sectoral borders. One concrete possibility would be to create joint EU-GCC networks for young researchers, inviting participants from across a range of relevant cross-disciplinary issues of relevance to both regions.

The most important challenges remain ahead. The information society can fulfil its promise of enabling a better future only when coupled with a vision of constructive, global cooperation.

Chapter 15
Establishing a New Framework for Lifelong Learning

Mohammed Chaib

15.1 Introduction

The Gulf Cooperation Council (GCC) countries have a strong need to put in place new mechanisms to promote skills upgrading and the development of new required competencies across the workforce. How can this be achieved? In this chapter, we examine the possibilities for developing expertise to build capacity in lifelong learning in the region. In particular, it is argued that the GCC, a collaboration between six Arabic speaking countries sharing a common culture, language, history and comparable level of economic development, could be the bridgehead and model of innovative cooperation in the field of lifelong learning and continuing education. On this basis, we examine the conditions that have so far prevented an efficient response to the challenges of lifelong learning in the Arab world. We also look at the conditions that could help establish a new framework for lifelong learning in the GCC region.

Lifelong learning as a policy for development is, as we will see below, associated with strategic issues such as the importance of merit-based promotion, cross-generational collaborative learning, workplace-related competence development and adult education. This chapter explores the advantages of developing a mutual response, based on research findings in this field in recent decades, and proposes to establish a GCC/MENA collaborative programme for professional and continuing education that takes advantage of the similar developmental challenges linking the countries of this region.

Section 15.2 reviews lifelong learning as a potential lever for development in the context of globalisation. Section 15.3 provides necessary background and

M. Chaib (✉)
School of Education and Communication, Jönköping University, and founder, Encell, Swedish National Centre for Lifelong Learning, Jönköping, Sweden
e-mail: mohamed.chaib@hlk.hj.se

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_15,

perspectives for understanding the vision and founding sources of lifelong learning. Section 15.4 describes some of the most salient activities of lifelong learning as practised today. The controversial question of whether lifelong learning is a tool that is useful for supporting development worldwide, as it is claimed to be, or rather a strategy primarily for the advancement of highly industrialised countries, is addressed in Sect. 15.5. Finally, the chapter concludes with a discussion of the special conditions that could help the GCC countries to shape an innovative pole for lifelong learning in the Middle East.

15.2 Lifelong Learning: A Potential for Development

The INCONET-GCC conference held in Muscat on 6–7 December 2010 stressed the presence of opportunities to create a platform that would be useful for identifying best practices on Science & Technology (S&T) policies of relevance to the special conditions and challenges present in the Middle East, and to introduce the idea of collaboration between the GCC and EU states and other Arab countries in different fields of research and innovation. One of the conference's main themes was how to facilitate the introduction of S&T by enhancing strategies to develop human resources in collaborative joint projects between countries in the region.

In the globalised knowledge-based economy, managing human resources poses a significant challenge to every society. For some decades now, we have been witnessing the articulation of two parallel discourses: one concerning the character of the knowledge economy and the second concerning the learning society. A debate is under way on the process of linking together the knowledge economy, learning society and lifelong learning. Jarvis (2007) and others have questioned whether globalisation is influencing the emergence of lifelong learning as a major discourse in economic development or whether lifelong learning is an intrinsic discourse that influences our understanding of the learned society and hence the phenomenon of globalisation.

Although most societies share a common view that no knowledge-based economic development is achievable without a resolute lifelong learning policy, the appropriation of the tools to build capacity in this field varies markedly among different countries, and also among groups of countries. Most noticeable is the gap between developed and less developed countries, where lifelong learning has, at least until recently, been perceived and approached rather differently. Lifelong learning strategies have been tested and implemented for more than five decades in developed countries, but until recently have been a marginal and more or less neglected issue in the developing world (Torres 2004), although some changes are under way. Why does such a discrepancy still exist in the era of the internet and global communication?

The development of a sustainable knowledge-based economy requires long-term strategies for education, with lifelong learning as a cornerstone. This is especially so for emerging countries, where rapid economic changes may be jeopardised by a lack of inadequate policies for the formation and management of a skilled workforce. Historically, it has been easier for developing countries to rely on experiences and models imported from abroad, rather than to experiment with domestic ones. The challenges posed by globalisation and higher education in the Arab Gulf states have been investigated in a recent book edited by Donn and Al Manthri (2010). In "*Globalisation and Higher Education in the Arab Gulf States*" the authors argue that the societies that prosper are those that generate knowledge through interwoven relationships between the academic and funded research bodies and industry. The authors also criticise the policies hitherto applied in the Gulf States in that the importation of increasingly sophisticated and costly education programmes makes these states consumers of other countries' knowledge and products, which is neither sustainable nor particularly useful.

Although international benchmarking between educational systems and countries is essential, we believe that systems of education and lifelong learning ought to be genuinely developed out of the cultural and social conditions prevailing in the countries in which they are supposed to function.

Considering the region's potential for technological and scientific development, the establishment of Inter-Arab regional cooperation in the field of lifelong learning and continuing education is a historical necessity. We have hitherto lacked the instruments to explore the ways lifelong learning and continuing education may be used for competence building systems to sustain the development of a knowledge-based economy. We need to discover what conditions would make it possible for the Arab countries to appropriate the tools to implement long-term policies for lifelong learning and continuing education.

15.3 Perspectives on Lifelong Learning

Strategies for the implementation of lifelong learning and continuing education have been on the agenda of the developed countries for the last 40 years. The notion of lifelong learning is both old and new. The term itself can be traced back to the French Revolution. The Marquis de Condorcet was commissioned by the Revolutionary Council to formulate a philosophy of education for the new post-revolutionary era. In his famous Address to the National Assembly in 1792, Condorcet delivered what has since become the fundamental philosophical conception of education "*durant toute la vie*" (lifelong education). For Condorcet, education should not abandon the people at the very moment they leave school, but should respond to the needs of all ages, for there is no one who cannot learn something useful. He added that "*…this second education is more necessary than the first one since during childhood, it has been more limited*". He then concluded"*…education must be general and include all citizens…and ensure that people at every stage of their life have the facilities to preserve and extend their own knowledge.*" (Jarvis and Griffin 2003). In Condorcet's view, lifelong education is also the way to re-evaluate the significance of the practical, manual education, which was neglected by the *ancient regime*. People who today make the argument for considering lifelong education as a basis for enhancing the need of practical knowledge may find support in Condorcet's arguments.

With few modifications, the terms employed by Condorcet more than 200 years ago are similar to those used in policy documents by the major actors in the field of lifelong learning—UNESCO, the OECD, the EU and the UN—when referring, for instance, to lifelong and life-wide learning. Learning is omnipresent, lifelong and life-wide. We do not only learn in formal settings in school but also, and indeed mostly, at home, at work and in real life. Learning is not limited in time and place but can occur anywhere in any context, sometimes without conscious awareness. That is why lifelong learning is such a generous and, at the same time, pervasive notion, subject to many interpretations. Yet, lifelong learning as a policy is incorporated in the official policy documents of all EU states in order to mark the convergence of the member countries' common educational policies.

Jarvis (2004) has provided a critical overview of the different stages that paved the way for the acceptance of the term lifelong learning. Lifelong learning changed the concept of education. According to Jarvis, the educational discourses and policies have gone through different stages, involving: adult education, continuing education, recurrent education, human resource development (HRD), community education, lifelong education and, finally, lifelong learning. Each stage is connected with its specific ideological, social and economic considerations. The term HRD, widely used and sometimes misused, has its origin in Schultz's introduction in 1961 of the concept of human capital (Jarvis 2007). It was intended to meet the need of corporations to define and implement ongoing processes of learning and competence development that they themselves managed.

In many countries of the developed world, for example Sweden, there has been—and still is—a significant focus on learning and competence development related to and/or located in the workplace. EU governments and lifelong learning programmes (LLP) in the region are investing huge amounts of money in grants for international joint cooperation projects aimed at developing and structuring strategies for competence development related to working life. A decade ago, the EU Commission extended member states' cooperation with countries outside the EU. One of them is Russia, which in recent years has increased its involvement in EU-sponsored workplace-related learning projects. Other partners are mostly located in Latin America and include Brazil, Argentina, Peru, Chile, Cuba and some of the Caribbean countries. The INCONET-GCC project, which provides the framework for this book, is an example of this initiative

All societies are confronted with the challenge of coordinating different coexisting systems of education. The task is to adopt policies that can merge non-formal education with formal education. The latter generally refers to school education, principally adult education, literacy and competence development. Lifelong learning is considered today to be the key organising principle for education and training and for building the knowledge society of the twenty-first century. The focus of education over the last few decades has shifted from education to learning and from lifelong education to lifelong learning (Torres 2004).

Awareness of the emergence of the knowledge-based society may be connected to a few major works from the end of the last century. It is generally recognised that four major publications sowed our awareness of the knowledge-based society as centred on lifelong education and lifelong learning. The work most referred to is Edgar Faure's 1972 report to UNESCO, *Learning to Be*, followed some 20 years later by a similar report by Jacques Delors (1996) to UNESCO entitled *Learning: The Treasure Within*. These two global policy documents are the most quoted, together with two major academic works: Jean Francois Lyotard's 1979 report to the Canadian Society of Science, *The Post-Modern Conditions of Knowledge*, and Emanuel Castells' monumental three-volume work on the *Rise of the Network Society*, published in 1996.

These books and policy documents have laid the foundations for our understanding of the development of modern society, of which knowledge acquisition and knowledge dissemination are expected to be the dominant elements. This kind of society has been alternately referred to as the "information society", "knowledge society", "post-modern society" and "learning society", each term relating to a specific conception of a given society based on its most salient features (Jarvis 1998).

Edgar Faure's report to UNESCO on the management of knowledge in future societies is generally considered the most fundamental source of inspiration for the development towards the notions of lifelong education and, later, of lifelong learning. The report was devoted to the structural and societal foundations of the upcoming knowledge society. It contained 21 key recommendations (Faure 1972) that, according to Boshier (1998), pertain to four concepts that are still widely used today. Faure's report conceived lifelong education as a process of *"vertical integration"*, referring to the lifespan aspect of education that should be provided throughout life from cradle to grave. The second process, *"horizontal integration"*, refers to the need to stimulate education in many different contexts, encompassing formal as well informal and non-formal settings. The third concept, that lifelong education should promote democratisation, is supposed to cut across both the vertical and horizontal integration. Democratisation is needed to remove barriers that impede access to education; learners should be more involved in the design of their educational process.

Finally, Faure's report introduced, as an overarching dimension, the concept of a "l*earning society*", described with the more poetic French denomination "*Cité éducative*". The learning society calls for education systems to be restructured so as to provide access to them on the basis of an inalienable human rights principle. The concept of the learned society has been, and still is, widely used by divergent ideological forces to mean different things: an arena for citizenship, a learning market or an arena for participation (Boshier 1998, p. 12).

Faure's report was followed approximately 20 years later by a similar report to UNESCO by Jacques Delors. In *Learning: The Treasure Within*, Delors actually assumed most of the concepts advanced in Faure's report, with one exception—the shift from the notion of lifelong education to lifelong learning. Since then, the concept of lifelong learning has been much discussed, and has been interpreted in various different ways (Kristensson Uggla 2010; Jarvis 2006, 2007). Delors' report also introduced the so-called four pillars of education—that education must be built upon the four pillars of "Learning to know", "Learning to do", "Learning to live together" and "Learning to be".

As mentioned earlier, the two prime academic studies that have marked the distinction of the learned society are the books of Jean François Lyotard and Emmanuel Castells. Lyotard's *The Post-Modern Condition* (1979) was the first attempt to analyse the evolution of knowledge in a post-modern society dominated by rapid, scientific and technological changes. In a post-modern society, the great narratives or meta-theories from the past—Marxism, Structuralism and so on—are no longer sufficient to explain the management of knowledge in a society in which technological transformations are expected to have considerable impact on knowledge. Two principal factors were expected to pave the way towards the knowledge society: the expansion of research and the transmission of acquired learning. Together with the miniaturisation, sophistication and commercialisation of technological machines, these factors were expected to transform the way in which learning is acquired, made available and exploited.

Back in the 1970s, these visionary words seemed to belong to academic utopia. Forty years later, with the development of the various so-called social media and their impact on social and political change in the world, Lyotard's prophecies are even more on the mark than he may have expected.

Castells' ideas about the "network society" have gained tremendous ground worldwide. According to Castells' view networks constitute the new social morphology of our societies. Castells defined a network society as one in which the key social structures and activities are organised around electronically processed information networks. In his mind, this is not just about networks or social networks, because social networks in a sense represent very old forms of social organisation; rather, the key issue is the rise of social networks which are capable of processing and managing information, using microelectronic-based technologies. For Castells, networks have become the basic units of modern society. The network society goes further than the information society in reshaping communication. Castells argues that it is not merely the technology that defines modern societies, but also the cultural, economic and political factors that make up the network society. Influences such as religion, cultural upbringing, political organisations and social status all shape the network society. Societies are shaped by these factors in many ways, and these influences can either facilitate or hinder how a society functions.

The "space of flows" plays a central role in Castells' vision of the network society. This is a network of communications, defined by hubs where these networks intersect. The elites of a given society are not attached to a particular locality but to the space of flows. Considering the extended role that social media assumed in the Arab world in 2010–2011, we can observe that Castells' vision is pertinent not only to the elite but also to the younger masses as well.

Castells places great importance on networks and argues that the real power is to be found within them rather than confined in global cities. From Castells we know, for example, that the Internet, with its often-praised benefits of communication between people and systems, is also a terrible instrument of social exclusion for those on the outside.

Castells' work on the network society is of great relevance to the ideas advanced in this chapter, whose thrust is to argue for establishment of lifelong learning and continuing education in the Arab region based on flexible forms of cooperation to which the interconnections between national and international networks are of central importance.

15.4 Lifelong Learning in Practice

We have previously seen how the way has been paved towards today's conception of lifelong learning as an overarching and unifying concept for different kinds of policies, such as recurrent education, continuing education and learned society. Lifelong learning is associated with a large number of policies, concrete manifestations and empirical fields of research. Different kinds of lifelong learning practices are relevant to different contexts and countries, whereas others are more general adoptions of universal values, such as the right to literacy.[1] Some lifelong learning practices are more universal and humanistic and related to individual needs, whereas others are aimed at meeting the needs of modern working life and at providing a skilled labour force to the market.

An attempt is made below to group some the most common practices into two main categories. The categories tentatively suggested here are not mutually exclusive but focus on different aims for lifelong learning initiatives.

The first group can be characterised as *individually motivated*. It comprises lifelong learning policies and practices considered to be universal in the sense that they characterise the educational systems of most countries, with few exceptions. This category encompasses lifelong learning practices that are historically anchored in national needs. They are generally rooted in the cultural and educational traditions of the respective countries and shaped thereafter. Within this category are:

- Adult education
- Liberal adult education
- Literacy
- Community based education
- Intergenerational learning

[1] An excellent source of information covering all the aspects of lifelong learning and related issues is to be found at the online "Encyclopaedia of informal education" database at www.infed.org.

The enhancement of individuals' levels of education, at least officially, motivates most of the educational practices in this category. This is the case for adult education. Some of the other practices are used to mobilise citizens for specific common actions in order to cope with national, regional or local concerns such as health or environmental problems. This is the case for community-based education, which is expected to bring some benefits to the local environment through common citizen works (Nicks-McCaleb 2005). Some other practices are typical in specific regions. The best known is liberal adult education (*folkbildning*), a genuine Scandinavian phenomenon (Chaib 2008) with a 110-year tradition. Literacy is a phenomenon normally associated with campaigns in Latin America and Africa, but it is also still a major concern for many countries. For example, literacy rates vary greatly between Arab states, ranging from 80 % in the United Arab Emirates, to less than 50 % in Mauritania and Yemen (Hammoud 2005).

The second group of lifelong learning practices can be characterised as *work-life motivated*. Practices within this category are more or less all motivated by the market's need for a skilled, flexible and employable workforce. We can tentatively place the following forms of lifelong learning in this category:

- Recurrent and continuing education
- Workplace-related and workplace-situated learning
- Validation of formal and informal knowledge
- Competence development and merit-based promotion
- Flexible learning and distance education
- Transition from education to working life
- International exchange programme for students and professors
- Transfer of knowledge—preservation of older workers' skills
- Advanced vocational education and training (AVET)

This category encompasses the majority of all lifelong learning practices in the developed Western world today. As an example, one of the largest items in the European Union's 6-year budget is the LLP, which officially aims to contribute to the development of the EU as an advanced knowledge society. The programme runs for 7 years (2007–2013), with a total budget of €6,970 million. Lifelong learning is also to be found in other EU programmes for technology, communication and basic research.

Some other countries in the world have taken on the challenge of adopting the EU strategy for lifelong learning as a means to build up their own knowledge-based economies. China, Canada, Japan, Australia and, to some extent, South Africa and the United States are countries that have entered the race with varying degrees of success.

The range of learning practices related to the workplace, such as competence development and work-related learning, is more or less absent in most developing countries. The lifelong learning practices listed in category two are adapted to the needs of advanced industrial production systems, which render them quite difficult to adapt to the needs of less advanced economies. Trying to raise the issue of lifework-related learning in Brazil, Vietnam or Qatar would appear to be quite challenging, at least for the time being. There are, however, some exceptions. China, for example, is engaging in a dynamic process of increasing its capacity for implementing lifelong learning and continuing education, drawing on Hong Kong universities as scientific sources of inspiration.

The policies of the industrialised countries concerning the preservation of older workers' skills through the transfer of knowledge from older to younger generations are very new. They are specific to Europe, where the ageing population is a structural demographic problem that is difficult to solve without innovative working-life-related learning policies. New means are required to preserve the skills accumulated, formally and informally, by the older generation and to retain these skills within the production system. One preoccupation concerns the transfer of so-called tacit knowledge possessed by older workers, and the recycling of this knowledge in the production systems (Gendron 2007).

Today these problems are simply unaddressed in developing countries, whose populations, in addition, are much younger.

Yet one problem is common to both developed and developing countries, although it is not sufficiently addressed by either of them. It is related to the fact that the transition from basic education to work poses problems with regard to productivity. Many employers complain that the majority of newly examined professionals, for example engineers, teachers, doctors and economists, have difficulty transitioning quickly enough to be operational and autonomous within a reasonable timeframe.

15.5 The North–South Dimension of Lifelong Learning[2]

"*Go west, young man, and grow up with the country*." In borrowing this famous exhortation we would like to affirm that the time has come for the emerging countries to overcome the necessary elements to enable them to build up capacities for the implementation of lifelong learning in their educational and developmental systems. Lifelong learning should no longer be considered as a panacea or complementary attribute to economic and social welfare, but a prerequisite for it.

Lifelong learning has been acknowledged as a need and a principle for education and learning systems worldwide and is being actively embraced by the developed countries. However, according to a recent report by the Swedish Agency for Development Assistance (SIDA), the learning needs of adults continue to be sidelined or ignored in recent international development initiatives and education policy recommendations for the South. There seems to be a tacit agreement between educational experts that lifelong education is for the developed

[2] The North–South dimension, in this text, is not used in a strictly geographical sense but as a common denominator, frequently found in the literature, distinguishing between the developed countries, mostly located in the Northern hemisphere, from the developing countries, mostly located in the Southern hemisphere (Torres 2004).

countries, whereas the developing world should be restricted to basic education (Torres 2004, op. cit.).

Despite its universal message, lifelong learning is characterised by a North–South, East–West and developed-developing dimension. If one looks at the geographical map of lifelong learning in the world, it is easy to adhere to the idea that lifelong learning, as an instrument for development, is more or less exclusively for the richer countries in the Northern hemisphere (Torres 2004, op. cit.). There are, furthermore, discrepancies even between countries and systems within the Western world itself. Lifelong learning is much more prevalent in countries in the northern part of Europe, such as Scandinavia, than in the south of the region, for instance in Greece, Portugal and Spain. The more sophisticated the systems of basic and continuing education are, the easier it is to adopt practices for lifelong learning. As mentioned earlier, the Scandinavian countries have more than a century of tradition in the field of adult and liberal adult education. This gives them an advantage in designing new flexible systems of lifelong learning and continuing education adapted to the needs of their changing societies (Chaib 2008, 2009). On the other hand, emerging economies—even the richest ones—are hitherto confined mostly to developing programmes for basic education. Designing strategies for lifelong learning and continuing education is still in the embryonic stage in these countries and dependent on external expertise.

Lifelong learning has, in common with its predecessors (lifelong education, recurrent education and continuing education), so far been designed and experimented with mainly by developed countries. These countries' experiences, however, are transferable to the developing world only on a limited basis. According to Torres (2004, op. cit.) this is not an historical accident but a strategy consisting of maintaining control or even preventing the transfer of knowledge and technology from developed countries to developing nations. According to the same author, there seems to be a worldwide tacit agreement to perpetuate an asymmetry in the distribution of advanced knowledge, with lifelong learning in the North and basic education in the South. It is no accident that countries that have enjoyed access to advanced knowledge from the industrialised world have also shown extraordinary technological progress. An often-cited example is the state of Israel.

In a knowledge-based market economy, acquisition and control of knowledge are of extreme importance. It is easy to observe this fact by listening to the political discourse in different parts of the world. The European Union's Lisbon Strategy (2000) declares the EU's official intention to become the most competitive and dynamic knowledge-based economy in the world by 2010. Although, allegedly, most of the goals of this strategy have not been achieved, the objectives still remain firm. This declaration implicitly means that the EU will be more competitive than, for example, the United States and China. The same discourse can be heard from the United States, this time directed towards other competitors, principally China.

Decision makers in the developed world often voice the intention that their economies should no longer compete on wages but through the acquisition, control and dissemination of knowledge and the application of such in the production systems. In this context, strategies of lifelong learning and continuing education are largely comprehensible as necessary to foster and to protect knowledge from being illegally appropriated by others. Lifelong learning is one of the most important investments a country can make and a significant indicator of national know-how.

As demonstrated by Bontis (2002), the development of knowledge contributes to enhancing a country's national intellectual capital index (NICI). In the case of the Arab region, the NICI is far more important than financial capital for national competitiveness. According to the author, four key assets comprise a nation's intellectual capital: human capital, process capital, market capital and renewal capital. Human capital is defined as the knowledge, education and competencies of individuals available for realisation of national tasks and goals. Process capital refers to the non-human storehouses of knowledge, which are embedded in a nation's technological and communications systems. Market capital is the intellectual capital embedded in national intra-relationships. It represents the capability to provide an attractive solution to the needs of a nation's international clients, as compared with other countries. Market capital is also defined as social intelligence created by elements such laws, market institutions, and social networks. Renewal capital is a nation's future intellectual wealth, that is, its capability to invest in renewal and development through R&D.

The transfer of knowledge and technology is easier to perform if operated through flexible forms of formation and education, such as continuing education, rather than through inefficient long-term programmes of basic formation like the ones imported by the developing countries. The transfer of knowledge, especially from the North to the South, was dramatically actualised four decades ago. In the mid-1970s, after the first so-called oil crisis, a dramatic situation emerged concerning the transfer of knowledge from developed to developing countries. Countries in both groups intensively negotiated issues relating to the transfer of technology to the developing world, which was seen as fundamental for establishing a better basis for global collaboration.

Developing countries in general, and the oil exporting ones in particular, were very eager to see the transfer of technology in terms of knowledge transfer and not only as the importation of a ready-made industrial plants and manufactured technical products. A central element in the strategy for the transfer of knowledge was expertise in the field of recurrent education and flexible programmes of formation adapted to the local conditions.

Some industrial leaders in Europe, among them the former chief executive officer of Volvo, Per G. Gyllenhammar, supported the legitimate needs of the developing countries in this matter. For some reason, this very global transfer of knowledge never fully occurred. As expected, the big industrial corporations in the West did what they had always been good at doing: exporting manufactured goods and techniques instead of sustainable knowledge. To be objective, the recipient countries did not possess the necessary expertise to properly formulate and define their needs in the field of recurrent education and formation. It was much easier for them to buy ready-made industrial products and factories—"turnkey solutions"—than to define long-term strategies for knowledge building through lifelong education. Unfortunately, in many aspects, a similar situation still prevails in many countries today.

15.6 Pathway for Lifelong Learning in Arab Gulf Countries

What are the primary factors that could facilitate (or hamper) the Gulf region's emergence as a central pole of development for lifelong learning and continuing education in the Arab region? Positive assets inherent to the region can facilitate this objective. Taking on this role entails a number of commitments that need to be addressed.

It is easy to adhere to the belief that the Gulf region's financial strength automatically allows it to build structures and procedures to establish sustainable cooperation in the field of lifelong learning. However, financial wealth does not necessarily guarantee success. As Bontis (2002, op. cit.) argues, intellectual capital is much more important than financial capital in driving social and economic change.

The Gulf region possesses assets that probably make cooperation on lifelong learning and continuing education more plausible and workable than in other parts of the Arab world. Taking full advantage of these assets would require fulfilment of a number of obligations that arise from leadership in the field of lifelong learning. Lifelong learning as a societal phenomenon is deeply rooted in humanistic and egalitarian visions of the world. The learner's needs are supposed to be the highest priority for the learning systems. The nature of lifelong learning requires the building of systems that allow for equality—the right of both men and women to access basic and continuing education, irrespective of their social or ethnic backgrounds. In turn, this entails the implementation of lifelong learning practices for democratic change processes, giving citizens the opportunity to realise their life projects. These goals should be included in any policy to create lifelong education systems that benefit both the state and its male and female citizens.

It is of prime strategic value to facilitate, in particular, the participation of women in the process of lifelong learning by empowering their potential for knowledge production and acquisition (as experience in industrialised countries has shown). Women's participation in the production process should be facilitated by their participation in all systems of education, particularly in adult and continuing education. Education is often regarded as the guardian of the *status quo*, aimed at control and containment. This widespread view must be replaced by the view that education and lifelong learning are tools for social change and equity. For Mehran (1999), education can empower or disempower based on class, gender, race and ethnicity. Mehran explored whether the lifelong learning experience provided to Muslim women in post-revolutionary Iran was able to empower them. Lifelong learning has been found to be an asset in linking adult women to socio-political networks and, hence, to facilitating, at least theoretically, the empowerment process.

The Gulf region's assets are easily identifiable. Among the most apparent are: common historical heritage, geographical proximity, similar political systems, linguistic commonality, similar economic structures, solid financial resources, positive demographic structure, and highly developed communication infrastructures, including information technology.

We would highlight another asset related to the region's shared colonial heritage. All the countries in the GCC region have at one time (in whole or in part) been part of the British sphere of influence. Thus, they are linked linguistically and culturally by historical ties to the Anglo-Saxon sphere of influence, which includes the United States and Australia, among others. A comparable situation prevails in the Arab countries of North Africa. They are linguistically and culturally linked to the French sphere of influence due to their former status as part of French colonial rule.

In many cases, being part of a European sphere of influence might be an asset, for instance facilitating communication in science and technology in the Anglo-Saxon or French-speaking communities and networks. The flipside of the coin is that this same feature might also act as a restriction. Countries that have been under the influence of one of these linguistic spheres for a long time may tend to concentrate their sources of inspiration on them, thus missing the opportunity to pick up influences from other interesting linguistic networks.

