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Dirk Meissner
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# Innovation and the Entrepreneurial University

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# Innovation and the Entrepreneurial University

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# Part I

# Innovation and Entrepreneurial University

# Innovation Ecosystems and Universities

# 1

Erkan Erdil, Dirk Meissner, and Joanna Chataway

**Abstract**

During the last decades the number of universities extending their initial education and teaching missions towards the triple helix and knowledge triangle paradigms, e.g. knowledge and technology transfer and innovation has increased substantially. In line with this evolution the term 'entrepreneurial university' became increasingly popular however until recently there is hardly a common understanding of 'entrepreneurial universities'. The main perception of 'entrepreneurial universities' rests with a visible and measurable contribution of universities to innovation and entrepreneurship in a broader sense. Although this perception is plausible and convincing it raises many open questions which mainly point to university governance models. The innovation and entrepreneurial university paradigm requires a holistic view on university governance approaches which include the full set of universities missions and respective management routines. In this respect it's of utmost importance that universities keep a "healthy balance" between their missions. This statement is frequently used in many instances yet thus far there is no clear indication what a "healthy balance" implies. The chapter provides first indications about entrepreneurial university governance and respective management approaches.

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**Keywords**
Entrepreneurial university · Knowledge triangle · Triple helix · Innovation · Knowledge transfer

## 1.1 Introduction

> I hold aloof from practical politics and recognize no purpose other than knowledge. . .
> Joseph Alois Schumpeter
> The Nature and Essence of Economic Theory, 1908

The ever-increasing significance of knowledge for almost all societies has shaped our daily routines and creative capacities. The principal nest of knowledge in today's world is universities. The recent decades have witnessed the changing role of universities in the so-called age of entrepreneurial university. This book aims to outline the issues associated with this transformation moving from theoretical underpinnings to empirical facts and illustrating with various examples.

## 1.2 Knowledge and Innovation

In the course of recent decades, knowledge has come increasingly to be viewed as a product. Yet, the commodification process of knowledge as the outcome of various activities exhibits different characteristics as compared to other commodities. The relationship between use and exchange value observed in other commodities have different peculiarities in the context of knowledge (Meissner et al. 2013a, b). The use value of other commodities decreases through consumption while the process is completely the reverse in the use of knowledge. The use value of knowledge usually increases as it is consumed. In order to consider knowledge as a commodity in economic sense, it should be convenient to be exchanged in the market. The main process in this context is the transformation of information to knowledge. The final output of this activity makes the knowledge measurable and as something that can materially valued. One of these processes is the codification of knowledge. Knowledge is the deduction and transformation of information in which it creates an impact on the decisions of economic actors. As defined in Oslo Manual (OECD 2005), "*An* ***innovation*** *is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*". In recent history, tremendous technological change and uninterrupted speed in flows of information have led knowledge to be treated as the central motor power of economic development and innovation as the key force of competition in the market. Then the question of how knowledge is embedded in the universities is now widely thought about in relation to the general welfare of societies.

The concept of entrepreneurial university has emerged from this context. In addition to classical missions of university—teaching and research, a new mission is added as the third mission. The knowledge-based economy and entrepreneurial university concepts are key to grasping this new mission of the universities.

## 1.3 Knowledge-Based Economy and Innovation

The knowledge-based economy is a relatively recent contribution of evolutionary economics school although the concept of knowledge has a long lasting history dates back to ancient philosophers. Among the various definitions of knowledge-based economy one has a distinctive character in summarizing the transformation we have experienced, that is to say the intangible capital is more significant than the tangible capital. Foray (2004) defines it as follows:

> By knowledge-based economies I mean, essentially, economies in which the proportion of knowledge-intensive jobs is high, the economic weight of information sectors is a determining factor, and the share of intangible capital is greater than that of tangible capital in the overall stock of real capital.

Foray (2004) further discusses this new type of economy, based heavily on intangibles, as a reasonable explanation of structural transformations witnessed in the past few decades. It is about 35 years since the pioneering study of Nelson and Winter (1982) *An Evolutionary Theory of Economic Change* which give the first insights of how our economies undergo the structural transformation. This study is widely considered as a challenge to neoclassical economics and has had significant impact on the way we think about economic growth and development. It moved away from a narrative based on equilibrium-positioned explanations arguing that the neoclassical framework cannot cope with the complexity surrounded the economic relations and dynamics in knowledge-based economy (Pyka and Hanusch 2006). Moreover, it makes a convincing argument that qualitative change is as important as quantitative change in the science of economics. The complexity of economic relations and the increasing intensive use of knowledge in economic-decision making in the market force us to consider and reconsider the relevance of the concept of knowledge-based economy (Perez Vico et al. 2017). In this set-up, the rapid formation of new knowledge and easy access to this knowledge are features spreading economic efficiency, innovation, quality of goods and services and welfare of individuals (Foray 2004).

In another pioneering study, *Tacit Dimension*, Polanyi (1966) was the first of many to point to the difference between tacit and explicit dimensions of knowledge. Later this approach was developed in an interdisciplinary manner by authors like Latour (1979, 1987, 2005), Kline and Rosenberg (1986), Cohen and Levinthal (1989), Eliasson et al. (1990), Pyka and Hanusch (2006) and others contributed to the growing literature. Following studies have been altered our consideration and conceptualization of innovation since Schumpeter with the increasing importance of knowledge for global economic relations and challenges.

## 1.4 Innovation and Entrepreneurial University

It is possible to relate the concept of entrepreneurial university with the notion of risk taker agents discussed by the classical economist Richard Cantillon, in fact, he can be treated as an entrepreneur and/risk taker in a primitive sense (Murphy 1986). Cantillon claims that entrepreneurs were required for both production and exchange. Cantillon is the first economist who has a serious attempt to put forward the activities of the entrepreneur. He showed throughout his career an ability to mesh entrepreneurship with economic theorizing (Murphy 1986). His main contribution is the concept of financial entrepreneurship that involves decisions to purchase financial assets at a certain price only to sell at an uncertain future price, requires skill and expertise.

Schumpeter (1934) basically defined "Entrepreneurial profit as a surplus over costs." This profit includes a premium for risk. In fact, this is the cost of cognitive capital of the entrepreneur or the cost and/or risk of novelty and creativity. Following Schumpeter, there was a little discussion on entrepreneurship until late 1980s and 1990s. The concept of entrepreneurship has generally been criticized as being too philosophical in terms of its ontological construction (Casson 2015). Its relation with innovation was first established by Schumpeter (1934). According to him, entrepreneurs have an appropriate mind set for innovative activities. Although Schumpeter's attention is on more radical innovation, hitherto the real success of entrepreneurs lies in the implementation of incremental innovations with their complementary skills in applying successful business plans to innovative activities. In this context, it can also be claimed that the real contribution of an entrepreneur is to take the innovation decision rather than being responsible for the mass production of an innovative product. This feature of entrepreneurship is highly connected with the concepts of novelty and creativity. Therefore, the concept itself contains an idiosyncrasy. What is more appealing is the spatial context of entrepreneurship in which *it is a highly localized process* (Stam 2006). As indicated by various studies, many modern entrepreneurs start their businesses in their home region or even at their home (Stam 2006). This finding establishes potential links of entrepreneurs with the local knowledge base mostly represented by the universities (Meissner 2017). According to Cooper (1985), entrepreneurs in most of the sectors are not inclined to change their location.

Knowledge flows from the other local firms are one of the most important factors influencing geographical location (Meissner et al. 2013a, b). Cooper's finding, however, do not confirm the direct impact of universities on entrepreneurial activities. Considering the date of the study, it is not surprising to reach such a conclusion. The mid-1980s are very early to search for a relation for university's significance in the process of entrepreneurial development. The changes incorporated with globalization also gradually altered the role of universities. Storey (1994) shows that different locations produce different outcomes both on small business and on the ecosystem. Greene et al. (2008) also show that how and why various locational choices produce different results although they are all subject to almost same policy environment. In sum, location matters for entrepreneurial performance given more or less the same inputs. However, each context has its own features and encourages different roles for entrepreneurs within ecosystems although some standard roles are attributed universally (Carayannis et al. 2017; Schibany and Reiner 2014).

What is significant in this evolutionary process is that the innovation ecosystem is becoming increasingly entrepreneurial and universities cannot remain isolated from this evolutionary change. The increasing complexity of production systems necessitates the integration and commercialization knowledge somehow isolated in the university system. Such a change towards more entrepreneurial functions of the universities necessitates change in structures, strategies, practices and more importantly mind setting of the existing universities. For most universities, this change is not easy and adaption to the changing era is difficult. The commercial environment and markets are transforming very rapidly yet the universities are relatively slow to mitigate the consequences of this makeover (Unger and Polt 2017). Of course, universities have bureaucratic structures and need to concentrate on education and research. Resources available for adaptation to the changing ecosystem often mean that there is limited capability and capacity (Fayolle and Redford 2014). Sometimes, this limitation makes the decisions on resource allocation more challenging in terms of its functions especially for developing countries.

However, the main mission of the universities should be to increase the social welfare through dissemination and diffusion of knowledge created inside the university (Anra and Yamin 2017). The vital question is how the universities will fulfill this mission. If the limited resources force them to make a choice, the solution will be specialization through its functions. Otherwise, the social welfare consequences of universities will be deteriorated. On the other hand, if they are able to manage resource allocation, then they will also complement with classical functions with the entrepreneurial function. Nevertheless, the various ranking practices put pressure on the universities, sometimes, in a meaningless way causing inefficient resource allocation. In fact, these ranking practices create a market for universities for attracting good students, researchers, etc. This situation creates a dilemma for the universities forcing them to enter into a competition trap. The long-term consequences of this competition coupled with inefficient resource allocation may be detrimental for the university system in the global sense. Under some circumstances, it is possible to obtain more efficient output through collaboration of universities. Collaboration is the key to success not only in the case of universities but also with the business world. Education and research functions feedbacks each other, without being a successful education institution, competitive research output is not possible except in the case of highly specific vocational training.

One of the most significant stylized fact on universities is that they are novel and creative platforms by definition. With the establishment of efficient interfaces such as technology transfer offices and with the market selection mechanism, the knowledge created in universities adds positively to their entrepreneurial function. In this context, they can be seen as suitable nests for innovative activities. However, the balance between these innovative activities and classical missions are highly important and generate fears that fundamental academic freedoms may be endangered through entrepreneurial transformation (Evans 2002, 2004; Gombrich 2003; Graham 2002; Boulton and Lucas 2008; Collini 2012). Naturally, there is a high possibility to risk academic freedoms if universities are not able govern the necessary ecosystem for this evolution. Thus, if this risk is taken, universities will have a chance to deal with the priorities of the society in general and business in particular. The entrepreneurial spirit can be utilized both for students and ecosystem outside the university yet this does not mean to abandon basic curiosity driven-research which provides necessary conditions for academic freedom. Unfortunately, this is not a sufficient condition for the academic freedom. The sufficient condition is to leave a space for the university as a whole for academic freedom via participatory decision-making in the university bureaucracy or academic boards. This further requires a strategic prioritization in the university management with an attempt to redefine the interaction between university and broader society. According to Gibb and Haskins (2014), "*the focus was on the impact of a growing complex and uncertain environment on key areas of university activity and the leadership challenges involved*." As the main knowledge repositories, universities inevitably play a leadership and create a public value as discussed by Moore (1995).

Gibb et al. (2013) discusses that the university has been subject to different conceptualizations both internationally and within national boundaries. This disagreement in the literature produces different taxonomies, roles and meanings for the public value of the universities. However, the recent classifications always include two concepts, namely commercialization of research output or university know-how- transfer of codified and tacit knowledge- and entrepreneurial university.[1] This change crates pressures on the universities to change the organization and management of the universities especially in the last decade (Eurydice 2005; Gibb et al. 2013; Sin et al. 2016). All these changes named as "Changing University Paradigm" by Gibb et al. (2013). Figure 1.1 summarizes the paradigm but what is in reality is the previously discussed dilemma. The universities face the problem of how to tackle with the problems around two axes namely simple to complex and certain to uncertain depending upon their capacities/capabilities (Gokhberg et al. 2016). The ones that solve the problem find higher ranks in various indices and become globally recognized entrepreneurial universities together with as champions of other classical missions. Such a success attracts both highly qualified students, researchers as well as entrepreneurs to the innovation ecosystem created by the university itself and somehow guarantees sustainability of further success ceteris paribus.

In sum, this book searches for an answer for the problems discussed above both on theoretical and empirical grounds. The book is organized under three main sections. The first section focuses on the changing role of universities as the indispensable actors of any type of innovation system. Chapter 1 studies young companies established by entrepreneurs with Ph.D. in the context of academic entrepreneurship. Moreover, it searches an answer how university acquired skills

[1]For a detailed discussion, see OECD (2012), Gibb et al. (2013) and Audretsch et al. (2016).

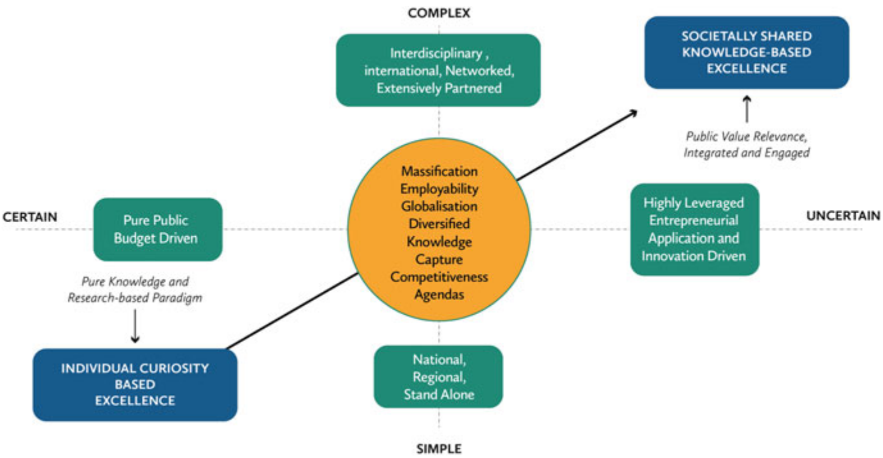


**Fig. 1.1** The Dilemma of Universities. Source: Gibb et al. (2013)

are transformed into the so-called ‘dynamic entrepreneurship’. The findings show the significance of academic entrepreneurship as a tool to create dynamic knowledge intensive ecosystems. Chapter 2 discusses the entrepreneurial university concept and clarifies its role in the triple helix model. It fills the gaps in the literature by providing a comprehensive understanding of the entrepreneurial university and developing a broader structured definition. Chapter 3 focuses on the impact of services offered in pre-incubation centers on the graduation rates of incubator participants in Turkey. It is found that university-based incubation centers are key actors for promoting entrepreneurial activities as producers and disseminators of knowledge. Chapter 4 discusses the role of university-industry collaborations for catching up in emerging economies with a specific reference to Turkey. It is claimed that different types of government interventions produce different result at varying degrees of success by addressing challenges for catch up and mitigation. Chapter 5 explores the importance of knowledge triangle concept in order to better align and integrate the research, education and innovation functions of higher education institutions through national policies and institutional activities. It claims that policy makers have somehow ignored the links between education and innovation until recently. The chapter further elaborates the enhancing the role of HEIs in innovation as a catalyst for economic growth and societal development.

The second part emphasizes the relevance of local and regional strategies and brings a spatial dimension to the book. Chapter 6 is to analyses the high-growth firms (HGFs) in the case of Turkey. It questions whether Turkish HGFs share common characteristics with HGFs in other countries and how the cohort of HGFs changes by using different definitions. It is found that Turkish HGFs have some common characteristics with other countries as being young and small. The chapter further proposes that all the growth definitions, methods and policies have to be designed according to regional or national characteristics in order to set successful HGFs policies. Chapter 7 explores the relationship building processes of new techno-entrepreneurs in Turkey. The chapter concludes that the stakeholder formation process presents a structure where challenger and supporter stakeholders are present at two opposing sides of the start-up and the entrepreneur benefited from the counterbalancing effect of these forces. Chapter 8 provides a general account of industry-university collaboration with successful results in Information and Communication Technology (ICT) and e-Government applications in Turkey. The successful case exhibits lessons for other regional and national attempts. The chapter also proposes a complementary cross-cultural knowledge management model to contribute to the conceptual discussions on collaboration models and interface designs. Chapter 9 focuses on the key factors that enable transition in a regional innovation system (RIS) in the context of triple helix model with a specific example from a Turkish region, namely Izmir. It concludes that the main driver of the current development of Izmir RIS was the co-evolution of a more advanced knowledge space with a comprehensive, high-density institutional structure and a solid knowledge base, a younger, but fast developing innovation space, an increasing number of technology transfer offices, technoparks and innovation-support institutions, and a thinner, but active Consensus Space promoting regional networking and collaborative leadership. Chapter 10 proposes a theoretical framework that aims to explain how and why interorganizational innovation network emerge, change and eventually dissolve over time. The chapter distinguishes various types of network actors, considers their networking strategy, and accounts for both formation and termination of ties among them in order to explain structural consequences at the intermediate level and the overall network level. Chapter 11 studies on the impact of the enlargement on border regions, especially between Germany and Poland, and introduces into the EU support programs that aim to integrate regions on both sides of the border. The scientific cooperation is picked as an example of cross-border activities. The empirical study presents that the extent of German-Polish cooperation is based on co-publication activity.

The third section focuses on the future of university-industry collaborations. Chapter 12 discusses current trends, drivers and enablers related to open science based collaboration as well as obstacles and tensions associated with open and global access to science. It further attempts to identify some of the policy challenges associated with moves towards more open science. The chapter concludes that the impact on university-industry collaboration will rest on several key assessments made by stakeholders and policymakers, such as cost and benefits of open access, researcher attitudes to open access, and influence on the research by industry. Chapter 13 provides a substantial overview of features and channels of knowledge and technology transfer in light of achieving impact from science and research. It also offers a taxonomy of transfer channels and proposes levels of impact from STI. The chapter finds that there are different levels of value generated from STI, each featuring different stakeholders with different agendas and expectations. It is further argued that to make knowledge and technology transfer impactful and sustainable a long-term holistic approach is required. Chapter 14 proposes data analysis techniques in order to provide a lens through which to view the university in its relations to other entities in society. The proposed metrics bring opportunities for gaining insight into these relationships. The possibilities for the reorganisation of the relationships between universities, industry and government so as to stimulate economic growth or innovation can themselves be classed as innovations.

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# Part II

# The Changing Role of Universities as Economic Actors

# Effects of University Research Exposure on Young Company Behavior and Performance

2

Yannis Caloghirou, Aimilia Protogerou, and Nicholas S. Vonortas

**Abstract**

The number of university graduates is continuously raising for many years creating an additional supply of highly qualified labor which doesn't always meet respective demand thus can't be absorbed fully. This holds especially true for Ph.Ds of which ever more are entering the labor market although the number of academic positions remains stable and also businesses have limited capacities for Ph.Ds. What follows is that entrepreneurial activities become a serious option for tertiary graduates. Namely Ph.D. graduates engaged in establishing companies by means of using state of the art scientific knowledge which they developed at universities thus generating substantial impact of university produced knowledge on the economy and the broader society. Specifically the cognitive base and the founders' educational background is an important determinant for the success and impact of knowledge-intensive entrepreneurship in general and academic entrepreneurship in particular. The chapter introduces a broader definition of academic entrepreneurship and investigates whether new ventures founded by Ph.D. holders

This chapter draws extensively on Y. Caloghirou, A. Protogerou and N. S. Vonortas "Does Exposure to University Research Matter?—Evidence from Europe", *Asian Research Policy*, 7(1): 17–32.

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exhibit different characteristics and/or different behavior patterns compared to the rest of the firms established in the same period in Europe.

**Keywords**
Knowledge transfer · Spin off companies · Entrepreneurship

## 2.1 Introduction

Universities have been increasingly involved in knowledge transfer activities especially during the last three decades along with a remarkable upsurge in new forms of entrepreneurship associated with new innovations (Franklin et al. 2001) usually taking the form of 'university spin-offs'. The idea that knowledge stemming from research conducted on university campuses can be used in commercial applications, led Etzkowitz (1998) to coin the term entrepreneurial university describing the role that universities have been assuming in modern economic development activities. In this vein, research universities are becoming increasingly engaged in entrepreneurial activities that allow them to capitalize and commercialize academic knowledge, while at the same time they also embrace entrepreneurial culture in the main academic areas of education and research (D'Este et al. 2010).

This chapter examines young companies established by entrepreneurs holding advanced post-graduate degrees (Ph.D.). It explores the formation of entrepreneurial ventures created by individuals who have been previously exposed to academic research for a considerable amount of time, at a bare minimum of three years, during the preparation of their Ph.D. thesis. This is a form of academic-related entrepreneurship—defined rather broadly—implemented by graduates with advanced education background. Recent research suggests that entrepreneurship in new independent firms represents a possible 'missing link' between publicly available knowledge and economic growth through the exploitation of this knowledge (Acs et al. 2008). By examining the attributes of firms founded by Ph.D. holders we seek to shed more light on whether university research outputs and acquired skills can be converted into 'dynamic entrepreneurship' which in turn may affect positively economic growth and social well-being.

Since the early 1980s there has been identified a significant increase in the university outputs in terms of licensing of research, patents and spin-offs established by faculty members. However, several alumni surveys also indicated that graduates from some universities start up a large number of new firms (Astebro et al. 2012). To the best of our knowledge, existing empirical studies do not usually cover entrepreneurial activities that have been initiated by university graduates, not to mention Ph.Ds, as their efforts are hardly based on university-generated intellectual property (Muscio et al. 2016; Astebro et al. 2012). On the other hand, graduates are only loosely connected to the university and are very difficult to identify in empirical studies, whereas, most universities do not keep records of the companies founded by graduates from their undergraduate, master or Ph.D. programmes (Wright et al. 2007). Taking into consideration that (a) there is a significant increase in the number of Ph.D. holders worldwide during the last three decades (OECD 2013) while at the same time there is a limited availability of permanent academic positions (Stefan 2012), (b) that the additional supply of highly qualified human capital cannot be fully absorbed in existing businesses, the need for new entrepreneurial activity becomes more significant. In addition, taking into consideration that Ph.Ds may bring the most up to date scientific knowledge they have already produced in the university or their capabilities in generating such knowledge into industry they may start up high quality entrepreneurial ventures compared to non-Ph.Ds (Lee et al. 2010). Our study, using a rich European dataset, attempts to address this gap in the literature by providing empirical evidence on the structure and behavior of young companies established by entrepreneurs holding advanced (doctoral) degrees. In this way it provides some evidence on the impact of university on entrepreneurship in the form of start-ups created by former students.