It would have been rather difficult to establish, for example, a functional cooperation between all the Arab countries, since half of them are French-influenced and the other are British/American-influenced. This may be one of the reasons why cooperation between all 20 Arab countries in the fields of education, science and technology has hitherto been quite limited (for example, via the 40-year-old ALECSO).[3]

The European Union has been able to design and implement functional 6-year LLP for cooperation between the 27 member countries, despite the fact that cooperation has spanned 27 different languages. The cultural and sociological differences—concerning cultural habits and culinary and social traditions—between these countries are much larger than those, for example, between Morocco and Bahrain. One major explanation for the successful implementation of the LLP within the European Union is the fact that these programmes are only part of a much larger political ambition. The cooperation between the countries in the EU is based on the will to build a common future based on shared democratic and social values. Many different projects designed to cement that common vision exist within the framework of this political ambition; lifelong learning is just one of them.

---

[3] Arab League Educational, Cultural and Scientific Organisation (ALECSO), a Tunis-based institution of the Arab League, established in Egypt in 1970. It works for the coordination of scientific, cultural and educational activities in the Arab world.

It is of interest to observe more specifically the lessons mentioned above regarding the cooperation between the EU countries in the field of lifelong learning. One of the reasons for the successful implementation of such a huge programme for lifelong learning is the EU member states' mutual conviction that they stand to gain by combining their resources. No country can face the tremendous task of developing strategic knowledge all on its own. The cooperation between the member states is built on the concept of bringing together experiences from different countries. This is particularly evident when it comes to the processes of linking theoretical research in advanced universities to practical applications. Although all the EU states are nominally industrialised countries, the disparities between them are rather significant. To be competitive with the largest knowledge-based economies in the world—the United States, China and India—they have to combine their expertise and to diversify their practices. Once again, this process of integration is occurring despite the large number of official EU languages.

Some EU states, such as Luxembourg, Malta, Cyprus and some of the Baltic countries, are very small. Their chance to be part of a global knowledge society depends upon their interplay with large countries like France, Germany, Italy or Britain. Here we can observe the benefits of cooperation for both the larger and the smaller states. It is also legitimate here to draw parallels with the Gulf region, which groups small nations like Bahrain with large states like Saudi Arabia. Gulf countries may be able to combine their intellectual and material assets to achieve the purpose of building up knowledge-based societies and technologically advanced economies. The common language, in this context, is an added value that facilitates the implementation of lifelong learning strategies for the realisation of the objectives.

In any attempt to build up cooperation between states and organisations, we must not overestimate the advantages upon which the cooperation will be built nor neglect to assess the obstacles that can impede such cooperation. Having a shared language, common historical past and a certain degree of cultural convergence is insufficient guarantee for realising sustainable cooperation. The region has to build into the cooperation process systems of incentives at individual, regional and national level. The kind of incentives suggested here must be negotiated and structured so as to yield both material and socio-cultural rewards.

15.7 Concluding Remarks

What is the significance of lifelong learning in emerging economies? This chapter has argued that this area needs to be addressed as an integral part of developing nations' strategy to transition towards knowledge-based economies. Across the Middle East, however, we still see very few such initiatives of true relevance to this transition. Why is this so? To illuminate this context, what are the factors that have facilitated constructive cooperation in lifelong learning between EU states?

What are the possible lessons that can help to guide the Middle East in this respect?

As we have observed, the Arab countries have many assets for achieving cooperation on a similar level to Europe. Attempts have been made since the 1950s to build political and economic collaboration. So far, they have not delivered as expected because they were or are purely politically motivated, with few references to economic and social development.

Building a common future based on shared knowledge is quite a complicated process. But it is not impossible. We believe that it is possible to test the option of gathering expertise from the different states in the Gulf region to establish frameworks for collaboration in lifelong learning and continuing education, provided that this cooperation is built on flexible collaborative programmes to avoid building bureaucratic institutions lacking substantive content.

The GCC might make the difference. It may prove successful in designing and implementing a joint collaborative effort in the field of lifelong learning and continuing education, thanks to the presence of the assets outlined above (the foremost being a common language, cultural proximity, sociological structures and political systems).

The objective of building common ground for cooperation in lifelong learning and continuing education should focus on:

- Developing R&D in lifelong learning by bringing together different types of stakeholders from academic, business and political circles. Finding ways to involve civil society with the cultural, social and educational organisations is also a key imperative.
- Developing structures for flexible learning and distance education. Countries such as Australia, China, India and Brazil are all developing structures for flexible, IT-supported distance education systems. The systems are a condition for the distribution of sustainable LLP. The experiences gained in these fields by the above-mentioned countries have to be studied. How a course can be developed at the University of Curitiba in southern Brazil and distributed deep in Amazonia is certainly a challenge worth studying.
- Designing and distributing work-life-related continuing education programmes for professional development. These programmes have to be evidence-based, combining high academic standards with adjustment to the real needs of the learners and the workplace. In this sense they have to be designed in close consultation with different stakeholders to ensure an optimal balance between programme theory and practice. They may be designed as continuing education programmes lasting from 6 months to 2 years. The best known are the AVET programmes available largely through the European Union's continuing education systems. The curriculum of these programmes consists of at least 30 % of practical training in the workplace, familiarising the students with practical aspects of working life (Chaib 2007). They also might be offered as long-term Professional Masters Degree programmes or even Ph.D. Degree programmes aimed at enhancing professional competencies among different categories of

professionals. Such courses have proven highly popular, for instance in Sweden, among students and employers alike. About 70 % of all AVET-enrolled students find a new job or change to another position at the end of their studies. The programmes are, however, partly financed by specific government grants and framed administratively by a National Agency for Advanced Vocational Training (*KY-Myndigheten*).

- Establishing interregional networks to identify the practices occurring in the region and elsewhere and to disseminate knowledge about them. This can be achieved through the establishment of an interregional centre for the dissemination of research and best practices from the partner countries involved and from other countries in the world. Depending on the level of ambition, the centre may be virtual—based on networking and extensive contact between the partners involved.
- Encouraging extensive communication between students, faculties and experts from different countries through sustainable exchange programmes. The EU programme for lifelong learning consists of four sectorial programmes and one transversal programme. The sectorial programmes aim at developing cooperation to sustain lifelong learning in schools (Comenius), higher education (Erasmus), vocational training (Leonardo Da Vinci) and adult education (Grundtvig). The transversal programme consists of different key activities related to language, policy, innovation of ICT-based education, and dissemination and utilisation of results. Some or many of these topics are equally relevant for the purpose of building up lifelong learning capacities in other regions of the world as well. It is generally known that the interchange of students and scientists between the Arabic countries is very limited, despite the existence of a common language. The establishment of inter-Arabic exchanges between professors, teachers and policymakers should be extended and developed beyond current levels.
- Intensifying international scientific cooperation, not only with the industrialised countries in Europe, North America, Japan and Australia, but also with the emerging economic regional powers such as China, India, South-East Asia and Latin America. There is added value in cooperating with countries which until recently have been facing the same problems as the Arab countries face today. It is also advisable to establish international scholarships and grants to facilitate exchanges between the countries.
- Being innovative in testing new policies and practices of lifelong learning while laying legal and practical foundations to facilitate initiative-taking, experimentation and testing of new educational ideas on a smaller scale. Many developing countries are inhibited by a lack of freedom to experiment with new ideas because of the constraints that emanate from bureaucratic and rigid development plans which inhibit innovation and new initiatives more broadly. Innovations should address the fact that Middle Eastern countries are facing enormous growth in their young populations. This calls for lifelong learning processes that can facilitate, for instance, the transfer of knowledge from older workers to younger, more skilled personnel. We have seen how developed

countries are designing new ways to cope with the needs of workplace-related learning systems. It is our belief that the needs are just as strong in the Arab world, but for other reasons compared to countries with ageing populations. It is equally important that knowledge be transferred from the younger, more technically skilled population to older, less skilled workers. Such experiences are occurring in many countries in Europe, and it is worth studying them to draw conclusions for the future to come.

It is certainly legitimate to ask how much it will cost to build up lifelong learning capacities, and who is going to pay for it. We believe that the costs should be managed within normal government budgets and financial frameworks. Certainly, pooling the resources of the different partners will bring costs to a level that is both marginal and fully acceptable considering the tasks envisioned. As the former president of the World Bank, Jean-Louis Sarbib said in a speech in Marseilles in 2002, “Harnessing the (Arab) region’s human and social capital so that it can take its place among today’s leading knowledge economies will take less financial investment than policy reform.” The Arab countries are known to spend higher percentages of GDP on education than nations outside the region. Would it not be a good thing if some of these investments were to go towards reinforcing initiatives in lifelong learning and continuing education for the benefit not only of one country but also of the whole region?

Chapter 16
University-Industry Cooperation and Conditions for Start-Ups

David Audretsch, Ahmed Alshumaimri and Taylor Aldridge

16.1 Introduction

After decades of relying on oil to generate economic growth, Saudi Arabia is pursuing a new, knowledge-based development strategy. Beyond simply increasing investment in education, a key component of the new strategy is to foster the entrepreneurial activities of scientists in order to create economic growth and enhance international competitiveness. This chapter seeks to analyse and identify the specific conditions in Saudi Arabia that either promote or inhibit scientist entrepreneurship. Future work on the subject will be merited to study actual start-up behaviour and determinants of success or failure. Also, the somewhat unexpected findings on female entrepreneurship call for a good deal more investigation, including how and why nascent female entrepreneurs decide to start companies and, more importantly, what start-up method they choose. For instance, do females use proxy start-ups, such as family networks, or openly start a company by themselves? Another study limitation is the lack of a codified human capital stock in Saudi Arabia (and in the Middle East in general), which indicates that future research may need to identify proper proxy variables to quantify human capital.

D. Audretsch (✉)
Indiana University, United States
e-mail: daudrets@indiana.edu

A. Alshumaimri
Entrepreneurship Centre, King Saud University, Saudi Arabia
e-mail: alshum@yahoo.com

T. Aldridge
Indiana University (United States) and The Max Plank Institute on Entrepreneurship, Germany
e-mail: ttaldrid@indiana.edu

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_16,

Despite these limitations, this chapter is able to present new data and observations on what determines scientist entrepreneurship in Saudi Arabia and how it differs from corresponding entrepreneurship elsewhere, thus contributing to our understanding of warranted policy reform in this area.

16.2 Background

The Eighth Development Plan, which King Abdullah unveiled in 2005, confirmed that the national administration was concerned with the unsustainability of continued over-reliance on oil. It was concluded that ‘‘revenue from oil resources, which are non-renewable by nature, should best be invested in renewable assets that would contribute to diversifying the economic base and achieving sustainable development. It is, therefore, essential for non-oil public revenues to be enhanced so that oil revenues may be gradually transformed into productive assets and effective human capital” (Ministry of Economy and Planning 2004). The anticipation of declines in oil revenue has spurred the government to consider alternative ways to drive the economy (Alshumaimri et al. 2010).

In *Twilight in the Desert* (2005), Simmons describes the unsustainable nature of oil production at its current level and predicts its inevitable decline in Saudi Arabia, an opinion that has been corroborated by over 200 technical studies by the Society of Petroleum Engineers. Saudi Arabia is the largest oil producer in the world and holds the largest proven oil reserves in the world (estimated at 267 billion barrels). The country accounts for 36 % of oil reserves in the Middle East and around one-fifth of the world’s total reserves (Simmons 2005).While there are a large number of oil fields, 60 % of Saudi oil production comes from a single oil field, the Ghawar field, and 90 % from five fields. As of 2008, Saudi Arabia produces 11 million barrels of oil per day. On average, 80 % of all government revenues are from oil (Saudi Arabian Monetary Agency 2010).

Historically, the Saudi government’s response to decreases in oil revenues, which highlighted the extent to which the economy was dependent on a single commodity, has been to place an increased emphasis on investment in education, see Fig. 16.1. In 1982, during the first period of a sharp, prolonged decline in oil revenues, investment in education increased from 3 % of gross national income to 5 % (Benavente and Dutta 2011; Saudi Arabian Monetary Agency 2010). Education expenditures remained fairly consistent until they increased to 7 % in1997, which marked yet another period of sharp decline in oil revenues. They have remained constant at 7 % since 1997, despite fluctuations in oil revenues.

Current demographic trends are a compounding factor in Saudi Arabia’s plans for economic development. Saudi Arabia has one of the highest population growth rates in the world, at 3.9 % per year in 2004 (al-Rasheed 2010). This has led to a huge population boom, with a disproportionate share of young people. Officially, unemployment for 2004 was 9.6 % for working-age Saudis, including women. However, Saudis represent only 19 % of the labour force; foreign workers, who

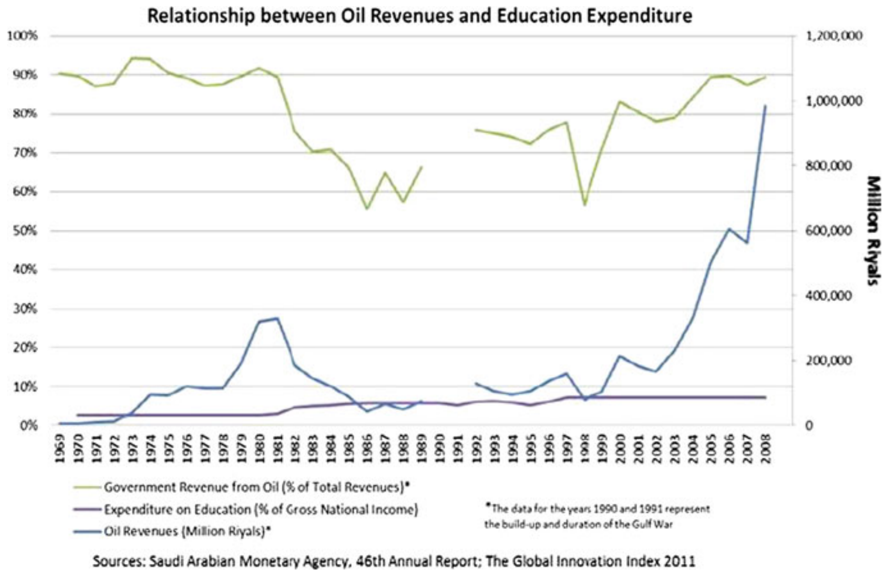


Fig. 16.1 Relationship between Oil revenues and education expenditure

account for more than 30 % of the population, comprise the bulk of the workforce in Saudi Arabia. Some estimate that as many as 30 % of working-age Saudis are outside the official labour force (al-Rasheed 2010). Around 9 million jobs would need to be created in order to ensure full employment for the current population. Neither the hydrocarbon sector nor the public sector can come close to creating that number of jobs.

Based on the anticipated decline in oil revenues and the urgency of addressing unemployment, Saudi Arabia has acknowledged that its future competitiveness must be based on knowledge and innovation, rather than oil. Investments in scientific research and the development of technology and informatics are identified as the key factors for creating a knowledge-based economy (Kingdom of Saudi Arabia, Ministry of Economy and Planning 2010).

16.3 Theoretical Background for Scientist Entrepreneurship

Recent studies of OECD countries have concluded that investment in scientific knowledge and research alone will not automatically generate growth and prosperity. In order for investments in research and education to create growth, innovation and competiveness, they must penetrate through the knowledge filter to leave the academic environment and move into the economy at large (Audretsch 2007; Audretsch et al. 2006). Overcoming the knowledge filter and facilitating spillover for commercialisation are the keys to fostering entrepreneurial activity.

Entrepreneurial activity, in turn, is what will ultimately lead to economic growth and employment creation (Audretsch 2007).

A large and compelling literature, both theoretical and empirical, has evolved to explain entrepreneurial behaviour for the general population (Aldrich and Martinez 2010). However, academic scientists appear to be more actively involved in entrepreneurial activity than was previously understood. For example, recent studies show that over one-quarter of scientists who were awarded a patent go on to start their own business, an astonishingly high rate of entrepreneurship based on comparable measures for other sub-groups of the population (Aldridge and Audretsch 2010 and 2011). Scientist entrepreneurship in the context used here refers to university scientists who are broadly engaged in the process of starting a firm (Aldridge and Audretsch 2010 and 2011).

Scientist entrepreneurship appears to be the sleeping giant of university research commercialisation. And yet, studies have only recently begun to distinguish scientist entrepreneurship as a special case that is distinct from the more general population (Aldridge and Audretsch 2010 and 2011; Mosey and Wright 2007; Phan and Siegel 2006; Elston and Audretsch 2010; Link et al. 2007).

16.4 The Nature of Scientist Entrepreneurship

Based on the findings from existing studies from OECD countries analysing scientist entrepreneurship, Aldridge and Audretsch (2010 and 2011) posit a series of hypotheses linking the specific characteristics of scientists to their propensity to engage or consider entrepreneurial behaviour:

1. *Experience*. Career experience subsequent to attaining a Ph.D. is positively linked to the likelihood of a scientist engaging in entrepreneurial activity. This relationship reflects the priority that university scientists tend to place on establishing their scientific reputation before engaging in commercialisation activities.
2. *Gender*. The likelihood of entrepreneurial activity is lower for females than for males (Minniti and Arenius 2003; Minniti and Nardone 2007; Elston and Audretsch 2010).Empirical evidence for the OECD suggests that the differential between male and female entrepreneurship rates found in the overall population[1] is even greater and more decisive than for university scientists.
3. *Social capital*. The social capital of a university scientist is positively related to the scientist's propensity to become an entrepreneur. This relationship has been found to be at least as strong for university scientists as it is for the general population for studies based on a country within the OECD (Aldrich and Martinez 2010).

[1] The participation of women in entrepreneurship is about two-thirds that of men across countries, taking national variances into consideration (Minniti and Arenius 2003).

4. *Human capital.* The human capital of a university scientist has a positive impact on the likelihood of that scientist engaging in entrepreneurship. Studies from OECD countries have almost always found a positive relationship between human capital and entrepreneurship for the general population.[2]
5. *University support.* Scientist entrepreneurship will be higher insofar as it is promoted by university and other institutional policies that aim to facilitate commercialisation and start-ups by university scientists and other researchers.

While studies have been able to test the above hypotheses concerning scientific entrepreneurship in the context of OECD countries, virtually nothing is known about this issue in the context of developing countries in the Middle East, such as Saudi Arabia, primarily due to a lack of available data. To determine the nature of entrepreneurship in the Middle East, we apply the same hypotheses to Saudi Arabia. However, since political, social and economic developments in Middle Eastern countries are specific to the region,[3] we do not expect that the nature of scientist entrepreneurship in Saudi Arabia will simply mirror the OECD countries. With regard to female entrepreneurship, for instance, we might expect an even larger differential than that found in OECD countries.

To test these hypotheses, we created a database of entrepreneurial intentions for university scientists in Saudi Arabia. In the current analysis, this new database has been used in such a way as to examine whether the emerging entrepreneurship of scientists at Saudi Arabian universities can be linked to the factors identified as inducing or impeding scientist entrepreneurship in the OECD countries.

16.5 Modelling Scientist Entrepreneurship in Saudi Arabia

The greatest impediment to analysing scientist entrepreneurship outside the OECD countries has been the lack of systematic data identifying scientists and their entrepreneurial activities. To overcome this deficiency of measurement, we implemented a survey of scientists at universities in Saudi Arabia. The actual survey instrument used is listed in the Appendix. The goal of the survey was to collect the data necessary to test the hypotheses discussed in the previous section.

Scientists were selected randomly from three universities in Saudi Arabia—King Abdulaziz University, King Fahd University and King Saud University. This trio was selected based on the following four criteria:

1. They are the only universities that have engaged in commercialisation activities up to this point in Saudi Arabia.

---

[2] However, Aldridge and Audretsch (2011) did not find statistical evidence for any such positive relationship among a sample of high-performing university scientists in the United States.

[3] For example, scientists at Saudi Arabian universities have only recently been allowed by law to engage in entrepreneurial activity.

2. They represent different geographic parts of Saudi Arabia: King Saud University is in the middle of the country, King Abdulaziz University is in the west and King Fahd University is in the east.
3. They are the oldest and most established in terms of scientific research in Saudi Arabia and are the leaders in terms of patents and papers published.
4. They are public universities that teach in English.

A total of 726 questionnaires were sent to scientists employed at all individual colleges within each of these three universities. The distribution of questionnaires was 42 % to scientists employed at King Saud University scientists, 50 % to scientists employed at King Abdulaziz University and 8 % to scientists employed at King Fahd University. There were 288 responses, of which 272 included usable responses, yielding a response rate of 37 %.

The variables and measures obtained from the survey are found in Table 16.1. The dependent variable is a dummy variable assuming the value of 1 if the scientist is considering starting a firm and zero otherwise. The independent variables are as follows:

1. *Experience.* Career experience since obtaining a doctorate was addressed by asking each scientist the year in which they obtained their Ph.D. A negative relationship would support the hypothesis that younger scientists are less likely to be entrepreneurial.
2. *Gender*. This variable was addressed by asking the scientist to reveal their gender. A dummy variable was then created, with 1 indicating that the scientist is male. A positive coefficient would support the hypothesis that male scientists are more likely to be entrepreneurial.
3. *Social capital.* Scientist social capital was addressed by asking the scientists to report if they serve on a board of directors or engage in research compatible with the needs of industry. A positive coefficient would suggest that social capital enhances the likelihood of scientist entrepreneurship.
4. *Human capital.* Human capital was addressed by measuring the number of publications of each scientist. A positive coefficient would suggest that human capital enhances the likelihood of scientist entrepreneurship.
5. *University support.* The level of support or impediment from the university was measured by an assessment of how encouraging the university is towards starting a company. A positive coefficient would suggest that high levels of university support enhance the likelihood of scientist entrepreneurship.

In addition to these measures, other variables were included to control for concerns the scientist might have that entrepreneurship will crowd out his or her scholarly research, income opportunities and lack of financial resources, and whether they obtained their Ph.D. in Europe, North America or the Middle East.

Table 16.1 Description of variables

Variable	Description
Entrepreneur	A dummy variable taking on the value of one if the university scientist is considering starting a new business and zero otherwise
Shared costs	Likert scale variable, scientist asked: "Research co-operations already helped me to share the costs of a research project with private firms"
Time-consuming	Likert scale variable, scientist asked: "Starting up a company is time-consuming and therefore reduces the time for my personal scientific research"
Income 0 pp	Likert scale variable, scientist asked: "Research co-operations greatly increase personal income opportunities of researchers"
Affects research	Likert scale variable, scientist asked: "Starting up a company is time-consuming and therefore reduces the time for my personal scientific research"
Research and coordination	Likert scale variable, scientist asked: ''In research cooperation confidentiality is a problem for researchers since industrial partners wish or contractually enforce that results will not get published''
University bureaucracy	Likert scale variable, scientist asked: "The current university bureaucracy is encouraging for starting up a company"
Research related to industry	Likert scale variable, scientist asked: "Coordination in research co-operations is problematic since research approaches and methods of private firms greatly differ from my research approaches and methods"
Board	Binary variable, for scientists indicating the scientist at time of reporting sat on a Board of Directors, Board = 1
Lack of finance	Likert scale variable, scientist asked: "The lack of financial support often keeps scientists from applying for a patent"
Gender	Binary Variable, where Gender is male. Male = 1
Research neg affected	Likert scale variable, scientist asked: "Doing cooperative research is time-consuming and therefore reduces the time for my personal scientific research''
Phdyear	The year where the scientist reported completing their degree
Phdeuro	Binary variable, where if scientist received their Ph.D. in Europe, Binary Variable = 1
Phdwest	Binary variable, where if scientist received their Ph.D. in North America, Binary Variable = 1
Phdmiddle	Binary variable, where if scientist received their Ph.D. in the Middle East, Binary Variable = 1

16.6 Results

A probit model was estimated whereby the dependent variable assumes the value of 1 if the scientist considered starting a firm and zero otherwise. The results, displayed in Table 16.2, suggest the following regarding our hypotheses:

1. *Experience*. The positive and statistically significant coefficient of the year in which the Ph.D. was obtained suggests that younger scientists who gained their Ph.D. more recently tend to be more entrepreneurial.

Table 16.2 Probit regression where nascent entrepreneurship is dependent variable

	1	2	3	4
Shared costs	−0.271 (4.46) [a]	−0.331 (3.75) [a]	−0.319 (3.62) [a]	−0.322 (3.66) [a]
Time-consuming	0.167 (2.72) [a]	0.207 (2.43) [b]	0.210 (2.47) [b]	0.205 (2.43) [b]
Income 0 pp	0.071 (1.17)	0.155 (1.57)	0.156 (1.61)	0.162 (1.67)
Affects research	−0.011 (0.16)	0.061 (0.66)	0.085 (0.9)	0.087 (0.92)
Research and coordination	0.022 (0.37)	−0.049 (0.55)	−0.051 (0.58)	−0.047 (0.54)
University bureaucracy	−0.169 (2.86) [a]	−0.165 (2.08) [b]	−0.164 (2.06)[b]	−0.163 (2.06) [b]
Research related to industry	–	0.092 (1.29)	0.103 (1.43)	0.106 (1.47)
Board	–	1.364 (2.57)	1.489 (2.69)	1.505 (2.73)
Publications	–	0.597 (1.85) [b]	0.451 (1.31)	0.464 (1.35)
Lack of finance	–	0.064 (0.82)	0.056 (0.72)	0.061 (0.79)
Gender	–	–	0.315 (1.1)	0.319 (1.11)
Research neg affected	–	−0.110 (1.36)	−0.115 (1.42)	−0.121 (1.51)
Phdyear	–	0.127 (5.01) [a]	0.117 (4.32) [a]	0.115 (4.29) [a]
Phdeuro	–	0.326 (0.55)	0.308 (0.52)	–
Phdwest	–	−0.654 (1.46)	−0.611 (1.35)	0.690 (1.63)
Phdmiddle	–	0.260 (0.8)	0.243 (0.51)	0.170 (0.58)
Constant	0.919	0.891	0.915	0.852
Number of obs	238	184	184	184
LR. chi2(6)	33.06	32.4	33.54	33.9
Prob chi2	0	0	0	0
Pseudo R2	0.1004	0.15	0.11	0.18

[a] Statistically significant at the 99 % level of confidence, two-tailed test
[b] Statistically significant at the 95 % level of confidence, two-tailed test

2. *Gender*. The coefficient of the dummy variable indicating gender is not statistically significant. This does not provide support for the second hypothesis suggesting that male scientists are more likely to be entrepreneurial.
3. *Social capital.* The coefficient of the dummy variable for belonging to a company board is not statistically significant, nor is the variable measuring research related to industrial applications. Thus, there is no support for linking social capital to entrepreneurship.
4. *Human capital.* There is at least some evidence that publications are more conducive to scientist entrepreneurship. This finding is consistent with the results of studies undertaken in OECD countries.
5. *University support.* There is evidence suggesting that the level of university support influences scientist entrepreneurship.

The findings generally suggest that university scientists in Saudi Arabia emulate their colleagues in OECD countries in some ways, but not in others. Scientists who are more productive in terms of publications have a greater propensity to be entrepreneurial in the Saudi Arabian context compared to the OECD context. Moreover, younger scientists with less experience in Saudi Arabia are more open to entrepreneurship. This result sharply contrasts with results from OECD countries, where maturity and experience are more conducive to scientist entrepreneurship. This disparity may reflect a generational shift in attitudes towards entrepreneurship among scientists at Saudi Arabian universities, where young scientists are more open and excited about pursuing entrepreneurial activities than their more experienced and older counterparts.

In an added contrast to OECD countries, we did not find a lower propensity for entrepreneurship among female researchers. Given the growing number of women researchers, and also the varying conditions for female and male entrepreneurship, it will be important to improve our understanding how attitudes of the former may evolve over time compared to those of their male counterparts, as well as compared to those of women researchers in other countries. We can expect the continued evolution of behaviour among female researchers in Saudi Arabia to exert an increasingly strong impact on overall outcomes.

16.7 Conclusions

This chapter has demonstrated the presence of an ongoing shift in the attitudes of scientists at Saudi universities. Although the recent literature has emerged identifying how scientist entrepreneurship differs from that of the more general population, these studies have focused exclusively on the OECD countries. By contrast, we analysed intentions and attitudes with regard to scientist entrepreneurship in the context of the Middle East. Based on a new and original data set focusing on university scientists in Saudi Arabia, we found compelling evidence that scientist entrepreneurship in the Middle East differs distinctly from what has been identified in the extant literature based on studies from OECD countries.

We found nascent scientist entrepreneurship in Saudi Arabia to be robust. The factors contributing to scientist entrepreneurship in the Saudi Arabian case were found to be remarkably similar those in OECD countries. For example, scientists with a high degree of human capital, as measured by number of publications, exhibited a greater propensity towards entrepreneurial activity.

Additionally, we found that universities play a key role in Saudi Arabia's attempts to transform its resource-based economy into a knowledge-based one. Not only do they serve as an important source for the creation of knowledge and new ideas, they can also provide a crucial source for entrepreneurship. Universities are a conduit for the spillover of knowledge into entrepreneurial activities, leading to the creation of new firms where knowledge is converted into innovation and ultimately economic growth and competitiveness (Audretsch et al. 2011). However, some of our findings deviated from the OECD countries. While human capital seems to play a similar role in facilitating scientist entrepreneurship, it is the younger and less experienced researchers who are more open to entrepreneurial activities in Saudi Arabia. Also, we found no evidence that female researchers would be less apt than male researchers to engage in entrepreneurship.

While we discovered evidence of scientist entrepreneurial propensity at universities in Saudi Arabia, the exact social and economic impact of scientist entrepreneurship can only be ascertained through subsequent research analysing the performance of the new firms actually being started. Such research would provide an important insight as to how targeted public policies to create a knowledge-based economy are succeeding, or how they may need to be adjusted to generate better results.

Acknowledgments This chapter was contributed by David Audretsch, Ahmed Alshumaimri, Taylor Aldridge, and Marcie Hummel.

Chapter 17
Building Knowledge and Innovation-Driven Economies in Arab Countries: How to Do It

Jean-Eric Aubert, Mats Karlsson and Anuja Utz

A move towards knowledge and innovation-driven economies is key to the development of the Arab region. It is critical to the ability of Arab nations to create the 3–4 million new jobs a year that are required to avoid a further deterioration in unemployment. It will also be essential for working out a viable response to the long-term water, food and environment challenges facing the region. Moreover, it would be in line with the dramatic advance of new technologies, ongoing globalisation and tougher economic competition among countries seen in the last decade or so.

This imperative is not new (Aubert et al. 2003), but the context in which it is about to take place has changed dramatically in just a few years. First, the Arab Spring has brought new winds of change to the region, creating aspirations for freedom and empowerment—essential ingredients for dynamic, innovative economies—while generating tensions in a number of countries. Second, similarly to the rest of the world, the region is experiencing the impact of the global financial and economic crisis, which has considerable implications for investment, trade and economic progress, all the more so as the region has close ties with the crises-struck economies of southern Europe.

This chapter discusses how Arab countries can build knowledge and innovation-driven economies (KE). It briefly reviews how the region has adapted to that prospect over the last decade and discusses the need to act under the umbrella of a broad economic strategy while pursuing cultural change. A KE-based strategy

J.-E. Aubert (✉) · M. Karlsson · A. Utz
Center for Mediterranean Integration, Marseille, France
e-mail: aubert.jeaneric@gmail.com

M. Karlsson
e-mail: ccoventry@worldbank.org

A. Utz
e-mail: autz@worldbank.org

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_17,

should focus on three policy frameworks combining institutional reforms, economic diversification programmes and international integration actions. The "cultural" approach, seeking to create an emotional drive for the development process, should combine short-term measures to facilitate mindset changes and reforms with long-term actions building on the basic values of Arab civilisation.[2]

17.1 Past Trends

The Arab world keeps facing several major challenges in adapting to KE trends. Societies are concerned on many fronts. As set out in the "four-pillar" framework elaborated by the World Bank (2007), there is a need to: (i) adapt education systems to reduce illiteracy and make the labour force more creative; (ii) invest in ICT infrastructure and related services, the backbone of modern economies; (iii) build innovation systems and make economies more competitive and more diversified; and (iv) improve significantly the business environment to facilitate FDI, enterprise creation and growth while establishing a more efficient government apparatus, with progress in governance, government efficiency, transparency and reduced corruption and application of the rule of law. To be sure, this is a challenging agenda—and one in which the Arab region has made some improvements. On the whole, however, progress has lagged behind most other regions of the world (Koivisto and Larsen 2012).

Within this general trend, the Arab countries present contrasting profiles: Some have already embarked significantly on the knowledge economy path, while others remain adrift. One can basically distinguish between three groups.

- *The first group* includes Tunisia, Morocco and Jordan, three countries that have articulated development strategies based on a KE approach but with limited resources. The roads they have travelled differ. Tunisia has included its KE strategy in its 5-year plan, featuring strong ICT investment, a large programme of techno parks and a substantial improvement of the education system, especially at tertiary level. Mediocre governance combined with a business environment insufficiently conducive to innovation and enterprise creation has limited the job creation process and caused considerable frustration among young people, leading to regime change and igniting the Arab Spring. Morocco began limited reforms in the early 2000s, liberalising and deregulating the telecom sector. It then pursued the development of a few techno parks and industrial sites, attracting foreign investors. In the last few years it launched a series of sector plans, such as the "Plan Emergence" for manufacturing industries, and the "Plan Vert" for agriculture. In parallel, it has begun to reform

[2] The ideas developed in this article benefit from studies being implemented in a project on the knowledge economy in the MENA region initiated by the Centre for Mediterranean Integration, leading to a report to be published in the course of 2012.

the education system to reduce the high rate of illiteracy and initiate change in higher education, notably through recently established private universities. The effects of this policy are beginning to be felt in a political context oriented toward sustained reforms and progressive democratisation. Jordan, for its part, engaged in a KE development strategy in the early 2000s, making a determined effort to build an ICT industry to diversify its economy. It also undertook a large-scale revamp of the education system, aimed at promoting KE-related skills. This policy has so far not borne all the expected fruits (unemployment has not fallen by much) but the sub-regional context in which the country operates is particularly difficult, given Jordan's proximity to Israel and the Palestinian Territories.

- *The second group* of countries is the resource-rich nations, which have made major investments in KE infrastructure. These are principally the Gulf States plus Algeria. The United Arab Emirates has been quite successful, with well articulated reforms of the business environment attracting foreign investors, driving economic diversification toward new sectors such as media, finance, tourism and creative industries, and raising educational standards to world level through effective partnerships with prestigious foreign universities. Saudi Arabia has to a certain extent followed a similar path, also investing in several new cities, building massive infrastructure and creating new educational institutions. Conditions for economic diversification are less obvious, given a continuing strong dependency on oil. The governance environment also affects the speed of reform. A major issue for all the Gulf countries is to "nationalise" their workforces, particularly at management level, because many jobs are currently filled by foreign specialists. Some countries, such as Qatar, have initiated significant steps in this direction. The evolution needs to be smoothly "negotiated", avoiding brutal changes, with due consideration to the human resources.
- *The third group* of countries includes those that have so far not travelled the knowledge economy road or have no articulated KE strategies. Among them are Egypt (which, nevertheless, has a vibrant ICT sector), Lebanon (with dynamic service industries in media, finance, etc.) and several countries currently experiencing serious internal conflict, such as Syria and Yemen.

Despite these national differences, efforts to build more knowledge and innovation-oriented economies have, with the exception of the UAE, been insufficient to cope with demand for jobs, particularly from the youth bulge. The reasons are two-fold. First, there has been a rather timid shift toward KE, with a consequently limited impact on the economy. Second, people's skills have not adapted to the emerging knowledge-intensive sectors, even among university diploma holders.

Moreover, it should be noted that, the impact of KE on employment is not well-known. If the rise of KE makes a clearly positive contribution to economic growth, the impact on employment depends on the employment/growth elasticity. This elasticity varies greatly from one sector to another, and depends ultimately on the expansion of markets. To create significant numbers of jobs in a KE model, strong effort is needed to achieve reforms and investments in the business environment, ICT, research, etc., and simultaneously to adapt and upgrade the labour force and expand markets, either through competitiveness gains or trade integration (Chen et al. 2012).

17.2 Three Strategic Frameworks

From the above, it appears that KE strategies should simultaneously (a) pursue institutional reforms on the KE pillars, (b) stimulate the emergence of new knowledge-intensive sectors to diversify the economy, and (c) facilitate processes of international and regional integration to expand markets, investments and other opportunities. Here, individual nations must devise their own strategies, taking their own specific features into account.

Each policy framework can symbolically be related to a specific major social scientist and classic historical figure: Max Weber, who laid down the formal conditions for building the modern state; Joseph Schumpeter, who theorised on the innovation process that renews economies and societies; and David Ricardo, who showed the importance of open trade for economic development.

The benefits of acting simultaneously on the three frameworks have been well illustrated by China, which embarked on limited market-oriented reforms that primarily facilitated the development of township and village enterprises and export zones. China then moved to broader reforms in education and the investment climate and at the same time joined the WTO, thus enlarging its access to the world market and becoming the world factory. The same evolutionary steps are observable in basically all countries that have successfully embarked on the knowledge economy path, including the GCC countries.

This chapter argues that there is virtuous process by which actions conducted simultaneously in the three frameworks, while often limited to specific segments of the economy or society, reinforce their mutual effects and create a dynamic thrust of self-confidence and trust, leading to further, more substantial and reforms.

17.2.1 Institutional Reforms

As for institutional reforms, there is a need to continue acting on all the four policy planks identified in the World Bank model (Zeidane 2011). The new governance conditions emerging from the Arab Spring in a number of countries create a favourable climate for breaking inertia and privilege situations. At the same time, a certain learning period exists for new political powers, such as Islamist parties, that shoulder government responsibilities for the first time.

Key reforms include the further improvement of the business climate, going beyond the not-insubstantial legal changes made on paper and in law in recent years (for instance, in Saudi Arabia and Egypt, both lauded as top reformers in the IFC/WB Doing Business reports of 2007–2010). The day-to-day reality is still very different from what has been formally enacted. Efficient judicial systems need to be put in place, for example, so that those who are affected by monopolistic behaviour, bureaucratic procedures and corruption can assert their rights. The rule of law has yet to become reality in a number of Arab countries. Another fundamental aspect is access to finance, particularly for small enterprises. The banking sector has not yet shown the flexibility and dynamism required to nurture an entrepreneurial economy. At the same time, the practice of Islamic finance, which prevents the claim of interest rates and rewards financers who join entrepreneurial initiatives according to the profit these initiatives bring in, can confer various advantages.

Another area of crucial importance is the education sector. Significant progress has been made in most countries in quantitative terms, but serious problems remain on the qualitative side. The effort to be made will require a deep and long-term approach. It is necessary to adapt curricula, to move the content and practice of teaching away from learning by rote, and to train large numbers of new teachers. The development of private sector schools can help to spur change, but strong quality controls should be put in place, as well as mechanisms to avoid inequality of access between rich and poor people. The same applies to the tertiary education sector, and the trend is already observable in a number of countries, with active partnerships between newly established private universities and foreign counterparts. Vocational and professional training should be given special attention as there will be (and already is) great demand from a number of sectors in need of “knowledge workers”, for instance tourism, health care and ICT. These sectors offer considerable opportunities for job creation, as discussed below.

For ICT infrastructure, the priority is the development of broadband networks with quick and easy access for all consumers. This has implications not only for investment but also for regulation. Moreover, Internet services, which are already doing quite well, would be further boosted by a strong IT literacy effort, as well as a systematic region-wide effort to develop Arabic websites. This would benefit the large number of (predominantly young) people who speak the Arabic language.

Finally, dynamic innovative systems need to be developed—a mission that requires carefully targeted actions as discussed below and also necessitates institutional reforms in S&T structures to facilitate university collaboration with the business sector, to raise the contribution of the business sector to the R&D effort, and to introduce solid evaluation mechanisms of research teams, programmes and laboratories (including peer review procedures for scientific productions). These vital reforms have hitherto received little attention in Arab states.

17.2.2 Economic Diversification

The second great pole of action is building more diversified and more productive economies: the Schumpeterian dimension. This requires a fine-tuned approach to exploit or create niches in which countries have a comparative advantage in the global competition. In general, that results from a combination of both the exploitation of a natural "gift" and the accumulation of knowledge, resulting from a long-lasting investment. For example, Jordan is currently able to develop a solid medical tourism industry because it has invested for years in hospitals and nurses, while also taking advantage of its natural and cultural heritage. Jordan can also become a hub for back office processing or call centres in the sub-region because it is well located, speaks the English language without a strong differentiating accent and has invested for years in ICT. Thus, all countries have to build on specific niches resulting both from "natural" and "constructed" advantages in which they have a competitive edge.

At the same time, in order to support job creation, the expanding sectors should have a high growth/employment elasticity. The attraction of foreign direct investment, which brings an inflow of financial resources, management competencies and technologies further matters for both competitiveness and jobs. The cost of job creation through FDI varies widely between industries: it is low in sectors such as call centres but high in the automotive sector. Even so, capital-intensive sectors may offer advantages to foreign investors because they are a way to approach new markets, as shown by the development of the Tangiers-Tetouan cluster in Morocco around the auto and aeronautics industries.

In addition to creating or developing new sectors, the Arab countries should invest in rural development and related industries such as agro food. This is important for countering the demographic bulge and for avoiding an anarchic process of urban concentration. Initiatives, such as the Moroccan Plan Vert, which involves a reorganisation of agriculture producers within larger integrated structures to facilitate commercialisation and exports, show that it is possible.

More generally, whatever the activities that countries wish to develop, they need to invest in packages of actions, combining infrastructure investment, skills training, business reorganisation, R&D, etc. The difficulty is to strike a good balance between the public and private sectors. Here, the public sector should act as a catalyst for private sector investment.

17.2.3 International and Regional Integration

The last and third great pole of action concerns the international integration of Arab economies. Arab states need to stimulate such integration themselves to facilitate an expansion of the internal Arab market, to facilitate labour mobility and to promote cross-investment of financial resources. Imagine an integrated Arab world where money from the Gulf was extensively invested in viable development projects across the resource-poor countries of the region. Indications of what could be achieved have been around for some years. A recent important contribution is Qatar's support to post-Ben Ali Tunisia. The potential exists for much more, however, given appropriate reforms in trade, finance and other areas that pave the way for further restructuring and commercial exchange. The integration process within the Arab region can be stimulated by initiatives between countries acting in tandem, notably on issues directly related to knowledge and innovation, for instance trade and investment agreements, the establishment of education programmes, new technology development and the building of infrastructure in areas like transport and logistics.

Then there is a need to accelerate integration within the Mediterranean area. This requires actions on the Arab side and at EU level to improve the conditions for trade, facilitate migration (at least for skilled persons) and to provide more financial support to the Southern Mediterranean countries (which have received, in the last decade, 50 times less in EU subsidies than the Eastern and Central Europe countries in transition). At the same time, initiatives should develop at a micro level that concretises cooperation in all sorts of domains, such as education, research, innovation and so on. Appropriate frameworks, with mutually agreed standards, for instance in university diplomas, can help. The current difficulties experienced by European countries may make the required moves difficult. But large-scale cooperation with the Southern Mediterranean countries would for Europe be a much-needed source of activity, growth and dynamism in the long term.

At a global level, the Arab countries should find ways to strengthen and expand their education and research bases. This can be done through appropriate partnership with prestigious universities, a process already in its infancy in some countries (notably in the GCC). FDI can contribute, especially when accompanied by the establishment of local R&D centres as part of joint ventures or other forms of cooperation with domestic firms. Again, a trend in this direction can be observed, for instance in Morocco and Jordan, and it is all the more attractive for both partners that FDI in research centres is the least costly investment in terms of dollars (or euros) per job created (ANIMA, 2011).

17.3 Mindset and Cultural Change

The strategic approach described above is built on a kind of rational design, encompassing the foundations of the Arab region's economic development in current times. Actions mobilising hearts and minds are needed to implement this new economic model. These actions are of two types: some aiming at quick and immediate impact on mindsets and behaviours, others building on fundamental values of the Arab world in a long-term perspective.

17.3.1 Immediate Actions for Mindset Change

Short-term actions should de designed and implemented with a view to facilitating a change process by building self-confidence through visible, concrete results. Such actions include measures to organise change agents around concrete, low-hanging-fruit projects, such as training of knowledge workers for sectors in need with good market prospects, regulatory reforms that can yield quick results, mobilisation of financial resources for promising ventures, etc.

As another area for reaping fast results, the Arab diaspora can be mobilised to help in various ways: providing contacts to exploit foreign markets, market or technical expertise, financial resources, etc. These various types of resources have proved a useful tool in many other countries for speeding transformation processes—and Internet-supported globalisation makes diaspora mobilisation easy. Diaspora communities that are actively seeking to support their country of origin already exist in various web-based environments in the United States, Europe and elsewhere (for instance, the LebNet for Lebanon in Silicon Valley).

Another type of candidate for immediate action is the design and management of a knowledge and innovation-based strategy. This fundamentally requires a cross-cutting strategy spanning various government ministries and uniting government with the private sector and civil society. The countries most adept at embracing the knowledge and innovation-driven economy age, such as Finland and South Korea, have set up institutional bodies organised along such principles and under the chairmanship of powerful offices such as the prime minister. India recently established a National Innovation Commission in the same spirit. In the Arab world, a first step should include mobilisation through national coordinating committees of actors from different parts of the administration, economy and society who want change. These actors should be experienced in related matters such as business and science. In cases where such inter-ministerial or cross-societal bodies already exist, for instance Algeria's Conseil National Economic et Social, it is important that they function properly.

Media campaigns to help people understand the essence of knowledge and innovation-based economies are also warranted. It is not least instructive to demonstrate success stories as a means to forge self-confidence—even success stories of apparently minor importance, such as small enterprises developing in slums and creating jobs by providing useful new community services through garbage collection. What matters is to show to large segments of the population that the building and achievement of a knowledge-based society is within the reach of all individuals, including the poorest. Even small examples can impact strongly on hearts and minds and make an enormous difference. Remember the Arab Spring, which was triggered by a young man who set himself alight in protest at the authorities' interference in his vegetable street vending business.

It should be noted that in a number of countries the fiscal situation does not allow for large expenditure and, therefore the move to KE should be made through optimisation of choices and actions. Governments should proceed with a deep understanding of measures that will have a systemic effect, with fine-tuned disposals. The problem is that governments are not well equipped for such "societal epistemology". Moreover they are tempted by social measures, such as subsidies for essential goods (food, energy, etc.). These are legitimate tools and can help to dampen the risk of social unrest or assist in passive employment policies (offering jobs in public services), but they are not really conducive to reforms and reduce overall productivity.

The international community can do much to support short-term, high-yielding actions—not necessarily financial support but, rather, offering expertise and advice on policy interventions. Some organisations, such as the World Bank, are well equipped to fill this role, offering various types of instruments including "rapid results" programmes or interventions that mobilise key actors to achieve organisational, proactive changes in business, financial, education and other sectors.

It is also important to use all disposable means to facilitate dialogue at different levels and for different types of audiences, especially in the Mediterranean context. The Centre for Mediterranean Integration (CMI), a multi-partner platform based in Marseille (CMI 2011), is shouldering this role in policy areas such as urban development, environment, innovation and technology, education and transport. Its actions have already begun bearing fruit through the creation of networks of urban developers to exchange experiences and articulate joint projects, for instance the renewal of traditional Mediterranean city centres (*medinas*).

Another key move is the organisation of trade and investment areas to facilitate deeper trade integration. In the wake of the G8 Deauville Summit (July 2011), which formally initiated a Partnership with Arab countries engaged in democratic transition, the G8 has asked the CMI to propose an action plan on this subject (CMI 2011). In addition, Arab states should aim at undertaking reforms that can open up for enhanced trade and investment flows within their own area.

17.3.2 Long-Term Value-Related Actions

The Arab Spring has considerably changed the conditions in which the Arab world will develop. The region is now engaged in a major transition whose trajectory is unclear and whose end is uncertain. The experience of post-Communist countries in the last 20 years or so presents interesting lessons, such as the inadequacy of big bang approaches (overall policy changes need to be more gradual, while also creating irreversible steps) and the risk of reform fatigue if changes do not yield concrete improvements in people's daily lives. But post-Communist countries are not comparable with the Arab region today. Europe's transition economies had a clear aspiration to membership of the European Community (and later European Union) and the carrot of financial support for restructuring from Brussels. This incentive is lacking in the Arab world, not least because of the weakness of the euro and the European debt crisis.

There is another striking difference that sets the Arab world apart from the old Communist-style administrations. Arab culture and societal organisation differs profoundly and also exhibits lower levels of literacy and industrialisation. The Arab region also is highly diverse—a diversity that explains the contrasting fortunes of government regimes following the Arab Spring. Here, a broad spectrum of events have been observed, from an ordered democratic transition (so far) in Tunisia to bloody civil war in Syria, Libya and Yemen, with smoother changes in evolving monarchies, under pressure, as in Morocco, Saudi Arabia and Jordan. The situation may become even more complex if tensions continue to grow with Iran and/or Israel.

In the long term, however, the transition to innovation and knowledge is ineluctable, it is important that the Arab world organises itself to move in that direction, whatever the circumstances and behaviour of neighbouring countries and regions. It could act in two directions relating itself to its original, cultural roots.

- The first is to embed the values that bear the knowledge and innovation economies in those values that are fundamental to the Islamic culture and religion in their original form. The Koran begins with a word meaning "read" (*Ikraà*), showing the importance of knowledge as the source of all development. In its original form, the Koran proposes an image of the woman making her an equal to the man and professes the highest respect for her, a decisive point for knowledge-based societies that should channel all human resources in a fully democratic and open manner. The Koran has very strict principles regarding speculative use of money and tough words against corruption. It speaks of protecting the environment, nature and the use of water (including for the practices of libations). Strong action to meld modern development and traditional values should be comprehensively promoted through multiple means, including the media and school programmes.
- The second type of action is to work on the Arab and, more broadly, the Islamic *Umma*, i.e. the broad community beyond the Nation States. It could be a unique source of prosperity, cooperation and mutual help. This means revitalising institutions such as the Arab League, updating trade agreements that have never functioned at regional or sub-regional levels, and mobilising institutions for science and culture such as ISESCO.

A very peculiar feature of the Arab culture and ethos should be borne in mind: the ability of values, behaviour and visions to propagate at a very high speed throughout the whole Umma. That was true at the very beginning of the Arab societies, when they conquered a large part of the then known world over just a few decades. That was true again in recent times as the winds of the Arab Spring run through the region at incredible speed. It is, thus, far from inconceivable that a new economic, political and societal model is about to be established in the region, within the spell of only a brief transition period, once the dust has settled after the struggles against change-resistant regimes have ebbed out, and when this model will have started to prove itself.

In a nutshell, building the future of the Arab world through advanced development strategies based on innovation and knowledge requires a recognition and strengthening of the region's fundamental identity as it has developed through history.

17.4 Concluding Remarks

The building of knowledge and innovation-driven economies should be at the core of development strategies for the Arab world. This requires a comprehensive, three-pronged approach including: the pursuit of basic institutional reforms that determine the quality of the business, education and innovation climate; the adequate promotion of knowledge-intensive sectors to achieve economic diversification; and the deepening of regional and international integration processes through efficient trade and investment agreements and cooperative research and education programmes. Actions should also be designed to stimulate changes in mindsets through rapid result initiatives. Moreover, long-term work is needed on recognising the specificities of the Arab world, including inner strengths that could serve to build new development frameworks.

Each country should aim to design and implement a development strategy inspired by these general principles, of course tailored to its specific situation. Specifics are determined by complex sets of parameters, including the political context, the degree of engagement and maturity in a KE development model, available financial resources and the comparative advantages and trade opportunities that exist. Countries should seek to cooperate as much as possible in this arena, working in tandem when appropriate.

Chapter 18
Special Considerations and Ways Forward

Thomas Andersson

As discussed extensively throughout this book, the Middle East used to belong on the centre-stage of science, technology and arts. The wonders of its achievements can still be glimpsed in places such as Baghdad, Cordoba, Damascus, Jeddah, Jerusalem and Samarkand. Preserving the historical memory and ancient base of the region's contemporary culture is a task that has gradually gained weight across this region. At the same time that effort has to be part of a broader struggle—for unique content and true value enhancement at the heart of the development process going forward.

The MENA region lost its leading position hundreds of years ago in those areas and sacrificed further ground during the colonisation era that followed. After the two world wars, it regained independence and, through further struggles, control of its natural resource base. In recent years, parts of the region, especially the GCC countries, have attained considerable financial strength. The GCC states now stand out as some of the most stable anywhere in macroeconomic terms and have thus far been able to weather the current global financial crisis better than most others. However, the GCC nations have yet to find a way to claw back ground lost in science and research. Meanwhile, new industries and jobs are slow in coming. Social and environmental challenges go unmet and indeed are growing in large parts of the region.

In the modern knowledge era taking hold, governments can no longer dominate and lead through a top-down approach—as has been the practice in the Arab world until now—as they seek to harness the opportunities ahead and tackle the outstanding challenges. Strategies and priorities need to be worked out in genuine collaboration with the actors throughout the economy whose active engagement,

T. Andersson (✉)
Jönköping International Business School,
Jönköping University, Jönköping, Sweden
e-mail: thomas.andersson@jibs.hj.se

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5_18,

creativity and innovation need to be unleashed if there is to be any genuine progress.

Continuous learning is a prerequisite for success and precise outcomes cannot be planned. Much is known about the resource issues that need to be addressed in the Middle East, as well as the kinds of mechanisms and incentives that need to be put in place, but we know next to nothing about what precise policies and instruments will be effective in the individual case. Every country and region has its unique set of strengths and weaknesses. The task of implementing change is about people not only coming along, but also taking action on the ground. The journey itself—the process of leveraging the assets and capabilities that are particularly valuable in a specific local context, along with learning by doing how to take it forward—is what matters most.

But efforts in this area must not be made in isolation. A wealth of information exists from the experience of others, and it is important to take advantage of opportunities for international collaboration to gain access to and build on relevant lessons. Again, multiple actors should be engaged in the reform process, at various levels. Business-as-usual is no longer the way to further our stock of knowledge or to put it to effective use.

This final chapter initially recapitulates some of the outstanding issues raised in this book and what is required to tackle them. It then ventures into some ongoing processes for international policy dialogue, reviewing the deliberations of the Muscat conference which, as part of the INCONET-GCC agenda, took place in the remarkable month of December 2010. Nobody obviously knew at that point what was cooking on the streets of Tunis almost 5,000 km to the east, and what implications the events there would have for the region. The conference addressed issues that were to prove tightly connected to those events-in-the-making, although many people may not yet even today realise their full significance.