A founding team's characteristics be can be critical to a young firm's success and subsequent growth. Founders with a broader general knowledge base are presumed to have a better ability to effectively search their environment and identify new opportunities (e.g. Ucbasaran et al. 2008; Shepherd and DeTienne 2005). At the same time, entrepreneurs with a high degree of human capital are capable to fruitfully exploit new opportunities. In particular, the cognitive base and the founders' educational background of founders is an important variable for the study of knowledge-intensive entrepreneurship in general and academic entrepreneurship in particular. In this study we adopt a broader definition of academic entrepreneurship and investigate whether new ventures founded by Ph.D. holders exhibit different characteristics and/or different behavior patterns compared to the rest of the firms established in the same period in Europe.

The rest of the chapter proceeds as follows: Sect. 2.2 provides the theoretical background focusing on the evolution of academic entrepreneurship and its indirect aspects on the entrepreneurial ecosystem. Section 2.3 describes the dataset and Sect. 2.4 presents the results of the empirical analysis and offers a discussion of the main findings. The paper ends with a section on conclusions.

## 2.2 Theoretical Background

The traditional rationale for academic entrepreneurship was based on the premise that it would increase the commercial exploitation of university research and also constitute a revenue source for the university. Early reviews of the academic entrepreneurship literature revealed that most studies were primarily focused on several measures of university technology transfer activity such as the establishment of technology transfer offices, licenses, patents and start-ups/spin-offs. Therefore the debate on academic entrepreneurship has been narrowly focused on university-industry links and largely ignored several dimensions of the new entrepreneurial ecosystem (e.g. the increasing number of courses and programmes on entrepreneurship in universities, the creation and growth of entrepreneurship centres, etc.) which has broadened out the rationale so as to reflect the wider social and economic benefits of academic entrepreneurship to university (Siegel and Wright 2015).

In light of the evolution in academic entrepreneurship, a focus on more indirect aspects such as social enterprises and commercial start-ups initiated by students and alumni has been induced. This suggests that university education and research may lead indirectly to entrepreneurial action once graduates have gained industrial experience. Most importantly, some empirical studies have indicated that these ventures may outperform university spin-offs indicating that they can generate higher societal benefits (Wennberg et al. 2011; Siegel and Wessner 2012). Furthermore, a remarkable shift beyond spin-offs based on formal IP is an increased diversity of start-ups at universities especially those created by students (Astebro et al. 2012). These start-ups are normally less demanding in terms of finance but they may require support in order to grow and create economic and social value. For example, there is a rising demand for specialized master's degrees for non-management disciplines' graduates so as to acquire the necessary entrepreneurial skill to shape and realize the business opportunities that they have identified (Siegel and Wright 2015).

A straightforward conceptualization of academic entrepreneur would suggest that he/she is "a university scientist, most often a professor, sometimes a Ph.D. student or a post-doc researcher, who sets up a business company in order to commercialize the results of her research" (Franzoni and Lissoni 2009). These people choose to work with industry because of a number of reasons, including greater availability of market or technology opportunities, lower availability of qualified posts, access to entrepreneurship programmes etc.

The majority of studies on new venture formation by academics have focused on the factors leading to academic entrepreneurship. Moreover, this strand of the literature has targeted almost exclusively on start-ups by university faculty (Nielsen 2015). However, several scholars have attempted to broaden the concept of traditional academic entrepreneurship. Wright et al. (2007) in their study on academic entrepreneurship in Europe, focus not only on university spin-offs that build upon formal, codified knowledge embodied in patents but also include start-ups by faculty based in university which may draw on their own IP or knowledge. They argue that they have broadened their perspective because in some institutional contexts intellectual property is not necessarily owned by the university and in this way they would miss a substantial part of reality. In a similar line of reasoning, Goel and Grimpe (2012) in their study of the differential forces driving academic entrepreneurship distinguish between *research-driven academic entrepreneurship* in which firm creation is a pure result of the scientist's drive to commercialize his research results created in the university, and *general academic entrepreneurship* in which firm creation is driven by factors (maybe chance, family connections, non-academic opportunity, due to someone else's research, etc.) other than the commercialization of the entrepreneur's own research results. However, as far as the role of individual academic entrepreneurs is concerned, while early work included a broad conceptualization of the academic entrepreneur (e.g. Doutriaux 1987), more recent and influential scholarship put emphasis almost exclusively on the role of individual university faculty (Hayter et al. 2016) disregarding the fact that graduate students can have a catalytic impact on academic entrepreneurship (Boh et al. 2016; Lubynsky 2012).

The lack of research concerning start-ups established by university graduates maybe attributed to several reasons. First, research on start-ups formed by university graduates may not have been aligned with the specific interests of policy makers who primarily focus on intellectual property creation by faculty members. Second, the limited availability of relevant data, even if researchers would choose to include university graduates in their studies. Most of past research examining spin-offs from universities uses TTOs (Technology Transfer Offices) data, or in some cases, data pertaining to faculty surveys. Due to fact that graduates typically do not create intellectual property owned by universities data provided by TTOs exclude new venture formation by students or graduates, while, faculty surveys exclude by default graduates' entrepreneurship (Astebro et al. 2012). In addition, most universities do not keep track of the companies founded by graduates from their undergraduate, master or Ph.D. programmes (Wright et al. 2007). However, even in the case that they do it is usually not clear whether the company's set up is based on knowledge developed and transferred in the university setting or whether it is based on knowledge accumulated by the graduate outside the university. Finally, while studies using alumni surveys may be useful they provide examples related to specific universities and therefore the general impact is unclear.

Nevertheless, the number of firms created by graduates should not be underestimated as empirical evidence show that they might even outnumber spin-offs (Wright et al. 2007). Several university-specific studies based on alumni data have shown that university graduates create a lot of new firms. These studies also suggest that although the rates of entrepreneurship differ considerably across universities, students should not be ignored when exploring the effect of universities on the creation of new firms (Astebro et al. 2012). Finally, Astebro et al. (2012) in their study on start-ups created by recent university graduates and their faculty suggest that recently graduated students in general outnumber faculty spin-offs by at least one order of magnitude and are not of low quality.

Most importantly, there has been a significant increase in the number of Ph.D. holders as a percentage of the population across all countries between 2000 and 2011 (OECD 2013). For instance, there is currently an oversupply of Ph.D. graduates in the US, and therefore, an increasing requirement for career opportunities outside academia (Boh et al. 2016). Traditionally, doctoral education was considered as passport to academia or public research organizations. Although higher education and academic careers are the main destination of employment for doctorate holders, their presence in other knowledge-intensive sectors of the economy is becoming more evident, especially in countries with higher R&D intensity (CDH-KNOWINNO Project, Final Report 2013). For example, a recent study on the career patterns of Science and Engineering (S&E) Ph.D. graduates from a UK university has pointed out the increasing significance of S&E Ph.Ds working in non-research academic/public research jobs and the dominance of employment outside the conventional technical occupations (e.g. managerial activities, business services and consultancy in industry) (Lee et al. 2010).

Therefore, it appears that Ph.Ds have the potential for diversified career options contributing to knowledge production and absorption across many sectors in the economy. In addition, the extent of their employment outside academia may have an impact on how academic research is transferred to industry. Essentially, entrepreneurial efforts to commercialize technologies or knowledge produced in their research labs would allow Ph.D. graduates who do not wish or do not have the ability to become academics to pursue a diverse but viable career path that builds on their doctorate training. Finally, it was also pointed out the importance of doctorate training for individuals who started but never completed their studies as they have chosen to develop their inventions or ideas by starting up a new business (CDH-KNOWINNO Project, Final Report 2013).

In the present study a wider perspective of academic entrepreneurship is adopted suggesting that agents who have been exposed to academic research for significant lengths of time can create high-potential entrepreneurial ventures. Moreover, it is assumed that these new endeavors do not essentially encapsulate scientific or research knowledge directly created and consequently transferred from university into the business setting. In this vein, these ventures can be founded by people with a strong scientific background and a prior formal relationship with the academia who do not necessarily exploit knowledge generated during their academic career. In particular, we hypothesize that Ph.D. holders can be involved in 'high-potential' entrepreneurial action or knowledge intensive entrepreneurship setting up firms which focus on the dynamic application of new knowledge.

Taking into consideration that the educational attainment and previous research exposure of founders may be strongly related to innovative entrepreneurship (Arvanitis and Stucki 2012; Shane 2004), these individuals constitute a pool of high-potential would-be entrepreneurs. In this paper we investigate whether new ventures founded by Ph.D. holders exhibit different characteristics and/or different behavioral patterns compared to the rest of the firms established in the same period in Europe. More specifically, we try to link prior academic research exposure to knowledge-intensive entrepreneurship (KIE).

Knowledge-intensive entrepreneurship can be considered a type of high-potential entrepreneurship. It indicates ventures the initiation or expansion of which is based on the dynamic application of new knowledge. Knowledge-intensive firms can play important roles in sectoral, local and national innovation systems by operating as problem-solvers, knowledge brokers, knowledge-intensive service providers, or specialized suppliers. Following Malerba and McKelvey (2016), we rely on a formal definition of knowledge-intensive entrepreneurship developed in the context of AEGIS,[1] a large-scale, integrated, EU-funded research project. Here, KIE is associated with four basic characteristics: (a) new firms (ventures); (b) new ventures that are innovative; (c) new ventures engaging in

[1]EU funded research project "Advancing Knowledge-Intensive Entrepreneurship and Innovation for Economic Growth and Social Well-Being in Europe" (AEGIS), 7th Framework Programme for Research and Technological Development, European Commission.

activities that are knowledge-intensive; and (d) new ventures that are not to be found solely in high-tech industries, but may well be active in lower technology industries.

## 2.3 Data

The data used in the analysis originate in the AEGIS survey. The survey purported to identify the motives, characteristics and patterns in the creation and growth of knowledge-intensive young firms in high-tech manufacturing, low-tech manufacturing and knowledge intensive business services (KIBS). For the purpose of this study we delineated young firms as those founded between 2001 and 2007 i.e. firms that had been established for 10 years or less at the time of the survey and also had managed to exceed the critical three-year survival threshold. At the time of the survey, then, the sample firms were between 3 and 10 years old (average firm age 6.81 years) and were established in ten European countries: Croatia, Czech Republic, Denmark, France, Germany, Greece, Italy, Portugal, Sweden, and UK.

The survey targeted 18 sectors spanning the categories high tech, medium high tech, medium low tech, low tech, and knowledge-intensive services (see Annex).

The initial population of companies was drawn from the Amadeus database, which contains comprehensive information on over 18 million companies across Europe. This was supplemented with companies from additional data sources, namely Kompass and Dun & Bradstreet, in order to reach the pre-selected targets of sample stratification per country and sector combination.

Data were collected through telephone interviews with one of the firm's founders carried out by a professional company using a structured questionnaire. The survey was launched in September 2010 and was completed in March 2011. A total of 4004 complete questionnaires were obtained, with data on almost 300 variables. Table 2.1 summarizes the obtained completed questionnaires per country across three categories of sectors: high tech (high and medium-high-tech), low tech (medium-low- tech and low-tech), and KIBS.[2] The average response rate to the questionnaire was 31.2%, however it varied from country to country ranging from 19.5% in the UK to 39.9% in Croatia.

In this paper we isolate the subsample of these new entrepreneurial firms that count among their founders at least one doctorate (Ph.D.) degree holder. These are 323 companies spread across all ten European countries. Their distribution across major sector groupings is shown in Table 2.2, in comparison to the sectoral distribution of non-Ph.D. founder firms. Knowledge-intensive business services account for a disproportionately large share: more than two-thirds of the Ph.D.-founder firms compared to almost half of the rest.

[2]See Annex for an analytical list of sectors in the three sector groups.

**Table 2.1** Firm distribution across country and sector group

| Country | Sector groups | | | Total |
|---|---|---|---|---|
| | High-tech | Low-tech | KIBS | |
| Croatia | 29 | 114 | 57 | 200 |
| Czech Republic | 26 | 78 | 96 | 200 |
| Denmark | 35 | 69 | 226 | 330 |
| France | 59 | 189 | 322 | 570 |
| Germany | 67 | 161 | 329 | 557 |
| Greece | 22 | 177 | 132 | 331 |
| Italy | 63 | 287 | 230 | 580 |
| Portugal | 29 | 154 | 148 | 331 |
| Sweden | 37 | 90 | 207 | 334 |
| United Kingdom | 56 | 160 | 355 | 571 |
| Total | 423 | 1479 | 2102 | 4004 |

**Table 2.2** Subsample characteristics

| Sector group | Ph.D. founder firms | | Non-Ph.D. founder firms | |
|---|---|---|---|---|
| | # | % | # | % |
| High-tech | 50 | 15.5 | 373 | 10.1 |
| Low-tech | 45 | 13.9 | 1434 | 39.0 |
| KIBS | 228 | 70.6 | 1874 | 50.9 |
| Total | 323 | 100 | 3681 | 100 |

The majority of firms in both subsamples are micro firms with up to 10 people. Micro firms account for 64% of the firms in the Ph.D.-founder subsample for 60% of the firms in the non-Ph.D. founder subsample.

## 2.4 Findings

Our basic premise is that exposure of company founders to university research affects entrepreneurial incentives and behavior in ways that reflect higher levels of creation and use of scientific and technological knowledge and market niche specialization. We look at the educational levels of employees, factors affecting firm formation, funding sources, factors to create and sustain competitive advantage, overall strategic direction, sources of knowledge, and innovativeness by two groups of new companies: those founded by at least one person holding a Ph.D. degree and the rest.

### 2.4.1 Educational Level of Employees

A very first indication that firms founded by entrepreneurs exposed to university research are more knowledge intensive comes from the finding that in our sample across 10 European countries and across 18 sectors the vast majority of such firms

**Table 2.3** Firms employing people holding a university degree per sector group

| | Ph.D. founder firms | | | Non-Ph.D. founder firms | | |
|---|---|---|---|---|---|---|
| Sector group | N | % | Mean number of university graduates | N | % | Mean number of university graduates |
| High-tech | 44 | 88.0 | 6.59 | 222 | 59.5 | 5.85 |
| Low-tech | 39 | 86.7 | 4.56 | 740 | 51.6 | 3.35 |
| KIBS | 211 | 92.5 | 9.16 | 1343 | 71.7 | 6.15 |

(91%) employ university graduates with a mean number of 8 per firm compared to 63% of all other firms and a mean number of 5 such employees (university graduates).[3] Breaking these numbers down per aggregate sector of activity, we observe sustained behavior across sectors with differences intensifying in low-tech sectors and KIBS (Table 2.3). Interestingly, differences increase when we look at employees with Ph.D. degrees (Table 2.4) where only a tiny 6% of non-Ph.D. founder firms employ a person with such a degree compared to more than three-fifths of the Ph.D. founder firms. These differences are consistent across all sector groups (Table 2.5).

### 2.4.2 Firm Formation and Availability of Finance

The observed differences above in terms of university graduates' employment do not carry over to the factors affecting firm formation (Table 2.5). Similar factors lead to company formation across the two subsamples. Irrespective of the education achievement of their founders, firms are established in fields where founders have had significant prior experience and adequate market knowledge. Technical knowledge in this field, knowledge of the specific market, and networks established in prior career are quite important factors in setting up a company. T-tests across the two groups indicate that firms with Ph.D. founders exploit more effectively their technical and engineering knowledge in the field, while at the same time they appear to evaluate the identification and exploitation of opportunities related to changes in technologies or markets as more important factors for firm set up compared to their counterparts.

Such observations hint to a positive link between prior significant exposure to academic research and to fields of business activity that require it and a tendency to continue in the same trajectory in their newly established business. That is, a focus on more knowledge intensive market niches.

Similar observations could be made for funding sources. The two subsamples seem to behave quite similarly with the exception of greater support of new firms with Ph.D. founders by venture capital (Table 2.6). The difference between the two

[3]We would expect the differences to be even larger if the comparison population was firms founded strictly by non-university graduates.

**Table 2.4** Firms employing people holding a Ph.D. degree per sector group

| | Ph.D. founder firms | | | Non-Ph.D. founder firms | | |
|---|---|---|---|---|---|---|
| Sector group | N | % | Mean number of Ph.D. holders | N | % | Mean number of Ph.D. holders |
| High-tech | 35 | 70.0 | 2.23 | 25 | 6.7 | 2.24 |
| Low-tech | 30 | 66.7 | 1.73 | 57 | 4.0 | 1.77 |
| KIBS | 161 | 70.6 | 2.24 | 130 | 6.9 | 1.79 |
| Total | 226 | 70 | 2.17 | 212 | 6 | 1.84 |

**Table 2.5** Factors affecting firm formation

| | Ph.D. founder firms (N = 320) | Non-Ph.D. founder firms (N = 3658) | *t*-test (observed differences) |
|---|---|---|---|
| Factors | Average rating | Average rating | |
| Work experience in the current activity field | 4.34 | 4.31 | 0.317n.s. |
| Technical/engineering knowledge in the field | 4.07 | 3.81 | 3.408*** |
| Design knowledge | 3.03 | 3.04 | −0.198n.s. |
| Knowledge of the market | 3.98 | 4.06 | −1.364n.s. |
| Networks built during previous career | 3.85 | 3.73 | 1.669n.s. |
| Availability of finance | 3.37 | 3.33 | 0.634n.s. |
| Opportunities in a public procurement initiative | 1.97 | 2.10 | −1.779n.s. |
| Existence of a large enough customer | 3.04 | 3.27 | −2.804*** |
| Opportunity deriving from technological change | 3.23 | 2.95 | 3.349*** |
| Opportunity deriving from a new market need | 3.42 | 3.25 | 2.096** |
| Opportunity deriving from new regulations or institutional requirements | 2.44 | 2.50 | −0.636n.s. |

*** denote statistical significance at $p < 1\%$, n.s.: no significant differences observed

subsamples was basically compensated by a relatively larger support of firms with no Ph.D. founders by banks (implying lower risk). For those firms receiving it, venture capital funding accounted for a very significant share of funding (Table 2.7).

### 2.4.3 Success Factors and Strategy

The ranking of critical factors for creating and sustaining competitive advantage indicates that in both cases market focus and offering novel products or services dominate. For companies with non-Ph.D. holders in their founding team it appears

**Table 2.6** Funding sources

| | Ph.D. founder firms (N = 315) | | Non-Ph.D. founder firms (N = 3605) | |
|---|---|---|---|---|
| Funding sources | # | % | # | % |
| Own financial resources | 287 | 91 | 3303 | 92 |
| Family member | 29 | 9 | 337 | 9 |
| Previous employer | 14 | 4 | 78 | 2 |
| Venture capital | 35 | 11 | 142 | 4 |
| Bank | 60 | 19 | 1018 | 28 |
| National government or local authorities | 31 | 10 | 250 | 7 |
| EU funds | 9 | 3 | 103 | 3 |
| Other sources | 27 | 9 | 150 | 4 |

**Table 2.7** Average percentage of funding

| | Ph.D. founder firms | Non-Ph.D. founder firms |
|---|---|---|
| Funding sources | Average % funding | Average % of funding |
| Own financial resources | 76.99 | 79.49 |
| Family member | 34.10 | 43.27 |
| Previous employer | 45.36 | 43.94 |
| Venture capital | 61.11 | 40.73 |
| Bank | 45.13 | 51.98 |
| National government or local authorities | 32.48 | 34.36 |
| EU funds | 27.78 | 34.51 |
| Other sources | 62.11 | 57.08 |

that the capability to offer products at low cost is a more significant success factor. For companies with Ph.D. founders R&D activities, networking activities and relationships with other firms or universities take up higher importance (Table 2.8). Marketing and promotion activities seem to be equally important for both groups.

Main company strategy is to offer unique products and services followed by the exploitation of new market niches at some distance (Table 2.9). Offering standardized products at low cost appears to be the least popular option for both groups. However, the percentage of firms with non-Ph.D. founders implementing the latter strategy is significantly higher compared to that of firms with Ph.D. holders.

### 2.4.4 Sources of Knowledge

Clients are clearly the most important source of knowledge for indentifying business opportunities in both business groups. However, companies with Ph.D. founders assign relatively lesser role to suppliers and higher importance to internal sources of knowledge including R&D and know-how (Table 2.10). Other external

**Table 2.8** Factors for creating and sustaining competitive advantage

| | Ph.D. founder firms (N = 323) | Non-Ph.D. founder firms (N = 3521) | *t*-test |
|---|---|---|---|
| Success factors | Average rating | Average rating | |
| Capability to offer novel products/services | 3.76 | 3.68 | 1.287n.s. |
| Capacity to adapt the products/services to the specific needs of different customers/ market niches | 4.23 | 4.22 | 0.087n.s. |
| Capability to offer expected products/ services at low cost | 3.00 | 3.29 | −4.201*** |
| R&D activities | 3.59 | 2.88 | 8.593*** |
| Establishment of alliances/partnerships with other firms | 3.26 | 2.92 | 4.407*** |
| Capability to offer high quality product/ services at a premium price | 3.89 | 3.72 | 2.597** |
| Networking with scientific research organizations | 3.00 | 2.18 | 10.325*** |
| Marketing and promotion activities | 3.22 | 3.23 | −0.035n.s |

***, ** denote statistical significance at $p < 1\%$, and $p < 5\%$ respectively, n.s.: no significant differences observed

**Table 2.9** Main strategy

| | Ph.D. founder firms (N = 323) | | Non-Ph.D. founder firms (N = 3681) | |
|---|---|---|---|---|
| | # | % | # | % |
| Offer standardized products and services at low cost | 31 | 9.6 | 608 | 16.5 |
| Offer unique products and services | 199 | 61.6 | 2148 | 58.4 |
| Exploit opportunities in new market niches | 93 | 28.8 | 925 | 25.1 |

sources of knowledge such as universities and research laboratories are reported of moderate importance in both cases. However, they appear to be ranked higher by firms with Ph.D. founders. Participation in nationally or EU-funded research projects appears to be limited across the two groups. Nevertheless, these knowledge sources appear more significant for companies with Ph.D. holders in their founding team.

These findings suggest that although both groups rely mainly on external knowledge sources related to industry (clients and competitors) to explore new technological and market opportunities, firms with Ph.D. founders appear to rely more on in-house R&D activities and external knowledge sources related to science and research activities for this purpose. This may be argued to indicate a more prominent capability both in generating new knowledge and in absorbing scientific knowledge through participation in collaborative activities. Most interestingly,

**Table 2.10** Sources of knowledge

| Sources | Ph.D. founder firms (N = 323) Average rating | Non-Ph.D. founders (N = 3681) Average rating | *t*-test |
|---|---|---|---|
| Clients or customers | 4.40 | 4.41 | −0.223n.s. |
| Suppliers | 2.82 | 3.41 | −7.639*** |
| Competitors | 3.22 | 3.28 | −0.858n.s. |
| Public research institutes | 2.45 | 2.07 | 5.000*** |
| Universities | 2.67 | 2.07 | 7.546*** |
| External commercial labs/R&D firms/ technical institutes | 2.22 | 2.02 | 2.868*** |
| In-house (know how, R&D laboratories in your firm) | 3.84 | 3.22 | 7.925*** |
| Trade fairs, conferences and exhibitions | 3.08 | 2.94 | 1.895n.s. |
| Scientific journals and other trade or technical publications | 3.21 | 2.84 | 4.896*** |
| Participation in nationally funded research programmes | 2.27 | 1.86 | 5.140*** |
| Participation in EU funded research programmes | 2.11 | 1.85 | 3.293*** |

*** denote statistical significance at $p < 1\%$, n.s.: no significant differences observed

**Table 2.11** Introduction of innovations

| | | Ph.D. founder firms | | Non-Ph.D. founder firms | |
|---|---|---|---|---|---|
| | | # | % | # | % |
| Radicallness of innovation | No innovation | 82 | 25 | 1374 | 37 |
| | New-to-firm | 49 | 15 | 825 | 22 |
| | New-to-market | 102 | 32 | 1002 | 27 |
| | New-to-world | 90 | 28 | 480 | 13 |
| Total | | 323 | 100 | 3681 | 100 |

suppliers appear to be more important knowledge source for companies with non-Ph.D. founders suggesting that these firms try to balance their lack of internally generated knowledge with knowledge seeking activities related to industry actors.

### 2.4.5 Innovation

Three quarters of the firms with Ph.D. founders reported to have introduced new or significantly improved goods or services in the last 3 years compared to two-thirds of the remaining (Tables 2.11 and 2.12). This was consistent across sector group, with firms in high-tech sectors leading firms in low-tech sectors followed closely by

**Table 2.12** Intellectual property protection

| | Ph.D. founder firms | Non-Ph.D. founder firms |
|---|---|---|
| Methods | % | % |
| Patents | 31.5 | 15.0 |
| Trademarks | 49.8 | 40.2 |
| Copyrights | 34.9 | 26.7 |
| Confidentiality agreements | 79.7 | 52.2 |
| Secrecy | 58.5 | 38.5 |
| Lead-time advantages on competitors | 59.8 | 53.1 |
| Complexity of design | 57.7 | 44.5 |

KIBS. It is important to note that innovating firms with Ph.D. founders outperform their counterparts in terms of introducing new-to-the market and especially new-to-the world innovations indicating capability to introduce more radical product innovations.

The firms in our sample generally use more informal (secrecy) or semi-informal (confidentiality agreements, trademarks) than formal (patents and trademarks) methods of intellectual property protection. Informal protection methods are often much simpler and faster to introduce than formal protection methods, and can be maintained with limited resources, which is very important especially for newly established firms. Formal protection methods require major financial and human resources if they are to be exploited thoroughly in business. Nonetheless, firms with Ph.D. founders use all methods of intellectual property protection more extensively than the rest (Table 2.12).

It is also worth noting that companies founded by Ph.D. holders also reported higher innovative inputs in terms of R&D expenses compared to the second group. Results suggest that there is a statistically significant difference in terms of the percentage of turnover spent on R&D activities during the last 3 years.

### 2.4.6 Firm Performance

Growth in firm size provides one measure of performance over time. Firm growth can be measured in terms of inputs (e.g. employees), value (e.g. assets) or outputs (e.g. sales revenues) (Delmar 1997; Weinzinmer et al. 1998; Colombo et al. 2010). We measure growth in terms of employees and sales. In addition we measured firm performance as the percentage of sales obtained in international markets during the last three years. Internationalization exposes young firms to multiple and diverse exogenous (e.g., competitive conditions) and endogenous stimuli (e.g., resource demand) (Sapienza et al. 2006). It reflects the degree of young firms' success in pursuing opportunities beyond domestic markets. Table 2.13 suggests that firms with Ph.D. founders outperform firms with non-Ph.D. founders in all performance measures used.

**Table 2.13** Firm performance

| Firm performance | Firm type | N | Mean | *t*-test (observed differences) |
|---|---|---|---|---|
| % sales in international market | Ph.D. founders | 323 | 26.04 | 6.466*** |
| | Non-Ph.D. founders | 3681 | 13.43 | |
| Avrg. growth sales (quartile) | Ph.D. founders | 301 | 5.77 | 2.966*** |
| | Non-Ph.D. founders | 3361 | 5.25 | |
| Avrg. growth employment (quartile) | Ph.D. founders | 306 | 2.29 | 2.589** |
| | Non-Ph.D. founders | 3391 | 2.08 | |

***, ** denote statistical significance at $p < 1\%$, and $p < 5\%$ respectively

## 2.5 Concluding Remarks

Research on the role of university graduates in pursuing entrepreneurial action is lacking although it appears to be a very important phenomenon. Most interestingly, Ph.D. holders are able to exploit business ideas of higher technological/knowledge content compared to other graduate students (Lee et al. 2010). Taking into consideration that the number of Ph.D. graduates keeps rising in modern economies it is important to better understand their role and impact in the emerging new entrepreneurship ecosystem.

This explorative work used a rich European dataset to take an initial look at the structure and behavior of young companies established by entrepreneurs holding advanced (doctoral) degrees. In this respect, the paper explores the formation and relative performance of new entrepreneurial ventures created by persons who have been previously exposed to academic research for a considerable amount of time. We suggest that this can be considered as a form of broadly defined academic-related entrepreneurship. We hypothesized that Ph.D. holders can be involved in "high-potential" entrepreneurial activity setting up firms focusing on the dynamic application of new knowledge. Our interest in this form of "high-potential entrepreneurship" stems from the fact that in the knowledge intensive economy this type of entrepreneurial activity matters more than ever before for economic development (Autio and Acs 2007; Henrekson and Johansson 2011) as it provides a link between the production of new technological knowledge and its consequent commercialization (Delmar and Wennberg 2010). Moreover, to the best of our knowledge, empirical evidence on entrepreneurial ventures founded by Ph.D. degree holders is practically non-existent.

The paper uses data from a large-scale survey undertaken in ten European countries which reached over 4000 young, small firms established during 2001–2007 in a set of manufacturing sectors and knowledge-intensive services. About one-tenth of this population has been established by entrepreneurs holding doctoral degrees.

Our findings suggest that young European companies whose founders have been exposed to academic research indicate, on the aggregate, a fair degree of similarity in behavior to those whose founders have not had the same exposure. Important similarities between the two groups of companies include: (1) Market focus and offering novel products or services are the critical factors for creating and sustaining competitive advantage; (2) Main company strategy is to offer unique products and services followed at some distance by exploiting new market niches; (3) Clients are the most important source of knowledge.

In addition, however, our results reveal that the former group of firms (Ph.D. founders) exhibits extensive dependence on university graduates and post graduates as employees, higher reliance on venture capital funding, higher dependence on internal R&D and external scientific and research networks as sources of knowledge, better innovative performance especially in terms of new-to- the world products, increased awareness of intellectual property protection and, last but not least, better performance both in terms of both employment/sales growth and international sales.

These results are suggestive rather than conclusive as they are obtained through simple tabulations and t-tests rather than extensive econometric analysis. Nonetheless, we believe that they are indicative of important differences in behavior and performance of companies founded by people with significant prior exposure to academic research.

In terms of policy, as new forms of academic entrepreneurship emerge the university-based entrepreneurial ecosystems should also evolve taking into consideration indirect effects of universities such as start-ups created by graduates and especially Ph.D. holders. Our findings suggest that national and regional policy makers as well as university administrators should promote Ph.D. entrepreneurship as it may offer large opportunities to foster the creation of highly dynamic knowledge intensive ventures that can dramatically improve regions' and countries' economies. For example, the design of educational programmes that foster entrepreneurship, the increase of students' involvement in university-industry collaboration and the organization of ad-hoc courses for scientists on entrepreneurship can enhance institutions' capability to have a tangible effect on local development processes and at the same time offer better career opportunities to students.

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## Annex

**Table 2.14** Industry coverage in the AEGIS survey

| Selected sectors | NACErev. 1.1 code |
|---|---|
| High-technology manufacturing sectors | |
| Aerospace | 35.3 |
| Computers and office machinery | 30 |
| Radio-television and communication equipment | 32 |
| Manufacture of medical, precision & optical instruments (scientific instruments) | 33 |
| Pharmaceuticals | 24.4 |
| Medium to high technology manufacturing sectors | |
| Manufacture of electrical machinery & apparatus | 31 |
| Manufacture of machinery and equipment | 29 |
| Chemical industry (excl. pharma) | 24 (excl. 24.4) |
| Low-technology manufacturing sectors | |
| Paper and printing | 21, 22 |
| Textile and clothing | 17, 18, 19 |
| Food, beverages and tobacco | 15 + 16 |
| Medium to low manufacturing sectors | |
| Basic metals | 27 |
| Fabricated metal products | 28 |
| KIBS sectors | |
| Telecommunications | 64.2 |
| Computer and related activities | 72 |
| Research and experimental development | 73 |
| Other business services activities | 74.1, 74.2, 74.3, 74.4, 74.5, 74.8[a] |

[a]Selection of most 4-digit sectors. Only some 74.87 (“other activities”) excluded

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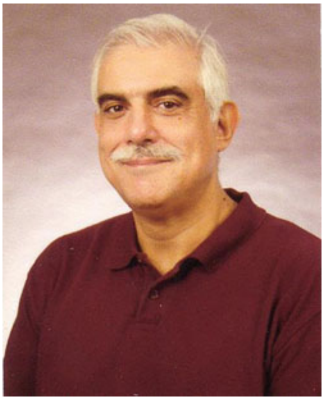

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# Entrepreneurial Universities: Towards a Revised Paradigm

# 3

Dirk Meissner

**Abstract**

This chapter explains the entrepreneurial university concept and its place and role in the triple helix in its entirety. It further elaborates on its implications for university management, departments, faculty members and supporting organizations. Moreover it reflects the meaning of the entrepreneurial university for stakeholders, i.e., university boards, regional and national policy and administrative bodies, funding agencies, the business community, university ranking institutions and the global university community overall. The chapter provides a comprehensive understanding of the entrepreneurial university, which is increasingly important because stakeholders' expectations towards universities are growing. This in turn leads to increased pressure on universities to move beyond their traditional roles and models towards taking responsibility for economic development, large scale basic education and targeted further education and the development of value from research. These expectations provide opportunities for universities, but impose threats on the existing models and practices. Recent literature on entrepreneurial universities is incomplete and mostly focused on the commercialization of research, technology transfer and the third mission of universities. The article expands the predominant thinking about entrepreneurial universities and gives a broader structured definition.

This chapter draws extensively on Meissner, D. (2017). Entrepreneurial Universities – Towards a Revised Paradigm. STI Policy Review Vol 8, No 1, pp 23–40

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**Keywords**
Triple helix · Knowledge triangle · Entrepreneurial university · Industry-science relationships · University-industry linkages · Open innovation · Active innovation

## 3.1 Entrepreneurial Universities in the Triple Helix and Knowledge Triangle

The role and meaning of universities for the wellbeing of societies is frequently under discussion by many different interest groups. In principle, universities are thought to be places of free thinking beyond the current knowledge of society and they have a function to explain complex phenomena which are not widely understood so far. In this regard universities are expected to take the role of think tanks, providing knowledge to decision makers at different levels, which brings an advantage to the people and countries in a sense that 'knowledge is power', e.g. the more one knows the more power and control one has over others. This common wisdom is one of the major motivations for governments to establish and support public universities and to allow private universities to exist. It is important to note the difference between public and private universities. The difference does not appear in the funding structure of the respective institution alone, but strongly impacts the organizational setup and the decision power of bodies steering the institutions and the resulting freedom of research and teaching staff.

The term 'entrepreneurial university' has been in frequent use since the early 2000s when Etzkowitz and Leydesdorf (2000) described the Triple Helix and found that universities are confronted with the quest to fulfill a third mission in addition to education (teaching) and research, which they postulated to be innovation. From this argument, they concluded that the university model is shifting towards an entrepreneurial model that stresses the application and exploitation of research, i.e., technology transfer. In this regard, the term 'entrepreneurial university' is misleading because it emphasizes the entrepreneurial activities of universities but pays limited attention to actual research and teaching. Furthermore the underlying assumption is that universities are developing strategies in all three fields and implement them accordingly (Fig. 3.1).

At first sight, one might argue that there is a reasonable overlap in the basic missions and activities of universities and companies, which, in principle, is true. However the generalized picture is not applicable to real conditions for several reasons. The intensity of the activities of universities and industries varies in all three dimensions (Bell 2010). Therefore the assumption that universities and industries' activities are complementary is not justified. Also, each of the missions imposes completely different requirements and expectations on the actors, i.e., universities and companies (Guinet and Meissner 2012). Aligning these is an ambitious undertaking which requires employees' support in the respective organizations. Finally, the actors shown are subject to different legal requirements imposed by governmental initiatives and the legal framework. Whereas for

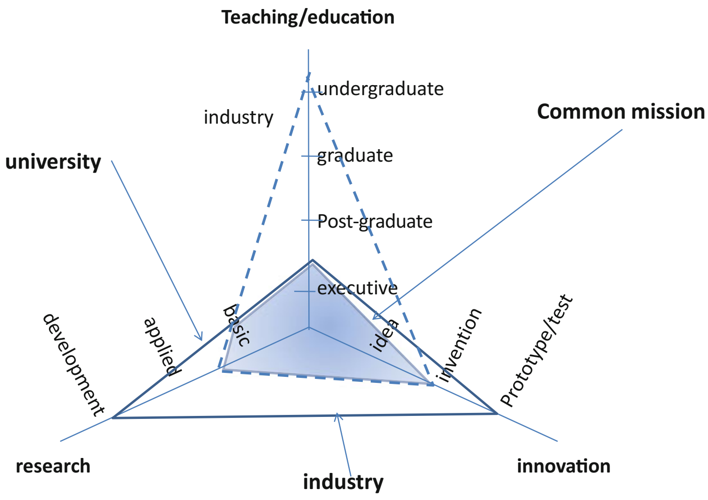


**Fig. 3.1** The overlap of universities' and companies' focus in the Triple Helix

companies, the liberal market thinking allows unlimited access, universities frequently enjoy the legal protection of academic freedom by law (often fixed in national constitutions) which puts universities in the unique position of making decisions about the use and application of knowledge and technology. This holds true for the university as an institution but even within the university this varies between faculties and schools (Martinell et al. 2008).

The challenges for universities that arise from changing the research, education and innovation environments are found in a more interactive and feedback-driven transfer approach of research competence and results, replacing the traditional linear transfer approach and the quest for universities to reorganize research agendas and portfolios to address new technology developments, which stresses interdisciplinary collaboration (Youtie and Shapira 2008). Despite the fact that many universities have established dedicated units to enforce technology and knowledge transfer, a reasonable share of relationships between university members (research and/or teaching staff) are engaging in external relations aimed directly at innovation, i.e., bilaterally without involving these dedicated units (Siegel et al. 2004).

It is the common view of governments that the existence of a university supports the attraction of foreign direct investment, which is especially dedicated to R&D activities. This belief can be traced back to the work by Luger and Goldstein (1997) who postulated that the human resources trained and educated by universities and the transfer of research results and research competences, which are core to universities, generate respective spillovers which companies are taking into account when establishing R&D facilities. Therefore governments aim at developing the regional innovation ecosystems involving private R&D investment friendly frameworks which are also assumed to attract follow up investment into other stages of the value chain (Sivak and Yudkevich 2008). The impact of universities takes many different shapes but mainly it is believed that universities fulfil the role of a “knowledge hub” with a primary regional outreach for the developed competences (Youtie and Shapira 2008).

Furthermore, it needs to be remembered that universities are frequently publicly funded with close links to public bodies such as governments (Schibany and Reiner 2014). In this regard, university staff at all levels is de facto government staff, which is under the steering and control of public agencies and is more or less directly forced to fulfil tasks and implement strategic ambitions imposed by governments. The latter is an issue which is hardly debated, and implicitly known and accepted. Dooley and Kirk (2007) argue that technology transfer is often a one-way channel for inserting existing technologies and knowledge, which stem from universities’ activities, into a company’s innovation processes, but hardly integrates feedback loops, which potentially inspires universities to design their own research activities. Moreover, the discussion and analysis of industry-science linkages focused for long time on the core of the transfer, namely knowledge and technologies from universities, while little attention has been paid to complementary sources of specialist knowledge such as consultancies and private research institutes. Such knowledge-intensive services (KIBS) are becoming increasingly important in creating and commercializing new products, services and technological processes. Given the structures of most innovation systems, such institutions should not be neglected as they complement the capacities of universities and other public research organizations.

Also universities need to be seen in a regional and national context, because different countries and regions are at different stages of development (Bramwell and Wolfe 2008). Highly developed economies which put a strong emphasis on upgrading the national economy to a knowledge economy, digital economy or any related concept, assume that industry possesses the necessary absorptive capacities to successfully apply and ‘digest’ universities’ research and teaching output (Etzkowitz et al. 2008). Depending on the national context, universities might have to develop human resources to upgrade a country to a knowledge economy. Therefore, universities are mainly challenged by their educational function instead of delivering technology to industry for further application. Furthermore universities’ research activities in these countries are focused on the absorption and assimilation of incoming technologies from the global scientific community with little being done on completely new knowledge generation (Wong et al. 2007). The reason is found in the national economy’s structure, which is often natural resource or commodity based and thus a basic technology base has not been developed. There are a reasonable number of countries which are on this development trajectory. Most of them experience that over the course of this transition, the low-wage feature of the economies is increasingly replaced by the call for higher wages, which is typical for knowledge-based economies, however, the transition period is significantly longer than commonly expected and understood. In this light, there is the view that well-established, highly reputed institutions are best equipped to provide the necessary education and training required.

The chapter proceeds as follows. The second part discusses the entrepreneurial university and shapes of universities’ linkages and, finally the third section develops a revised ‘entrepreneurial university’ paradigm. The concluding section develops a framework for the main stakeholders, organizations and units involved in the entrepreneurial university.

## 3.2 The Entrepreneurial University and External Linkages

The widespread perception of the contribution of universities to the advancement of science and more recently to innovation has lead to the emergence and global diffusion of university rankings, which are used by different communities, including the policy maker community, the university management community and potential and existing students as well as alumni communities. These rankings are frequently used to compare universities according to the predefined criteria which are imposed by the ranking institution. However thus far the term ‘entrepreneurial university’ is understood as a university which engages in the commercialization of its services in education and research, hence delivering its own innovations or significantly contributing to innovations by companies and spin-offs from the universities. The term also needs to include the education and the actual research mission of universities in order to better reflect reality. Whereas Etzkowitz et al. (2000) postulate the exploitation function of research results as the core of the “entrepreneurial university,” today this thinking needs to be extended beyond the original horizon for the following reasons:

1. The pure focus on technology and knowledge transfer barely reflects the content developed by universities in terms of research performed and educational programs designed.
2. The linkage of a university’s internal knowledge transfer between research and education is not considered at all.
3. The full potential of the broad range of available knowledge and technology transfer channels is not covered by the sole focus on technology transfer and commercialization.
4. This focus ignores the technology life cycle and the often immature technologies under consideration for transfer.
5. Considering a university an ‘entrepreneurial university’ based on the technology commercialization aspect alone would require a significant change of universities’ portfolio of activities and the dominance of university management accounting and control, and also the faculty’s short-term mind-sets to meet stakeholder interest and the resulting requirements.

The now predominant understanding of the ‘entrepreneurial university’ is too narrow because it does not reflect the full range of linkages between universities and the other actors in the national innovation system, the Knowledge Triangle. These linkages typically cover the full spectrum of universities’ activities and its relationships with the surrounding actors and are described in the following paragraphs.

Well-established linkages between universities and industry as well as governments are found in the **education and further education** role of universities. Here the actual tertiary education at the undergraduate, graduate and also postgraduate levels together with targeted further education programs is one channel of transferring knowledge and technology which has been established for a long time. The challenge for entrepreneurial universities is to adapt the curricula to the changing requirements and environments and to maintain high quality levels.

It has frequently been observed that universities introduce full-fledged programs entitled '*entrepreneurship*', '*innovation management*' or similar to meet the challenge of entrepreneurial education imposed on universities primarily by governments and partially by companies. The underlying assumption is that such programs inspire currently enrolled students to take entrepreneurial and innovator roles and also motivate university research staff doing the same. However, this requires an initial motivation of students and employees who consider different paths for their future careers, but it hardly reaches the full audience to raise awareness about innovation and entrepreneurship on a wide scale. There is some episodically experience that integrating innovation and entrepreneurship in existing curricula on a very modest scale, for example by complementing core course of engineering, natural and social science programs, shows a strong impact because students in such fields are becoming familiar with the entrepreneurship and innovation at the early stages of their education and professional careers.