As complementary background, this chapter further reflects on the outcome of a second conference, held in Muscat in March 2012 on the subject of entrepreneurial universities, or "entrepreneurship through higher education". Building on these events while synthesising other observations in the book, the chapter concludes with some specific recommendations on steps forward for the GCC countries and also the broader MENA region.

18.1 GCC Precedence Issues

The arrival of globalisation and intensifying technical progress make it increasingly essential for basically all countries and organisations to benefit from the rapidly growing and increasingly accessible global stock of knowledge. However, the global knowledge base remains diverse and partly fragmented, with tacit knowledge being critical for what can be achieved in a specific location or by a particular network and configuration of actors.

At the same time, a particular community crucially needs to find a way to take advantage of—and leverage the value of—its unique assets. On the one hand, globalisation and increased competition tend to increase efficiency and reduce market prices which lead to increased economic gains. On the other hand, if local assets are not utilised and valued, a loss of diversity is likely to follow, with essential cultural, social and economic values destroyed in the process, resulting in fewer options for future development.

For additional reasons, practically any region and local community has growing motives to foster and communicate its virtues to the wider world. Mobile and competent people are looking for conditions that are amenable to their professional careers and private lives. Excellent infrastructure, efficient administration, good schools, rich culture and a healthy and aesthetically pleasing physical environment are great attractions of relevance to the most creative people in most kinds of activities. The people who are the most development-oriented and high-performing in a particular niche are also critically influenced by what is beneficial to further advancement in their specific domain—perhaps excellent lab facilities, R&D funding, the presence of other individuals who are key to progress in that area, and suchlike.

The GCC countries possess significant financial resources (and in some respects also infrastructure) that can help generate an edge in building or acquiring needed resources. The previous chapters of this book recorded the progress made in areas like investment in education and ICT infrastructure. Likewise, a strengthening of research output has been seen in some areas. The heterogeneity of the GCC countries and also the wider MENA region must be kept in mind, but systematic weaknesses nevertheless continue to hinder tangible progress. Previous chapters have highlighted serious concerns relating to educational quality, a fragmented science and research arena plagued by bureaucratic hurdles and lack of critical mass, the lack of a research and innovation culture, a weak university-industry interface, a dearth of technological capabilities, a mismatch between education and labour market needs, constraints that prevent women (now in the majority among higher education students) from fulfilling their potential in the labour market, and the absence of building blocks and mindsets to underpin experimentation, innovation and entrepreneurship.

Across the MENA region, the research effort depends heavily on public investment. The private sector invests hardly anything in R&D, with some exceptions in oil and gas and a few other niches where foreign MNEs are present. The public sector effort, meanwhile, tends to focus on a few mainstream dimensions reflecting economic development needs. At the same time, a vibrant research community is hardly possible when subjected to rigid top-down directions, micromanagement by heavy institutional bureaucracies and devoid of opportunities for synergetic linkages with evolving ecosystems of related competencies in research or innovation.

Science and research are needed to energise education and general awareness. Investment must be inspired by experimentation in working out responses to outstanding and unresolved societal issues, including in industrial development.

As of today, research grants tend to be sanctioned by government and subject to strict rules and regulations at national and/or institutional level. Meanwhile, relations are underdeveloped between universities and surrounding society, including private companies, schools, hospitals and other employers of graduates. Part of the problem emanates from the limited autonomy and preparedness of HEIs to carve out their own unique knowledge constellations spanning research, education and linkages to surrounding society.

In the wake of the Arab Spring, the MENA region now faces a range of acute challenges. In Tunisia, Egypt and Libya, whose autocratic regimes were the first victims of the movement, reforms are stalled and regimes torn by the requirements for political and economic initiatives to spur growth and job creation on the one hand and the calls for a return to traditionalist family and cultural values on the other. Syria finds itself in a gruelling civil war, while Yemen and Bahrain continue to be stifled by tensions or outright turmoil. Meanwhile, the relatively high-income GCC states are, in a sense, paralysed. The increased attention to the deeds of policymakers has created a new kind of nervousness not to commit any errors, stay on solid ground and refrain from trying out anything new and previously untested. At the same time, the growing number of young people who are better connected and informed than the generations before them, and who have expectations of quality education and job opportunities, are calling for action. All countries across the region (in particular the resource-rich GCC countries, with their high-cost economies and stark dependency on oil and gas and the public sector) desperately need to diversify through mechanisms that enable the development of new high-value-added products and industries as a basis for creating well-paid jobs.

In this context, the identified weaknesses are bound to prove increasingly costly. Calls for enhanced private sector development as well as for a stronger S&T sector are largely lip-service at this point. Many policy reforms and planned initiatives have been put on hold. Burgeoning natural resource rents are used for continued real estate investment, large but piecemeal infrastructure projects and for temporary easing of tensions and frustrations, rather than to build the conditions required to foster dynamism at micro level. Some jobs are being opened up to locals, for instance in Saudi Arabia and Oman, at the expense of expatriate workers but the underlying issues remain unchanged and the lack of skills that are needed for achieving competitiveness are, if anything, dwindling in the companies and sectors concerned.

The countries and actors in the region need to change tack to cope. A new formula must be found with ways and means that can succeed in enabling growth and renewal. In this, the GCC countries and also the wider region find themselves in the same boat, which could serve as motivation to join forces to address shared problems. Tendencies towards increased collaboration within the region are visible in some respects. Saudi Arabia has stepped up its efforts to create a more cohesive Gulf region and to deepen the commitment among fellow GCC partners to political unification, to advance policy harmonisation and to move closer to a common market and joint institutions similar to those in the EU. Saudi Arabia has also increased its disbursements of financial support for capital spending and infrastructure in Bahrain and Oman, as well as more broadly across the Middle East.

Through these developments, the GCC countries and the wider Arab community of nations have further developed their collaboration with one another in areas already the subject of rather close collaboration, including national security. But when it comes to research collaboration and the mechanisms required for revitalising synergies in education, innovation, industrial development and the deployment of modern ICT infrastructure, collaborative efforts remain mostly uninspired and insignificant, with few exceptions.[1] Still, this is perhaps where joint effort and collaboration could make the biggest contribution, partly because so-called innovation systems and knowledge frontiers are not bounded by national limits. Research, education and ICT investment can benefit from a wider geographical basis. A greater pool of resources can help underpin critical mass in competencies and efforts, resulting in a richer and more potent interface between research, innovation and the development of new economic and social activities.

On the other hand, the purposes and mechanisms for working together matter greatly. If collaboration aims to put in place limitations to put a cap on experimentation, counter diversity and achieve lock-in, closer ties can be detrimental.[2] In fact, enhanced regional collaboration must be accompanied by increased connectedness on a wider geographic scale. Mutually beneficial collaboration with related specialised research groups all around the world, requires, for instance, that local research teams are capable both of contributions to and tapping of global knowledge stocks and flows. The attraction of human capital, should likewise be unrelated to provenance. Alternative origin and context may indeed add value to what already exists in a particular location.

The benefits materialise through various channels. Collaborative R&D environments tend to give graduates greater opportunities to learn, upgrade their skills and concretise innovative ideas. Institutions that expose faculty and students to international research partnerships are likely to promote linkages with external mentors and open up for other sources of inspiration as well. Industry-academia collaboration will be essential for generating research output that is concretely relevant for resolving real engineering problems. A competitive and attractive science and research community is vital for developing a cadre of first-rate, inspired teachers who can generate waves of learning impetus in the educational system, and thus for the rise of young promising scientists in domestic institutions and attracting leading scholars from abroad. The benefits go beyond mere economic payoff but can help fortifying a culture of openness, institutional strengths and raise the overall development capacity of society.

[1] The Egyptian Sawariki Group has contributed strongly to building ICT infrastructures throughout the region in the face of tough competition from elsewhere.

[2] The close cooperation within the Maghreb and associated incentives for collaboration within limited Francophone networks has for instance countered the development of wider international partnerships and benefits from global cooperation (Andersson et al. 2006).

It is important that cross-border collaboration connects citizens. A richer supply of educational and development opportunities throughout the region and beyond would make young people conscious of a wider universe of options and establish healthier competition in various educational and related services, promoting new forms of specialisation, innovation and development in the process.

Effective cross-border collaboration must be furthered at several levels—policy, university, faculty and research group level, as well as the individual researcher's level. Decision makers, professionals, industrialists and the public need to become more aware of the potential benefits of STI for growth, jobs and prosperity.

The academic landscape across the GCC countries has hitherto focused primarily on education, particularly of the routinised and sectoral kind that is thought to direct students into future employment within government agencies or large companies. Now attention is being paid to the need of achieving quality education, though the emphasis is on higher education rather than the full learning cycle and a superficial attachment to attracting high-branded international academic institutions. More fundamental tasks, such as improving teachers' education, are being discussed but addressed only weakly.

Strengthening the standing of basic research is a particularly daunting yet nevertheless essential component of the wider agenda. On the one hand, it is necessary to convey a sense of patience to decision makers and the general public. Basic science will not prove itself valuable through successful commercialisation of its results any time soon. Funding must be sustainable and the attraction of competent researchers capable of leveraging confidence that the investment in capacity building is long-term and able to survive the twists and turns of sometimes fickle political leadership. On the other hand, quick results are in demand and frustrations with lack of visible outcomes can erode public support. It is thus important to organise for quick returns as well, in areas where there is a good chance of reaping "low-hanging fruit" by way of contributions from science and innovation to society, as well as to eliminate unproductive obstacles related to government bureaucracy and working conditions that stifle research work across the board.

Compared to academic research, there has been more talk about the importance of stimulating industrial and applied research and innovation. In reality, however, there is almost a complete absence of private sector R&D in the MENA region. This is critical, since lack of own R&D makes firms unable to absorb the results of R&D more broadly and thus cut them off from a range of avenues to stimulate innovation.

Success in education, research, innovation and commercialisation is interrelated and requires that a whole range of enabling and contributing factors are in place. Synergies and communication channels need to operate both ways between scientists, entrepreneurs, financiers, mentors and business people. An ecosystem for innovation and entrepreneurship, capable of breeding diversity, pooling resources, connecting those with new ideas to markets, fostering critical business services, managing risk and coping with both success and failure, needs to evolve to enable new innovation-driven enterprises to come on stream. This is a precondition for the rise of new high-quality jobs capable of attracting and breeding a skilled and well-trained scientifically literate workforce that can meet the future demands of the knowledge-based society.

Such an agenda cannot be driven by government bodies alone. Close collaboration is needed with other stakeholders, including the private sector, universities and a brimming research community. A vibrant civil society that can help articulate and channel support for measures to address outstanding critical needs is much important. Non-academic, practically-oriented creative individuals, devoted to developing new solutions need viable avenues to further their contributions. Such individuals often pursue non-conventional development tracks that may not fit with existing corporate and institutional frameworks. However, so-called "inventors' associations" can enable them to link with other similar-minded individuals and to connect with viable channels for gaining access to technologies, resources and markets. At present, such support structures are all but absent across the MENA region.

The Arab Spring has given the region its wake-up call. The current focus is largely on what values and what new leaderships are to prevail, whether the tide of change that swept aside autocratic regimes will continue and if and how it will stabilise in new shapes—or whether a conservative counterrevolution will usher in traditionalist practices. But the issue of young people becoming better educated, better informed and looking for opportunities and avenues in their lives will not go away. And the young are quickly outnumbering the elderly.

The cause for addressing these issues is not helped by perceptions that the Middle East has to adopt and copy the means and tools for development from other parts of the world. Observing and drawing constructive lessons from the experience of others and from the contrast between what is achieved by others and by oneself is, however, a different matter. The nature of the main policy issues of the current era is critically about inspiring and engaging people in constructive innovative and entrepreneurial efforts. In this kind of agenda, there simply does not exist any silver bullet policy recommendation that can just be plugged into make everything work out in an ideal manner. Policy design and implementation are interrelated; the task is crucially not about what the government itself does but how it collaborates with and enables the success of other stakeholders, including established industry, small businesses, universities, innovators and entrepreneurs, and civil society. Indeed, our collective ability to observe and distil sensible lessons and carve out new building blocks from the knowledge base of the wider world—and the ability of various actors to transform and tailor that collective ability to effective use within a particular location- and context-specific environment—now forms an essential part of what shapes the performance and destiny of peoples and nations.

18.2 Selected Themes Under Scrutiny

Building constructive forums for exchanging experience and learning is an important part of shaping the infrastructure that is required for structured knowledge interactions. Some locations in the Middle East—notably Egypt in the years leading up to the Arab Spring and also Dubai, Abu Dhabi and Qatar in the GCC area—have evolved into popular destinations for international conferences, including both academic and business events. Much of these happenings have had little or no roots in a local context of research and development and have thus had little in-depth impetus. The INCONET-GCC project is different in that it has been designed for the particular purpose of engaging a varied set of partners across the GCC states, other MENA countries (notably Egypt, Jordan, Morocco and Yemen) and in Europe in debate and considerations on how to contribute to genuine capacity building in research and innovation.

The Muscat event opened up for dialogue on five selected themes identified as important for the region's advance in STI. Invited experts, policymakers and other stakeholders participated in parallel sessions addressing the themes outlined below. Each area featured extensive brainstorming, resulting in a rich set of proposals for action. For each theme, we present the issues that had been selected to initiate the discussions as well as a snapshot of the outcomes.

(i) Capacity building in research, issues set out as background:

- In emerging economies, including the GCC states, science and research systems tend to be highly concentrated, with the lead taken by a few institutions covering limited areas. Is this an advantage or a liability?
- How can a systems approach to STI be adopted and operationalised in the GCC countries?
- Institutions are generally heavy and slow-moving. What are desirable ways to facilitate greater dynamism and more fluid structures in GCC countries? How can collaboration with EU programmes and European players contribute, or does that risk introducing additional rigidity?
- GCC universities are marked by heavy top-down governance. What ways might exist to introduce more autonomy (and what would that require?) as a means to enhance development capacity and diversification at various levels of the system (regional, university and faculty level)? What is the role of international linkages in this respect?
- What are the key factors for making EU collaboration attractive and accessible to GCC countries in capacity building?

Brief on the outcome:[3]

[3] This section partly draws on the summary report produced by the chairs of this session, Saif Al Hiddabi, The Research Council, Oman, and Cristina Flesia, University of Ferrara, Italy.

A comprehensive approach to S&T policy is one that emphasises the launch and sustainment of a high level of activity when it comes to research and innovation. It also rewards effective performance by universities, research institutions, labs and private enterprise. Governments must provide public funding for public goods components that are essential for a functioning innovation system, such as basic research, basic education and fundamental infrastructure (physical as well as regulatory). Capacity building in research requires parallel progress on several fronts. Examples include: undertaking institutional reforms to create an enabling and widening convenient environment for research and innovation; allocating public funding in support of science and research, particularly basic research; designing incentives to stimulate R&D activities; attracting foreign capital and actors in research and innovation and encouraging foreign entities to establish or deepen their activities; and performing required relevant public sector activities, including procurement, regulation and infrastructure investment.

On this basis, a systems approach rather than a piecemeal agenda must be applied. The global context is likewise essential. The task of increasing the local value-added component in cross-border supply chains often meets with formidable difficulties. Finding the means of stimulating a significant international involvement in the local economy may be critical in this respect. This applies notably to transfers of technology and knowledge to the local environment, where there can be absorption by local actors and win–win in international cooperation. First-rate infrastructure, such as fully performing information and communications technology (ICT) as well as appropriate other physical as well as soft infrastructure is becoming a necessity for all countries in the region.. Raising the quality of human capital capabilities, enhancing mobility, inspiring talents or promoting entrepreneurship are other critical needs.

The discussion group's members pointed to the presence of outstanding issues with regard to:

1. The limitations of domestic science and research capabilities.
2. Areas of excellence are concentrated and limited to certain fields and institutions without linkages between them or spill-over effects to surrounding society.
3. There is a need for greater freedom to engage in innovation and to allow for unexpected and diverse directions in research.
4. Knowledge is lacking how to achieve competitiveness in S&T.
5. While it takes time to build critical mass in research capabilites and the number of scientists, policies are short-term and there is a lack of patience.
6. Researchers in the region need to become more visible and appreciated.
7. Human resources are lacking since talented young people tend to have other inspirations.

The group acknowledged that there is trade-off between different areas. Widening the agenda puts pressure on resources. Still, it is critical to develop more areas of excellence, while managing to obtain constructive links between them. International cooperation is important for:

- Finding common areas of interests in human resources (HR) development, working together to produce mutual benefits in this area and harness the competitiveness of each area to produce common benefit.
- Participating in international development programmes generally helps in easing the process of identification of joint research priorities for the countries concerned.
- Helping in evaluating societal outcomes and finding possible opportunities.
- Bringing experience and exchanging knowledge, skills and human factors.

(ii) Technology diffusion and innovation, issues set out as background:

- Finding ways to link different institutions and functions in the innovation system is critical. Which linkages may offer the strongest possibilities for rapid strengthening? What initiatives and incentives could work?
- How to boost the capabilities of enterprises, including absorptive capacity and workplace learning?
- What are the prime instruments (e.g. industrial institutes or technology transfer "offices") being used by government and other policy institutions to support technology diffusion? What resources, competencies and motivations are required for such units? Are there systematic weaknesses in adopted approaches? What are the prime difficulties?
- What is the role of SME policy in this context?
- What are the most useful approaches to managing intellectual property rights?

Brief on the outcome:[4]

Technology diffusion is not limited to the distribution of products and services but includes skills, training and the publication and communication of both technical applications and human capabilities. Measures to establish improved collaboration between separate but related institutions and the inception of new communities or forums for people to address issues of common interest are examples of initiatives that are central to this task.

Several key elements were identified which could help facilitate and advance the diffusion process between organisations, groups and individuals in regard to S&T:

- Incentives and interests of each party.
- Areas of strengths for each party individually and collectively.
- Exchange and mobility of people within related organisations.
- Availability of multi-research grants.

[4] This presentation partly draws on the summary report produced by the chairs of this session, Abdullah Al-Mahrouqi, The Research Council, Oman, and Mohammed Chaib, Jönköping University, Sweden.

- Degree of involvement by the government and the public and private organisations.
- Availability of leading R&D experts and organisations for joint projects.
- Working and living environment.
- Availability of facilitator or coordinator entity between research bodies.

SMEs should be viewed as key to processes of technology diffusion and innovation facilitation, both in conventional form and by prototyping ideas originating in bigger firms as spin-offs. Hindrances for outsourcing, funding and logistical support importantly influence conditions in that regard, however. Other weaknesses that may act to impede the role of SMEs and start-ups in the process include a lack of IPR frameworks, access to professional services, and business expertise in HR.

Technology transfer offices (TTOs) at universities can help attract funds and deal with IPRs and other legislative issues, but must not operate as an alternative to direct industry contacts.

(iii) Social and non-technical innovation, issues set out as background:

- What is the role of culture in scientific work and technology adoption in the GCC countries? Is culture an impediment today? Can it be turned into a source of strength? Are there concrete examples of this happening?
- What role does social capital play in the GCC countries in this context? Is social capital a distorting force for science and technology, and if so how? Does it result in more introverted actors and strategies? Is it a source of strength, and if so how?
- Special features of entrepreneurship in the GCC countries? Opportunity-based versus necessity-based?
- The rapid advance of ICT opens up for new kinds of virtual networks. What changes and opportunities does this connote?
- Europe has built in considerations of cultural diversity, gender and social cohesion in its research agendas at home. What strategy should be put in place to support collaboration between researchers in Europe and the GCC countries?

Brief on the outcome:[5]

Social innovation (SI) is about the development of new services that are motivated by the goal of meeting a social need and that predominantly are supplied through organisations whose primary purposes are social. SI differs from business innovation, which is generally motivated by profit maximisation and provided by companies. Diverse fields could be linked with social innovation, such as:

[5] This summary is partly based on the report produced by the chairs of this session, Said Al Kitani, Oman National Commission on Science, Education and Culture, Ministry of Education, Oman, and Paris Kokorotsikos, Euroconsultants, Thessaloniki, Greece.

- Social entrepreneurship.
- Cities and urban development.
- Social movements.
- Community development.

SI represents a great opportunity for developing new creative solutions. Fields and issues of relevance include raising life expectancy, cherishing the diversity of countries and cities, countering inequalities, resolving affluence-related behavioural problems, addressing challenges in the transition to adulthood, increasing happiness and contentment, tackling contemporary global issues (e.g. climate change), and cushioning social impacts of new technologies.

At global level, social innovation is perceived increasingly favourably. In the Gulf, on the other hand, social innovation and social research continue to receive far less attention than technical innovation, though the former may be more directly concerned with the well-being of the wider population.

A related issue raised during the discussion addressed the transformation through social change that resource-based economies must undergo to develop into knowledge-based societies.

For governments to be fully effective in meeting SI concerns, more evidence is needed, based on appropriate indicators, on the positive impact of social innovation programmes in different sections of society to justify public expenditure in this domain.

Key initiatives such as road safety and social networks have received attention due to their clear impacts on people.

Despite their common cultural background, GCC countries are at different levels of social development—a fact that has an impact on priorities. However, common subjects for research could be identified. Discussion members agreed on the following SI research topics:

- Nature conservation, sustainability and cross-border environmental issues.
- History and cultural heritage.
- Indigenous development of the education system.
- Need for social innovation to support government efforts to combat illiteracy.
- GCC background and impact on:
  - Culture of entrepreneurship;
  - Culture of research;
  - Learning sessions from national history about social innovation.

The social agenda generally requires inter-disciplinary research and can also benefit greatly from inter-cultural and bi-regional exchange and collaboration, for instance in regard to:

- Culture, heritage, history, content and ICT.
- Youth, employment, entrepreneurship, social networks and business platforms.
- Environment, resources, sustainability and cross-border cooperation.
- Population, health, well-being, social networks and tech platforms.

In the discussions, participants observed various hidden challenges:

- The nature of knowledge produced by research on social innovation is qualitative, which makes decision-making process more difficult.
- Some social habits hinder innovation.
- Funding instruments for such activities are often lacking, applying to public sources as well as private, including through corporate social responsibility (CSR) programmes.
- Skilled HR are fragmented.

(iv) Governance, issues set out as background:

- How can policymakers arrange horizontal coordination of related policy fields relevant to research and innovation and thereby enable an effective systemic approach?
- What is the appropriate combination of top-down and bottom-up initiatives?
- To what extent should public policy operate as a source of demand and leadership to pave the way for innovation, e.g. through public–private partnerships or new forms of public procurement?
- What are the prospects for the GCC countries adopting an ambitious S&T policy stance that pushes for solutions to the "grand challenges" (water, renewable energy, desalination, preserving biological diversity, managing marine resources, addressing mass disease, etc.)?
- What is government's role in removing hindrances and reducing transaction costs, notably for vulnerable players such as individual inventors, entrepreneurs and SMEs in the startup phase?
- What strategies can be deployed to engage key stakeholders more thoroughly to become effective champions for science, technology and innovation?
- What are the key organisational issues affecting the relationship between science and technology and education, entrepreneurship and enterprise development?

Brief on the outcome:[6]

Sustainable growth requires interaction between business, research and policy/the public sector in line with the triple helix framework. The interactions need to be framed so that they can help drive new products, services and processes. Overriding amendments are required in the Middle East today to shape an environment that is conducive to innovation. That is also the best method to strengthen industrial and business competitiveness and social well-being.

Whatever preparations are made, new and previously unforeseen developments will take place, frictions and contradictions will arise, and adjustment and flexibility will be a prerequisite for capturing new opportunities. Mindsets across the Middle

[6] This presentation extends from a summary produced by the chairs of this session, Mohamed Al-Maskari, Knowledge Oasis, Muscat, Oman, and Costas Kiparissides, Centre of Research and Technology Hellas and Aristotle University, Thessaloniki, Greece.

East are geared towards investment in tangibles, based on detailed budgetary planning and accounting. Decisions to accept risk, and to try what is not already tested and proven beyond doubt, are highly stigmatised, reflecting the governance model that has marked the region for a long time. Top-down decisions can be made at short notice without orderly consultation processes. At other levels, however, attitudes are highly cautious and officials are mindful of not overstepping decision-making limits and of following the book and seeking consensus from concerned parties. This is particularly the case with public authorities.

The result is a paradoxical combination of apparently unchecked power and a veil of bodies and bureaucrats that are prone to impose limits on new initiatives proposed by other actors and to walk away with scepticism from proposals that are unconventional.

In science and technology policy, there is a need for policymakers and stakeholders to review current practices and to open up new ground for critical research and innovation activities.

The following is a list of recommended focus areas:

- Establish networks of excellence in selective areas across the GCC countries.
- Build support for and achieve increased R&D investment intensity: target of GERD/GDP ratio to reach 3 %.
- Improve the division of labour between public and private R&D.
- Follow a combined top down/bottom up approach for establishing an STI policy (e.g. foresight studies drawing on international best practice).
- Develop the capacity to monitor and respond to the actual demands of stakeholders in a transparent, credible and open way.
- Work out incentives to pull market demand through incentives for higher-added-value products, processes and services, embracing stakeholders (universities, research institutes, industry and SMEs) in the form of awards, research funding, IP, royalties, patent exploitation rights, fiscal policies, etc.
- Recognise the role of researchers in society.
- Build the competencies and counselling mechanisms required to support individual inventors and SMEs how to use them.
- Strengthen general trust and cooperation through innovation in communication and awareness building.
- Programmes for increasing mobility and exchanges between academia and industry, including the adoption of new mechanisms to engage future employers in educational institutions with academic curricula that respond to industrial needs.
- Reconcile natural discrepancies in academic-business objectives in relation to STI.
- Create public awareness and involvement through inspirational projects and attractive information campaigns.
- Establish an independent programme assessment mechanism.

(v) Digital convergence and utilising ICT, issues set out as background:

- ICT is making a tremendous difference to science, research and innovation. In some respects, GCC countries match and surpass the performance of advanced developed countries, for instance in mobile network and service roll-out. On the other hand, many applications are routine in nature. How can ICT be effectively exploited to pull innovation?
- Some examples of genuine leapfrogging can be seen in emerging and developing economies through ICT. What is the key to such success?
- Incumbent technologies and vendors are responsible for significant lock-in. The tools for obtaining more diverse choices, and stronger bargaining power, are readily available. Several countries have embarked on applying open Source. Brazil, for instance, has consistently promoted open source among its government agencies. Is this desirable, and if so how?
- ICT is moving into a phase of digital convergence, promising more powerful and all-encompassing applications but with attendant risks including poorer security and integrity, along with privacy and authentication problems. What prospects do GCC and other emerging economies have to take the lead in confronting these challenges and thus positioning themselves for strategic niches and advantages? Can partnerships with EU contribute? How?
- The development of content must be present from the outset and not an afterthought. What good examples are there? What characterises the successful approaches and what is there to learn from them?

Brief on the outcome:[7]

Being capable and able to utilise ICT and different networks to carry out similar kinds of services and/or the ability to combine different services within one network is known as digital convergence.

Manifold challenges exist in respect of ICT development and convergence in the MENA region. The discussion led members to stress the following:

- An increasing dependence on IT service outsourcing, resulting in a lack of local experience and capabilities especially in programming.
- Problems of assigning third parties to build institutional electronic systems (buying the product), leading institutions to act as consumers (end-users) rather than providers.
- Ways of meeting basic needs through the development of e-services in areas such as: e-health, e-education and e-government.
- Marketing and promotion strategies and approaches to tailor e-services to users' needs.