*Further education* programs, including executive education, complement the educational programs offered by universities. These programs are typically designed to meet the demand of a targeted group of companies or individuals for special topics and themes.

Debates about the entrepreneurial university and the Knowledge Triangle (the Triple Helix concept respectively) frequently consider **R&D cooperation** between universities and mainly companies as the main features used for describing the entrepreneurial spirit of universities. However, such cooperation varies in extent, scope and duration among many other typical project features. The most widespread linkage appears in form of *contract research*, which is aimed at universities working on a predefined subject for a company that is fixed in a formal contract. A similar constellation is found in *joint research projects*, which are undertakings in which a university and a company cooperate, or sometimes this involves several universities and companies. In this case, it frequently happens that research or innovation funding agencies are involved by financially supporting these activities. More recently, *public private partnerships for STI* (STI PPP) are emerging which bring together universities and companies for research and innovation and are commonly designed for longer periods of cooperation and work on more complex topics and fields than contract or joint research undertakings. In addition, universities and their employees are typically involved in networks of a different shape, e.g., cluster organizations, technology platforms among others, which aim at research and innovation partnerships.

Another important channel for transferring technology and knowledge between industry and universities as well as governments and governmental bodies is by means of **scientific communication** including scientific publications, conferences and other kinds of publications. These channels of communication take different shapes: in traditional hard copy *journals* or *books* as well as through personal interaction during relevant events. Also *university libraries* are a frequently used source of information and knowledge for non-university employees when it comes to gathering complementary knowledge or information which is not fully connected to actual research- or innovation-related challenges.

Another related channel is *doctoral students* and the respective *doctoral studies* which attempt to expand the horizon of scientific knowledge. Most recently these works increasingly include the application of the underlying scientific work, which makes them valuable for use by industrial communities. Furthermore there is a tendency for universities to accept and supervise doctoral studies by so called "external doctoral students," who hold positions at companies or other organizations outside universities while performing doctoral qualification programs. This approach allows for a targeted analysis of phenomena which are relevant for application and use but not fully covered in the scientific community. The same appears in case of the *graduate thesis*, i.e., the Master's thesis, which often focuses on the application of existing knowledge and solutions for specified tasks and challenges and are done in cooperation with universities and companies or governments and their affiliated bodies.

In addition to the channels in this section, there are *sponsored professorships or institutes,* which, though financed by a non-university sponsor are per se independent from any external influence, but are often complemented with boards or councils who possess significant influence over the research agenda of the professorship or department. Accordingly sponsors of such entities are frequently members of councils or boards and therefore possess reasonable indirect influence over the entities' activities.

Complementing the linkages described under education/further education and scientific communication, **information and communication technology**-related channels need to be touched upon. *Scientific and technical information* (including patents) as well as publications are commonly stored on online *databases* operated by different actors. Only recently such depositories are changing from paid models to open access models. These emerging models are broadly believed to enable faster diffusion of information to a broader audience. Another frequently used informative channel are *social media platforms* and *topic specific communities and networks* including blogs among many other forms, which provide information and knowledge and facilitate the exchange of experiences, views and assessments within and beyond communities.

Over the last several decades, universities began to increasingly use **intellectual property rights** (IPR). Mainly universities focus on patents and the commercialization of patents by using different exploitation paths such as licences, sale of patents or using patents as investments into spin-off companies and the like. Less frequently, universities are engaging in trademarks and related IPR. The challenge for universities' engagement in IPR-related activities is in the first instance to develop and establish a seamless invention disclosure scheme which takes into account the special organizational structure of universities and the awareness of university employees for these. Furthermore, university research activities are often thought to be very basic in nature and therefore risky in application and often not eligible for IPR with the potential for exploitation. This thought remains debatable and is certainly applicable to a limited number of science and research fields only. The bigger problem seems to be the establishment of professional IPR management at universities which does not conflict with the research and publication missions of the institutions.

Other frequently used and important linkages between universities and external partners are found in the more broad **mobility of individuals** and **spin-offs** from universities. Mobility of individuals refers to the mobility of university employees to take fixed term positions at companies, governments or other organizations, which are related to their original field of expertise including the right to return to their original position. Such models have rarely been found in practical application until recently, whereas supporting spin-offs is a measure that has been supported by universities for a long time. Both approaches provide a clear indication of the entrepreneurial attitude and shape of a university because it demonstrates and visualizes the underlying motivation of a university to achieve a visible impact from its original missions.

The broad range of linkages or channels used by universities are typically bundled and managed within a dedicated service unit, called "**Technology Transfer Office**", "**Industry Liaison Office**", "**University Incubator/Accelerator**' or similar. Not only do the services offered by these entities vary, but so does the organizational structure and the alignment of them in the university organization itself. Among the biggest challenges for these entities is gaining acceptance within the scientific community and the industrial community.

In conclusion, it can be summarized that the mere analysis of university—industry linkages in the Triple Helix and Knowledge Triangle context is misleading, it causes a partial misunderstanding of the entrepreneurial university, because it implies a strong application orientation of universities in many respects leading to widespread, short-term thinking, which is mainly due to the lack of evidence of the contribution of university activities towards innovation eco-systems at different levels in the long term. Also educational activities of universities form one extremely important link with companies and governments, especially because it is broadly understood and accepted that the quality of education is one major cornerstone of graduates' future professional performance. R&D cooperation has been a long established channel for transferring knowledge and technology in different directions, although this connection is mainly from universities to companies, which often deliver immediate value to companies. However, such cooperation is also a source for inspiration for universities when it comes to identifying future fields of research, i.e., from experiences made in R&D cooperation, universities can also draw conclusions about the need for research in selected fields. In addition, IPR is a feature of entrepreneurial universities if treated carefully and expectations concerning potential economic impacts are kept low. It should be thought of as IPR management for universities, which is different from company IPR management in many ways. Moreover, scientific communication is not fully reflected in the understanding of the entrepreneurial university and also only occasionally in the discussion about industry-science linkages, the knowledge triangle or triple helix.

## 3.3 A Revised 'Entrepreneurial University' Paradigm

A revised 'entrepreneurial university' paradigm needs to take into account the diverse challenges universities are facing. Universities are frequently focused on extending their outreach not only by means of publications but also by means of the internationalization of research and teaching faculty as well as the students' cohort. By opening up to international faculty members and students, universities achieve a broader global reputation over time but probably more importantly, they enhance competition for potential faculty members and also for prospective students who are interested in affiliation with the university. In other words, it is clear that the internationalization of faculty and students is extending the impact and reputation of universities from a local dimension towards a broader recognition. However, there is not sufficient space for universities in the world to develop and maintain global recognition among researchers and teachers as well as students.

Publicly funded universities are increasingly confronted with pressures by stakeholders to use public funds for local or national employees and students for the development of the local and national innovation ecosystems and the creation of local and national competitive advantages instead of the education and training of potential competitors abroad (O'Shea et al. 2007).

Dooley and Kirk (2007) argue that in the long term, one precondition for universities to attract third party funding, namely government research and innovation support, is excellence in research and probably more importantly, excellence in formulating research proposals and communicating research projects. At first sight, this line or reasoning is plausible but it neglects the fact that in the case of faculty members, this competition intends to attract the best brains for local and national education as well as the fact that international student cohorts not only contribute to more intercultural interactions and hence broaden the horizon of education, but also these same international students potentially may be willing to remain at the place where they were educated, meaning internationalized alumni networks, which evolved from those internationalized cohorts. The latter are frequently used networks for communication between former students from one alma mater for different aspects of academia but also commercial (business-related) issues (Wong et al. 2007). Incorporating the entrepreneurial spirit into students' attitudes is not meant to prepare students to found companies during or after their studies, but it is a means of preparing students for the changing conditions in the labor market, which in many industries and countries is characterized by an increasing share of fixed term appointments. The entrepreneurial mindset is thought to provide students with a mind that takes these changes on the labor market into account early in their educational and professional careers.

Against many prejudices, external linkages do not limit the actual research work by university employees. It is often stated that engagement in transfer would distract researchers from the scientific work, but on the contrary practice shows that these linkages provide valuable information and inspiration sources for university members (Siegel et al. 2004). This is supported by the findings of Azoulay et al. (2009), which give evidence that protecting the outcome of research by means of intellectual property rights, namely patents, does not impact the research activities of a scientist. Instead, there is an indication that researchers who actively use intellectual property rights show a more open mindset when collaborating with industry researchers, which is reflected in more co-authored publications between scientists and industrial researchers. Also, there is no evidence and no indication that the scientific activities of researchers who patent would suffer. Furthermore Siegel et al. (2004) found that reward schemes for university employees are designed in such a way that they almost exclusively consider the research and partially the teaching mission of universities. Indeed, the innovation mission expressed in the transfer activities is not fully reflected in the evaluation schemes. Instead it is a common practice to consider third party (external) funding raised by university employees as an appropriate means to measure their contribution to the innovation mission. However, the challenge remains to distinguish between the different types of external funding.

The term ‘entrepreneurial university’ needs to be further explained and analyzed by extending the understanding of ‘entrepreneurial’ from application-driven inspirations towards the actual meaning of the term, which implies ongoing changes and overcoming routines including potential negative impacts and threats resulting from standard routines during ongoing activities. With these in mind, one might define ‘entrepreneurial universities’ as

> Universities who are undergoing continuous change in their activities, adjusting them to current and potentially expected demands from stakeholders and most importantly, aligning their activities by explicitly delivering value to society. Thereby entrepreneurial universities develop an internal culture of academic freedom, scientific values and awareness of incorporating ‘delivering value thinking’ into education and research and establish, maintain and expand linkages with other research and education institutes, companies and governments. Entrepreneurial universities’ activities are characterized by entering new grounds in the respective field which are not yet fully explored by other institutions.

The so developed understanding of the term and concept ‘entrepreneurial university’ allows one to describe the following characteristics of entrepreneurial universities:

- The core activities are teaching and education, which are understood as the platform for the third mission of universities: ‘innovation’.
- Teaching involves targeted obligatory courses for all students in innovation and entrepreneurship with an explicit focus on value creation from research and science. This type of teaching aims at raising awareness among graduates, hence the next generation of workers, for innovation generation and research that is achieved by integrating entrepreneurship and innovation thinking in undergraduate and graduate educational programs.

- Furthermore, teaching includes complementary courses preparing graduates for changing labor markets and requirements imposed on employees that arise from life-long learning.
- Curricula include training graduates in problem detection and solving, especially the search for, collection and processing of information.
- Research is open to take account of the challenges faced by society at present or in the future. Universities follow a research portfolio management approach which assures a balance between the different types of research as defined by the maturity of the research work and topic.
- Technology and knowledge transfer is considered a support function for the initial university activities. The focus is not limited to technology as a transfer object, but extended to the transfer of knowledge.
- A broad range of channels for transferring knowledge and technologies is used. These channels are always focused on the individuals involved and the specific characteristics of the transfer objects.
- The internal organization recognizes the endeavours of employees, appreciates employees' willingness to enter new paths outside the mainstream research topics in their fields and employs professional development programs which support the openness of employees and cooperation with partners.
- Innovation, research and teaching are weighted equally in the performance measurement of university employees. Additional measurement criteria include the quality of the research project pipeline instead of the common indicators which typically measure tangible output only.
- The preservation of academic freedom for universities to allow blue sky works and thinking within the institution while building and maintaining university culture that supports and appreciates exchange within the university and with outside partners.
- The openness of universities to reflect on external stimulus for actual activities, the acceptance of outside inspiration and critical reviews of activities.
- The awareness of university employees for the initial mission of the university and for delivering value to society in a broad sense, including responses to changes in the environment.
- Purposeful support of knowledge and technology spillovers outside the university and incorporating spillovers from the outside.
- Continued improvement and adjustment of educational programs' curricula.
- Efficient and effective support units for managing external relationships of universities, thus removing the administrative burden from researchers and teachers.
- The recognition of the intrinsic motivation of research staff to earn scientific merit while limiting the performance evaluation of researchers to an absolute minimum.

These general features create challenges for all university employees at different levels.

*Departments including university professors and other faculty members* who form the core of the 'entrepreneurial university' are increasingly forced to align their curricula and research portfolios in order to generate more applicable and practical outcomes such as graduates and research results. This is an area which inherently threatens the academic freedom of departments in different ways and calls for a change to the research portfolio and curricula development. Such measures need to balance the freedom of minds and thoughts against the quest for applicability of outcomes in order to assure the sustainable performance of the institution. Herewith it needs to be noted that the performance of universities in many cases goes along with the reputation of the institutions because universities with a strong global reputation are highly attractive as places to work for talent. To develop and maintain this, an understanding of the complex entrepreneurial university, Knowledge Triangle and Triple Helix thinking is required to help faculties and professors formulating responses to external inquiries or for preparing strategic initiatives to maintain excellence and academic freedom in their fields.

*University Management* at all levels is frequently challenged by stakeholders, namely by university financiers, to adapt to the Triple Helix and Knowledge Triangle, thus the entrepreneurial university, but they find it hard to fully understand what the stakeholders might mean and what the inquiries imply. Hence for senior university management, it is important to have a valid, common and broad understanding of these concepts which enables them to respond to the challenges accordingly, in the interest of the university. For middle management, this is equally important because it is they who convert the strategic decisions of senior management into action and therefore with a broader understanding of what they do and which implications these activities have, one can expect a much smoother and more targeted implementation.

*University boards and councils* are typically found at all levels and units of universities overseeing the activities and approving strategies and funds among other functions of universities and the respective units. In this respect, they form powerful bodies within the institution contributing to the long-term orientation of the respective entity. Therefore board and council members need to possess a profound understanding of the full potential impact of their decisions concerning the design of the shape of universities, which might lead to an entrepreneurial university.

*Knowledge and Technology Transfer Offices/Industrial Liaison Offices* (KTT offices) need to take a systemic view on the entrepreneurial university in order to better align their activities with the actual and arising needs and requirements they face by their respective counterparts. Typically counterparts of these offices are companies and governments on the one hand and university employees on the other. The challenge for KTT offices is to contribute to the establishment and maintenance of respective linkages while understanding the difference between the ecosystems in which university employees and companies/governments act. Furthermore, KTT offices are often associated with an image which is less positive but casts them as administrators and bureaucratic institutions.

Meanwhile, it is common practice that *policy makers and governments* formulate requirements for universities, negotiate targets to be achieved by the universities and couple financing of the institution to the achievement of targets. Although these targets often reflect individual features of the Knowledge Triangle and Triple Helix, they rarely mirror the full picture and therefore they direct the universities in an unbalanced manner according to the recent fashionable topic picked from respective debates. The entrepreneurial university's understanding however reflects the overall institution and its environment, which is why policy makers need to understand the full impact of the rules they impose upon the universities and design the indicators for measurement accordingly.

*Funding Agencies* have become important actors for funding research at public institutions such as universities and public research institutes, but also company research and innovation activities. These agencies typically finance research under the constraint that this work satisfies requirements stemming from a partial understanding of the entrepreneurial university concept. It is essential that funding agencies learn and understand the overall function and the increasing role of the entrepreneurial universities for designing funding programs and allocating support. This is mainly relevant for these agencies when it comes to setting funding priorities, assessing funding applications and designing reporting and evaluation procedures with regard to the frequency of steering the public funds and indicators used to evaluate them with which agencies indirectly influence the choice of the topics of applications.

Interactions within the Triple Helix and Knowledge Triangle, namely between entrepreneurial universities and companies, follow the clear aim to enhance companies' innovation competence base and capacities, hence these interactions are considered beneficial for all parties involved (Dooley and Kirk 2007).

For universities and companies especially the following advantages appear.

- *Companies* frequently appreciate the opportunity to complement their own abilities with the university competence base, which is typically a science and technology niche from the company's point of view but still it is connected with excellence in this field. Such links are perceived as advantageous by companies who expect to stay at the frontier of science and technology, which is perceived as an advantage over competitors whose access to respective knowledge is limited to documented knowledge thus leaving aside the essential tacit knowledge component possessed by the scientists. Furthermore, in selected cases companies can access and use sophisticated equipment which might not be available at their organizations.
- *Universities* at first sight meet the requirements imposed by their stakeholders when engaging in relationships with companies. A more insightful view discloses that active links between universities and companies do allow universities to acquire additional knowledge about the approvability of their research as well as educational activities. Therefore, these links put them into a position where they can align these activities more with the demanded

competencies. This said, it does not imply that universities are reshaping their research activities portfolio towards industrial style research but that research projects are designed differently, taking into account professional research management approaches which are common practice in industrial research but less widespread and known in university research. In addition such feedback loops enable the discovery of additional science and technology fields which deserve attention by university research while remaining rather basic challenges.

- *Both*, universities and companies, frequently find it easier to attract research- and innovation-related funding from public funding sources while demonstrating existing links and willingness to convert academic work into an application at some stage. This is a condition often found in announcements regarding the public funding of research and innovation activities in different shapes.

Education at different levels and research for knowledge generation was and remains the main mission of a university (Youtie and Shapira 2008). The switch of traditional universities to the revised 'entrepreneurial universities paradigm' is a lengthy process featured by a reasonable risk and uncertainty of successful implementation (Jacob et al. 2003; Pascoe and Vonortas 2015). This uncertainty is mainly rooted in the fact that universities are extremely knowledge-intensive organizations employing almost exclusively highly qualified staff, who are also considered the intellectual elite of a country. University employees are well aware of this view; accordingly they often argue that there is no reason and occasion for an institutions' leadership to impose changes in the understanding of the institutions' mission and respective organizational adjustments (Gibb 2005). Instead there appears to be strong resistance from university employees regarding this, especially when it comes to the mere focus on transferring knowledge and technology, which might be overcome by understanding the commercialization aspect of universities and their employees as complementary sources of inspiration for their own works (D'Este and Perkmann 2011; Guerrero and Urbano 2012). In addition, experience tells that universities' educational activities are the probably most challenging to develop and adjust to changing demands and requirements. This includes not only new educational measures but also the further development of existing programs.

Frequently, due to their internal structures and externally imposed procedures, universities find it difficult to adjust their educational activities to changing requirements within a short timeframe, which is often postulated mainly by industry but also by governments. Furthermore, Youtie and Shapira (2008) found that in order to successfully transform a university to an innovation hub, it requires revised governance models and the involvement of the broader eco-system involving the entrepreneurial, venture capital, industrial and public spheres. In this respect a university functioning as an innovation hub can be considered similar to an entrepreneurial university with the special feature of technology and knowledge transfer units that emphasize the enforcement of direct personal relationships between university members and external parties, which is often done by organizing, facilitating and developing social and thematic networks.

The frequent quest for universities, upon entering various partnerships with companies, needs to reflect upon the experiences of companies in R&D and also innovation partnerships, that is, when it comes to forming partnerships, universities can learn valuable lessons from companies' partnerships which had been practiced for a long time. Among the core features of sustainable partnerships is a solid profound strategy formulation and explicit definition of partner's contributions, obligations and rights as well as reporting and decision making routines (Williams and Vonortas 2015). Partners often enter into a partnership when the counterpart possesses valuable and multiple types of knowledge and recognized competences around which partnerships are formed (Hertzfeld et al. 2006). Frequently R&D cooperation is established by companies with various partners but for similar motivations among which are R&D and innovation-related cost and risk sharing, avoiding the duplication of R&D activities, leveraging synergies as well as taking advantage of knowledge spillovers and accessing complementary resources and skills. In addition, it is assumed that cooperation at early technology development stages is a means of improving a company's position for developing and diffusing standards in technology fields (Hemphil and Vonortas 2003). It is extremely important that entrepreneurial universities are aware of the motivations and also the actual and hidden agendas of companies before entering into comprehensive cooperation with companies to limit the risk of failure due to diverging intentions and motivations in the long term.

## 3.4 Conclusions

Over the course of the last decades, entrepreneurial style universities have increasingly emerged and have begun to challenge government policies. While policies often have traditional approaches and instruments, these seem not be the most effective in maximizing national benefits from open global knowledge, technology and innovation markets and networks. Instead of established policy instruments which frequently feature a more reactive characteristic, e.g. responding to changing environments, policy is challenged by actively supporting developments. This pushes policy makers to develop visions for an overarching national innovation system and set priorities which eventually promote all forms of linkages within and between innovation ecosystems at the national or regional levels. Another important objective should be the improvement of the framework conditions for innovation, including dedicated infrastructure namely in the sphere of public research which is understood as one important issue to retain or attract science, technology and innovation related investments and talent.

The understanding of the entrepreneurial university provides a valuable overarching view on the role and meaning of universities for the national innovation system. It shows similarities with the open innovation paradigm, which has become widespread among companies. A recent OECD study (OECD 2013) finds that many OECD countries are reflecting upon their national policy efforts toward linkages between universities and companies in the light of open innovation. Until recently, such policy measures were mainly targeting the commercialization activities of public research by means of supporting networks and markets for transferring and commercializing the results of public research. However these approaches and models face considerable limitations among which are (Cervantes and Meissner 2014):

- A narrow focus by employees on research and teaching related positions as knowledge and technology owners and hence inventors, the natural/physical and engineering sciences and patenting/licensing as well as spin-off companies as means of channels to transfer knowledge and technology;
- An apparent mismatch between the supply and demand of public sector knowledge;
- The still existing lack of financing for university originated new ventures.

These barriers appear also due to limited evidence and metrics for assessing changes in the whole ecosystem and not only at the university level but also with regard to relationships between actors at other levels. Accordingly, policy interventions are in many cases based upon anecdotal evidence rather than solid evidence. Naturally one might argue that learning from episodes is one essential element of anticipatory policy which assumes that episodes do arise from a broader phenomenon thus policy makers aim at providing the grounds for designing a more supportive environment stimulated by government policy intervention. However, policy initiatives until recently hardly take into account ongoing organizational changes, strategic developments and orientations and the intensity and shape of transfer channels used as well as other factors. Therefore governmental and institutional support for new models of linkages between universities and companies will have to ensure quality and sustainability with adequate rewards to all who contribute to education and research and respective application efforts.

Despite the ongoing discussions of ‘entrepreneurial’ and ‘open innovation’ induced attitudes of universities and companies, the initiation and maintenance of relations between universities and companies remain determined by the supply and demand for technology and knowledge and personal relationships. Therefore existing organizations and their external interfaces need to be contingent upon knowledge and technology supply and demand (development) as well as on the framework conditions, and consequently change over time (Kroll and Schiller 2010), making a broader understanding of the evolution of innovation necessary, which eventually shows that innovation ecosystems may be characterized by fragmentation and isolation (Gokhberg and Meissner 2013; Meissner 2014). Still, information and knowledge flow freely across borders and limitations implying that the need arises to overcome thinking in terms of national innovation systems, which challenges national policy interventions. Hence all actors need to account for an approach to an idea of networks, which are spread globally but increasingly interconnected and accessible. It thus becomes increasingly important for governments to understand the nature and extent of these networks (Tether and Tajar 2008; Cervantes and Meissner 2014).

For entrepreneurial universities to perform well in the Knowledge Triangle and Triple Helix context, current and former students are valuable multipliers and links to act as key actors in the exploitation of new knowledge and technologies. Acknowledging this role, understanding the driving factors, and equally important the underlying challenges are essential to know in order to develop a promising sustainable strategic vision for future entrepreneurial university orientation. An entrepreneurial university publicly acknowledges the role and importance of graduates as the institutions' ambassadors, but also as sources of inspiration for the future positioning and development of the university. Furthermore it recognises the complexity of linkages with companies and governments which are driven by the characteristics of the object underlying the relationship between the partners, the uniqueness of offerings and competences but also by the research and innovation culture of the institutions and administrations involved as well as the flexibility of the receiving institution and the competitive pressure of receiving or sending institutions. In addition, building and maintaining linkages between universities and companies needs to take account of the rather short time horizon of industry, which is often the case. Furthermore, they need to consider the fact that switching partners is a common procedure for companies and that the ongoing assessment of the price/quality ratio of the relationship is a common practice as well as the assessment of the quality of the relationship and transfer process such as project management, project milestones kept, budgets among others (Lawrence and Kirk 2007).

The chapter discussed the understanding of an entrepreneurial university and its meaning for universities as institutions, university employees and stakeholders in light of the challenges arising from the Knowledge Triangle and the Triple Helix thinking. It showed that the entrepreneurial university concept is well suited for empowering universities to contribute value to society and the economy if understood fully. In order to do so, it is necessary to extend the predominant perception of the term and concept of 'entrepreneurial university' and the therefore the inherent limitations on technology commercialization in understanding 'entrepreneurial university'.

Applying the broader thinking as outlined implies that the predominant evaluation schemes of researchers, teachers and universities as a whole but also science, research and innovation funding need to be rethought and developed further in order to provide incentives for researchers to develop the entrepreneurial university. The question of how university employees are incentivized by the using institutions to make the entrepreneurial university real, to participate in knowledge and technology transfers and commercialization and to engage in the ongoing process of change could be another interesting avenue for future work. This has to take special account of informal contacts, consulting and research collaboration especially because these channels are hardly visible, yet they are important to stakeholders and only partially perceived. The understanding university employees' involvement in these channels needs more profound clarity regarding their mindset, motivations and competences, and equally important are the institutional culture and leadership in which they are embedded.

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# Impact of Pre-incubators on Entrepreneurial Activities in Turkey: Problems, Successes, and Policy Recommendations

4

Emek Barış Kepenek and Zeliha Eser

**Abstract**

Entrepreneurship can be considered a driving force for economic growth, employment creation, and competitiveness in societies. However, a crucial issue is the ability to produce knowledge and train a skilled workforce that has a proper entrepreneurial mindset. In this regard, there are three main actors: public governance, universities, and the private sector.

Universities should take more role as both producers and disseminators of knowledge in entrepreneurial activities. The concept of pre-incubation centers, which is the central focus of this paper, is one outcome of such activities.

By providing targeted resources and services, incubation serves as a business-support process that accelerates the successful development of start-ups and companies. Incubation ideas focus on already established firms—either start-up or senior firms; however, pre-incubation centers focus on the early-stage ideas of students and entrepreneurs.

This study addresses the impact of services offered in pre-incubation centers—namely infrastructure, coaching, and business networks—on the graduation rates of incubator participants in Turkey. Based on interview data with 23 of 40 pre-incubation managers, we found that it is necessary to develop synergy among universities and achieve local economic alignment. The educational system should produce individuals with requisite skills: at that point, they can become active in furthering government policies to promote

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entrepreneurship. In this context, entrepreneurial universities play an important role as both producers and disseminators of knowledge. University-based incubation centers will become key actors for promoting entrepreneurial culture in societies.

**Keywords**
Entrepreneurship · Incubation · Success · Policy making

## 4.1 Introduction

During the last decade, the evolving digital economy has been the preeminent driver of structural change and economic growth at both national and local levels in developed, industrialized economies. However, there are substantial differences among countries and local regions with regard to their role in the development of information and communication technology (ICT) and their propensity to adopt and apply ICT applications in various sectors and activities. Hence, countries and local regions differ markedly in how far they have pursued the road to the digital economy. The concept of innovation through the creation, diffusion, and use of knowledge has become a central driver of economic growth.

Innovations mainly result from increasingly complex interactions among individuals, enterprises, and different kinds of knowledge institutions—i.e., clusters. Interestingly, innovation activities are localized, and they tend to aggregate in regions that offer favorable conditions for innovation. Thus, emerging regional innovation networks create new forms of learning and knowledge production. One important aspect of these localized clusters of knowledge production is that such knowledge flows could be exploited by third-party economic agents, i.e., entrepreneurs. We believe that for developing or less developed local regions, adequately establishing this relationship with entrepreneurs would be key to the development process. Thus, cluster initiatives that encourage regional entrepreneurial capacity are essential for success.

Entrepreneurship is crucial in the creation of innovative societies. Entrepreneurship can be considered a driving force for economic growth, employment creation, and social competitiveness (Vonortas 2017). However, a vital link in that process is the ability to generate knowledge appropriately. In that regard, three main actors should adopt that role: public governance, universities, and the private sector. With respect to universities, pre-incubation and incubation centers are vitally important in the entrepreneurial ecosystem.

The concept of incubation and pre-incubation centers is the prime subject of the present study. Incubation is a form of business support that accelerates the successful development of start-ups and companies by providing targeted resources and services. Although incubation focuses on already-established firms, including start-up and senior firms, pre-incubation centers concentrate on the ideas of students. In broad terms, a pre-incubation initiative offers infrastructural opportunities, such as office space, equipment, and such administrative facilities as fax machines, telephones, and Internet access. A pre-incubation initiative also offers training and educational workshops or seminars. However, the most important contribution is business networking. Here, this networking signifies the access available to tenants of the incubator to managers, administrative, management, financial, legal, and insurance consultants, scientists, academics, and prospective customers (Peters et al. 2004).

Entrepreneurship in Turkey has clearly made tremendous progress. Most universities have initiated programs and areas to promote entrepreneurship, such as technology development zones, technology transfer offices, and incubation and pre-incubation centers. The first pre-incubation center in Turkey was established in 2004; now, there are almost 40 such centers. Most of them have been in existence for less than 5 years. The impact of these centers will become more apparent within the next few years. The biggest problem these centers face is the lack of an entrepreneurial mindset among incubatees. In addition, success is a critical target for all of them. The present study examines the impact of the services offered at pre-incubation centers, namely infrastructure, coaching, and networks, and on the graduation rates of the incubators' tenants in Turkey. To improve the quality of the services provided at those centers, it is necessary for governmental bodies to implement effective policies. As a major source of skills and knowledge, universities also play a crucial role.

This study comprises five parts. In the next section, the concept of pre-incubation centers is discussed along with the idea of entrepreneurial universities. The third part introduces the methodology; the fourth part presents an analysis of the data; the final part outlines the results of field research and implications (policy ideas).

## 4.2 Literature Review

### 4.2.1 From Traditional to Entrepreneurial or Third-Generation University

The role of entrepreneurship is not only to increase outcomes and annual income; it is also to set the foundations for structural changes in economic and social activities. The importance of entrepreneurship in development can be emphasized "as an engine of economic development" (Amiri et al. 2009). There are various actors in the entrepreneurship ecosystem and, as noted above, universities play a very important role in that. It is indisputable that universities need to create an encouraging environment for fostering entrepreneurship, thereby contributing to real economic and social development at the regional and national level (Kirby 2006).

Etzkowitz et al. (2000) observed that traditional universities undertake academic education and conduct basic research without directly focusing on developing entrepreneurship. Thus, traditional universities do not concentrate on pure entrepreneurial culture and systems to elevate entrepreneurship. Owing to global competition, universities need to review their functions and respond to internal and external forces so as to change their role to one of entrepreneurial institutions (Amiri et al. 2009). Clearly, converting traditional universities to entrepreneurial institutions is no easy task: it requires support from different sections of society, such as universities (university management, faculty, students, and staff), government, and industry (Etzkowitz et al. 2000; Etzkowitz and Leydesdorff 2000; Pahurkar 2015). It is also necessary to undertake various strategic actions and policy decisions that support entrepreneurial culture at universities.

Traditional universities tend to produce graduates with no entrepreneurial background; such institutions measure their output only in terms of student enrollment and graduation. However, universities also need to consider and evaluate their social and economic contribution. In this regard, universities should emphasize activities that lead to economic and social development, and it is necessary to coordinate relations among universities, industry, and government. A university that succeeds in this manner may be termed an "entrepreneurial university" (Etzkowitz and Leydesdorff 2000). Entrepreneurial universities can undertake various entrepreneurial activities, as follows (Pahurkar 2015):

- Establishing technology parks
- Assisting with new venture start-ups
- Protecting intellectual property rights through patents
- Contracting research
- Setting up executive education or industry training courses
- Providing assignment consultation
- Providing research funding and grants
- Undertaking publication and documentation of research activities
- Arranging participation in international research exhibitions and conferences

The above possible entrepreneurial activities have different levels of proximity to entrepreneurship and academia. Activities closely related to entrepreneurship are termed "hard activities" (e.g., patenting, licensing, and spin-off venture formation); those closely related to academia are termed "soft activities" (e.g., academic publishing, research grants, contract research, publication, conferences) (Klofsten and Jones-Evans 2000).

As large organizations with an academic purpose, universities do not possess the core function of entrepreneurship. Accordingly, some of their inherent characteristics operate as barriers in this regard (Kirby 2006):

- Strict, complex organizational structure with many levels of approval
- Monolithic relationships
- Restrictive controls, rules and regulations, protocols, and following standard procedures
- Burden of bureaucracy, red tape, corruption, and extensive formalities
- Lack of corporate culture and talent
- Inappropriate compensation plans.

In addition to these general barriers of universities, other factors impede the entrepreneurial activities of students. Some of these are as follows (Pahurkar 2015):

- Negative examples of others conducting business and fear of failure
- Difficulty in coping with problems arising from business that involves risk
- Lack of financial security, as found in salaried employment
- Financial problems in starting a business
- Family resistance to starting a business
- Lack of experience in coping with the psychological burdens of business
- Limited knowledge of business operations
- Previous negative experience with business.
- Benefits of a good salaried job, such as high social status
- Bureaucracy, red tape, corruption, long-established procedures, and tax issues

The barriers for universities may be eliminated with new regulations and policies. However, the barriers for students cannot be controlled in this way, and it is necessary to understand such barriers toward cultivating entrepreneurial culture. Universities are generally regarded as academic organizations with intellectual integrity; they are devoted to critical inquiry and committed to learning and understanding. When universities become entrepreneurial, that may divert their attention from core academic matters. Most academics consider their primary duties to be research and teaching, not acting as entrepreneurs. Thus, there is a fear of conflict of interest with respect to academia and entrepreneurship: there could be a negative impact on an institution's research performance if its leading academics devote their efforts to entrepreneurial activities (Kirby 2006). However, many institutions, such as the universities of Surrey, Stanford, California, and Columbia and the Massachusetts Institute of Technology, have become more entrepreneurial as well as having a strong research output. They have therefore proved the above fear to be unfounded.

Above, we examined barriers and fears on the part of entrepreneurial universities. However, it is important to note that there is both a positive and a negative side to this issue. Some motivational factors and positive outcomes with respect to entrepreneurial universities include (Pahurkar 2015; D'Este and Perkmann 2011):

- International exposure and funding
- Revenue from patents and licensing
- Commercialization of research output and starting spin-off ventures
- Intellectual property rights, licensing, publications, and collaborations with industry
- Global exposure and reorganization
- Research grants from industry and government
- Encouraging feedback from industry about research work and real-life applications
- Learning opportunity
- Expertise and advance information about specific industries

- Access to industrial equipment and materials
- Becoming part of a global research network

As the benefits of becoming entrepreneurial are very significant, universities need to develop business and entrepreneurship as strategic goals. Universities that grasp this situation review and reorganize their structure and policies to become third-generation universities. Their role is indisputable in the entrepreneurial ecosystem. Universities that understand their role in entrepreneurship have started to establish resources, such as technology transfer offices (TTOs), pre-incubation and incubation centers, and even technoparks, to meet the demands of students, academics, and industry. Specifically, as the first and second stages of entrepreneurship, pre-incubators and incubators have gained importance among third-generation universities. In the following section, we will examine pre-incubation and incubation centers in detail.

### 4.2.2 Pre-incubation and Incubation Centers

Before considering pre-incubation centers at universities, it will be helpful to define "pre-incubation" and "incubation". Pre-incubation plays a key role in providing different forms of assistance to nascent entrepreneurs—especially in the initial development stages of their ideas. Knowledge produced in universities is studied extensively, and it has an impact on industry. The pre-incubation level supports entrepreneurial ideas so that they can attain the start-up level of business incubation.

Kirby (2004) describes a pre-incubator as a facility for a very early stage of a start-up that has yet to formulate its business plans, develop a prototype, or establish an entrepreneurial team; the pre-incubator leads the embryonic business to an investment or market-ready stage. Accordingly, it can be stated as follows: pre-incubation relates to the overall activities needed to support the potential entrepreneur in developing his business idea, business model, and business plan, to boost the chances to arrive at an effective start-up creation.

The definitions of a business incubator may vary in detail but agree in some basic characteristics. The National Business Incubation Association refers to business incubation as follows: "Business incubation is a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services. These services are usually developed or orchestrated by incubator management and offered both in the business incubator and through its network of contacts. A business incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding" (Bathula et al. 2011, p. 2). Another authority gives the following definition: "Business incubators are facilities that provide rental space, shared basic business services and equipment, business assistance, coaching and financial support to start-ups and young firms in order to accelerate their successful development" (EBN 2010; Jones et al. 2013; Stal et al. 2016).

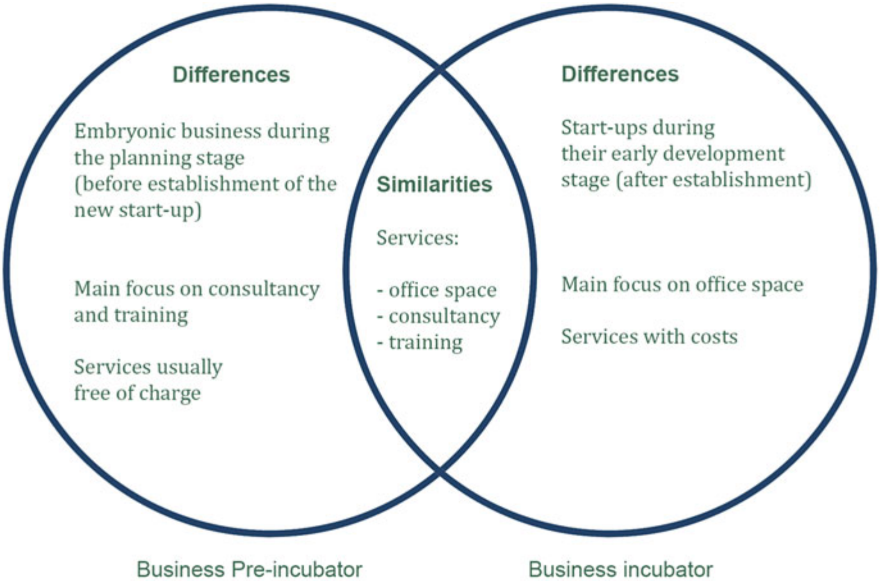



**Fig. 4.1** Similarities and differences between business incubators and pre-incubators. Source: Deutschmann (2007)

The main difference between business incubators and pre-incubators is usually defined by the development stage of the incubatee's business. A business incubator provides its services to already founded start-up companies at the early stage of their development; a business pre-incubator supports businesses at the planning stage before they have actually become established (Kirby 2004). Nevertheless, there are certain similarities between the two types in terms of provided services, and the pre-incubation and incubation stages can have areas of overlap, as shown in Fig. 4.1.

### 4.2.3 Role of University-Based Pre-incubators

The pre-incubation concept was developed to promote enterprise and spin-out ventures of universities. The first defined pre-incubator in Europe was established in 1997 at the University of Bielefeld in Germany (USINE 2002). As the name indicates, university-based pre-incubators are a special type of pre-incubator located in universities. They are sponsored by universities and are popular in both developed and emerging countries. University-based pre-incubators link higher education and private sector initiatives for wealth creation: they generate new products and reduce the associated risk (Bathula et al. 2011).

To understand the popularity of university-based pre-incubators, it is necessary to consider the current business environment in which universities operate. As noted above, the main purpose of universities is research and teaching in various fields and building an academic foundation. However, universities are also under pressure from government and industry to contribute to the social and economic development of the nation. Grimaldi and Grandi (2005) state that government authorities expect universities to lend resources, faculty time, and talent to economic development efforts. Universities have additional significant roles, such as establishing links with industry. By doing so, universities can provide their faculty with a platform for conducting research; they can also give their students an opportunity to find jobs and support them in starting their own ventures (Bathula et al. 2011).

A university-based pre-incubator provides a good training environment for potential entrepreneurs or entrepreneurial teams by putting them in active positions. Academics assume an active role in the commercialization of their R&D results by starting their own profit center. In addition, university-based pre-incubators offer special support, such as entrepreneurial courses, personal mentoring, access to relevant networks, and applying for patents. University-based pre-incubators can provide the following to academics and students (EBN 2010; Jones et al. 2013; Stal et al. 2016):

- A pre-incubator offers the chance to test business ideas and gain business experience without actually forming a company.
- Unlike a business incubator, a pre-incubator supports only entrepreneurial projects and enterprises not already registered.
- The pre-incubator management and both academic and students conclude a contract; this enables the profit centers to conduct normal business transactions, such as the sale of pilot products, on behalf of the pre-incubator.
- Since the chief executive manager controls all business transactions, financial risks are minimized for academics or the entrepreneurial team.
- After a successful period of pre-incubation, academics or their entrepreneurial team will have gained sufficient knowledge, skills, and experience to run a company on their own. Registration of an enterprise usually takes place after those individuals have completed their terms at the pre-incubation center.
- The fear of failure is significantly reduced as a result of improved self-confidence and experience gained during the pre-incubation.
- Pre-incubation involves the development of a “risk mitigation strategy,” which helps ensure success among the participants in their enterprises.
- In the course of pre-incubation, participants are able to test the markets for their products and services; this allows emerging entrepreneurs to gauge the feasibility of their business ideas before undertaking the risk of establishing their own company.
- Pre-incubation reduces risk by selecting business ideas that have the greatest chance of success.
- The pre-incubation time is limited: it may vary from a couple of months to several years, depending on the concept of pre-incubation. This limited time is often referred to as the “probationary period.”

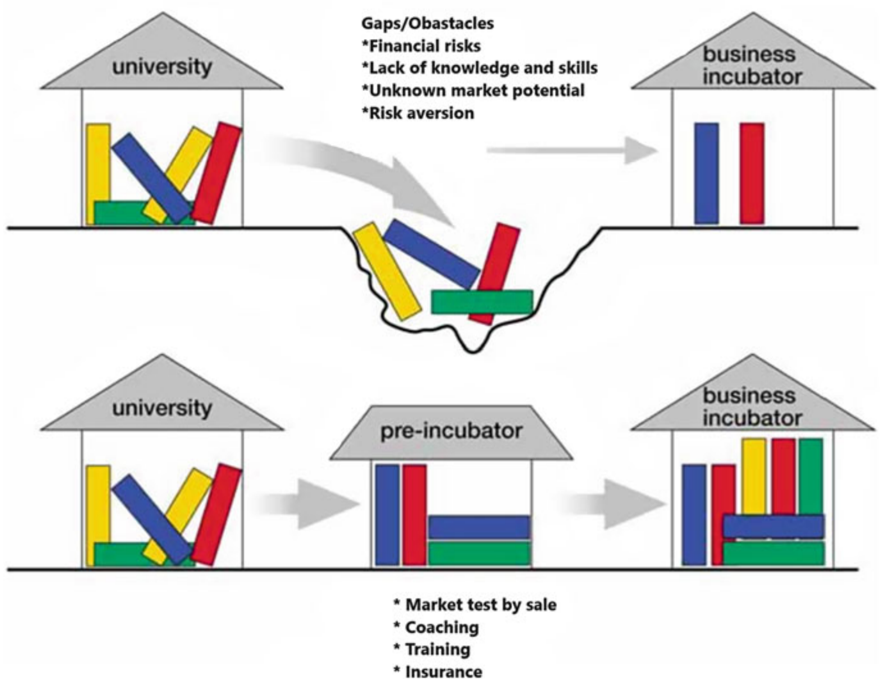



**Fig. 4.2** Pre-incubator: filling the gap between universities and the business incubator. Source: USINE (2002)

In the light of above clarification, the primary aims of the university-based pre-incubator can be stated as follows: (1) to qualify academic entrepreneurs to found and manage a company of their own; (2) to increase the number of academic spin-offs; (3) to create sustainable spin-offs; and (4) to create a culture of entrepreneurship within the university.