[7] This draws on the summary produced by the chairs of this session Abdullah Al-Zakwani, Industrial Innovation Centre, PEIE, Muscat, Oman, and Sylviane Toporkoff, ITEMs International, Paris, France.

- Need to meet users' demands in areas such as privacy, security, identity management and so on as a source of innovation for improved service delivery and developing a more competitive and development-oriented IT-sector.

The group agreed on a number of possible solutions and recommended the following:

- A local needs assessment exercise should be conducted as a basis for ICT projects identified in joint efforts.
- Joint ICT projects should arise spontaneously as a consequence of shared interests by multiple stakeholders. A clear agenda based on the common objectives of all relevant parties should be defined.
- Multimedia labs should be established to boost creativity and better content. Media labs will constitute the research centres for developing projects at the convergence of design, multimedia and technology. Media labs can help foster attractive e-services and products in many different fields, such as health, government, education, entertainment and environment.
  - Creating a media lab can attract companies as sponsors. It can trigger new combinations of competencies to join forces in the development of IT applications and help raise digital literacy.
- Economic development strategies should take advantage of the new opportunities offered by creative industries in the IT and media sectors.
- Policies should build on common ground between some GCC countries, such as language and culture, as a key element for promoting joint projects.
- New initiatives should be taken to provide a friendly and easy-to-adopt platform for software development that can also serve as a learning environment.

The following section presents parts of the continued process, as sessions in plenary aimed to enable cross-fertilisation across areas and a succinct set of shared conclusions.

18.3 Advancing the Dialogue for Action

Following the parallel sessions, presentations of the outcomes stimulated common discussion among all participants in the Muscat conference. Throughout there was a search for solutions and common understanding on how to achieve a critical effort in priority areas and how to enable the implementation of most needed reforms and initiatives. From an early stage, participants including Abdullah Al-Najjar[8] observed that the holding of meetings for meetings' sake was of little use. Time is one of scarcest resources and whilst networking and exchanging experiences is essential, it is also crucial to prioritise concrete initiatives and actions that

[8] President of the Arab Science and Technology Foundation, based in Cairo and Dubai.

have the potential to exert lasting impacts. The INCONET-GCC agenda, geared to meeting these objectives, was wholeheartedly welcomed.

The plenary sessions were structured to generate input of three kinds: (i) what projects to emphasise in the next two years; (ii) what follow-up activities INCONET-GCC can catalyse, and; (iii) what other constructive outcomes can be generated through the interplay between stakeholders (regardless of whether these outcomes would fit within the EU frameworks). The aim is to collaborate in an inclusive rather than proprietary spirit, with a generous attitude to welcoming indirect benefits and spin-offs. We all stand to gain from opening up the opportunities for building research capacity together. Those who are ready to go faster should commence the collaborative work, while others can join later. Others may try it out on their own, or with others. This landscape will prosper from intensive cooperation and competition.

The GCC countries face a host of compelling issues that are projected in social tensions and uncertainty over future direction. In many cases, research and innovation have an important role to play. Governments must come up with their own strategies but cannot work in isolation. There is a need for improved coordination and joint initiatives between governments to build better synergies and critical mass and for collaborative initiatives with external partners.

Participants voiced a variety of views on the issue of nailing down priorities for capacity building in research and where to put the emphasis of EU-GCC collaboration. Some worried, how to engage stakeholders and how to ensure constructive synergy between objectives at local, national and international level. Hilal Al-Hinai[9] noted that while the EU has a well worked out structure for inspiring and generating common research initiatives, the GCC countries lack such a fabric and rather have a tendency to view each other as competitors, thus preferring to go it alone. Such tactics will lead to substantive overlap and limit the scope for mutual learning and specialisation and building critical mass. Al-Hinai saw great potential in a constructive INCONET-GCC agenda that facilitates shared initiative and shows the way through concrete joint activities.

Other remarks took the form of requests for putting the emphasis on strengthening education and human resource management. Participants underlined the tremendous challenges of enabling mindset change, so that the outcomes of education are able to get closer to the needs of industry and society and so the workforce and conditions for enterprise development can become more conducive to the development of new jobs, through entrepreneurship and the establishment of more dynamic small- and medium-sized enterprises (SMEs). Mohamed Chaib[10] emphasised the importance of organising for lifelong learning, including learning in the workplace. Actions are needed to create new drivers, not only in higher

[9] Secretary General of TRC, Sultanate of Oman.

[10] Professor at the School of Learning and Communication, Jönköping University, and founder of Encell, the Swedish Centre for Adult Learning. See also Chap. 15.

education but throughout the stakeholder landscape, to inspire a genuine interest in continuous learning.

Several commentators took note of the frustrated process of setting directions for STI policy. Representatives from Yemen, Morocco and Jordan were among those who provided valuable insights into the presence of impediments. Participants emphasised the need to work out a road map and observed the benefits of wider collaboration in this area. It was stressed that a road map should reflect social needs as well as the means available for research activities to help craft practical solutions to specific issues. At the same time, there is a need for increased patience on the policy and funding side to create an understanding that building research capacity takes time. Academic researchers must be allowed to operate under longer time horizons than business. The point is that research communities must be actively connected to the agendas of meeting with societal needs.

Emphasis was placed on institutional reform, cutting the weight of government-led, top-down initiatives and reducing bureaucracy and red tape.[11] Different views were expressed on the role of IPRs. Though there are no generally applicable solutions for how to apply IPR in support of intangible assets, participants recognised that the absence of a policy—and a strategy—is a hindrance. An evolving dynamic institutional environment in support of innovation needs to include the presence of actors that understand the situations in which IPRs matter and how they can be approached and applied in the specific field. Universities and individual researchers must frame a joint interest in appropriating and defending gains from the development and commercialisation of new ideas.

The main obstacles to the creation of an effective higher education system were perceived to be related neither to a lack of skills or awareness from policymakers and stakeholders nor to a lack of public investment, but primarily rather to a general lack of “scientific culture”. Progress in public investment, the optimisation of the funding schemes and the autonomy of research institutions is very important but could result in an unsatisfactory outcome without a strong effort to forge a productive, stimulating and challenging scientific environment.

A call for novel approaches in addressing health issues saw Kazem Behbehani[12] note the severe state of public health in the GCC states, where a high number of people suffer from lifestyle-induced disorders—a phenomenon that is increasingly prevalent at a young age among the highly youthful population. Other areas addressed included energy, water management and sustainable development. The conference’s conclusions on these aspects feed into the continued project agenda.

The duality of whether masters and PhD education should be dispensed abroad or *in loco* reflects a trade-off between retaining some of the best human capital on the domestic stage and awarding talented students opportunities to pursue a scientific and technical career. Keeping students in domestic institutions implies a

[11] Abdullah Al-Zakwani, Director of the Industrial Innovation Centre, PEIE, Muscat, Oman.

[12] Secretary-General of the Dasman Diabetes Institute, Kuwait. See also Chap. 11.

great investment and effort to guarantee a high level of education and research in a relatively short time frame and in several different research fields. But many participants judged this unfeasible as a general strategy, given the fast technical and scientific progress under way worldwide. On the other hand, sending the best students abroad results in the definitive departure of promising talents who will be unable to find in their home country the infrastructures and fruitful scientific environment to which they could meaningfully return for the purpose of eventually contributing to research, innovation and economic diversification.

Greater value can be generated through a positive approach to culture, and young people must be better attuned to the opportunities offered by research. Throughout, there is a need to acknowledge, understand and address the impediments to the rise of innovation and a research culture. Putting research and innovation to work will require parallel improvement in research funding, incentive structures for researchers, university governance, IPR and so forth.

18.4 Institutional Reform: Universities and Entrepreneurship

In the GCC countries, governments receive the bulk of national revenue directly via exploitation of the natural resource base and with less accountability than is common in most another parts of the world. The boundaries between governmental and non-governmental spheres are often less clear-cut than elsewhere, fuelling a widespread tradition of waiting for the government to act.

In these conditions it is essential to find ways to inspire engagement and build capacity for a wider set of actors to contribute to economic and social development. Returning to the Knowledge Triangle, government, business and academia must all be actively engaged if the knowledge economy is to thrive, and the nature of the linkages between them will matter crucially. Government cannot be just about power and proprietary achievement. Business cannot just do its own thing and stay away from research and education. The academic sector similarly cannot just carry out an educational task. For progress to be possible, the role of all three spheres must evolve and a broader range of constellations arise.

Here, the development of universities (and other HEIs) may hold the key to change. In many parts of the world, especially in the Middle East, there is a critical need to induce and enable universities to move out of the academic corner, to engage with other societal bodies and to assume more of a driver or catalyst role for new initiatives. In this, the availability of financial resources is not necessarily the main issue in the Middle East today. The question is how resources are attained and what incentives exist for universities, as well as what room universities have for manoeuvre.

Managing universities is known to be difficult. In contrast to companies, their backbone has less to do with the payment of salaries to staff but emanate from managing knowledge and learning processes, which by definition embrace values and attitudes. Faculty and students are, for instance, bound to carry with them strong ideas how things should or should not be done. Universities have through the ages been the breeding ground for revolutions and resistance to governments, as in the US or Europe in the 1960s and the 1970s. They may, however, also be home to student movements that operate as custodians of conservative perceptions and values, as in Pakistan or Tunisia today.

Compared to industry, universities have the greater room not to be pushed by immediate results. They need to be granted the scope to evolve in different directions and achieve as measured by various criteria. The attainment of a first-rate education offering should be given the attention and rewards it deserves. Excellence in research needs to be strived for—and enabled—in niches, with a jealous eye on the link to education. Some research institutes can specialise more in "pure research", though that too will require linkages—to industry and to universities as well.

Again, most universities in the Middle East specialise in offering education of a standardised nature. The call is on, however, to develop programmes that enable higher value-added and greater local relevance. Universities and colleges are also increasingly expected to build constructive links with local industry and wider society to allow for better synergies and matching between educational programmes and social needs. There is also an increasing demand for establishing research capacities. As has been underlined, the Middle East needs a genuine advance in research, for several reasons. It is important for connecting to the international research community, including by attracting international talent (and also retaining or attracting back local talent), for broadening horizons, for building reflective capacity on societal issues and for raising the quality of higher education.

For all the societal benefits, basic research may seem awkward and detached from daily needs, and policymakers and the general public may have a hard time being patient in the face of burning daily issues. The presence of applied research and demonstration of successes in commercialisation is needed, not least to maintain political support. Other ingredients are needed as well, however, including within the development of universities themselves.

In this context, we emphasise the notion of the "entrepreneurial university", which may overlap with research universities but also displays a fabric and development part of its own. In some cases, research capacity and entrepreneurial mindset will go hand in hand; in other cases there will be trade-offs.

Increasingly popular around the world in the last few years, the entrepreneurial university concept was introduced in the workshop/conference "Entrepreneurship through Higher Education" on 17–18 March 2012, again in Muscat. Panels of international speakers and representatives from higher education institutions (HEIs), business and entrepreneurship networks debated the agenda. A student competition, "Mountains 24″, was held alongside the conference sessions. After 2 days of preparations, students competed over 24 h in how to develop business plans and the frameworks for establishing their new companies.

The entrepreneurial university may be viewed as a response to particular issues in the GCC countries, notably:

- Inability of traditional higher education to produce adequate soft skills for enterprise development, e.g. with regard to team-working ability and self-initiated innovation in setting up new companies.
- Lack of skills and expertise, e.g. in marketing and financial and legal affairs, among faculty and students alike, as well as a lack of understanding for—and social acceptance of—risk-taking as a necessity when engaging in entrepreneurial activity.
- Lack of R&D activities.
- Lack of awareness and access to competencies with respect to IPR.
- Lack of innovation support mechanisms and specialised services to back potential high-growth start-up activities based on the commercialisation of new ideas.
- Lack of organised channels for funding, mentoring and coaching entrepreneurs, including shortage of seed funding, too few business networks and an absence of exit mechanisms for early investors.

As a response, the entrepreneurial university represents a special amalgam of teaching, research and entrepreneurial interests whose characteristics include:

(a) A redefinition of institutional goals to encourage and enable new initiatives in response to market demand and social needs.
(b) A culture of preparedness to undergo continual internal renewal, with motivated academics engaged in formal and informal technology transfer and administrators delegated with decision-making authority to help speed decisions processes and facilitate rather than obstructing new horizontal combinations.
(c) Integration of traditional departments into a synergetic entrepreneurial culture, encouraged by the belief in value creation rather than zero-sum games.
(d) The respect for peripheral units located outside the regular department structure, acceptance of novel ways to interact with the external environment, developing new tools for working with industry, generating ideas, training and nurturing entrepreneurs, and producing start-ups and spinoffs.
(e) A diversified funding base, which reduces dependence on government and is capable of assuming experimentation and risk.

The entrepreneurial university introduces and embraces mechanisms for knowledge development that add value to the innovation system both as a human capital provider and as a seedbed of new enterprises through the extension of both its research and teaching missions. Entrepreneurial universities have a particular ability to take the lead in inspiring engagement in innovation agendas by local actors, at all levels, among faculty, students, administrators, SMEs, and community-based actors.

Four developmental mechanisms and emergent structures are typically required for a university to adopt an entrepreneurial culture.

1. Internal transformation
   Faculty is willing to examine how its research and teaching activities can contribute to socioeconomic development in addition to educating students and creating knowledge. Traditional academic tasks are redefined and expanded by encouraging students to test their academic knowledge in "real-world" situations and to act as intermediaries between academia and other sectors, for instance as interns in business.
2. Trans-institutional impact
   Regulatory and institutional obstacles are addressed. Universities are stimulated or enabled to engage in a dynamic collaboration with industry and government sectors.
3. Interface processes
   Universities develop a capability for intelligence, monitoring and negotiation with industry and government, enabling a confluence of interest between external organisations and their academic counterparts. Faculty members and technical personnel may be assigned special responsibilities to assess the commercial potential of their research findings.
4. Recursive effects
   Beyond establishing links with existing organisations, universities develop capabilities to assist in the creation of either commercial or non-profit start-ups based on academic research. They also take initiatives to form, or participate actively in, regional organisations aimed to link various sectors around the common purpose of fostering innovation, such as research centres connected to several universities, companies and government laboratories.

In the Middle East, there may be strong interest in entrepreneurship, but many look to the government for leadership and support while desiring more flexibility in academic rules and regulations. Public universities tend to focus on their societal prestige, while private universities are preoccupied with short-term profits. Response from external entrepreneurship programmes tends to be sluggish, while changes to classroom-based curricula are restricted by government rules and lengthy approval process.

Tangible progress on a systems level requires, at the minimum, a "let-go" attitude on the part of the ministry of higher education. There is also the need for buy-in from ministries that are responsible for manpower or labour market affairs. Such buy-in is necessary if there is to be a reasonably consistent and holistic approach, spanning not only the educational system but also human resource management as a whole. An interest and mindset that is conducive to entrepreneurship must be anchored early in life, and learning processes need to continue way beyond formal schooling has ended. The private sector, networks for entrepreneurs, and civil society must also be engaged. Indeed, with the arrival of the information era, the attitudes to students, users and the work force need to evolve. Recipients and transmitters of information will alternate or become the same. The perspective on education versus learning, teaching versus coaching, or authoritarian discipline versus authority will have to change.

The Muscat conference further pinpointed three main resources for entrepreneurship:

- Idea capital: The ability to find the most relevant, creative idea.
- Financial capital: The funds required by entrepreneurs to establish their businesses.
- Social capital: The value of social relations and networking that ought to be developed.

Against this backdrop, the Muscat conference resulted in recommendations for the following specific actions, based on the principles of how to enable the rise of entrepreneurial universities and their activities. They are presented under three headings: (a) general; (b) specific for HEIs, and (c) students. Although some references are made to Oman specifically, these observations are broadly relevant to the region.

(a) Enabling Entrepreneurship—General:

  i. Entrepreneurship should start at the earlier stages of life in school.
  ii. Strengthening conditions for entrepreneurship will require a systemic approach, including all relevant regulations, processes and procedures.
  iii. Training entrepreneurs is not sufficient. There must be a mindset change from early on, permeating from parenthood and kindergarten through the school system as a whole, as well as the presence of enabling conditions and support structures.
  iv. ICT should be systematically used to open up new areas for entrepreneurship.
  v. Measures should be taken to counter late payment from both government and private entities. Effective dispute resolution mechanisms should be put in place.
  vi. There are no standardised statistics covering SMEs in Oman, a situation which must be rectified in order to build well-founded strategies. A reliable database and source of information must be established, addressing relevant aspects.

(b) Enabling Entrepreneurship—Specific for HEIs:
The following principles will be at the centre of our continued task to foster entrepreneurism:

  i. The best approach to practising entrepreneurship in higher education is to motivate and teach students to think of becoming entrepreneurs, to adopt entrepreneurial behaviour, acquire entrepreneurial skills and attitudes, understand business ventures and develop entrepreneurial competencies.
  ii. Education will not create entrepreneurs but it can help inspire, empower and enable them.

iii. Trainers who provide coaching and mentoring should be drawn from pools of established and experienced entrepreneurs, and students throughout the higher education system should be offered the opportunity to meet relevant role models and mentors.
iv. Universities must develop the capacity to offer special training and support services to assist entrepreneurs in making informed decisions on patents and intellectual property rights.
v. There should be a well-established entrepreneurship culture among academic faculty and students.
vi. Current higher education and business policies should be examined and simplified for enhanced flexibility and to remove unwarranted barriers to entrepreneurship.
vii. Multidisciplinary programmes can, if used constructively, open up promising channels for entrepreneurship.
viii. We need both incubation and acceleration. Entrepreneurship can be taught in incubators and then we need to accelerate it. Action-based learning is the best methodology for teaching entrepreneurship.
ix Universities have to focus more on critical thinking and soft skills for use in the business world. Students should be left to choose what they want to learn or do.
x. There is a large gap and miscommunication between the education and business sectors. Most students know little about business practices or how to work in the real world when they complete their theoretical studies. Universities need special programmes that help students graduate with the knowledge of how business works, for example internship assignments within an established community of mentor companies.
xi. Entrepreneurial universities should be capable of experimenting and encouraging an attitude in support of sensible risk-reward rations.
xii. Ministries of higher education should not regulate curriculum activities in detail and open up for more university autonomy in developing entrepreneurship. Ministries should engage in active dialogue with universities to carve out room for increased autonomy and specialisation in entrepreneurship education.

(c) Enabling Entrepreneurship—For students:

i. Students should be exposed to the marketplace before they graduate, by linking theory to practice and meeting with prospective role models and representatives from key societal spheres during their education.
ii. Students should have awareness of real issues in their community, which will inspire them to develop solutions.
iii. Processes and tools should be adopted that can assist students in moving from ideas to business and enable them to develop their own business while still at university.
iv. Entrepreneurial students should be invited to share their success stories with other students.

v. Society should celebrate the success of Oman's entrepreneurs to inspire students and share their accomplishments.
vi. The development of social enterprises among university students should be supported and stimulated.
vii. Multidisciplinary networks should be encouraged to motivate students to think and act locally and globally and to share their visions for making a difference.
viii. Student organisations may engage students to collaborate with local communities and work out innovative solutions to support sustainable development.

To conclude, economic diversification and the development of new industries and jobs depend on younger generations gaining new capabilities and inspiration for entrepreneurship and innovation. There is thus a need to devise comprehensive policies to encourage HEIs to work out their own strategies in this area. Each university or university college may have its way of motivating teachers and students and building support structures. Channels for providing seed funding, along with mechanisms for mentoring and coaching of entrepreneurs, need to be put in place.

A multi-disciplinary and cross-boundary approach is generally warranted, alongside actions to introduce soft skills, for instance in regard to teamwork and a mindset that is conducive to experimentation as well as the acceptance of risk and of failure. The prime challenge is one of mindset. Ultimately, entrepreneurship results from a mixture of innate personal characteristics (that not everyone shares) and a culture that can encourage those characteristics where they exist. It requires a mindset that views big problems as big opportunities. Entrepreneurs are ready to embark on a journey without knowing the exact destination and are not afraid to fail in reaching for success. They have the aptitude to live with risk, uncertainty and ambiguity because the world they inhabit is highly unpredictable. They are willing to venture outside their comfort zone and to be "life-long learners." The fact that there is no perfect answer is reassuring to them, perhaps because they were not necessarily the smartest kid in the class. Because so much of what entrepreneurs do has not yet been invented, they are willing to make it up as they go along.

18.5 Concluding Remarks

The deliberations of both events reviewed in the previous sections and also reflected in contributions throughout this book emphasise that strengthened frameworks for science, technology, innovation and entrepreneurship—along with improved education and human resource management—are essential for the ability of the GCC countries to diversify their economies. While resource abundance in these countries provides the means to undertake essential investments, it also serves to create complacency and underpin traditional approaches that hinder adjustment to the new era. In other Arab countries in the wider MENA region, resources are generally much scarcer. At the time of writing, an acute economic downturn has taken hold, with an attendant shortage of confidence and capital. A key message is that the urgent issues cannot be resolved without genuine adjustment and an effort to cope with the long term challenges that apply throughout the region.

A viable solution goes beyond a piecemeal agenda and compartmentalised governance. The task is also not merely about channelling sufficient investment and resources into particular projects, although the importance of an adequate resource allocation must not be trivialised. The region is one in which new technologies and means of communication are making headway but where investment in people and knowledge assets is a long shot. Mindsets remain focused on traditional investments in land and real estate. Research, experimentation and innovation are stifled, commerce is a harsh reality and serious outstanding social and environmental problems receive relatively scant attention.

Today, technical progress and innovation, when put to use by organisations and people, offer the tools to turn the presence of outstanding problems and needs into a source of opportunities for a more prosperous future. However, building strengths in STI requires shared engagement and commitment by multiple stakeholders. The point is not that everyone has to agree before there can be progress, or that everyone must stake out their returns and profits before steps forward can be taken. There is a need for genuine engagement by relevant stakeholders, not merely vested interests. Similarly, a common understanding must be built for the need for a shared commitment to introduce enabling factors that remove hurdles. Key decision makers need to give ground, count the success of others as the success of the research and innovation agenda and allow for the risk of failure as an inevitable companion of genuine efforts to gain new ground.

This book has underlined the importance of learning from the lessons of others. What, for instance, made it possible for Finland to forge the commitment and engagement among different stakeholders that enabled the country to join forces around realising the opportunities of S&T? What made it possible for Ireland to seal its social contract?

The book notes some of the answers to such questions. The two countries found themselves in a state of crisis. Both experienced decisive leadership, whether from the prime minister personally in Finland or union leaders in Ireland. Pivotal to their approach was a constructive combination of top-down and bottom-up. It was not about giving up government responsibility. Nor was it about centralising power and decisions. It was about leadership of “letting go”—of having everyone agree on joining forces in enabling the success of others.

Finland and Ireland obviously had a degree of luck in timing as regards European integration and the availability of international investors. Nevertheless, circumstances and joint efforts made it possible for both to break with previous patterns and to embark on new growth trajectories. Times are different now. The developed world is staged in financial crisis and unresolved structural issues. The

GCC countries and the broader MENA region are confronted by an opportunity to take a major leap into a new era and capitalise on new sources of growth and prosperity for the long term.

This is partly because the Middle East has run into its own kind of wake-up call. While the needs were observed and intensively debated among researchers and practitioners meeting in the white city of Muscat in that month of December 2010, the avalanche was put in motion roughly a week later amid the turmoil of Tunis. The Arab Spring reflects the arrival of a new awareness, coupled with compelling demographic issues and jobs challenges that cannot be resolved without a new fusion and reconciliation between what is old and what is new.

A comprehensive set of policy measures needs to be designed and be adopted by the GCC countries which, for all their multifaceted features, hold the lead in the MENA region in, e.g., resource availability and investment in modern infrastructure. In regard to societal innovation, the situation is more mixed. The growth model of Dubai, the media revolution in Qatar, the health policy initiative of Kuwait and the policy response by Oman to the call for reform in the early stage of the Arab Spring, exemplify significant advancement in these countries. Yet their ability to build upon or shape their own unique strengths, and to feature bottom-up initiatives, has further to go. Much more needs to be done to get a handle of the new growth factors. Science, research, innovation and entrepreneurship need to be put on the centre stage, along with the upgrading of quality education and learning for life. The countries of the region should make collaboration among themselves in this area part of their priorities, without throwing themselves into a pit of policy coordination that would stifle experimentation and development.

The following should be high on the agenda:

- Enabling both-way linking and inspiration between science and research on the one end and real-life needs and improvements on the other. Finding ways to inspire the new generation to embrace science and technology.
- Putting the development and use of new knowledge to work in resolving the outstanding major societal, environmental and economic challenges, turning daunting problems into a source of opportunities.
- Making relevant stakeholders partners in new investments, instituting mechanisms for a vibrant university-society interface and promoting public–private partnerships along with civil society contributions in research and innovation.
- Shifting the role of government from doer to enabler, with benchmarking against other actors including in service provision to small and medium-sized enterprises. Professional private service providers should evolve to support the broader development of new goods and services; this role should not be filled by publically owned agencies, though it should be aided by public goods functions put in place by government.
- Developing strategies for carving out and strengthening niches that build on unique local values and assets, while countering herd behaviour and loss of own identity.

- Investing in quality education and embracing brain circulation, between societal spheres and also in regard to the wider world.
- Engaging in a constructive effort to “train the trainers”, including government officials, university management, teachers and other key professions, to achieve mindset change in support of horizontal, cross-departmental synergies and inclusive growth, involving the population at large.

Acknowledgments Participants at the Muscat INCONET-GCC conference in December 2010 contributed to the background material that was subsequently processed to form this chapter, in particular Umaima Al Mahdhori and Talal Al Balushi. This chapter further draws on the workshop on Entrepreneurship and Higher Education, also held in Muscat and organised by the Ministry of Higher Education. This was primarily organised by Abdullah Al Sarmi and Robert Craig of the ministry and in collaboration with TRC, including Miad Al-Balushi and Zaki Muscati whose substantive report was extensively drawn upon. The material has been processed and updated by Thomas Andersson.