In the university environment, pre-incubators are regarded as a necessary facility that fills the gap between a university and science-based business incubators (Fig. 4.2). In pre-incubation, participants receive support for their business ideas and plans, in testing the markets, and building up resources (Dickson 2004).

As noted above, pre-incubation usually involves an initial assessment of an idea, training, and personal assistance so that the incubatee is able to write a complete business plan. Pre-incubators offer training, mentoring, and facilities (at minimum, a workstation) to support potential entrepreneurs in developing their business ideas and elaboration of their business plans. Once participants have completed their business plans, the next stage is to direct them to incubation centers to establish their start-ups (Fig. 4.3).

The resource-based view is an organizational theory that is often used to explain entrepreneurial performance, and it may be applied to examine the business pre-incubation process. The key principle of this theory is that it addresses competitive advantages through strategic positioning; the aim is identification and intelligent

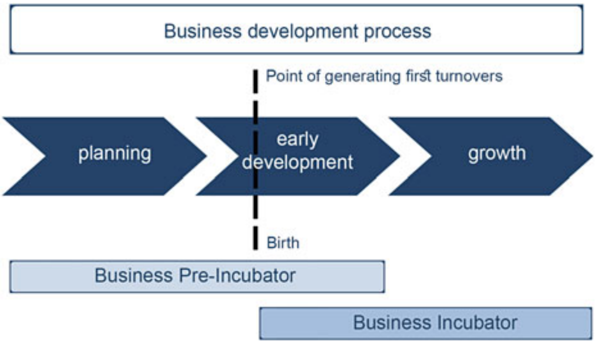



**Fig. 4.3** Entrepreneurial process-oriented classification of business incubators and pre-incubators. Source: Deutschmann (2007)

application of a unique set of valuable resources (EBN 2010; Jones et al. 2013; Stal et al. 2016). The resources necessary for creating start-ups can be classified into various categories, such as technological, financial, physical, human, social, and organizational.

Some of those resources are intangible, such as human, social, and organizational; they are generally more difficult to acquire. Dierickx and Cool (1989) found that there are two types of resources: physical tangible and knowledge-based intangible resources. In business pre-incubation centers, physical resources may be infrastructure and financial resources; knowledge-based intangible resources are the training, mentoring, administrative support, technology expertise, professional services, and consulting.

### 4.2.4 Characteristics of University-Based Pre-incubators

As indicated above, the presence of pre-incubation services at universities can encourage entrepreneurial awareness and stimulate entrepreneurial activity. Pre-incubation facilities have been initiated by many universities. These facilities have as much diversity as standard incubators, though Dickson (2004) identified four groups of common characteristics (Voisey et al. 2013).

1. **Targeted processes:** The pre-incubation process provides the entrepreneur participant with the appropriate support to develop their business ideas and plans, build up the necessary resources for the creation of a viable business, and then test the market. The standard pre-incubator services provided to participants are office facilities, business plan assistance, practical guidance, mentoring, training, financial counseling, and business networking. All this is at a nominal cost to the would-be entrepreneur.

   Not all services can be provided directly by the pre-incubator. The existence of local business support networks—in both the public and private sectors—allows for the development of enterprise education.

2. **Selection policies**: Pre-incubation processes offer a risk mitigation strategy. The would-be entrepreneur has access to an environment in which knowledge-based support is provided at low cost. During pre-incubation, the viability of an idea can be developed and tested before taking on the significant risks associated with business start-ups. The selection of candidates is also seen as a risk-reducing strategy within the incubation chain: funding targets are often associated with recorded successes, not the number of business ideas tested.
3. **Period of incubation:** The time a business idea spends in the pre-incubation stage before proceeding to the business incubator is limited. The time spent in the pre-incubator is often termed the probationary period. This time may vary from a couple of months to several years, depending on the culture and operation of the pre-incubator.
4. **Linked:** Pre-incubation service centers are usually linked to universities. As a result, the centers promote and support graduate entrepreneurial intent, thereby acting as feeders for other incubators. Even though no two incubators are exactly alike, they have several traits in common, such as co-location of businesses, shared services, management assistance, and networking. One distinctive feature of pre-incubation facilities is that they have a common purpose.

It is evident that university-based pre-incubation centers play a very important role in the entrepreneurial ecosystem in emerging economies such as Turkey. The first university-based pre-incubation center was established at University of Bielefeld in Germany in 1997. Since then, the number of university-based pre-incubation centers has increased around the world. The first pre-incubation center was established in Turkey in 2004, and there are about 40 university-based pre-incubation centers in the country. This rapid growth has underlined the necessity to conduct the present study, which aims to provide a general overview of university-based pre-incubation centers in Turkey.

## 4.3 Methodology

The main goal of the present investigation is to examine the structure, organization, activities, and problems related to pre-incubation centers in Turkey. This study adopts both qualitative and quantitative research methods. First, we conducted a literature survey and established the scope of our field research. After setting the theoretical basis for the study, we designed a survey instrument. We divided the survey instrument into three parts. The first part consisted of 29 questions related to general information about pre-incubation centers. The second part comprised 18 questions about beneficiaries. The third part included 35 questions related to problems and successes of pre-incubation centers. We pretested the survey instrument with two academics to confirm that the survey questions were clear and lacked confusion regarding wording, descriptions, and measurement scales. Based on feedback from those pretests, we improved and refined the instrument. We also implemented a pilot study before administering the survey instrument to managers of pre-incubation centers.

### 4.3.1 Sample

There is unfortunately no official database about the number of pre-incubation centers in Turkey. For that reason, we used the database of the Association of Technology Development Zones in Turkey to create a list of such centers. We then asked the managers of identified centers to provide their own list of pre-incubation centers in Turkey. We thus used the snowball sampling method to establish our sample. This method is also referred to as the chain sampling method. It is mainly used in complex and problematic field studies (Neuman 2006). Initially, we conducted interviews with a small number of managers of pre-incubation centers, and we utilized their networks to identify other actors. Currently, there are 40 - pre-incubation centers in Turkey. We made interview requests to the managers of all centers but succeeded in interviewing only 23 (58%). We asked the managers both open- and close-ended questions. We conducted both face-to-face interviews and interviews via Skype. After analyzing the resultant data, we prepared policy recommendations.

## 4.4 Analysis and Findings

Many universities in Turkey have taken decisive steps to stimulate entrepreneurial quality. They have also started to take on a role in the entrepreneurship ecosystem. Universities have established several centers within their local regions, such as technology parks, technology transfer offices, and acceleration, incubation, and pre-incubation centers. In addition, governmental institutions have become involved: they have launched many supportive mechanisms. However, the history of entrepreneurial support in Turkey is fairly short. The first step was taken by KOSGEB, which is a governmental institution that supports small and medium-sized enterprises in Turkey. The first technology development center (TDC) was founded. At the beginning of the 2000s, the first technology development zone (TDZ) was established. Today, there are 42 TDCs and 63[1] TDZs in the country.

Since the new millennium, supporting entrepreneurial activities before the establishment of start-ups has increasingly appeared on the agenda in Turkey. Both TDZs and universities have started instituting incubation and pre-incubation centers. The first TDC began operations in 2004.

In the following section, we discuss the results of our field study, which aimed to analyze the structure, organization, and problems related to pre-incubation centers in Turkey.

[1]Of the 63 TDZs, 13 are inactive. They were officially founded but are not in operation.

### 4.4.1 Pre-incubation Centers in Turkey

Pre-incubation centers of Turkey are quite young institutions. As of 2016, the oldest is just 12 years old; however, the youngest is just half as old. It is interesting that 73% of them were established in the last 3 years. This highlights the strength of the entrepreneurial spirit in Turkey.

Geographically, most pre-incubation centers are located in Turkey's three largest cities: 77% are in Ankara and Istanbul, 10% in Izmir.[2] Those three cities have thus taken the leadership in this area. They have made a great contribution to the entrepreneurial ecosystem in terms of operations and human resources. The remaining centers (18%) are located in several other cities. This geographic distribution should be beneficial in supporting entrepreneurs living around the country.

Nineteen pre-incubation centers were founded by public or private universities. The entrepreneurial activities of those centers are managed through TDZs and TTOs (Fig. 4.4). Activities related to the incubation are operated under the umbrella of those two bodies. Two private pre-incubation centers are located in each of Ankara and Istanbul. One pre-incubation center was established by a municipality located in Istanbul. Those numbers indicate that universities are the key stakeholders in Turkey's entrepreneurial ecosystem. These institutions have undergone the transformation from a traditional role (education) to a contemporary one (entrepreneurial support). Universities are thus the main source of knowledge and skilled labor force for the private sector.

Pre-incubation centers operate with a small number of staff. The greatest number of people working in one managerial team is eight. At some centers, only one person is employed. Only four centers (18%) are profit-making operations; 82% are non-profit organizations. All the services provided by the centers are free for entrepreneurs. Pre-incubation centers derive their profits from partnerships. When a start-up is founded, the center receives 5% or 10% of company shares for its services. The center retains its shares if the start-up is sold.

With regard to the purpose of pre-incubation, the centers are very supportive of entrepreneurial ideas at a very early stage of development. The incubatees are young and face considerable problems, among which is finance. The non-profit or free services offered by such centers are the main draw for potential entrepreneurs.

We found that 81% of pre-incubation centers had a strategic aim along with a defined vision and mission. They aimed at contributing to both the regional and national development of Turkey. We observed no sectoral differentiation among 45% of the centers: they supported innovative ideas from all sectors, especially ICT (Fig. 4.5). Five pre-incubation centers decided to support one special sector: two supported ideas in the health sector; one supported the digital games sector; one supported projects that aimed to contribute to civil society; and one supported smart

[2]The distribution of the pre-incubation centers is as follows: 17 in Istanbul (43%), 10 in Ankara (25%), four in Izmir (10%). The remaining centers are located in several cities in Anatolia: Bursa, Eskişehir, Samsun, Gaziantep, Kahramanmaraş, Kayseri, Elazığ, and Sakarya ve Konya.

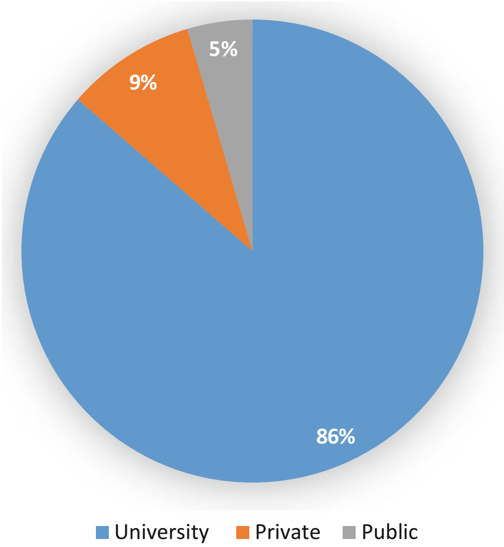



**Fig. 4.4** Type of pre-incubation centers

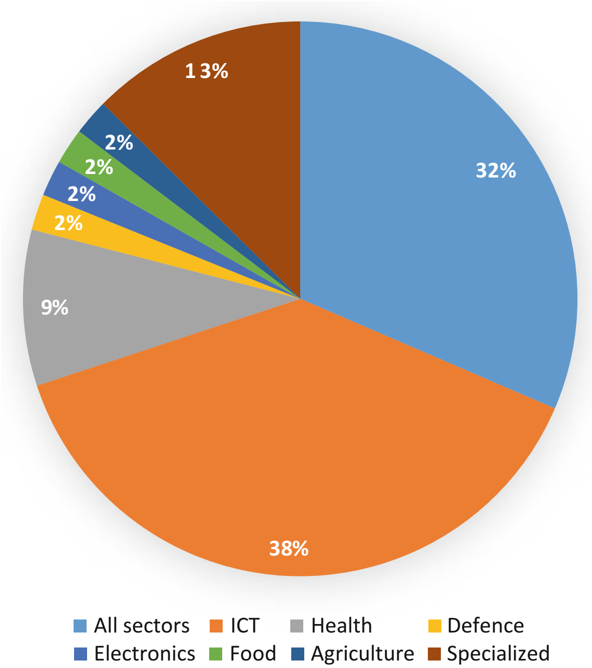
cities. Specialized pre-incubation centers are crucial for entrepreneurial activities. It would likely be more effective if they concentrated on one particular sector. Specialization also offers particular services and support mechanisms for incubatees. If pre-incubation centers focused on one sector that would be more profitable for both the local region and nation.

### 4.4.2 Criteria for Incubatees

Deciding which individuals to support is a critical issue for pre-incubation centers. We found that two criteria were vital for all the centers: having an innovative R&D project and the characteristics of the group. The project should involve a new idea, aim at solving an existing problem, and be marketable. More important, the characteristics of the group members should be in keeping with the idea. If disparities exist in this regard, the rate of failure increases enormously. Thus, the attitudes of the members should be appropriate for the project. The experience of group members is also an important criterion for selection of incubatees.

As to why characteristics of the group members are so important, the first reason is that pre-incubation centers obviously want to be successful. That is to say, with limited resources, they wish to achieve good results. Accordingly, pre-incubation centers consider potential incubatees very carefully before deciding. The centers are looking for skilled, experienced entrepreneurs. The second reason is that discrepancy between the theme of the project and the characteristics of the group members promotes the rate of failure. Failure also signifies loss of time and resources, which are invaluable assets for the centers. It is not easy for young

**Fig. 4.5** Sectoral priorities among the pre-incubation centers




entrepreneurs to maintain their sustainability. Most projects fail to see the light of day. In addition, the candidates need to show their commitment to their ideas or projects. If owners of an idea do not believe in themselves, nobody else will do it for them. Another crucial criterion is whether the end product has market or investment potential. We found that 50% of the centers did not accept new candidates, and they also did not accept start-ups at a very early stage. The other 50% never accepted any kind of enterprise.

### 4.4.3 Services

Pre-incubation centers provide many different types of services for incubatees; however, almost all the centers offered the same services (Fig. 4.6). All except one center provided open office spaces; that center focused on network, mentorship, and training without using office space. As noted above, the pre-incubation centers operate under the umbrella of TDZ or TTOs. Incubatees have the opportunity of receiving support following graduation. The differences among the center mainly start at that point. For example, some TDZs offer accelerator programs and international collaborations for their entrepreneurs. The public institution KOSGEB has launched a support program for TDZ, which aims to open accelerator centers overseas. It is obvious that such services increase the rate of success.

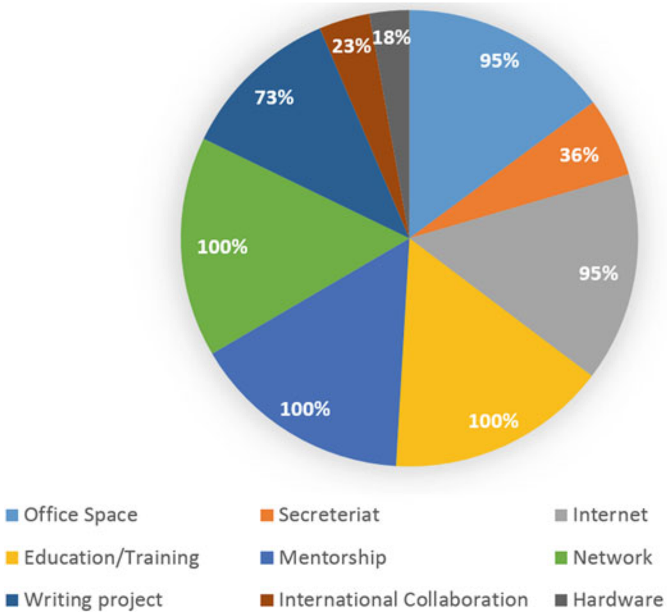



**Fig. 4.6** Services provided for incubatees

We found that 86% of pre-incubation centers did not use financial support: they depended on their own equity. We observed collaborations with private firms and sponsors among 14%. It might be expected that pre-incubation centers would engage in projects in conjunction with their sponsors. However, we found that managers of the centers showed considerable interest in state incentive programs. The Scientific and Technological Research Council of Turkey (TÜBİTAK), KOSGEB, and development agencies provide very good support mechanisms for entrepreneurs and incubation centers. We found that 13 pre-incubation centers (59%) benefitted from such programs. TÜBİTAK 1512-BİGG[3] was the most preferred support program, being used by eight centers. We observed that development agencies were another source of support: three centers in Istanbul were supported by Istanbul Development Agency[4]. One center was supported by European Union programs.

Partnership is vital for pre-incubation centers in terms of service provision. We found that 90% of centers had at least one operational partnership with another center; 16 centers had regular training and mentorship programs in collaboration with another center; eight centers (35%) had international collaborations. The

[3]Tübitak 1512-BiGG is the support program for entrepreneurs at an early stage. Although the program is provided by TÜBİTAK, it is executed by university TDZs or TTOs. The advisory board of TÜBİTAK decides on the institutions to execute the program.

[4]Those are state-operated agencies. They aim to be centers that provide support for production and implementation of projects as well as original development strategies; they do so by adapting innovative, sustainable development models created around the world to their own regions. There are 26 such agencies in Turkey.

centers organized activities on experience sharing, increasing networks, and joint workshops. We observed that 50% of the centers collaborated with the private sector in terms of mentorship and networking.

As noted above, the universities of their location are crucial stakeholders for pre-incubation centers. Universities have started to become increasingly engaged in entrepreneurial activities. They are sources of knowledge, technical support, and a skilled workforce for start-ups. Universities can also help transform students into young, talented entrepreneurs. The role of third-generation universities is a subject of much debate.

### 4.4.4 Problems with Pre-incubation Centers

Pre-incubation centers face a number of problems related to organization, field of interest, and the services they provide. Many of them share the same problems. We found that 41% of managers stressed that group members were very resistant to change and that they could not easily change their way of thinking. Young entrepreneurs tend to be very conservative about their projects. If they are unwilling to make changes to their project or business model, their chances of failure are high. Pre-incubation centers offer mentorship for the sake of the project. It is important that young entrepreneurs understand the value of such services. In this regard, 26% of centers reported that for most incubatee groups, the commercialization process takes too long. Most incubatees spend too much time developing prototypes and forget about marketing the product.

Another problem is the slow decision making of higher boards (28%). At some pre-incubation centers, the bureaucracy is too restrictive. This lowers their effectiveness. In this respect, private centers display better organization: decisions can be easily made in short, straightforward meetings. In addition, 23% of centers complained about a lack of adequate physical and financial resources. Most centers are located on university campuses and use existing buildings. All of them have open office spaces, but they need more and bigger spaces. However, greater resources demand higher budgets and more time.

We found that 23% of pre-incubation centers reported that lack of resources prevented staff from providing appropriate services for incubatees. If an entrepreneurial idea has the potential for special interest value, that will definitely heighten its attractiveness; however, if a center is serving too many incubatees, it cannot easily provide individualized services to every group of entrepreneurs. For example, centers may be unable to find a mentor from the same academic discipline as the incubatees. By contrast, centers that specialize in a particular sector do not face that kind of problem. They can provide focused services. It is believed that a new approach to resource management and organization with stakeholders will solve such problems.

We found that 77% of managers desired greater state incentives—especially private pre-incubation centers—to solve the above problems. However, sustainability becomes a key issue in this regard. Instead, centers themselves need to explore potential resources. Centers also need to develop more, broader network opportunities.

### 4.4.5 Needs of Incubatees

Incubatees need support in several areas during the incubation process (Fig. 4.7).

Incubatees need more support in finding potential customers (45%). As mentioned earlier, the biggest mistake among incubatees is an inability to focus on market dynamics while working on their projects. In this regard, they are unable to develop a proper business model (37%). Although training is available about generating a business model, groups still have a problem with this issue. Resistance to change may also be a cause of such problems. A business model lends the entrepreneur the ability to give value to their enterprise and gain sustainability (http://www.businessmodelgeneration.com/). Entrepreneurial groups clearly need to have adequate resources to identify that value and present it to customers or investors. This creates another crucial problem—scaling the project. If the entrepreneur cannot produce an appropriate business model, they cannot anticipate future actions; failure becomes inevitable. To overcome this problem, special mentorship and more networking opportunities should be provided for incubatees. Network channels will offer the chance for incubatees to find real customers. The main problem is matching the product with the right customer. Training in effective market research and network relations should help deal with that problem.

### 4.4.6 Education and Training

Education is the most important input source for the entrepreneurship sector. We found that all the centers organized education programs for incubatees. Training programs were held in various fields from the initial acceptance period to the center until graduation. Three to four education programs were organized at each center on

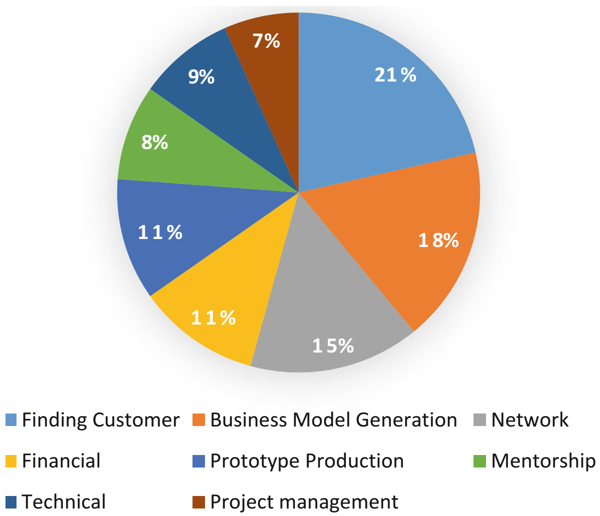
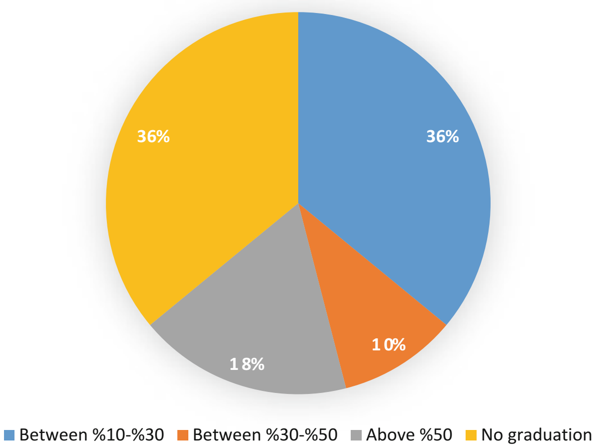



**Fig. 4.7** Support needs among incubatees

**Fig. 4.8** Survival rates




a monthly basis. The educational content was almost the same, such as business plans, business models, marketing, sales, and effective presentation techniques. Some centers also organized education programs to meet the needs of entrepreneurs. Education programs also covered such areas of technical training as lean manufacturing, product verification, crisis management, and coding. It is evident that the pre-incubation centers succeeded in this area.

In addition to the education programs, all the centers provided mentoring services. We found that 82% of the centers had their own mentor pools. The remaining centers did not possess such a pool; however, upon requests from teams, a mentor could be assigned and interviews conducted. Moreover, 59% of the centers stated that they would set up mentor interviews upon request. We found that 41% of centers held interviews on a periodic basis.

### 4.4.7 Beneficiaries

Approximately 700 beneficiaries were supported by 22 centers. Among those beneficiaries, 80% were university students. The centers did not welcome entrepreneurs only from their own universities, but also those from different cities and universities. However, the low number of women entrepreneurs should be noted. At 13 centers, women constituted less than 10% of entrepreneurs. At only three centers, the proportion of women entrepreneurs was 20%. The lack of female employees, managers, and skilled personnel is evident everywhere in Turkey, and this also applies to entrepreneurship.

It is not expected that every candidate who leaves the pre-incubation center should start their own company. To graduate successfully (by starting a company or finding investment) after acceptance to the center; the "survival rate" for entrepreneurs varied among the centers (Fig. 4.8).

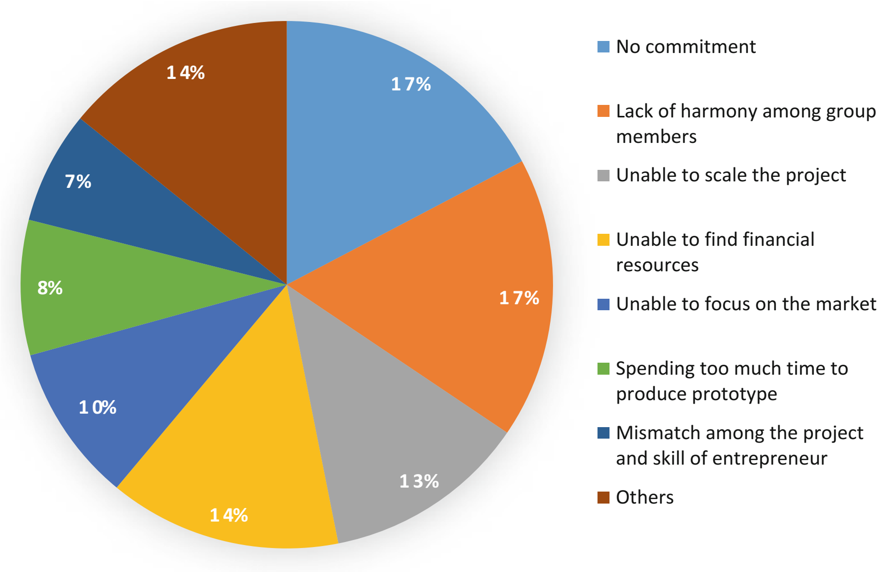



**Fig. 4.9** Reasons for failure

The survival rates of eight centers among the nine that were established in 2015 have not been calculated since they have not yet produced graduates. The proportions in Fig. 4.8 naturally lead to a discussion of the reasons for failure. We found that the teams failed for very different reasons. However, some reasons for failure applied to the entrepreneurs at every center (Fig. 4.9).

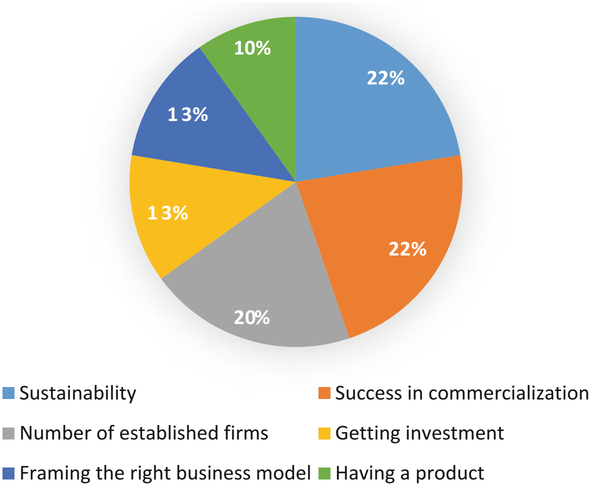
Not being sufficiently committed and lack of harmony in the group were considered the major reasons for failure. Some center managers cited cultural behavior issues related to commitment. Individuals who lack the entrepreneurial mindset can easily give up if they are forced to explore new ideas. In this context, universities need to help create a culture of entrepreneurship in their approach to education. Subjects and workshops directed at entrepreneurship should be added to the educational process.

With respect to lack of harmony, problems occur regarding team and project management among team members throughout the project process. These problems may persist despite training devoted to this area at the centers. Working more closely with team members at the center and increasing social sharing to help improve internal communications among members will be beneficial in this area.

### 4.4.8 Success

According to the organization and field of interest, the meaning of success differed from center to center (Fig. 4.10). For some centers—especially young ones—the number of established firms was the main criterion. The older pre-incubation

**Fig. 4.10** Criteria for success among pre-incubation centers




centers focused more on the sustainability of their groups after establishing their enterprises; they were thus interested in quality, not quantity.

Among specialized pre-incubator centers, increased consciousness of the incubatees in terms of their aims and targets was a criterion of success. In addition, groups were expected to produce a minimum viable product.

The main target of pre-incubation centers is to train groups and increase their experience. Thus, newly established start-ups are appropriate for TDZs. TDZs are the first step toward nurturing an entrepreneurial ecosystem in a local region. For that reason, sustainability is a crucial aspect. All incubatees in-pre-incubation centers are necessarily expected to start their own firms. However, the meaning of success is very much related to quality. For that reason, it is necessary to develop long-term plans.

## 4.5 Policy Recommendations

It is evident that universities have evolved from playing a tangential role in local, regional, and national business ecosystems to becoming key partners. Entrepreneurial universities focus on knowledge spillovers and commercialization of research. Successful regions have vibrant university–business partnerships.

### 4.5.1 Entrepreneurial Mindset

An important function of an entrepreneurial university is therefore creating awareness of the importance of developing a range of entrepreneurial abilities among students and faculty. A university should initiate awareness-raising steps across the whole institute. For example, universities can restructure their curriculum and include courses and workshops related to entrepreneurship. In addition, the links between business pre-incubation and higher education institutions and research centers should be stronger. This would help facilitate the commercialization of research findings, promote innovation transfer to entrepreneurship, and aid the creation of spin-offs. Students should be encouraged to attend pre-incubation centers in order to gain experience and entrepreneurial skills.

Universities should develop strategic targets that encompass an entrepreneurial vision for the future. Strategies should focus on generating entrepreneurial thinking and competence, commercializing research results through technology transfers and business start-ups, and strengthening cooperation between the institution and local firms.

### 4.5.2 More Resources

Pre-incubation centers need more resources in terms of a skilled workforce and finance. Government involvement is necessary: it has an impact on incubator models, organization, and funding structure. The government should support those centers in establishing their own financial fund. This fund can be used in the prototyping process. It is also vital that the university invest in its entrepreneurial activities through a sustainable financial strategy.

An effective managerial staff will establish closer contact with incubatees. This will provide the ability to create more extensive, special services for the groups. It is better to appoint incubator managers with high-quality professional business expertise.

Public institutions clearly need to play a more active role in terms of generating incentive programs—especially incentive programs to reduce the structural problems of pre-incubation centers. This does not mean that public institutions should provide only financial resources. Special support mechanisms need to be prepared, such as commercialization and special fund for pre-incubation centers.

### 4.5.3 Greater Collaboration

A university should be involved in a range of partnerships, including, for example, regional and local organizations, small and medium-sized enterprises, social enterprises, schools, alumni, and entrepreneurs. Matching student and graduate entrepreneurs with experienced entrepreneurs will increase a business's chances of success and boost other support services. Universities should make mentoring services available to both student and graduate entrepreneurs. Mentors could be educators with entrepreneurship experience or dedicated business coaches. Entrepreneurial universities should also make use of their alumni as mentors.

Internationalization may offer a chance to integrate international, national, and local dimensions. Universities should develop internationalization strategies, including entrepreneurial activities as well as incubation and pre-incubation centers. Universities should establish stronger links with international networks and university innovation clusters in addition to setting up bilateral partnerships with other institutions. Universities should use their networks, partnerships, and international alumni to provide feedback for teaching, learning, and research agendas.

A particularly important mechanism for knowledge exchange is staff and student mobility. Such mobility can also be implemented for young entrepreneurs, and it includes internships or programs for exchange. Universities should establish the necessary mechanisms to support the mobility of staff and students into the external environment.

### 4.5.4 Impact Assessment

To ensure that entrepreneurship activities reach their full potential, they should be regularly monitored and evaluated. However, in Turkey, the evaluation of services in this area is not conducted properly. For example, monitoring and evaluation should assess changes in the participants' motivation and level of competence in skills gained through the activities related to the entrepreneurship education. Universities should measure the impact of entrepreneurship education at different phases of the associated activities (beginning, end, subsequent time points). In this way, strategic forecasts could become more precise.

The goals of entrepreneurship programs should be made explicit, based on a thorough analysis of local economic circumstances and of the problems that the incubator is intended to address. Setting clear goals in advance will also ensure proper monitoring and evaluation of a scheme.

Identifying appropriate areas and products that are relevant to the socioeconomic context is a critical area that needs to be considered when making a decision about university-based business incubators. Future research should focus on identifying high potential areas and undertaking a comparative analysis of university-based business incubation processes in different countries.

### 4.5.5 Pre-incubation Centers

These centers need to become autonomous managerial bodies. The time for decision-making processes should be reduced. The centers clearly need more skilled specialists and managers. People from academia could perhaps be employed in the management teams of these centers. In addition, the working spaces need to be designed to foster synergy among incubatees.

## 4.6 Conclusion

An entrepreneurial society refers to one where knowledge-based entrepreneurship has emerged as a driving force for economic growth, employment creation, and competitiveness. In this context, entrepreneurial universities play an important role as both knowledge producers and disseminating institutions. University-based incubation centers will be the key actors for promoting entrepreneurial culture in societies. By supplementing government activities, they will play a significant role in job creation and economic development.

Turkey is quite young country in term of entrepreneurial institutions. The first TDC was established in 1991. The youngest one is pre-incubation centers. As of 2016, the oldest is just 12 years old; however, the youngest is just half as old. It is interesting that 73% of them were established in the last 3 years. Turkey is younger but faster country.

We can state that universities are the key stakeholders in Turkey's entrepreneurial ecosystem. Nineteen pre-incubation centers were founded by public or private universities and approximately 700 beneficiaries were supported there. Among those beneficiaries, 80% were university students. So to say, The transformation from a traditional role (education) to a contemporary one (entrepreneurial support) make them the main source of knowledge and skilled labor force for the private sector.

The number may bring the problem of quality. The authors believe that pre-incubation centers have to focus on one single sector. In other words, specialization is needed. Specialization also offers particular services and support mechanisms for incubatees. The supported sector should be definitely chosen according to the needs and targets of local private and governmental bodies. Turkey is at very low levels in that sense. Only five centers have decided to focus on single sector. On the other hand, 45% of centers support innovative ideas from all sectors, especially ICT.

The lack of harmony among group members and low level of commitment are the major reasons for failure. This is may be due to the lack of entrepreneurial mindset. They can easily give up when problems occur or when they are unable to scale the project. In this context, universities need to help create a culture of entrepreneurship in their approach to education. Besides, close communication with incubatees will definitely improve their interest and self-confidence.

To ensure that entrepreneurship activities reach their full potential, they should be regularly monitored and evaluated. Universities should measure the impact of entrepreneurship education at different phases of the associated activities (beginning, end, subsequent time points). In this way, strategic forecasts could become more precise.

The government should take the initiative to develop more business incubators in general and university-based business incubators in particular. Government involvement is vital for incubator models, organization, and funding structure. These efforts could be directed to establish public-private partnerships and financial hubs to sustain them in their early stages.

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# Catching-up and the Role of University-Industry Collaboration in Emerging Economies: Case of Turkey

5

Hadi Tolga Göksidan, Erkan Erdil, and Barış Çakmur

**Abstract**

In the last century, universities have played a significant role in stimulating technological change and innovation. The recent decades have witnessed a change in the mission of the universities, namely their social mission in disseminating knowledge and interacting more broadly with the surrounding society, in addition to conduct education and research. This dissemination and interaction is *often* realized in the form of successful university-industry collaborations (UICs) in the developing countries. Nevertheless, this sort of realization still lacks comprehensive view. Besides, such comprehensive view is also required to address gaps and types of barriers to economic development and some possible mechanisms which could lead to catching up on the basis of UICs. Academic studies deviate such possibility of catching up is due to the balance between barriers and resource usage among institutional actors. In order to address this gap, first, we implemented a review on literature on UICs. The review provided an overarching process framework, which are distilled from the analysis. However, as current research on this issue points to, different types of university-industry interaction with government intervention and with a strong

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emphasis on education programs that may have high pay-offs for developing countries. In this context, we administered the concept of UICs in the case of Turkey as a developing country by which we provide a substantial contribution by creating an integrated analysis of literature and further mitigations for research topics distilled from our analysis.

**Keywords**
University—Industry Collaborations (UICs) · Catch-up · Institutions · Government intervention · Emerging economies · Turkey · Triple Helix

## 5.1 Introduction

Universities play a central role in the context of the development of knowledge and technology base of societies. On the other hand, creation, distribution and transfer of knowledge and technology is a different and complicated task and needs demanding technology management practices. Since knowledge is distributed within each entity (actor), within each organization and within the economic and social system, it is expected to grow provided that it must also sufficiently be coordinated through increasing interdependencies and welfare economies (Loasby 1999).

In this paper, we tried to establish the context and rationale for an academic literature to set up a basic understanding of transformation of university–industry relationships as reflected in different academic research papers, with regard to certain types and theories of University-Industry Collaborations (UICs). Hence, we analysed the transformation effects for the economic development and catch-up caused by changing collaboration scheme especially for the emerging economies and utilizes the case of Turkey in order to present some realized determinants. Furthermore, we expect our study to contribute to the literature on the economics of university–industry relations by highlighting different forms and objectives of university–industry interaction in emergent countries.

Conclusively presumed, the academic literature on welfare in evolutionary economics mainly focuses on fostering education and innovation as a central means of welfare and growth. In this perspective, it is considered that the transformation and development of societies is *strongly* depended upon the technological development or the emergence of technological routines. However, one may argue that this strong emphasis on innovation and technology only represents a fragment of an evolutionary welfare economics. Nevertheless, some additional arguments and theories related to other dimensions of economic welfare might highlight the importance of the need for a proper analysis of knowledge creation in societies. In this context, it can also be argued that suggesting a concise concept of evolutionary welfare is a necessary condition for the development of an evolutionary welfare framework.

Supposedly, the evolutionary welfare framework, presented in Fig. 5.1, points out that growth and development has a bidirectional causality and thus, a concurrent

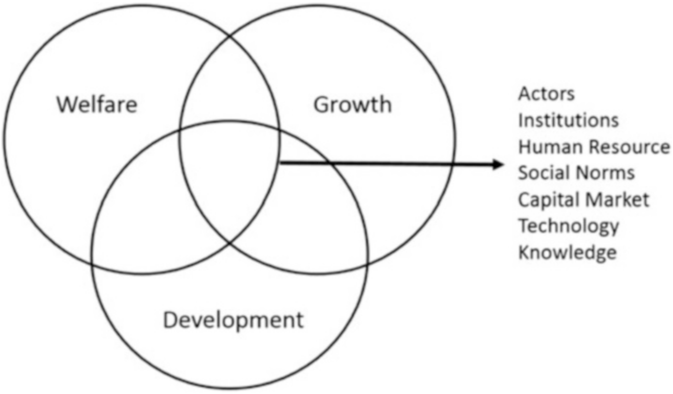


**Fig. 5.1** The evolutionary welfare framework. Source: Own construction

feedback. Moreover, current approaches suffer from a vague or limited applied research to determine the *real* strength of welfare economies. Of course, we are challenging a neoclassical welfare or purely Keynesian welfare; but the locus of our research is *implicitly* founded on the theory of evolutionary welfare including gradual improvements of *all* capital infrastructures including actors, institutions, human capital and relational capital through collaboration networks in the context of economics of technology. From this perspective; as one of the most important per-capita for welfare economics; we propose that the university-industry (U-I) interactions (linkages, collaboration, etc.) should further be analysed through the *synopsis* of technological development. In addition, we further propose that the specific analysis for U-I interactions should be accomplished for emerging economies that encounter infrastructural problems or problems at various levels of innovation systems (national, regional, sectoral, technological); but having *relative* advantages in terms of relational capital and technology transfer as well.

Furthermore, according to *technology policy-oriented* evolutionary studies, it is widely recognised that the interface between U-I interactions are founded on the basis of technology and knowledge transfer. Universities, by any means, are essential players in the process of innovation, technology and knowledge transfer; and the last decades have *clearly* shown us that the emergence of structured mechanisms for knowledge and technology transfer from universities inventions into industry, products and services are also critical in sense of welfare economics. Perkmann and Kathryn (2007) clarifies this status by explaining that technology transfer complies with the use of knowledge codified within research papers, patents or prototypes, undoubtedly occurs in some circumstances, the concepts of open, networked and interactive innovation point to the role of collaboration and other types of relationships underpinning and enabling such transfer.

Nevertheless, scholars recently have interested in technology and knowledge (but also in policy making) transfer from different points of view involved with the determinants, characteristics and barriers of university–industry (U-I) knowledge transfer activities. Hence, firms' innovative activities are examined in order to distinguish between the impact of knowledge transfer and the impact on overall firms' economic performance. In this sense, most of the analysis that exploit direct measures of knowledge interactions, such as U–I R&D cooperation, or the use of university as an external knowledge source, find positive effects on firms' innovative activities (see e.g. Bozeman 2000; Arvanitis et al. 2008; Becker 2003; Fritsch and Franke 2004; Lööf and Broström 2008).

As an outcome of the above described research, from the perspective of "university", universities are termed to be essential elements for any innovation system. Accordingly, they are considered as *leverages* for the economic development in the case of search accomplished for emerging countries. This fact is proven many times by the theoretical and empirical framework of the triple helix and, more recently, quadruple helix approaches, where the focus is on how the interplay between university, industry and government and civic society can stimulate knowledge-intensive economic development (Etzkowitz and Leydesdorff 1995; Carayannis and Campbell 2009, 2010).

In this perspective, as one of the important missions of universities, i.e. the *social* mission, signifies that they should engage in external partnerships related to community needs and support economic development. Today, universities are also coupled with new challenges determined by the emergence of the learning economy. Current academic literature identifies certain changes in the context of universities that derives new dynamics in the economic sphere. More specifically, the combination of growing complexity of the knowledge base, as well as the accelerated renewal and obsolescence of knowledge, entails that positioning of the firms and universities in business networks has become a vital factor for their relative success (Håkansson and Snehota 1995). Complementarily, the creation of these business networks and alliances are often realized with entrepreneurial universities and triggered successful U-I interactions.

In the next section, the prominent studies and approaches aiming to understand and systematize the university–industry interaction in retrospect; and how these interaction changes are connected to the economic and societal changes are discussed. In the third section, the University-Industry collaboration in emerging economies with respect to the change in the knowledge and technology production is examined. The chapter is followed by a forth section which includes the analysis of organizational forms of UICs in Turkey by further discussing the role of UICs in the catch-up process. Last two sections explore preliminary outcomes and include some related policy recommendations with risk mitigation how UICs have been structured under the influence of all these discussions/controversies.

## 5.2 University-Industry Interaction in Retrospect: An Evolving Domain?

Etzkowitz (2002) delineated that the first examples of university-industry interactions are observed in seventeenth century in German pharmacology sector. These examples are classified as the seeds of academic entrepreneurship. However, the early instances for the intermediary role of researchers between university and industry and consultancy services are witnessed in Harvard and MIT by the end of nineteenth century. It is only within the twentieth century, U-I relations analysis is extended with changing relations between science and industry as related with how knowledge is produced and how social linkages effect the relationship between science and the university (Martin 2003).

Extended transformation of U-I relations is depicted in the end of twentieth century with one of the most common approaches namely as "Triple Helix" (Etzkowitz and Leydesdorff 2000; Etzkowitz 2008). This approach is based on the assumption that there exists three intrinsic poles in economic terms: university, industry and government. It is evident that, in the twentieth century, all these poles have *abruptly* connected with each other.

Etzkowitz (2008) clearly states that Triple Helix model must be considered as an arrangement for capitalizing knowledge in order to pursue innovation to create an economic value added either in direct or indirect ways to the economy. Therefore, it is also notable that the knowledge generated in Triple Helix has an institutional character to emerge catch up at different scales.

One of the important scales is that the Triple Helix model succeeds catch-up by creating new forms of organizations. Academia, industry and government play the intrinsic role of organizational and economic development. Finally, this new means of economic growth has of course an important role to recognize catch-up for emerging economies. In principle, the Triple-Helix model has three main configurations (Ranga and Etzkowitz 2013) (see Fig. 5.2):

1. Governments pave way to develop new collaboration (university–industry collaboration—UIC) scheme by defining objectives and putting limitations for the interaction between university and industry,
2. Industry becomes the driving force for the collaboration environment where both university and government have limited roles (university acts as provider of academic talents, where government role is to regulate the social and economic mechanisms),
3. All three actors act as partners aiming for the transition of knowledge to society.