Appendix A
Additional Information

Table A.1 Performance of the Arab World using the global competitiveness index (GCI)

GCI world rank	Country	GCI
14	Qatar	5.24
17	Saudi Arabia	5.17
27	UAE	4.89
32	Oman	4.64
34	Kuwait	4.62
37	Bahrain	4.54
40	Tunisia	4.47
71	Jordan	4.19
73	Morocco	4.16
87	Algeria	3.96
94	Egypt	3.88
98	Syria	3.85
138	Yemen	3.06

Source Arab world competitiveness report, world economic forum and organisation for economic cooperation and development; 2011–2012. ISBN-13: 92-95044-54-1

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5,

Table A.2 Ease of doing business rankings for Arab and comparison countries

	Ease of doing business		Starting a business		Dealing with construction permit		Registering property		Getting credit		Protecting investors		Paying taxes		Trading across borders		Enforcing contracts		Closing a business	
	World	Arab countries	World	Arab countries	World	Arab countries	World	Arab countries	World	Arab countries	World	Arab countries	World	Arab countries	World	Arab countries	World	Arab countries	World	Arab countries
Algeria	136	14	150	15	113	13	165	20	138	5	74	5	168	19	124	16	127	11	51	4
Bahrain	28	2	78	7	17	2	29	4	89	4	59	4	14	6	33	5	117	19	26	1
Egypt	94	8	18	2	154	19	93	13	72	2	74	6	136	17	21	3	143	16	131	20
Iraq	166	20	174	19	102	11	96	14	168	17	120	13	54	10	179	20	141	15	183	20
Jordan	111	10	127	12	92	9	106	16	128	9	120	12	29	8	77	8	129	12	98	11
Kuwait	74	7	141	14	91	8	90	12	89	5	28	2	9	5	113	13	114	8	61	6
Lebanon	113	11	103	9	142	17	111	17	89	6	93	8	36	9	95	11	122	10	122	12
Morocco	114	12	82	8	98	10	124	18	89	7	154	18	124	16	80	9	106	7	59	5
Oman	57	6	76	6	70	7	21	3	128	10	93	9	8	4	88	10	104	6	72	8
Qatar	50	4	111	10	30	4	58	7	138	12	93	10	2	1	46	7	95	5	36	2
Saudi Arabia	11	1	13	1	14	1	1	1	46	1	16	1	6	3	18	2	40	14	65	7
Syria	144	15	134	13	134	15	80	11	168	18	109	11	110	15	120	14	176	20	95	10
Tunisia	55	5	48	4	106	12	64	8	89	8	74	7	58	11	30	4	78	2	37	3
UAE	40	3	46	4	26	3	4	2	72	3	120	14	5	2	3	1	134	13	143	20
W Bank & Gaza	135	13	173	18	157	20	76	10	168	19	44	3	28	7	111	12	93	4	183	20
Yemen	105	9	57	5	50	5	53	6	152	15	132	16	146	18	123	15	34	1	90	9
Iran	129	–	42	–	143	–	156	–	89	–	167	–	115	–	131	–	49	–	111	–
Turkey	65	–	63	–	137	–	38	–	72	–	59	–	75	–	76	–	26	–	115	–

Source World Bank and International Financial Corporation's Doing Business Statistics. Downloaded september 2011 from: http://www.doingbusiness.org/rankings

Table A.3 Researchers in, and total expenditure on, R & D in Arab and comparison countries

Country	Researchers in R&D (2006)	Total expenditure for R & D as per cent of GDP (2006)
Algeria	5,593	0.07
Egypt	n/a	0.19
Jordan	n/a	0.34
Kuwait	200	0.18
Morocco	n/a	0.66
Oman	9	n/a
Sudan	9,340	0.28
Syria	435	n/a
Tunisia	14,650	1.03
Iran	88,000	0.59
Turkey	42,663	0.76

Source Data downloaded from the World Bank's KAM Database in august 2011 from: http://info.worldbank.org/

Table A.4 Number of users of top ten languages on the web updated for may 31 2011

EnglishTop ten languages on the internet	Internet users by language (millions)	Internet penetration by language[a]	Growth in internet (2000–2011)	Internet users (percent of Total)	World population for this language (2011 estimates; millions)
English	565.00	43.4	301	26.9	1,302.28
Chinese	509.97	37.2	1,479	24.3	1,372.23
Spanish	164.97	39.0	807	7.9	423.09
Japanese	99.18	78.4	111	4.7	126.48
Portuguese	82.59	32.5	990	3.9	253.95
German	75.42	79.5	174	3.6	94.84
Arabic	65.37	18.8	2,501	3.1	347.00
French	59.78	17.2	398	2.8	347.93
Russian	59.70	42.8	1,826	2.8	139.39
Korean	39.44	55.2	107	1.9	71.39
Top ten languages	1,615.96	36.4	421	77.0	4,442.06
Rest of the languages	350.56	14.6	589	16.7	2,403.55
World total›	2,099.93	30.3	482	100.0	6,930.06

[a] Internet penetration is the ratio between the sum of internet users speaking a language and the total estimated population that speaks that specific language. No adjustments are generally made for infants or illiteracy in calculating internet penetration rates

Source Internet World Stats, accessed in august 2011 at: http://www.internetworldstats.com/stats7.htm

Appendix B
Survey on Research Commercialisation

Hello Dear ………..

The King Saud University is conducting a study on the commercialisation of research. You have been identified as a professor who may be likely to commercialise and we would like to take 10 min of your time to understand your commercialisation behaviour. Our previous work has been featured in the New York Times and Nature and we believe your responses will help us better understand the nature of university commercialisation in Saudi Arabia. All the information in the study will remain strictly confidential.

For any inquiries you could contact us through the following means:

e-mail: alshumi@ksu.edu.saor fax: 014670329.

Thank you,

Prof. Ahmed Alshumaimri
(King Saud University)

Prof. David Audretsch
(King Saud University)

Commercialization Means: The Process of Introducing a New Product Into the Market

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5,

1) In which year did you receive your Doctoral Degree?

A. Year: …………

B. The country you got it from : ………………..…

2) Gender: ☐ Male ☐ Female

3) Your Nationality ……………………………

4) Did you start up a business or did you startup a business which was aided by your university?

☐ Yes ☐ No

(If no, please go to question 8):

5) When did you start your business: …………..

6) Would you define your company as an innovative company, in terms of the product or service?

☐ Yes ☐ No

7) If yes, approximately how many employees are currently employed, please include yourself in the count, if the company no longer exists, please type "N/A", if the company was purchased, please type "purchased":

Number of employees: ……..

8) Do you currently sit on any industry science advisory board or a board of directors?

☐ Yes ☐ No

9) Do you have any Science Citation Index publications (ISI, Web of Knowledge)?

☐ Yes ☐ No

If yes, how many would you estimate to have? ………..

10) If applicable, who would you categorize as having significantly contributed to you being able to commercialize your start-up(s), please choose all that apply:

☐ Yourself ☐ Academic colleagues

☐ Your University ☐ Banks ☐ Professional Connections to industry

☐ Other: …………………

11) Did you have any other major sources of funding (totalling over SR500'000) over a five-year period?

☐ Yes ☐ No

If yes, please choose the source(s) of funding that apply:

☐Non-profit ☐ Governmental ☐ Your University

☐ Industry ☐ Other: …………………….

12) Did you have any consulting contracts with commercial industry?

☐ Yes ☐ No

13) Do you feel your university directly helped you commercialize your research between 2000 and 2101?

☐ Yes ☐ No

14) Would you like to start up a company at some point in your academic career focusing exclusively on your research?

☐ Yes ☐ No

15) Would you like to start up a company at some point in the future?

☐ Yes ☐ No

16) If you do not want to startup a company in the future, what are your reasons?

You may select more than one reason:

☐ Research is not applicable to commercialisation

☐ Unable to find viable business partners

☐ Do not believe academic research should be commercialised

☐ Are not legally allowed to commercialise

☐ Are satisfied with current work load

☐ Do not believe your research to offer and commercial value added

☐ The current bureaucracy makes it prohibitive

17) Do you have concrete plans for starting a company in the next two years?

☐ Yes ☐ No

About the Editors

Thomas Andersson Prof. PhD, holds a number of international advisory and board positions. He is Senior Advisor of Science, Technology and Innovation at the Research Council of Oman, and Chairman of the International Organisation for Knowledge Economy and Enterprise Development (IKED), the International Entrepreneurship Academy (Intentac) and the Global Identity Networking of Individuals (GINI), a support action for the Information Society and Media Directorate-General, European Commission. He also serves on the advisory boards of the Global Forum and the World Student Community on Sustainable Development (WSCSD). He has been the main consultant for the Executive Council of Abu Dhabi on measuring gaps and performances in innovation, and collaborated closely with King Saud University, Riyadh, on international entrepreneurship education in connection with the establishment of the Prince Salman Entrepreneurship Institute. He has recently held seats on several high-level expert groups at the European Commission. Earlier, he was Deputy Director of Science Technology and Industry at the OECD, where he coordinated the technology section of the *Jobs Study* and the *Growth Study* and the OECD's collaboration with the World Bank on building knowledge-based economies. He has also served as Assistant Under-Secretary at the Ministry of Industry and Commerce in Sweden. As a member of the Royal Swedish Academy of Engineering Science (IVA) he was Vice Chairman of Division XI in charge of education and research policy. Thomas Andersson became full Professor of Economics at Jönköping International Business School and was previously President of Jönköping University. He received his PhD in 1989 from the Stockholm School of Economics, where he became Associate Professor in 1993. He has been a Visiting Fellow at Harvard University, the Bank of Japan, Hitotsubashi University and the University of Sao Paulo.

Abdelkader Djeflat was appointed full Professor in Economics at the University of Oran in Algeria in 1992, where he was Dean of the Faculty of Economics and then Chairman of the Scientific Committee. He was also a researcher and member

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5,

of the Scientific Board of the Centre of Applied Economics for Development (CREAD) in Algeria. He currently teaches industrial and development economics at the University of Lille in France and is Director of the Master on International Cooperation. He is Chairman of the Network on S&T for Maghreb Development (MAGHTECH) and Senior Researcher at the Clerse Laboratory (CNRS). He is member of the Scientific Committee of Globelics, the international Jury for the Award of the Most Admired Knowledge City (MAKCI) and, since 2007 of the International Academy of Entrepreneurship (Intentac). He was principal consultant and member of the ad hoc Committee on Knowledge-based Economy of the National Economic and Social Council (CNES) of Algeria and helped design the National Innovation System. He has collaborated with and advised several government ministers. He has also been one of the principal consultants for the World Bank Institute since 2002 on the knowledge-based economy for the MENA region, and expert at the United Nations Commission for Western Asia (ESCWA) and the Economic Commission for Africa (ECA). He wrote the first knowledge-based economy report in Morocco and was member of the expert team on KBE for Saudi Arabia and principal consultant for the first High Level International Conference on "Building Knowledge Economies for the Arab World", held in Tunisia in December 2009 (World Bank/ISESCO). He has written and edited several books and published about 100 articles in various international journals. He has been visiting professor at several universities in Belgium, Senegal, Japan and Spain. He obtained his PhD in 1982 at the University of Bath, UK.

About the Contributors

Taylor Aldridge is a visiting assistant professor at the School of Public and Environmental Affairs, Indiana University and a research fellow at the Leibniz Institute for Regional Development and Structural Planning in Berlin, Germany. His research areas include how ideas manifest into innovations, academic entrepreneurship, barriers to entry and patent opposition, and innovation in public R&D. Professor Aldridge received his Ph.D. in innovation and entrepreneurship in 2009 from the University of Augsburg and was also a Max Planck Institute of Economics fellow from 2005 to 2011. He has published in such journals as Research Policy, Journal of Technology Transfer and International Small Business Journal and has received funding from the European Union (fp7), the European Commission, the U.S. Small Business Administration, the Marion Ewing Kauffman Foundation, the OECD and Saudi Arabia. His research has featured in media outlets, such as, The New York Times, Nature and Red Herring Magazine. Professor Aldridge also holds a B.A. from Earlham College (Economics and Political Sciences) and an MPA with a concentration in Economic Development from the School of Public and Environmental Affairs, Indiana University.

Ahmed Alshumaimri is a practitioner of and mentor for entrepreneurial innovation. He is one of the founders of Entrepreneurship in the Kingdom of Saudi Arabia. He holds positions as Dean of Entrepreneurship Center and Dean of Development at King Saud University. Previously he was a professor of Marketing at the college of Economics and Business at Qassim University, and Dean of Graduate Studies at the same university for 4 years. Prof. Alshumaimri received a Masters degree of Business Administration (MBA) from Southern Illinois University at Carbondale in the US, and a Doctorate of Philosophy (PhD) in Marketing from Nottingham University in the UK. Prof. Alshumaimri is a bilingual author and has published six books entitled “Management is first”, “Entrepreneurship, “Principle of Management”, “Direct Marketing”, “Job Ethics” and “Be an entrepreneur”.

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5, © Springer Science+Business Media New York 2013

Jean-Eric Aubert works as senior consultant for international organisations. He began his career at the Organisation for Economic Co-operation and Development (OECD), in the Directorate for Science, Technology and Industry, where he has been notably in charge of country reviews and policy outlooks. He joined in 2000 the World Bank Institute where he has led knowledge and innovation economy studies. He managed the WB office in Marseille and its transformation in the multipartner Center for Mediterranean Integration. Throughout his career, Jean-Eric Aubert has advised more than 50 countries of all development levels, in the fields of innovation, science and technology policies, knowledge economy strategies, and regional and local development. He has published several dozens of books, as main author or chief editor, and a number of peer-reviewed articles in international publications. A French national, he holds post graduate diplomas in Economics and in Applied Mathematics from Paris Universities.

David B. Audretsch is a Distinguished Professor and Ameritech Chair of Economic Development at Indiana University, where he also serves as Director of the Institute for Development Strategies. He is also an Honorary Professor of Industrial Economics and Entrepreneurship at the WHU-Otto Beisheim School of Management in Germany. In addition, he serves as a Visiting Professor at the King Saud University in Saudi Arabia and as an External Director of Research at the Kiel Institute for the World Economics, Honorary Professor at the Friedrich Schiller University of Jena in Germany, and is a Research Fellow of the Centre for Economic Policy Research in London.

Audretsch's research has focused on the links between entrepreneurship, government policy, innovation, economic development and global competitiveness. His research has been published in over one hundred scholarly articles in the leading academic journals. His books include Entrepreneurship and Economic Growth, with Oxford University Press in 2006 and The Entrepreneurial Society, also with Oxford University Press in 2007. He is co-founder and co-editor of Small Business Economics: An Entrepreneurship Journal. He was awarded the 2001 Global Award for Entrepreneurship Research by the Swedish Foundation for Small Business Research. In 2008, he received an honorary doctorate degree from the University of Augsburg, and in September, 2010 he received an honorary doctorate degree from Jönköping University.

He is a member of the Advisory Board to a number of international research and policy institutes, including the Deutsches Institut für Wirtschaftsforschung (German Institute for Economic Analysis), the Basque Institute for Competitiveness, and the Swedish Entrepreneurship Forum.

Peter F. Beales studied Medical Entomology at the Royal Army Medical College, London, was awarded his MD from Liverpool University, and is a Fellow Faculty of Public Health. He devoted his life to improving the health of citizens in developing countries. He is presently consultant in International Health and eLearning to the Dasman Diabetes Institute in Kuwait and a Member of its International Scientific Advisory Board. He was invited to join WHO HQ 1956, and served at country and headquarters levels becoming Chief, Malaria Programme Development and Training, Chief Training for the Control of Tropical Diseases, Coordinator of the Health Academy from 2002 to 2005, and a consultant on numerous occasions. Past appointments include Director of Medical Services American Samoa, Assistant Professor Faculties of Medicine and Public Health University of Hawaii, Visiting Professor Tropical Hygiene, Thailand, Visiting Professor Faculty of Medicine, Kuwait, Visiting Lecturer University of Valencia, and Honorary Fellow Liverpool School of Tropical Medicine. He served on boards and committees in WHO, Samoa and the Pacific Basin and has received honours and letters of commendation. He has written many of WHO's guidelines, reports, and publications and personally has over 67 publications.

Kazem Behbehani is Director-General of the Dasman Diabetes Institute in Kuwait. He received his PhD from London University, an Honorary MSc from Harvard School of Public Health and was Visiting Scholar at Harvard Medical School. He is a Lord Harris Visiting Fellow at Oxford. At Kuwait University he became Professor of Immunology and Medical Parasitology, Vice-Dean Faculty of Medicine and Vice-President Research. Following the invasion of Kuwait in 1990 he began a distinguished career in the World Health Organization firstly in tropical diseases and rising to Assistant Director-General for External Relations and Governing Bodies and subsequently WHO Health Envoy. Notably, he brought the European Commission and WHO closer as partners and pioneered WHO industry collaboration, obtaining free drugs to treat and prevent filariasis ("elephantiasis") for millions of people. He has been appointed to the boards of many national and international organisations, and is on the Boards of Trustees of a number of international charitable foundations. He is the recipient of several awards and scientific recognition and has published over 100 scientific articles and a book.

Omar Bizri is CEO of SCITECH, a consulting firm specialising in science, technology and innovation (STI) for development with focus on the Arab countries of the Middle East. He served for nearly 15 years with the United Nations Economic and Social Commission for Western Asia (ESCWA), retiring as Chief of the Information and Communications Division; having initiated a number of technology-based community development and poverty reduction initiatives in several Arab countries. Since 2007 he has been actively engaged, in projects implemented by a variety of international, regional and national organisations, including the World Bank, UNESCO and UNDP targeting the design and implementation of STI policy initiatives in Lebanon, Syria, Jordan, Iraq, Kuwait, Qatar and Saudi Arabia. He has authored and contributed to a variety of reports. Omar Bizri obtained his PhD degree in Chemical Physics, in 1970, from the University of London, UK. Before joining ESCWA, Omar Bizri was a Director of Research and Assistant Director General at the Scientific Studies and Research Centre in Damascus, Syria.

Mohamed Chaib is Professor Emeritus of Education at the Jönköping University, Sweden. He studied at Lund University and Linköping University, Sweden, where he obtained his PhD in 1978. He worked at the Ministry of Education in Algeria in 1975–1977 as Senior Expert in Educational Research and as a teacher at the University of Algiers. In the 1980s he spent 2 years as Senior Consultant to the World Bank, MENA region. He joined Jönköping University in 1979 as Senior Lecturer, later becoming a full Professor of Education and, from 1994 to 2002, served as Vice-Chairman of the Board of the Faculty of Research. From 2001 to 2010 he was Founder and Director of the Swedish National Centre of Lifelong Learning. In 1995–1996 and 2004–2005 Chaib was Visiting Professor at Sorbonne Paris 1, Centre for Research on Advanced Technology (CETCOPRA). In 2003 and 2006 he was Guest Professor at UNESP, Sao Paulo, Brazil, Campus Presidente Prudente and in 2004 was Visiting Professor at the Hong Kong Institute of Education (HKIED). In September 2011 Mohamed Chaib was invited by Universiti Teknologi Malaysia (UTM) to lead seminars on the improvement of masters and PhD programmes. He is engaged in various aspects of research related to adult education and lifelong learning and currently serves as coordinator of an international research group on education, professionalization and social representations.

Cristina Flesia currently teaches Atmospheric Radiation Effects for application the Satellite for Earth Observation at the University of Ferrara, Italy. After receiving her PhD in Theoretical Physics from the Swiss Federal Institute of Technology in Lausanne, she jointed the University of Geneva where she developed a research group on the space lidar applications. In 1999 she moved to Italy as responsible of the new Space Laboratory of the Optronic Center of Excellence of the Italian National Institute for Optics. She jointed the University of Ferrara in 2004 as Professor of "Chiara Fama". Prof. Cristina Flesia has been responsible for more than 30 European and International programmes in the frame of Science and Education. Her scientific co-operations included the major Space and Atmospheric Agencies—ESA (EU), NASA (USA), NOOA (USA), JAXA (Japan), ASI (IT), CNES (FR), DLR (GE), Russian Academy of Science, Byelorussian Academy of Science, several aerospace industries—British Aerospace, Alcatel, Alenia Spazio, AEADS, and more then 40 primary scientific institutes in Europe, United States, Russia, and Japan. She has been member of several international scientific committees in the field of Space Research, Atmospheric Research and Education in the USA and in Europe. She authored and co-authored over 80 scientific articles published on international journals and over 10 detailed ESA reports on different aspects related the space-borne lidars. Her present research interests are in the field of space research and climate change processes. Moreover, recent interests are in devoting her experience, scientific and institutional knowledge and personal contacts to the development of the European Research International collaborations, in particular with the Gulf States and China.

Mats Karlsson is Director of the Marseille Center for Mediterranean Integration (CMI) in the MNA region since April 2010, coming from the World Bank, after having had positions in Swedish administration, politics and government. His focus has been on global governance, African development, and now more particularly on Maghreb development and Mediterranean cooperation.

CMI is a collaborative arrangement between the bilateral members, World Bank and other multilateral institutions, and operates in partnership to nurture knowledge and share good practices.

Mats Karlsson was successively the World Bank Vice President of External Affairs and United Nations Affairs (1999–2002), Country Director in West Africa (for Burkina Faso, Ghana, Guinea, Liberia and Sierra Leone), (2002–2007), and Country Director for the Maghreb (Algeria, Libya, Mali, Morocco and Tunisia) (November 2007 onw.). During this time he was involved with the UN (the Millennium Development Goals), the Monterrey Summit on Financing for Development and the Johannesburg Summit on Sustainable Development, as well as leading the World Bank's engagement with civil society in the globalisation debate, and promoted multilateral system-wide cooperation as co-chair of the UN High-Level Committee on Programmes under the UN Chief Executives' Bureau. He assisted in the creation of, and chaired, UN-Energy 2004–2007. He led the UN system working group on climate change in the lead up to the Copenhagen Climate Change Conference.

He was Swedish State Secretary for International Development Cooperation (1994–1999), having served earlier with SIDA (joining in 1983), the Foreign Ministry where he became Chief Economist. He served as Foreign Policy Advisor to the Social Democratic Parliamentary Group (1991–1994). He was secretary in the Commission on Global Governance 1992–1994. He has co-authored four books on the transformation of Central and Eastern Europe.

John D. Liu is a Senior Research Fellow, IUCN. From 2003 to 2006, Mr. Liu was a visiting fellow in the Faculty of Applied Sciences and Faculty of the Built Environment at the University of the West of England (UWE). In 2006, Mr. Liu was named the Rothamsted International Fellow for the Communication of Science. In 2008, Mr. Liu became a part-time PhD candidate in Research at Reading University. In 2009–2010, Mr. Liu was appointed Assistant Research Professor at George Mason University.

Mr. Liu helped open the CBS News bureau in Beijing at the time of normalization of relations between the U.S. and China and worked for CBS News for 10 years. He also worked as a photojournalist for Radiotelevisione Italiana (RAI Italian Television) and Zweites Deutsches Fernsehen (ZDF German Television). His work on ecological film making has appeared on BBC World and other networks and taken him to over 70 countries. In 2003, Mr. Liu wrote, produced and directed "Jane Goodall—China Diary" for National Geographic.

Since 1997, Mr. Liu has directed the Environmental Education Media Project (EEMP), which uses television to deliver ecological, sustainable development and public health messages in China and other countries. He was also the driving force in the creation and development of the China Environment and Sustainable Development Reference and Research Centre (CESDRRC), the China HIV/AIDS Information Network (CHAIN), and the Environmental Education Media Project (Mongolia). For many years Mr. Liu has studied and worked to promote the potential of ecological restoration including presenting the recent films "Hope in a Changing Climate", "Rwanda—Forests of Hope" and "Emerging in a Changing Climate".

Eoin O'Sullivan is a Senior Policy Fellow in the Institute for Manufacturing, Cambridge University and the Director Designate of a new science, technology and innovation policy research centre. Dr O'Sullivan's research interests include: comparative analysis of national innovation systems; models of intermediate R&D institutes; and the role of standards and regulation in supporting emerging technologies. Dr O'Sullivan has worked closely with a range of UK research and innovation agencies and policy-makers. Recent policy work has included projects for the Department of Business, Innovation & Skills, the Engineering & Physical Sciences Research Council; the Higher Education Funding Council, Technology Strategy Board and British Standards Institute. He has also been a consultant and programme reviewer for research foundations and economic development agencies in his native Ireland, as well as the US, Asia and the United Arab Emirates. From late 2006 through 2007, Dr O'Sullivan was a Research Programmes Director at the Cambridge-MIT Institute. Before that he was Special Advisor to the Director General of Science Foundation Ireland and Senior Policy Advisor at Forfás, the Irish Government's National Policy Board for Enterprise, Trade, Science, Technology & Innovation. Dr O'Sullivan has a D.Phil. from the Physics Department of Oxford University.

Andrea Prat is Professor of Economics at the London School of Economics and a Co-director of the Programme for the Study of Economic Organisation and Public Policy at the LSE. He received his PhD in Economics from Stanford University in 1997. After working as assistant professor at Tilburg University, he joined the LSE in 2000.

Professor Prat specialises in organisational economics and political economy. He is particularly interested in the role of communication, both within organisations and in the public arena. He has done extensive work on campaign finance and the political economy of mass media. Professor Prat is the author of numerous articles in top journals in economics, finance, and political science, including the American Economic Review, Econometrica, the Review of Economic Studies, the Quarterly Journal of Economics, the Journal of Finance, the Review of Financial Studies and the Quarterly Journal of Political Science. He has also published in an array of field journals and policy outlets. His research has been widely reported by the media, including articles on The Economist and The Wall Street Journal.

Andrea Prat is Chairman of the Editorial Board of the Review of Economic Studies. He is an associate editor of Theoretical Economics and a council member of the Royal Economic Society. He is one of the two directors of the Industrial Organisation programme of the Centre for Economic Policy Research. He has also served on the council of the European Economic Association, on the editorial team of the Review of Economic Studies, as well as on boards and scientific committees of non-profit and governmental organisations. In 2011 he was elected a Fellow of the British Academy.

Sylviane Toporkoff is Partner and Founder of ITEMS International, a company specialising in strategic ICT consulting, and full Professor at the University of Paris 8, Institute of European Studies, in France. She holds a Doctorate in Economics from the University of Paris 1 Pantheon-Sorbonne.

Toporkoff specialises in international research consulting in the information society; public policy; economic and strategic international partnerships for industrialists, operators and local authorities; marketing and e-business; e-government; e-health; local, regional and international development through ICT use; e-democracy; and telecommunications industry regulation.

She is President and founder of the Global Forum/Shaping the Future, a not-for-profit think-tank dedicated to business and policy issues affecting the successful evolution of the information society. Since 1992, the forum holds an annual gathering of senior government officials (at local, regional and national level), top-level executives of leading companies and organisations, as well as International experts.

Toporkoff serves as expert to the European Commission and is a Member of the Scientific Committee of the Medici Framework at the Politecnico Milano, Italy. She is also a Member of the Scientific Committee of Market Management, Editions ESKA, and Founder and Animator of European Education New Society Association (ENSA), an association on the future of education and ICT.

The author of various publications in the ICT field, Toporkoff lectures at numerous universities and speaks regularly at leading industry association events and at national and international conferences and forums in France, Europe, the US, and Asia.

Sylviane Toporkoff is Chevalier of the Legion of Honour and holds the Arts, Sciences and Letters Medal.

Anuja Utz is Deputy Director of the Center for Mediterranean Integration (CMI). She supports the Director, CMI in the overall management of the Center and contributes substantively to the Center's work programs, including leading the work on the Knowledge Economy for Growth and Employment for MENA. Before this assignment, Dr. Utz was the Programme Leader of the *Knowledge for Development* (K4D) programme at the World Bank Institute (WBI) where she managed the design and delivery of a variety of capacity building fora for high level policymakers from Africa, East Asia, Latin America, and MENA. She is the author of the World Bank report on *India and the Knowledge Economy*, and a contributor to *Building Knowledge Economies: Advanced Strategies for Development and Innovation Policy: A Guide for Developing Countries.* She has also done work on innovation and competitiveness, and on country strategy reports on the knowledge economy for Argentina, Brazil, Chile, China, Korea, and Tanzania. In addition to more than 15 years experience as a development specialist at the World Bank, she has also taught and carried out research at Emory University, USA, where she received both her Master's and Ph.D. degrees in Economics.

Erina Ytsma a PhD student in Economics at the London School of Economics under the supervision of Prof. Andrea Prat. In 2010 she received an MRes degree in Economics from the LSE for which she wrote a thesis entitled "Social Networks: Link between Evasion and Corruption" under the supervision of Prof. Tim Besley and Prof. Andrea Prat. She obtained an MPhil in Economics (cum laude) from Tilburg University in 2008 for which she wrote a thesis on "The Triangular Relationship between Corruption, Governance and the Underground Economy" under the supervision of Prof. Eric van Damme and Prof. Jeffrey James. In 2004 Erina obtained a BSc in Science (summa cum laude, valedictorian) with minors in Economics and Drama from University College Utrecht. For this degree she wrote a thesis on temporary agency work in the Netherlands under the supervision of Dr. Giovanni Russo. She currently teaches a third year undergraduate Public Economics course at the LSE and previously taught introductory Economics courses there. Erina's work focuses on social and professional networks and peer and spill-over effects in the fields of public and labour economics and political economy.

References

E. Abele, G. Reinhart, *Zukunft der Produktion: Herausforderungen, Forschungsfelder* (Hanser Fachbuchverlag, Munich, 2011)

H. Abouleish, Sustainable Agriculture, Food Security and Responsible Competitiveness, in *Responsible Competitiveness in the Arab World 2009, Accountability, Sustainability, Excellence*, ed. by S. Zadek, A. MacGillivray, D. Rovere (Arabia, London, 2009)

J. Adams, C. King, D. Hook, *Global Research Report Africa* (Thomson reuters, 2010), http://www.ukcds.org.uk/publication-Global_Research_Report_Africa-288.html

J. Adams, C. King, D. Pendlebury, D. Hook, J. Wilsdon, *Global Research Report, Exploring the Changing Landscape of Arabian, Persian and Turkish Research* (Thomson Reuters Science, Leeds, 2011)

W. Adams, *The Future of Sustainability, Re-thinking Environment and Development in the Twenty-First Century* (University of Cambridge, Cambridge, 2006)

A. Adimi, *The Publicity of Hatred* (Echourouk Éditions, Algiers, 2010)

P. Aghion, M. Dewatripont, C. Hoxby, A. Mas-Colell, A. Sapir, *The Governance and Performance of Universities: Evidence from Europe and the US* (NBER Working Paper 1485, Cambridge, 2009)

E. Albert, S. Mickan, Closing the gap and widening the scope. New directions for research capacity building in primary health care. Aust. Fam. Physician **31**(12), 1038–1041 (2002)

J. Albors-Garrigos et al., New R&D management paradigms: Rethinking research and technology organizations strategies in regions. R&D Manag. **40**(5), 435–454 (2010)

H.E. Aldrich, M.A. Martinez, Entrepreneurship as Social Construction: A Multilevel Evolutionary Approach, in *Handbook of Entrepreneurship Research: An Interdisciplinary Survey and Introduction*, ed. by Z. Acs, D. Audretsch (Springer, New York, 2010), pp. 387–430

T.T. Aldridge, D.B. Audretsch, Does policy influence the commercialisation route? Evidence from national institutes of health funded scientists. Res. Policy **39**, 583–588 (2010)

T.T. Aldridge, D.B. Audretsch, The Bayh-Dole act and scientist entrepreneurship. Res. Policy **40**(8), 1058–1067 (2011)

M. Alexeev, R. Conrad, The elusive curse of oil. Rev. Econ. Stat. **3**(91), 586–598 (2009)

I. Al-Rashdan, Y. Al-Nesef, Prevalence of overweight, obesity, and metabolic syndrome among adult Kuwaitis: results from community-based national survey. Angiology **61**(1), 42–48 (2010)

M. Al-Rasheed, *A History of Saudi Arabia*, 2nd edn. (Cambridge University Press, New York, 2010)

A. Alshumaimri, T. Aldridge, D.B. Audretsch, The university technology transfer revolution in Saudi Arabia. J. Technol. Transf. **35**(6), 585–596 (2010)

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5,

T. Altan, Manufacturing Education and Research in the US and Germany: What Can We Learn from Each Other? in *Proceedings of the International Conference on Manufacturing Education*, San Diego, 13–15 March 1996

T. Altan, *Mechanical Engineering Education and Research in US and German Universities: A Personal Perspective*, Presentation at the Workshop of the German Science Council, 2003

M. Amin, S. Djankov, *Natural Resources and Reforms* (The World Bank, Washington, 2009)

L. Anderson, Demystifying the Arab spring: Parsing the differences between Tunisia, Egypt, and Libya, *Foreign Affairs*, vol. 90, no 3, May, June, 2011 http://www.foreignaffairs.com/articles/67693/lisa-anderson/demystifying-the-arab-spring

T. Andersson, Managing a systems approach to technology and innovation policy. Sci. Technol. Ind. Rev. **22**, 9–29 (1998)

T. Andersson, *OMAN in the Arab Spring—Growth Miracle and Governance Model*, ed. by A. Utz, J.-E. Aubert, *Transforming Arab Economies: Travelling the Knowledge and Innovation Road* (CMI, Marseille, 2012a Forthcoming)

T. Andersson, in *Evolving Technologies and Emerging Regions: Governance for Growth and Prosperity*, ed. by D. Audretsch, *The Strategic Management of Places* (Edward Elgar, 2012b Forthcoming)

T. Andersson, E. Carayannis, P. Formica, S. de Johansson Silva, S. Mahroum, *Towards Innovation Policy in Abu Dhabi: Indicators, Benchmarking, and Natural Resource Rich Economies* (General Secretariat of the Executive Council, Abu Dhabi, 2010a)

T. Andersson, M. Curley, P. Formica, *Knowledge-Driven Entrepreneurship. The Key to Social and Economic Transformation* (Springer, New York, 2010b)

T. Andersson, A. Djeflat, *Relevant Best Practice in Science, Technology and Innovation Policies*. Interim Report from the INCONET-GCC cooperation in Science and Technology (The Research Council (TRC), Muscat, Oman 2011)

T. Andersson, A. Djeflat, S. Johansson de Silva, *The Innovation System and Related Policy Issues in Morocco*, Prepared for the United Nations Conference for Trade and Development (UNCTAD), Geneva (2006)

ANIMA, *Mediterranean Niches and Sectors with High Potential of Job Creation and Growth* (Contribution to the CMI Knowledge Economy Study, Marseille, 2011)

Arab Thought Foundation, Third Report on Cultural Development, Beirut (2010)

E. Arnold, Benchmarking Science and Technology Policy, TIP Workshop, Austrian Economic Chamber, Vienna (2002)

E. Arnold et al., *The Role of Industrial Research Institutes in the National Innovation System* (Vinnova, Stockholm, Sweden, 2007)

R. Arzeki, M. Bruckner, Oil Rents, Corruption, and State Stability: Evidence From Panel Data Regressions, IMF Working Papers 09/267, International Monetary Fund, Washington (2009)

R. Arzeki, M.K. Nabli, Natural Resources, Volatility, and Inclusive Growth: Perspectives from the Middle East and North Africa, CESifo Working Paper 3818, May 2012, Washington

Asian Green Study Index, Study Commissioned by Siemens and Performed by the Independent Economist Intelligence Unit (EIU) (2011)

R. Assaad, F. Roudi-Fahimi, *Youth in the Middle East and North Africa: Demographic Opportunity or Challenge?* (Population Reference Bureau (PRB), Washington DC, 2007)

J.E. Aubert, J.L. Reiffers, *Knowledge Economies in the Middle East and North Africa, WBI Learning Resources Series* (The World Bank, Washington DC, 2003)

D. Audet, Government procurement: a synthesis report. Organ. Econ. Cooperation Dev. J. Budgeting **2**(3), 1–194 (2002)

D.B. Audretsch, *The Entrepreneurial Society* (Oxford University Press, New York, 2007)

D.B. Audretsch, T. Aldridge, A. Oettl, The Knowledge Filter and Economic Growth: The Role of Scientist Entrepreneurship, Papers on Entrepreneurship, Growth and Public Policy 2006–11, Max Planck Institute of Economics, Entrepreneurship, Growth and Public Policy Group (2006)

D.B. Audretsch, D.P. Leyden, A.N. Link, Universities as research partners in publicly supported firms. Paper presented at the Basque Institute of Competitiveness, 8–9 Sept 2011, http://www.uncg.edu/bae/econ/research/econwp/2012/12-02.pdf. Accessed 1 January 2012

R. Auty, *Resource-Based Industrialization: Solving the Oil in Eight Developing Countries* (Clarendon Press, Oxford, 1990)

M.H. Babiker, R.S. Eckhaus, Unemployment effects of climate policy. Environ. Sci. Policy **10**, 600–609 (2007)

I.J. Bachellerie, Knowledge creation and diffusion: the role of UAE Universities, science and technology program, Gulf Research Center Reports (Also paper presented at the WAITRO 20th Biennial Congress Leadership for Innovation, DIT Dubai 13–14 Oct 2010), http://www.grc.ae/data/contents/uploads/Report_950.pdf

M. E. Badimon, Diplômés chômeurs au Maroc: dynamiques de pérennisation d'une action collective plurielle. L'Année du Maghreb. **III**, 297–311 (2007). http://anneemaghreb.revues.org/376?lang=en. Accessed 20 Oct 2012

O. Bandiera, A. Prat, What determines the quality of research in Public University systems? International data analysis and discussion of the british system, Presentation to the Italian Parliament, 18 March 2010

O. Bandiera, A. Prat, T. Valletti, Active and passive waste in government spending: evidence from a policy experiment. Am. Econ. Rev. **99**(4), 1278–1308 (2009)

A.L. Barabási, H. Jeong, Z. Néda, E. Ravasz, A. Schubert, T. Vicsek, Evolution of the social network of scientific collaborations. Physica A **311**, 590–614 (2002)

M. Barber, M. Mourshed, How the world's best-performing school systems came out on top, McKinsey & Company, Report, London (2007), http://mckinseyonsociety.com/downloads/reports/Education/Worlds_School_Systems_Final.pdf

L. Barkho, Strategies of power in multilingual global broadcasters: How the BBC, CNN and Al Jazeera shape their Middle East news discourse, Ph.D. Dissertation, Jönköping International Business School, Jönköping, 2008

I. Bayoumi, I. Shady, H. Lotfy, Prevalence of obesity among adolescents (10 to 14 years) in Kuwait. Asia Pac. J. Public Health **21**(2), 153–159 (2009)

H. Beblawi, The Rentier State in the Arab World, in *The Arab State*, ed. by G. Luciani (Routledge, London, 1990)

D. Benavente, S. Dutta, *The Global Innovation Index 2011: Accelerating Growth and Development* (INSEAD, Fontainebleau, 2011)

R.G. Bertelsen, Private Higher Education in the GCC: Best Practices in Governance, Dubai Initiative Harvard University, Belfer Center for Science and International Affairs, Dubai, Quality Assurance and Funding (2009)

B. Beyhan, D. Dayar, D. Findik, S. Tandogan, Comments and Critics on the Discrepancies Between the Oslo Manual and the Community Innovation Surveys in Developed and Developing Countries, Science and Technology Policies Research Center, Working Paper Series, 09/02, TEKPOL, Ankara (2002)

J. Blewitt, *Understanding Sustainable Development* (Earthscan, London, 2008)

M. Blomström, A. Kokko, in *From Natural Resources to High-Tech Production: The Evolution of Industrial Competitiveness in Sweden and Finland*, ed. by D. Lederman, W. Maloney, Natural Resources: Neither Curse nor Destiny (The World Bank, Washington DC, 2007)

R.W. Blum et al., Adolescent health in the 21st century. The Lancet **379**, 1567–1568 (2012)

N. Bontis, National intellectual capital index: a united nations initiative for the Arab region. J. Intellect. Cap. **5**(1), 13–39 (2002)

R. Boshier, Edgar Faure After 25 Years. Down But Not Out, in *International Perspectives on Lifelong Learning*, ed. by J. Holford, P. Jarvis, C. Griffin (Kogan Page, London, 1998), pp. 3–20

A. Bowen, *"Green" Growth, "Green" Jobs and Labour Markets, Policy Research Working Paper 5990* (The World Bank, Washington DC, 2012)

M. Brett, *Ibn Khaldun and the Medieval Maghrib* (Ed.) (Variorum Collected Studies, Great Yarmouth, 1999)

E. Brynjolfsson, A. McAfee, *Race against the machine: how the digital revolution is accelerating innovating, driving productivity, and irreversibly transforming employment and the economy* (Digital Frontier Press, Lenington, 2011)

S.E. Buckner, The role of higher education in the Arab state and society: historical legacies and recent reform pattern. Comp. Int. High Educ. **3**, 21 (2011)

E. Bulte, R. Damania, R. Deacon, Resource intensity, institutions and development. World Dev. **7**(33), 1029–1044 (2005)

A. Cadbury, *Report of the Committee on the Financial Aspects of Corporate Governance* (Gee, London, 1992)

E.G. Carayannis, D. Campbell, Mode 3 and Quadruple Helix: toward a 21st century fractal innovation ecosystem. Int. J. Technol. Manag. **46**(3/4), 201–234 (2009)

G. Carey, V. Salama, *Middle East Leaders Address Unemployment in Arab Spring's Wake*, Bloomberg, 20 Oct 2011, http://www.bloomberg.com/news/2011-10-20/middle-east-leaders-address-unemployment-in-arab-spring-s-wake.html

F. Carvalho, *Technology and the Technical Shaping of Society, Mimeo* (UNU-MERIT, Maastricht, 2006)

M. Castells, *The Rise of the Network Society*, vols. 1–3 (Blackwell, Oxford, 1996)

J. Chaaban, The Costs of Youth Exclusion in the Middle East, The Middle East Youth Initiative, Working Paper, Number 7 May 2008, Wolfensohn Center for Development, Dubai School of Government, Dubai (2008)

J. Chaaban, Job Creation in the Arab Economies: Navigating Through Difficult Waters, United Nations Development Programme (UNDP), Regional Bureau for Arab States, Arab Human Development report, Research Paper series, New York (2010)

C. Chaib, Bridging the gaps between theory and practice in advanced vocational education and training in Sweden. Paper presented at 5th ESREA European Research conference in Seville, Spain, Sept 2007

M. Chaib, Social Movement. Lifelong Learning and the Rise of the Welfare State, *Opening Address to the Conference, Community Based Lifelong Learning Practices—Experiences from Japan and Sweden*, Encell National Centre for Lifelong Learning Jönköping University, Jönköping, Sept 2008

M. Chaib, The Meaning of Quality Assurance in Lifelong Learning—A Critical Approach. *Opening address to the 38th EUCEN Conference 'Quality & Innovation in Lifelong Learning—Meeting the Individual Demands*, Encell National Centre for Lifelong Learning Jönköping University, Jönköping (2009)

D. Chen, Y. Sun, N. Diop, *Economic Growth and Employment, Contribution to the CMI Knowledge Economy Study* (World Bank, Marseille (internal document), 2012)

C.M. Christensen, R. Rosenbloom, Explaining the attacker's advantage: technological paradigms, organisational dynamics and the value network. Res. Policy **24**, 233–257 (1995)

C.l. Christensen, China's growth will force an innovation competition with the west, 28 June 2011, Arabic Knowledge@Wharton: http://knowledge.wharton.upenn.edu/arabic/article.cfm?articleid=2688

CIA World Fact book (2011), https://www.cia.gov/library/publications/the-world-factbook/. Accessed 4 Dec 2011

CMI, The Role of Embedded Professionals, (various presentations), *Cambridge-MIT Institute workshop for the Higher Education Funding Council of England and the Department of Innovation, Universities & Skills* (2008a), http://research-interfaces.org/events/article/default.aspx?objid=2664

CMI, Managing Critical Mass Research Activities & Centres (Various Presentations), Cambridge-MIT Institute Workshop (Royal Society, London, 2008)

CMI, *The year in review*, (Marseille 2011)

J. Cole, *Engaging the Muslim World* (MacMillan, New York, 2009)

M.W. Corden, Booming sector and dutch disease economics, survey and consolidation. Oxf. Econ. Pap. **36**, 359–380 (1984)

G.M. Crawley, E. O'Sullivan, The 'Celtic Tiger' and a knowledge economy. Ind. High. Educ. **20**(4), 225–229 (2006)

C. Dahlman, T. Andersson, *Korea and the Knowledge-Based Economy: Making the Transition International Bank for Reconstruction and Development* (The World Bank, Washington DC, 2000)

Dasman Diabetes Institute, Kuwait Health Network Informatics Training (2011), http://www.dasmaninstitute.org/news/kuwait-health-network-informatics-trainings

G. Declerck, *NESTA Conference*, London, 20–21 Sept 2005

J. (Chair) Delors, *Learning: The Treasure Within* (UNESCO, Paris, 1996)

P. Devalan, *L'Innovation de rupture: Clé de la compétitivité* (Hermes-Science—Lavoisier, Paris, 2006)

S. Devarajan, T. Minh Le, G. Raballand, *Increasing Public Expenditure Efficiency in Oil-rich Economies* (World Bank, Africa Region, Chief Economist Office, Washington, 2010)

N. De Bellis, *Bibliometrics and Citation Analysis: From the Science Citation Index to Cybermetrics* (Scarecrow Press, Lanham Md, 2009)

N. Dhillon, P. Dyer, A. Fahmy, M. Kraetch, D. Salehi-Isfahani, T. Yousef, *Missed by the Boom, Hurt by the Bust—Making Markets Work for Young People in the Middle East, Middle East Youth Initiative Report* (Wolfensohn Centre for Development at Brookings, Washington, and Dubai School of Government, Dubai, 2009)

N. Dhillon, T. Yousef (eds.), *Generation in Waiting: The Unfulfilled Promise of Young People in the Middle East* (Brookings Institution Press, Washington DC, 2009)

N. Dimitri, G. Piga, G. Spagnolo, *Handbook of Procurement* (Oxford University Press, Oxford, 2006)

A. Djeflat, Transfert de Technologies Industrielles et Développement Technologique endogène: Théories et Pratiques *Cahiers du CRIDSSH* No. 17, Université d'Oran, 1985

A. Djeflat, *National Innovation Systems in the MENA Region* (World Bank publications, World Bank, Washington DC, 2002)

A. Djeflat, in *L'Économie Fondée sur la Connaissance: Etat des Lieux et Perspectives pour l'Algérie*, Collection Maghtech (Dar El Adib, Oran, 2006)

A. Djeflat, Universities and scientific research in the maghreb states: power politics and innovation systems. Int. J. Technol. Manag. **45**(1/2), 102–113 (2009a)

A. Djeflat, *Building Knowledge Economies for Job Creation, Increased Competitiveness, and Balanced Development: Individual Country Overviews* (World Bank Report, Washington, 2009b)

A. Djeflat, La Mobilité des Diasporas et les Logiques de Retour: Cas des Pays du Maghreb, Paper presented at the first symposium on migrations and development, CREAD, Algiers, 19–22 Oct 2010

A. Djeflat, P. Devalan, F. Youcef-Ettoumi, *Evaluation des Politiques et Programmes d'innovation dans le secteur industriel* (European Commission-Ministry of industry, Algiers, 2008)

G. Donn, Y. Al Manthri, *Globalisation and Higher Education in the Arab Gulf States* (Symposium Books, London, 2010)

e4e (Education for Employment), *Education for Employment—Realizing Arab Youth Potential* (International Finance Corporation (IFC), Islamic Development Bank Group, Jeddah, and World Bank Group, Washington DC, 2011)

R.G. Eccles, I. Ioannou, G. Serafeim, The impact of a corporate culture of sustainability on corporate behaviour and performance, Harvard Business School Working Paper 12-035, Novemb 2011

Economist Intelligence Unit, *Country Profile for Saudi Arabia*, ISSN 0269-6355 (2008)

Economist Intelligence Unit, *E-Readiness Rankings 2009: The Usage Imperative*, a report from the Economist Intelligence Unit (2009), http://graphics.eiu.com/pdf/E-readiness%20rankings.pdf. Accessed 16 Dec 2011

EITO, *European Information Technology Observatory Report* (2010), www.eito.com

European Commission, Digital Agenda for Europe, Brussels, 19 May 2010

M. Elagati, The Arab Spring: Common Roots, Common Challenges, Hivos Knowledge Programme (2011), http://www.hivos.nl/eng/Hivos-Knowledge-Programme/News/The-Arab-Spring-Common-Roots-Common-Challenges. Accessed 5 Oct 2011

M. El-Shazly et al., Prevalence and factors associated with chronic diabetic complications among patient attending primary healthcare a multi-centric study in Kuwait. Alex Bull. **2**, 165–176 (2010), http://www.ajol.info/index.php/bafm/article/viewFile/61021/49225

J. Elston, D.B. Audretsch, Risk attitudes, wealth and sources of entrepreneurial start-up capital. J. Econ. Behav. Organ. **76**(1), 82–89 (2010)

ERC Association, *Best Practices Manual*, ERC Association (2010), www.erc-assoc.org/manual/bp_index.htm

H. Etzkowitz, The triple Helix of University-Industry-Government: Implication for Policy Evaluation, Working Paper 2002.11: Science Policy, Stockholm (2002)

H. Etzkowitz, J. Dzisah, Professors of practice and the Entrepreneurial University. Int. High. Educ. **49**, 10–11 (2007)

H. Etzkowitz, L. Leydesdorff (eds.), *Universities in the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations* (Cassell, London, 1997)

European Commission, *Riding the wave, How Europe can gain from the rising tide of scientific data*. Report of the High Level Expert Group on Scientific Data, Brussels (2010a)

European Commission, Digital Agenda for Europe, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM (2010) 245, Brussels (2010b)

European Commission, *Lifelong Learning Programme (LLP)*. Guide 2012. Part I: General Provisions (2011a), http://ec.europa.eu/llp

European Commission, Structuring Inter-Regional Cooperation: International Cooperation—INCONET projects, calls 2007 and 2009 (Publication Office of the European Union, Luxembourg, 2011b), http://ec.europa.eu/research/iscp/pdf/brochure_1100913.pdf

European Commission, Strategic energy technologies information system, *European Initiative on Smart Cities* (2012), http://setis.ec.europa.eu/about-setis/technology-roadmap/european-initiative-on-smart-cities. Accessed 25 April 2012

M. Fafchamps, S. Goyal, M.J. Van der Leij, Matching and network effects. J. Eur. Econ. Assoc. **8**(1), 203–231 (2010)

U. Fasano, With open economy and sound policies, U. A. E. has turned oil curse into a blessing. IMF Surv. **21**, 330–332 (2002)

E. Faure et al., *Apprendre à être*, (UNESCO, Paris (Eng. *Learning to Be*), 1972)

C. Flesia (ed.), INCONET-GCC report on the identification and engagement of target stakeholder's group, Deliverable D2.1 of the INCONET-GCC project (University of Ferrara, Ferrara 2011)

R. Florida, *The Rise of the Creative Class: And How it's Transforming Work, Leisure, Community and Everyday Life* (Hazard Press, Christchurch, 2003)

J. Frankel, *The Natural Resource Curse: A Survey*, Cambridge, Harvard Kenny School, Faculty Research Working Paper Series, Febr 2010

C. Freeman, *Technology Policy and Economic Performance: Lessons from Japan* (Pinter, London, 1987)

J.L. Furman et al., The determinants of national innovative capacity. Res. Policy **31**(6), 899–933 (2002)

B. Gendron, Emotional capital and older workers learning and transfer of knowledge management: toward a better ageing, working and learning together, Case Study of a local response to global concerns, Paper presented at Globalisation versus Glocalisation. Implications for HRD? 8th International Conference in Human Resource Development Research & Practice across Europe, UFHRD, Oxford (2007)

Global Entrepreneurship Monitor (GEM Report), *Global report, entrepreneurs and entrepreneurial employees across the globe* (Babson College, Cambridge 2011), http://www.gemconsortium.org/docs

Global Wealth Report, *Shaping a new tomorrow: How to capitalize on the momentum of change* (Boston Consulting Group (BCG), Boston, 2011), http://www.dasinvestment.com/fileadmin/images/pictures/0907/BCG_2011_0106_Global_Wealth_Report_client_version_May2011.pdf

H. Gottlieb, When "Best Practice" is Bad Practice, http://hildygottlieb.com/2009/09/20/when-%E2%80%9Cbest-practice%E2%80%9D-is-bad-practice/ Accessed 20 Sept 2009

S. Goyal, M.J. Van der Leij, Strong ties in a small world. Rev. Netw. Sci. **10**(2), 1–20 (2011)

S. Goyal, M. Van der Leij, J.L. Moraga-Gonzalez, Economics: an emerging small world. J. Polit. Econ. **114**(2), 403–412 (2006)

D.O. Gray, S.G. Walters, *Managing the Industry/University Cooperative Research Center: A Guide for Directors and Other Stakeholders* (Battelle Press, Columbus, 1998)

A. Grove, *How America Can Create Jobs*, Bloomberg Business week, 1 July 2010

GSEC, *Towards Innovation Policy in Abu Dhabi: Indicators, Benchmarking, and Natural Resource Rich Economies*. Report prepared for the General Secretariat of the Executive Council, Abu Dhabi, UAE (2010)

T. Gylfason, Natural resources, education and economic development. Eur. Econ. Rev. **45**(4/6), 847–859 (2001)

P. Haddawy, A Bibliometric Study of South East Asia, Presentation, 3rd SEA-EU-NET Conference: Sharing the Benefits of Joint Research, Budapest, Novemb 2010, http://www.sea-eu.net

H.R. Hammoud, Illiteracy in the Arab World. Unpublished paper, Beirut, Lebanon (2005), http://scholar.google.se/scholar?q=illiteracy+in+the+Arab+world&hl=sv&as_vis=1&btnG=Sök

H. Hauser, *The Current & Future Role of Technology & Innovation Centres in the UK*, Report for the Department of Business, Innovation & Skills (BIS) (London, 2010), www.bis.gov.uk/assets/biscore/innovation/docs/10-843-role-of-technology-innovation-centres-hauser-review

E. Hazelkorn, *University Research Management, Developing Research in New Institutions* (OECD, Paris, 2005)

Health Kuwait, Health & Vital Statistics Division, Department of Statistics Medical Records, Ministry of Health, Kuwait (2009)

V. Hediger et al., Private Solutions for healthcare in the Gulf: To encourage the private sector, governments must learn how to regulate the health care industry appropriately, McKinsey Quarterly, Special Edition: Reappraising Gulf States (2007), pp. 49–59, http://www.who.int/topics/ehealth/en/

G. Heimeriks, M. Hörlesberger, P. Van den Besselaar, Mapping communication and collaboration in heterogeneous research networks. Scientometrics **58**(2), 391–413 (2003)

M. Herb, No representation without taxation? Rents, development and democracy. Comp. Polit. **3**(37), 297–317 (2005)

A. Hildebrant, M. Al Aufi, M. Amerjeed, M. Shammas, E.A.B. Eltahir, Ecohydrology of a seasonal cloud forest in Dhofar. Water Resour. Res. **43**, 1–13 (2007)

J. Holford, P. Jarvis, C. Griffin (eds.), *International Perspectives on Lifelong Learning* (Kogan Page, London, 1998)

A. Hughes, *Innovation Policy as cargo cult: Myth and Reality in knowledge-led Productivity Growth, ESRC Centre for Business Research—Working Papers, WP348* (2007)

IKED, Towards a new growth and innovation policy in Norway, Malmo, 2010

E. Ianchovischina, J. Loening, C. Wood, How Vulnerable are Arab Countries to Global Food Price Chocks, Policy Research Working Paper 6018, Middle East and North Africa Region, World Bank, Washington DC (2012)

ILO, Promoting Employment Opportunities for Young Men and Women in the Arab Region, Issue Paper, Arab Forum on Development and Employment, Doha, Qatar, 15–16 Novemb 2008

ILO, Growth, employment and decent work in the Arab region: Key policy issues. Thematic Paper, Arab Employment Forum, Beirut, Lebanon, 19–21 Oct 2009

ILO LABORSTA, Topic: Employment—2C Total employment, by occupation (Thousands) http://laborsta.ilo.org/STP/guest. Accessed 3 and 14 April 2012

IMF, *Regional Economic Outlook, Middle East and Central Asia, April 2011*, Washington

INSEAD Global Innovation Index (2009–2010), http://www.globalinnovationindex.org/gii/main/reports/2009-10/FullReport_09-10.pdf 2011

International Diabetes Federation, *Diabetes Atlas*, 4th edn (2010), http://www.idf.org/diabetesatlas/middle-east-and-north-africa

I. Ioannou, G. Serafeim, What Drives Corporate Social Performance? The Role of Nation-level Institutions, Harvard Business School Working Paper 11016 (2010)

J. Isham, M. Woolcock, L. Pritchett, G. Busby, *The Varieties of Resource Experience: Natural Resource Export Structures and the Political Economy of Economic Growth, World Bank Economic Review* (Oxford University Press, Oxford, 2005)

ISI Journal Citation Report (JCR) Thomson Reuters (2009), http://admin-apps.isiknowledge.com/JCR/JCR

ISI Web of Science, Thomson Reuters (2010), http://apps.isiknowledge.com

ITU, *Measuring the Information Society*, Geneva (2009)

ITU, *Measuring the Information Society*, Geneva (2011)

ITU, *Report on the World Summit on the Information Society*, Geneva (2012)

Y. Jang, N.S. Vonortas, Performance Measurement for Government R&D Programs: In Search of Best Practice, Korea Institute for Science and Technology Evaluation and Planning (KISTEP), Seoul, Korea, Dec 2002

P. Jarvis, in Paradoxes of the Learning Society, ed. by J. Holford et al. *International Perspectives on Lifelong Learning* (Kogan Page, London, 1998), pp. 59–68

P. Jarvis, *Adult Education and Lifelong Learning, Theory and Practice* (Routledge, London, 2004)

P. Jarvis, *Towards a Comprehensive Theory of Human Learning* (Routledge, London, 2006)

P. Jarvis, *Globalisation Lifelong Learning and the Learning Society, Sociological Perspectives* (Routledge, London, 2007)

P. Jarvis, C. Griffin, *Adult and Continuing Education, Major Themes in Education*, vol. 1. (Routledge, London, 2003)

C.I. Jones, *Introduction to Economic Growth* (Norton, New York, 2002)

N. Kabbani, E. Kothari, Youth Employment in the MENA region: A Situational Assessment, SP. Discussion Paper No. 0534, World Bank, Washington DC (2005)

R. Kaiser, H. Prange, The reconfiguration of national innovation systems—the example of German biotechnology. Res. Policy **33**, 395–408 (2004)

M. Karlsson, The Arab Spring and Integration in the Mediterranean, Center for Mediterranean Integration, Marseille (2011), http://www.nai.uu.se/forum/entries/2011/05/12/the-arab-spring/index.xml

H. Khalfaoui, Les Conditions d'Emergence d'une Communauté Scientifique en Algérie: Savoir et Pouvoir de 1962 a 1992. Cahiers des Sciences Humaines **32**(3), 611–628 (1996)

Kingdom of Saudi Arabia, Ministry of Economy and Planning, *The Eighth Development Plan* (2010), http://planipolis.iiep.unesco.org/upload/Saudi%20Arabia/Saudi_Arabia_Eighth_Development_Plan.pdf

F. Kitagawa, The regionalization of science and innovation governance in Japan? Reg. Stud. **41**(8), 1099–1114 (2007)

M. Koivisto, K. Larsen, Competition and Growth in the MENA Region, Contribution to the CMI Knowledge Economy Study, World Bank, Marseille (internal document) (2012)

N.C. Kojo, Diamonds Are Not Forever, Botswana Medium-term Fiscal Sustainability. Policy Research Working Paper 5480. World Bank, Washington DC, Novemb 2010

S. Kota, *Innovation and US-based Manufacturing,* presentation to the 21st Century Smart Manufacturing CTO/CXO Roundtable and Leadership Workshop, hosted by SPM UCLA, Washington DC, 14–15 Sept 2010

B. Kristensson Uggla, *Ricoeur, Hermeneutics and Globalization* (Continuum, London, 2010)

A.B. Krueger, M. Lindahl, Education for growth: why and for whom? J. Econ. Lit. **39**(4), 1101–1136 (2001)

S. Kuhlman, E. Arnold, RCN in the Norwegian Research and Innovation System, Background report No 12 in the Evaluation of the Research Council of Norway, Fraunhofer ISI and Technopolis (2001)

Y. Kuznetsov, *Towards a Pragmatic Innovation Agenda* (World Bank Institute, Santiago, 2004)

B. Lal et al., *Designing the Next Generation of NSF Engineering Research Centers: Insights from Worldwide Practice*, A Science and Technology Policy Institute Report to the National Science Foundation (2007)

D. Lederman, W. Maloney, Neither Curse Nor Destiny: Introduction to Natural Resources and Development, in *Natural Resources, Neither Curse nor Destiny*, ed. by D. Lederman, W. Maloney (Stanford University Press and World Bank, Latin American Development Forum Series, Palo Alto, California and Washington DC, 2007)

L. Leydesdorff, I. Rafols, A global map of science based on the ISI subject categories. J. Am. Soc. Inform. Sci. Technol. **60**(2), 348–362 (2009)

A.N. Link, D.S. Siegel, B. Bozeman, An empirical analysis of the propensity of academics to engage in Informal University technology transfer. Ind. Corp. Change **16**(4), 641–655 (2007)

C. Lipson, *Standing Guard: Protecting Foreign Capital in the 19th and 20th Centuries* (University of California Press, Berkeley, 1985)

G. Lugones, D. Suarez, Science, Technology and Innovation Indicators for Policymaking in Developing countries: An Overview of Experience and Lessons Learned, Trade and development board, TD/B/C.II/MEM.1/CRP.1, UNCTAD) (2010)

B.-Å. Lundvall, *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning* (Pinter, London, 1992)

J.F. Lyotard, *The Postmodern Condition: A Report on Knowledge* (Manchester University Press, Manchester, 1991)

McKinsey Global Institute, Internet matters: *The net's sweeping impact on growth, jobs and prosperity,* May 2011

G. Mehran, Lifelong learning: new opportunities for women in a muslim country (Iran). Comp. Educ. **35**(2), 201–215 (1999)

MENESRSFC, Data from the Moroccan Ministry of higher education and research (*Ministère de l'Enseignement Supérieur de la Recherche Scientifique et de la Formation des Cadres*, 2002)

S. Metcalfe, in The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives, ed. by P. Stoneman. *Handbook of the Economics of Innovation and Technological Change* (Blackwell, Oxford, 1995)

E. Milbergs, N. Vonortas, Innovation Metrics: Measurement To Insight, Center for Accelerating Innovation and George Washington University, National Innovation Initiative 21st Century Working Group, 22 Sept 2004

A. Mina, D. Connell, A. Hughes, *Models of Technology Development in Intermediate Research Organisations*, Centre for Business Research, University of Cambridge, Working Paper No. 396 (2009)

Ministry of Economy and Planning, Kingdom of Saudi Arabia (2004), *The Eighth Development Plan* (1425/1430) A. H., http://www.mep.gov.sa/index.jsp?event=ArticleView& Article. ObjectID=3

Ministry of Economy and Planning, Kingdom of Saudi Arabia (2010), *The Ninth Development Plan* (1431/1435) H., http://www.mep.gov.sa/index.jsp;jsessionid= 0416D5BC3D4E5293 CF6D6330517F5095.alfa?event=ArticleView&Article.ObjectID=79

M. Minniti, P. Arenius, in *Women in Entrepreneurship, The Entrepreneurial Advantage of Nations: First Annual Global Entrepreneurship Symposium*, United Nations (2003)

M. Minniti, C. Nardone, Being in someone else's shoes: the role of gender in nascent entrepreneurship. Small Bus. Econ. **28**(2–3), 223–238 (2007)

S.M. Mirghani, K.J. O'Sullivan, V. Ribière, A paradigm shift in the Arab region knowledge evolution. J. Knowl. Manag. **12**(5), 107–120 (2008)

G.A. Moore, *Inside the Tornado: Marketing Strategies from Silicon Valley's Cutting Edge* (HarperCollins, New York, 1995)

T.H. Moran, *Multinational Corporations* (Lexington Books, Toronto, 1985)

A.P. Morriss, W.T. Bogart, A. Dorchak, R.E.Meiners, Green Jobs Myths, Law and Economics Research Paper No. lE09-001, University of Illinois, and Research Paper Series, No. 09-15, Case Western Reserve University, March 2009

S. Mosey, M. Wright, From Human capital to social capital: a longitudinal study of technology based academic entrepreneurs. Entrepreneurship Theory Pract. **31**, 909–935 (2007)

M.A. Moussa, M. Alsaied, N. Abdella, T.M. Refai, N. Al-Sheikh, J.E. Gomez, Prevalence of type 2 diabetes mellitus among Kuwaiti children and adolescents. Med. Prin. Pract. **17**(4), 270–275, (2008). School health and youth health promotion: http://www.who.int/school_youth_health/en/

R. Mourtada, *Innovation Culture for Youth Empowerment in the UAE: The Role of ICT*, Policy Brief (Dubai School of Government, Dubai, Mar 2010) p. 3

F. Moya-Anegón, B. Vargas-Quesada, V. Herrero-Solana, Z. Chinchilla-Rodriguez, E. Corera-Álvarez, F.J. Munoz-Fernàndez, A new technique for building maps of large scientific domains based on the co-citation of classes and categories. Scientometrics **61**(1), 129–145 (2004)

A.E. Murphy, The Celtic Tiger—An Analysis of Ireland's Economic Growth Performance, European University Institute Working Papers, No. 2000/16, Florence (2000)

National Centre for Education Statistics, the U.S. Department of Education and the Institute of Education Sciences, http://nces.ed.gov/timss. Accessed 16 April 2012

National Committee, WSIS—Successful Stories, Commitment and Dedication 2011–2012, Abu Dhabi (2012)

NCURA, *Guiding Principles for University-Industry Endeavors*, Report of a Joint Project of the National Council of University Research Administrators and the Industrial Research Institute. (National Academies Press, Washington, 2006)

R.R. Nelson, *National Innovation Systems: A Comparative Analysis* (Oxford University Press, Oxford, 1993)

NESTA *Innovation by Adoption*, NESTA Research Report, London, Oct 2008

M.E.J. Newman, in Who is the best connected scientist? A study of scientific coauthorship networks. *Complex Networks*. (Springer, Berlin, 2004)

S.W. Ng, S. Zaghloul, H.I. Ali, G. Harrison, B.M. Popkin, The prevalence and trends of overweight, obesity, and nutrition-related non-communicable diseases in the Arabian Gulf States. Obes. Rev. **12**, 1–13 (2011)

L. Nicks-McCaleb, The impact of state funded higher education on neighbourhood and community in the United Arab Emirates. Int. Educ. J. **6**(3), 322–334 (2005)

NISTEP, Comprehensive analysis of Science and Technology Benchmarking and foresight, Report No. 99, 3 May 2005

M.A.S. Nour, Science and technology (S & T) development indicators in the Arab region: a comparative study of Arab gulf and Mediterranean countries. J. Sci. Technol. Soc. **10**(2), 249–274 (2005)

M.A.S. Nour, Arab spring: Will more freedom boost knowledge transfer? http://unu.edu/articles/science-technology-society/knowledge-transfer-in-arab-world. Accessed Sept 2011

NRC, *21st Century Innovation Systems for Japan and the United States: Lessons from a Decade of Change*, ed. by S. Nagaoka, M. Kondo, K. Flamm, C. Wessner, The Committee on Comparative Innovation Policy: Best Practice for the 21st Century, National Research Council (US National Academies Press, Washington DC, 2009)

NSF, *Engineering Research Centers (ERC): Partnerships in Transforming Research, Education and Technology*, Program Solicitation, NSF 09-545 (NSF website) (2009)
NSTC, *Manufacturing the Future: Federal Priorities for Manufacturing R&D,* National Science & Technology Council (2008), US Government: www.manufacturing.gov/pdf/NSTCIWGMFGRD_March2008_Report.pdf
R. Nurkse, *Problems of Capital Formation in Underdeveloped Countries* (Cambridge University Press, Cambridge, 1953)
OECD, *Technology, Productivity and Job Creation—Best Policy Practices*, Paris (1998)
OECD, *Science, Technology and Industry Scoreboard 2003—Towards a knowledge-based economy,* Paris (2003)
OECD, *The Oslo Manual*, Paris (2005)
N. O'Higgins, Trends in the youth labour market in developing and transition countries, Social Protection Discussion Papers 27876, The World Bank (2003)
S.J. Olshansky, D.J. Passaro, R.C. Hershow, J. Layden, B.A. Carnes, J. Brody, L. Hayflick, R.N. Butler, D.B. Allison, D.S. Ludwig, A potential decline in life expectancy in the United States in the 21st century. N. Engl. J. Med. **352**, 1138–1145 (2005)
S. O'Reagain, R. Keegan, in *Benchmarking Explained*, ed. by PSI, EU-Commission Benchmarking in Europe—Working Together to Build Competitiveness, Brussels (2000)
E.D. O'Sullivan, *A Review of International Approaches to Manufacturing Research*. A report to the Engineering and Physical Sciences Research Council, Institute for Manufacturing (2011)
G. Pagels-Fick, *Setting Priorities in Public Research Financing* (VINNOVA, Stockholm, 2010)
R. Palmer, Inventory of Health Research, and Innovation in Alberta (2009), www.advancededucation.gov.ab.ca
PCAST, *Sustaining the Nation's Innovation Ecosystems: A Report on Information Technology Manufacturing and Competitiveness*, President's Council of Advisors on Science and Technology (2004), White House: www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-04-itreport.pdf
PCAST, *University-Private Sector Research Partnerships in the Innovation Ecosystem*, President's Council of Advisors on Science & Technology (2008), White House: www.whitehouse.gov/files/documents/ostp/PCAST/past_research_partnership_report_BOOK.pdf
PCAST, *Report to the President on Ensuring American Leadership in Advanced Manufacturing,* President's Council of Advisors on Science & Technology (2011)
P. Phan, D.S. Siegel, The effectiveness of university technology transfer: Lessons learned, managerial and policy implications, and the road forward. Found. Trends Entrepreneurship **2**(2), 77–144 (2006)
G.P. Pisano et al., Restoring American competitiveness. Harv. Bus. Rev. **87**, 3–14 (2009)
G.P. Pisano, The evolution of science-based business: innovating how we innovate. Indust. Corp. Change **19**(2), 465–482 (2010)
F. Van der Ploeg, S. Poelhekke, Volatility and the natural resource curse. Oxf. Econ. Pap. **4**(61), 727–760 (2009)
F. Van der Ploeg, S. Poelhekke, The pungent smell of red herrings: subsoil assets, rents, volatility and the resource curse. J. Environ. Econ. Manag. **1**(60), 44–55 (2010)
R. Pollin, J. Heintz, H. Garrett-Peltier, The economic benefits of investing in clean energy, PERI and the Center for American Progress, University of Massachusetts, 18 June 2009
M.E. Porter, *The Competitive Advantage of Nations* (The Free Press, New York, 1990)
M.E. Porter, Clusters and the new economics of competition. Harv. Bus. Rev. **76**, 77–90 (1998)
M.E. Porter, Clusters of innovation: Regional foundations of U.S. competitiveness, Council on Competitiveness, Washington DC (2001)
J. Prescott, Best practice: A part of the Australian renewal, Maintaining the momentum, Key Papers from the Best Practice Week, The university of Adelaide (1993), http://www.adelaide.edu.au/pvclq/benchmarking/ref/

M. Puchet, G. Dutrenit, M. Teubal, Co-evolutionary processes and economic development: stylising evidence coming from Mexico and Israel, Paper presented at the 8th Globelics Conference, Kuala Lumpur, Malaysia, 1–3 Novemb 2010

Public/Private Partnerships in Science and Technology: An Overview, Background, STI Review No. 23

M.A. Raouf, The Middle East Institute, *Climate Change Threats, Opportunities, and the GCC Countries*, 2008

D. Reiche, *Energy Policies of GCC Countries—Possibilities and Limitations of Ecological Modernization in the Rentier States* (Elsevier, Amsterdam, 2009)

V. Romani, *The Politics of Higher Education in the Middle East: Problems and Prospects*, Middle East Brief, Crown Center for Middle East studies, Waltham, May 2009

W.W. Rostow, *The Stages of Economic Growth: A Non-Communist Manifesto* (Cambridge University Press, Cambridge, 1960)

F. Roudi, *Youth Population and Employment in the Middle East and North Africa: Opportunity or Challenge*? United Nations Expert Group meeting on adolescents, youth and development, Population Division, Department of Economic and Social Affairs, United Nations Secretariat, New York, http://www.un.org/esa/population/meetings/egm-adolescents/p06_roudi.pdf. Accessed 21–22 July 2011

P. Ryan, The school-to-work transition: a cross-national perspective. J. Econ. Lit. **39**, 34–92 (2001)

R&D Maroc, Réalisation d'une enquête nationale sur la Recherche-Développement et l'Innovation dans les entreprises, Internal Report, Casablanca (2005)

K. Sabbagh, R. Shehadi, S. Oknayan, Booz & Co., Next-Generation ICT Parks Bridging the GCC Technology Gap (2009), http://www.booz.com/media/uploads/Next_Generation_ICT_Parks.pdf

J. Sachs, A.M. Warner, in Natural Resource Abundance and Economic Growth, ed. by G. Meier, J. Rauch. *Leading Issues in Economic Development* (Oxford University Press, New York, 1995)

J. Sachs, A.M. Warner, Natural resources and economic development: The curse of natural resources. Eur. Econ. Rev. **45**, 827–838 (2001)

X. Sala-i-Martin, A. Subramanian, Addressing the natural resource curse: An illustration from Nigeria, IMF Working Paper 139(3) (2003)

R. Salama, Education and formation of knowledge capital in the Arab knowledge report, the Mohammed Bin Rashid Al Maktoum Foundation (MBRF) and the United Nations Development Program (UNDP), New York (2009)

P.R. Sarkar, *Neohumanism: the Liberation of Intellect* (Ananda Marga Publications, Tiljila, 1982)

Saudi Arabian Monetary Agency, Kingdom of Saudi Arabia (2010), *Forty Sixth Annual Report: The Latest Economic Developments* (1431) H., http://www.sama.gov.sa/sites/samaen/ReportsStatistics/ReportsStatisticsLib/5600_R_Annual_EN_2010_11_14.pdf

A. Scherzinger, *Die Technologiepolitik der Länder in der Bundesrepublik Deutschland—ein Überblick, DIW Discussion Paper No 164* (DIW, Berlin, 1998)

Scopus, Elsevier B. V. (2011), https://www.scopus.com/home

J. Senker, University-industry linkages in Britain: Government policy and its effects, Paper presented at the Workshop on Relationships Between Universities and Firms, Associacão das Universidades da Região Norte (AURN), Porto, (1998)

SFI, *Centres for Science, Engineering & Technology* (CSETs). Science Foundation Ireland: www.sfi.ie/investments-achievements/investments/

M.I. Shammas, Sustainable management of the Salalah coastal aquifer in Oman using an integrated approach. Doctorae thesis, KTH, Stockholm, 2007

M. Simmons, *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy* (Wiley, New York, 2005)

K. Smith, Innovation and Growth in Resource-Based Economies, Australian Innovation Research Centre, University of Tasmania, Hobart (2007)
R. Solow, Technical progress and the aggregate production function. Rev. Econ. Stat. **99**, 312–321 (1957)
P. Stollenmayer, Convergence in ICT, Challenge and opportunity for the telecoms industry, Eurescom (2008), http://archive.eurescom.eu/message/messageOct2005/Convergence_in_ICT.asp
M. Sturm, P. Adolf, J. Peschel, The Gulf Cooperation Council Countries. Economic Structures, Recent Developments and Role in the Global Economy. European Central Bank, Occasional Paper Series 92, July 2008
T. Tamer, Knowledge Economy, Economic Growth and Job Creation in the MENA Region, CMI (2011)
G. Tassey, Rationales and mechanisms for revitalizing US manufacturing, R&D strategies. J. Technol. Trans. **35**(3), 283–333 (2010)
Teknikföretagen, *Swedish Production Research 2020: A Report by the Association of Swedish Engineering Industries* (Stockholm, 2009)
Telecommunications Management Group, Inc., Arlington VA, U.S.A. June 2011, http://reports.tmgtelecom.com
M.K. Tolba, N.W. Saab, *Arab Environment: Future Challenges*, Report edited for the Arab Forum for Environment and Development, (AFED) Beirut, Lebanon (2008)
S. Toporkoff (ed.) *Beyond eGovernment-Measuring Performance* (PTI, Public Technology Institute, Washington, 2010a)
S. Toporkoff, *e-Health: A Global Perspective, in Beyond eGovernment-Measuring Performance* (Public Technology Institute, PTI, Washington, 2010b)
S. Toporkoff, Changing Concepts & eGovernment as a Service, *8th Eastern European e|Gov Days*, Prague (2010)
S. Toporkoff, *The Future of Innovation, Contributing Author Book Edited by Innovation Leadership Forum* (MPG Books Group, London, 2009a)
S. Toporkoff, *Digital Solidarity & Cooperation* (II Summit of Mediterranean Digital Area, Malaga, 2009b)
S. Toporkoff (ed.) *Beyond E-Government & E- Democracy* (PTI, Public Technology Institute, Washington, 2008)
R.M. Torres, *Lifelong Learning in the South, Critical Issues and Opportunities for Adult Education*, Swedish International development Agency, SIDA Studies No. 11, Stockholm (2004)
UCINET, Borgatti, Everett and Freeman, Natick, Mass: Analytic Technologies, 1999 & later—latest version UCINET 6, 2004
UNCTAD, *Science, Technology and Innovation Indicators for Policymaking in Developing Countries: an Overview of Experiences and Lessons Learned*, Geneva (2010)
UNDP, *Arab Human Development Report, Challenges to Human Security in the Arab Countries* (New York, 2009)
UNDP, *Human Development Report* (New York, 2010)
UNEP, *Towards a Green Economy: Pathways towards Sustainable Development and Poverty Eradication* (2011), www.unep.org/greeneconomy
UNESCO Institute for Statistics, UIS 1970-2010 Education Statistics. (Montreal, 1970-2010) http://www.uis.unesco.org. Accessed 15 April 2012
UNIDO, *Policy benchmarking in the developing countries and the economies in transition: principles and practice*, (New York 1998)
United Nations, Resolution 55/2 *United Nations Millenium Declaration*, Resolution adopted by the General Assembly, New York, 18 Sept 2000
United Nations Country Team (UNCT) Iraq, http://iq.one.un.org/Facts-and-Figures. Accessed 15 April 2012

L.P. Visentin, *Politics in the University*, Ecclectica, Brandon University (2005), http//www.ecclectica.ca/issues/3/
D. Wanless, *Securing Good Health for the Whole Population* (HM Treasury, London, 2004), p. 23
D.J. Watts, The 'New' science of networks. Ann. Rev. Sociol. **30**(1), 243–270 (2004)
Webometrics, Ranking Web of World Universities, Top Arab World (2011a), http://www.webometrics.info/top100_continent.asp?cont=aw
Webometrics, Ranking Web of World Research Centres, Top 4000 (2011b), http://research.webometrics.info/top4000_r&d.asp
World Intellectual Property Organization, WIPO (2010)
World Bank, *Constructing Knowledge Societies: New Challenges for Tertiary Education*, Washington DC (2002)
World Bank, *World Development Indicators* (Washington DC, 2005)
World Bank, *Building Knowledge Economies: Advanced Strategies for Development* (WBI Development Studies, Washington DC, 2007)
World Bank, *Middle East and North Africa Region Economics Developments and Prospects Report 2007: Job Creation in an Era of High Growth* (Washington DC, 2007)
World Bank, *The Road Not Travelled—Education Reform in the Middle East and Africa* (World Bank, MENA Development Report, Washington DC 2008)
World Bank, in *Science, Technology and Innovation: Capacity Building for Sustainable Growth*, ed. by A. Watkins, M, Ehst (Washington DC, 2008)
World Bank, *World Development Indicators* (Washington DC, 2010)
World Bank, Middle East and North Africa Region, Regional Economic Update, May MENA Facing Challenges and Opportunities (2011), http://siteresources.worldbank.org/MENAEXT/Resources/EDP_MNA_2011.pdf)
World Bank, World Development Indicators, http://data.worldbank.org/indicator/EN.ATM.CO2E.PC. Accessed 20 April 2012
World Bank Data, http://data.worldbank.org/country
World Bank Institute, *Establishing a Knowledge Economy in Saudi Arabia*, Knowledge for Development Programme, July (World Bank Institute, Washington DC, 2008)
World Commission on Environment and Development, *Our Common Future* (Oxford University Press, New York, 1987)
World Economic Forum. The Global Competitiveness Report 2009–2010 (2009), https://members.weforum.org/pdf/GCR09/GCR20092010fullreport.pdf. Accessed 16 Dec 2011
World Economic Forum, *Global Competitiveness Report 2010–2011* (Geneva, 2010)
World Economic Forum, *Global Competitiveness Report 2011–2012* (Geneva, 2011a)
World Economic Forum, *Arab World Competitiveness Report, 2011–2012* (Geneva, 2011b). ISBN-13: 92-95044-54-1
World Health Organization, *World Health Report 2006* (Geneva, 2006)
World Health Organization, Working Together for Health (Geneva, 2006) www.who.int/whr/2006/en/index.htm
World Health Organization, A58-21 eHealth, Report by the Secretariat. Fifty-eighth World Health Assembly, 7 April 2005, http://apps.who.int/gb/ebwha/pdf_files/WHA58/A58_21-en.pdf
World Information Technology and Services Alliance (WITSA), Markaz Research (Kuwait, 2009)
World International Property Organization (2010), *World International Property Indicators*, http://www.wipo.int/ipstats/en/statistics/patents/index.html
Yale University, Environmental Performance Index. Yale Center for Environmental Lax & Policy (YCELP) and the Center for Earth Information Science Information Network (CIESIN) at Columbia University (2012)

G. Zawdie, Strategies for Science and Technology-Based Development and Transition: The Maghreb Perspective, in *Technology and Transition: The Maghreb at the Crossroads*, ed. by G. Zawdie, A. Djeflat. (Frank Cass, London, 2002)

Z.O. Zeidane, *Réformes institutionnelles pour un modèle d'économie de la connaissance dans la region arabe* (CMI, Marseille, 2011)

Index

T. Andersson and A. Djeflat (eds.), *The Real Issues of the Middle East and the Arab Spring*, Innovation, Technology, and Knowledge Management,
DOI: 10.1007/978-1-4614-5248-5, © Springer Science+Business Media New York 2013