Moreover, in a heuristic sense, changes in the system of U-I interaction effects the course of knowledge production systematically at all three spheres within their conjunction in the trilateral networks to innovate (see Fig. 5.2) (Hessel and Van Lente 2008).

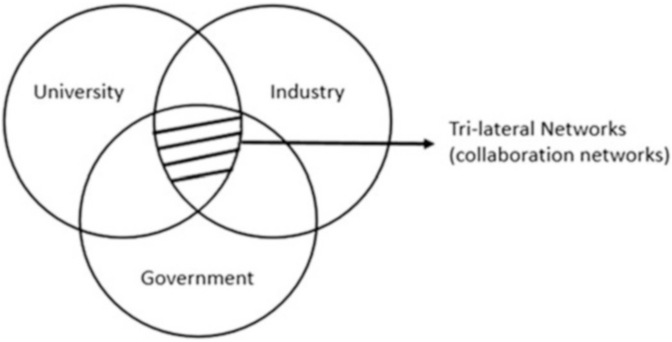


**Fig. 5.2** Triple Helix model. Source: Own construction

The *old* model of UIC (industry and university alone) was influenced with the linear model of innovation, which describes how ideas move sequentially from research to production through process development, and ultimately diffused into the market (Malecki 1991). This new reconfiguration of university-industry-government networks are strengthened also with the emerging concept of open innovation in the beginning of the twenty-first century (Powell et al. 1996; Chesbrough 2003). In the context of open innovation from the UIC perspective, one should notice that the network linkages with high relational involvement facilitate new inter organizational relationships as the "locus of innovation" (Powell et al. 1996). This concept furthermore clarifies the importance of a new trend in which mainly start-up companies tend to utilize the knowledge produced outside the company; and value the importance of universities in the dissemination of knowledge in the society. In a sense, we might also comment that start-up companies represent the transfer of applied knowledge and technology created in a university into industry for further development and commercialization having risks inadequate financing, etc.

On the following, engaging a wide range of actors has long been fundamental to economic development, the significance of and the need for a new approach has emerged: Quadruple Helix model by proposing to add a fourth group (civil society as innovation users) to a classical Triple Helix model. This model is potentially *open* to support economic development (since these different actors have skills and knowledge); furthermore, this model develops open innovation's dialect with a new development approach in that of innovations are pertinent for users who drive the innovation processes. In line with this new perspective, innovative products, services and solutions are developed with the involvement of users in their role as lead users, co-developers and co-creators (see Fig. 5.3).

Moreover, we should also denote that the interaction between industry and university *mostly* happens to take place within a national Research and Development (R&D) system. The cooperation and collaboration between parties takes place within the tri-lateral networks for the process of technical change in developing countries, as in the case of Triple Helix model. Nevertheless, it is *inseparably*

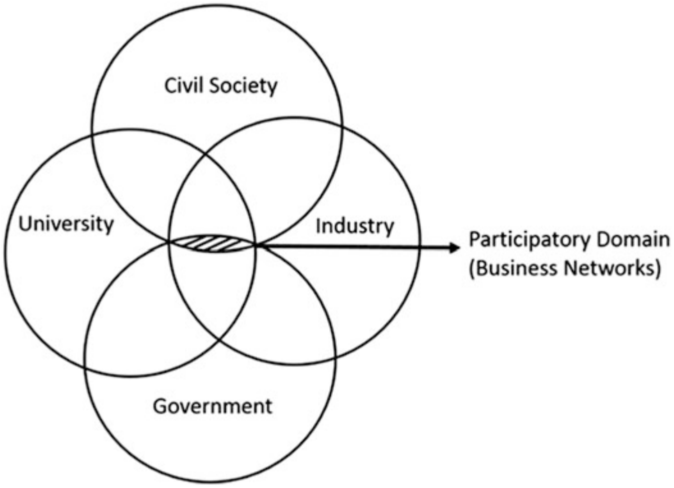


**Fig. 5.3** Quadruple Helix model. Source: Own construction

important to define formal structure of national R&D regime in which university and industry functions through the overall R&D system. Hence, different objectives, emphases and regimes in the many countries creates the set of economic gaps.

Closing the gap or *catch-up* terminology relate to the ability of a single country to narrow the gap in economic aspects (productivity and income) and technology (as an intermediary) with a leader country in order to reduce the overall differences as a whole. The issue of catch-up has been crucial for the academic research as growth proceeds such convergence on the long run (Solow 1974). Of course, it is highly metaphorical that all developing countries tend to converge and succeed in catching-up while others fall behind (Abramovitz 1986).

Any examination of failure of catch-up between university-industry interactions reveals different approaches. Nevertheless, we claim that the underlying reasoning is the potential failure of the “iteration” process, or “feedback” loops, which characterize the continuing progress of science and technology. As Beckers (1984) depicts in his study, the iterative process involving universities and industry should be complementary to each other in which society progresses ideas, knowledge and applications together.

Above described *iterative* interactions between U-I; addressed from different sets of viewpoints in the academic research papers; partially, explains the closing gaps (*catch-up of*) between the developed and developing countries. Besides, we tend to analyse different characteristics for each agent in the triple helix model in order to determine the degree of U-I cooperation as well as the societal and economic nature of the developing country. Nevertheless, our approach is different and difficult in the sense of defining objectives and indifferences in economic development that *eventually* create some intrinsic results as the failure of catch up within the many developing countries.

Furthermore, we are basically trying to reflect the basis of university-industry interactions; as the traditional role and strengths that each partner brings to the relationship in order achieve certain economic achievements and developments. Moreover, in our opinion, this intrinsic status implies the importance of each UIC partner to sustain its fundamental technical capacities so that projects conducted in parallel are to be successful contributions to the science and technology reservoir of that developing country.

Hence, on the essence of U-I interaction, one might comment that it is the *desire* to advance simultaneously the universities' role in educating new graduates and to advance new technical and societal achievements. These mechanisms pave way for many other economic functions that can produce the optimum benefits from cooperation schemes. Here, *strategic* importance of this approach may be referred as a *must* if a country or an industry, especially high technology industry, wants to sustain its leading position.

Complementarily, the "Quadruple Helix" model better explains U-I interactions by the development of a society with new technology-based firms (start-up companies) that eventually benefit from proximity to the university. Benefiting from organizational and technologies proximities, we may summarize the fact that firms are eventually created by either academics or (former) students or by companies that moved in from other areas, including international enterprises. Start-ups' emergence in technological districts have also provided a technological development environment, as common to the early stages of twenty-first century.

In this article, we are discussing some issues whether the successful U-I relations would be sufficient to stay at the leading edge of science and technology hence to lead way to catch-up. To be precise, our predictive empirical research on UIC policies gives us the incentive that universities (beyond the old traditions) create value to society (value creation for economic and societal development) and universities are essential *pioneers* to cooperate with industry if governed successfully.

## 5.3 A Snapshot on University-Industry Interaction in Emerging Economies

Today, we are witnessing an expanding number of technologies, products and services, all combined together in various kinds of institutional networks formed by U-I interactions. Concurrently, we need a robust understanding for economic growth for new applications, products and services. In addition, among developed and emerging economies, a usable framework that captures the essence of economic growth theory is needed. Hence, in this complex and competitive regime of economic analysis, the role of U-I interaction with regard of economic growth and innovation makes *sense*.

Often, economic growth is associated with innovation through new technology or new products. But, in reality, a significant amount of innovation research is also about new ways of producing knowledge and transfer of knowledge. For innovative economies, collaboration between U-I is expanded through norms that lead to the transfer and creation of knowledge among different business networks involving companies and universities. These networks are natural *leverages* for research and development (R&D) that leads to matching of knowledge and technology with new applications by facilitating the creation of new business and market opportunities.

Hence, through the universities and businesses, in order to continue to create new knowledge and business opportunities, newly industrialized countries (NICs) (for instance namely Brazil and Turkey) are increasingly focusing on fostering science–industry interactions and developing high-technology sectors (Gouvea and De Kassicieh 2005). Policy-makers in both developed economies and newly NICs have been focusing on designing policies aimed at building up the *innovative capacities* via different research and training programmes.

In an aim to develop relevant innovative capacities, the challenge for governments is *how* to sustain a *suitable* innovation environment that supports and facilitates new ideas, knowledge flow and entrepreneurial spirit within tri-lateral networks of innovation. Wong et al. (2007) denotes that making a suitable network for more entrepreneurial environment; and to support the growth of high-technology activities; it is important to develop certain indigenous technological capabilities of NICs in a more dynamic economic network.

In accordance with above prepositions, it is possible to claim that, through the universities, indigenous technological capabilities are transformed to produce value-added output surprisingly with an increasingly innovative pace. In this regard, for knowledge-based or learning economies (NICs), such innovative pace is achieved through collaborative interactions among different actors within the innovation systems to produce, accumulate and diffuse knowledge for promoting competitiveness through technological changes and innovations (Archibugi and Lundvall 2001).

In certain academic literature, universities have been considered the essential source for knowledge utilization for sustainable competitiveness (Huggins et al. 2012; Etzkowitz 2002). Nevertheless, through time, the role of universities in developing new knowledge and shaping societies through innovation has become more evident. Moreover, business networks and innovation capacity among university and industry have become more important through "entrepreneurial universities" (Powers 2004; Etzkowitz and Leydesdorff 2000) and "academic entrepreneurs" (Shane 2004; Meyer 2003) that are highly *effective* in the establishment of start-up firms.

In this perspective, similar to findings presented in Perkmann and Kathryn (2007), academic research results also indicates that partnerships between firms and universities are one of the most intermediary for developing new innovative and technological capacities through new start-ups. As technological innovation is *literally* being transformed, the creation, dissemination, and utilization of knowledge moves from the periphery to the centre of industrial production and university–industry interactions (Etzkowitz 2012). Furthermore, the concept of *innovation systems* comprises some other institutional arrangements between university and industry that enable the utilization of knowledge in NICs as they tend to be a more research-based country (see Huggins et al. 2012; Etzkowitz 2008).

In this perspective of research-based innovative economies, larger firms tend to focus on building non-core competences, whereas start-ups and smaller firms focus on developing core areas (Santoro and Chakrabarti 2002). It is also argued that the most successful knowledge is transferred through universities through business networks (Lockett et al. 2009). Universities in these business networks are also considered to be the key actors in the process of industrial technological development and catch-up in specific industrial sectors (Mazzoleni 2008). Universities can also support the collaborative networks to develop new technological capabilities. They can also sustain *catch-up*, through the provision of training for scientist and engineers, support for personnel exchanges involving international researchers, experts and students, access to collaborative research networks (national or international) and new technologies, and advanced knowledge and skills in relevant science and engineering fields (Pavitt 1998; Robertson and Patel 2007).

Aforementioned collaborative support through networks also involves external interactions among customers, suppliers, regulators and knowledge providers (Edquist 1997; Freeman and Louca 2001). Among the different forms of collaborations, networks and alliances, this study also concentrates on U-I interaction on the basis how these interactions facilitate catch-up between developed and NICs and how companies relate to this scheme.

In this sense, for developed countries, there exist a huge number of case studies exploring the role of the universities in stimulating economic development. For instance, Cohen et al.'s (2002) inclines that university research results play little if any role in triggering new industrial R&D projects.

Such a context is also associated with major contributions to academic research at national levels. In the case of developing countries, Hershberg et al. (2007) denote the few business start-ups associated with a university, yet missing any significant linkages of local businesses to universities. In Japan, for instance, localized spillovers and university-associated clusters are infrequent, although the informal and occasionally formal collaboration among the leading universities and the major corporations that spearhead Japan's technological advances is widespread. Continuously, in their study, authors summarized the fact that they realized few instances of university–industry linkages (UILs); however, when we focus on the studies accomplished for United States, in most of the studies, it is exemplified in Hershberg et al. (2007) that universities encourage companies to establish new business connections. (see Aniello 2004; Cosh et al. 2006; Proudfoot 2004; Saperstein and Rouach 2002 for more).

Complementarily, the benefits of university-industry collaboration are also evident in the studies accomplished for developing countries. For instance, for emerging economies (for NICs), Brimble and Doner's (2007) study indicates a very low level of innovation linked up with universities in Thailand. Hershberg et al. (2007) denotes also that the faculties relatively do not conduct *enough* applied research at most of the universities in emerging economies. For example, in their research, they have underlined the fact that, in Korea and Singapore, the leading universities have only recently begun paying attention to research and its commercialization mostly limited to consulting and small-scale contract research. In a different study, Meredith and Burkle (2008) identified a positive attitude among industry and university informants on the joint benefit of building bridges between universities and industry in Mexico. In addition, Marotta et al. (2007), in their study accomplished for Chile and Colombia, show that collaboration with universities substantially increased the propensity of firms to introduce new products and to patent.

Subsequently, from a developing country context, a study by Egbetokun and Savin (2015) also provides a positive insight for the relationship development between interactive learning and the development of innovative capacities in Nigeria. In a more recent study, Huang and Chen (2016) depict that universities in Taiwan facilitate more interaction in business networks with industry thereby contributing to the creation of more partnerships and improved academic innovation. Moreover, in their study, the same findings show us that government funding facilitating new collaboration may have significant impact on the implementation of *correct* regulations and the support for *innovative climate* in universities.

In order to create an innovative climate in universities, we might discuss the effects of two kinds of challenges: The first one arises from barriers to networking that often accompany the codification of knowledge as imposed by the knowledge sources in universities. The second challenge is posed by the limitations on the use of unrestricted (codified) knowledge by mostly innovative (start-ups or spin-off) firms. From a developing country's standpoint, the creation or strengthening of university and industry linkages might be structured with technology transfer.

From this perspective, the capabilities to transfer knowledge depend on the intended uses of the knowledge to be acquired (see Castro and Neira 2005; Connelly et al. 2012). These may range widely, from country to country according to the relative governance settings. We must also denote that there are also sectoral differences effecting the scheme how codified knowledge is transferred (or transformed) or how complex to define a suitable economic model to analyse the differences between university and industry.

The divergent economic performance of developing countries as related UICs may also be characterized by convergence in productivity and income and GDP per capita compared to the industrialized economies (as the most striking evidence on the great variation of performance between countries). However, the efforts for catching-up cannot be solely explained by higher growth in GDP per capita. For instance, according to a recent financial report by PWC (2015), Turkey, *as an emerging economy*, is expected to perform a lower GDP growth as compared to Brazil (with a *fragile* economy). In this report, Turkey is ranked 16th in the world as GDP per PPP in 2011 and expected to be ranked 12th in year 2041 (see Table 5.1 and Fig. 5.4). On the contrary, Brazil sustains its relative economic and geographic

**Table 5.1** Top 20 countries by GDP on a PPP basis (constant 2009 US$bn)

| Rank | Country (FY2011) | Rank | Country (FY2041) |
|---|---|---|---|
| 1 | US | 1 | China |
| 2 | China | 2 | US |
| 3 | India | 3 | India |
| 4 | Japan | 4 | **Brazil** |
| 5 | Germany | 5 | Japan |
| 6 | Russia | 6 | Russia |
| 7 | **Brazil** | 7 | Mexico |
| 8 | UK | 8 | Indonesia |
| 9 | France | 9 | Germany |
| 10 | Italy | 10 | UK |
| 11 | Mexico | 11 | France |
| 12 | Korea | 12 | **Turkey** |
| 13 | Spain | 13 | Nigeria |
| 14 | Canada | 14 | Korea |
| 15 | Indonesia | 15 | Italy |
| 16 | **Turkey** | 16 | Canada |
| 17 | Australia | 17 | Vietnam |
| 18 | Argentina | 18 | Saudi Arabia |
| 19 | Saudi Arabia | 19 | Spain |
| 20 | South Africa | 20 | Argentina |

Source: PwC Analysis Report 2016 (based on International Monetary Fund World Economic Outlook April 2012)

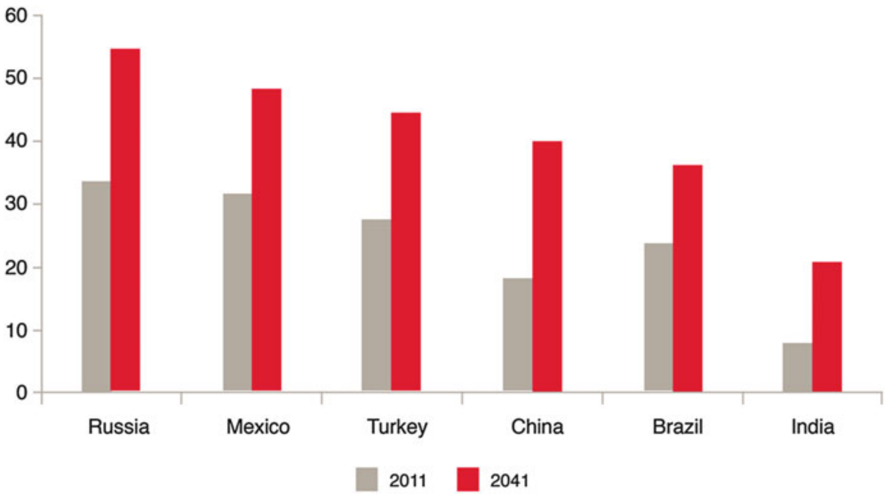


**Fig. 5.4** GDP per capita in PPP terms in 2011 and 2041 (constant 2009 US$% of US GDP per capita). Source: PWC Analysis Report 2016 (constructed with IMF WEO)

advantages by sustaining a bigger GDP growth as ranked 7th to 4th in 2041. Nevertheless, current academic evidence on economic growth (see IMF World Economic Outlook 2016) and innovativeness index (see The Global Innovation Index 2016 in Cornell University, INSEAD, and WIPO 2016) show us that Turkish rankings are preferably *stable* (ranked 42nd in 2016; was 58th in 2015). But, it can be argued that Turkey is showing relatively *low performance* when compared to other developing countries having higher income like Brazil (ranked 70th in 2016; was 69th in 2015; and Chile (ranked 44th in 2016; was 42nd in 2015). Further argument might be extended in such a manner that economic gap analysis restricted with average GDP growth and catching-up require *more* (analysis and policy development) than average growth in GDP with respect to the target levels of innovativeness growth.

To analyse patterns of convergence and divergence related with the U-I interactions, it is also necessary to assess organizational changes and economic development that influenced the accumulation of technological and social capabilities in catching-up countries. The role of U-I interactions in catching-up at the country level experiences relatively shows us that the diversity of growth processes among developing countries reflects differences in institutional patterns in which social and technological capabilities have been accumulated through U-I interactions (see UNIDO 2005).

In order to assess the role of universities in catching-up models (one important model is the formation of entrepreneurial and technological capabilities in emerging industries), we might focus on the components of knowledge transfer mechanisms through universities. Different forms of knowledge transfer mechanism can also be experienced through technical and vocational training, academic and technical research, laboratories, technology transfer offices, technology development zones, associations, and technical regulatory bodies and institutions that support the interactions between training and research activities in the quadruple helix domain (social factors assessed literally).

The institutional change in the basis of quadruple helix domain in industrialized countries such as Germany, US and Japan in the twenty-first century (as well as in China, Taiwan and Korea) relates to the role of collective competence-building in economic catch-up. For all these cases, described above, significant institutional adaptation and innovation noted in macroeconomic studies to take place in response to resulting diversity in contemporary national or industrial policies (OECD 2007). Hence, we might also comment that the success of the respective achievements often relied on achieving a balance between U-I relations based on the rapid accumulation of knowledge; and enhancing the demand from industry for technological skills and capabilities.

Remaining questions about spillovers and accumulation of knowledge, new skills development as related to relationships between UICs, technological progress, and catch-up needs further applied research. Accordingly, related bodies of literature assume that firms that are located near universities may frequently collaborate with them and benefit from knowledge spillovers (see Bonaccorsi et al. 2013). Nevertheless, the preliminary findings in this article also targets the need for further *econometric* analysis on the relationship between knowledge transfer and economic development with regard to UICs.

Within the strand of literature related to the effect of UICs over economic development, Maietta (2015) summarizes the findings that proximity to a university may positively be associated with innovation as well. Accordingly, in Boardman (2009) and Thune and Gulbrandsen (2011), it is denoted that normal UIC management mechanisms are also beneficial for collaborative relationships in order to facilitate the improving the interaction between universities and industry. Nevertheless, we must underline the fact that *few* academic studies quantify the *real* management and policy perspective.

In this context, we claim that implementing formal UIC management and policy mechanisms within universities can facilitate UIC development. Supportively, Youtie et al. (2006) and Corley et al. (2006) summarized collaborative relationships between university and industry require more formal, standardized, and structured manner. In addition, in need of a formal framework for defining a *suitable* UIC environment, we claim to define a relative policy measure that will eventually develop interorganizational relationships. Therefore, in this study, we propose a framework model for the development of UIC environment to determine formal UIC management mechanisms (see Fig. 5.5).

Above described UIC environment might help business actors as well as universities to influence the diffusion and transfer of knowledge. Supportively, from the management perspective, a *good* public policy may influence collaborative scheme with universities and the scope of collaborations in many different ways. For instance, an *efficient* public policy may lead institutional actors to sustain the necessary infrastructure through intermediate organizations such as technology transfer offices, science parks (technology development zones), and business incubators (Innovation Policy Platform Report 2013).

Furthermore, we also claim that governments can stimulate collaboration through other measures, such as providing specific support services to firms/universities in the search for partners and conducting outreach activities to promote networking and raise awareness of the importance of collaboration. Given these challenges, in the case of developing countries, (with regard to limited budgets, and multiple competing priorities), governments might concentrate efforts on the most appropriate policy instruments. The following sections review also some policy options to promote U-I interactions and UICs specifically related to the case of developing countries.

Our preliminary research targets in this article further indicate that the less-developed economies contain a potential of rapid economic growth (see Table 5.1 and Fig. 5.4) Hence, further applied research might also focus on GDP growth rates that might be *oppositely* correlated to innovativeness levels. To implement this hypothesis, we claim that the determinants for productivity levels has to be regressed with the country's technology production level of capital stocks. As cited in Abramovitz (1986) supporting the constitution of quadruple helix model, as technology of the leader country is always before the other follower countries' time, one of the most important determinants for catching up is termed to be "social

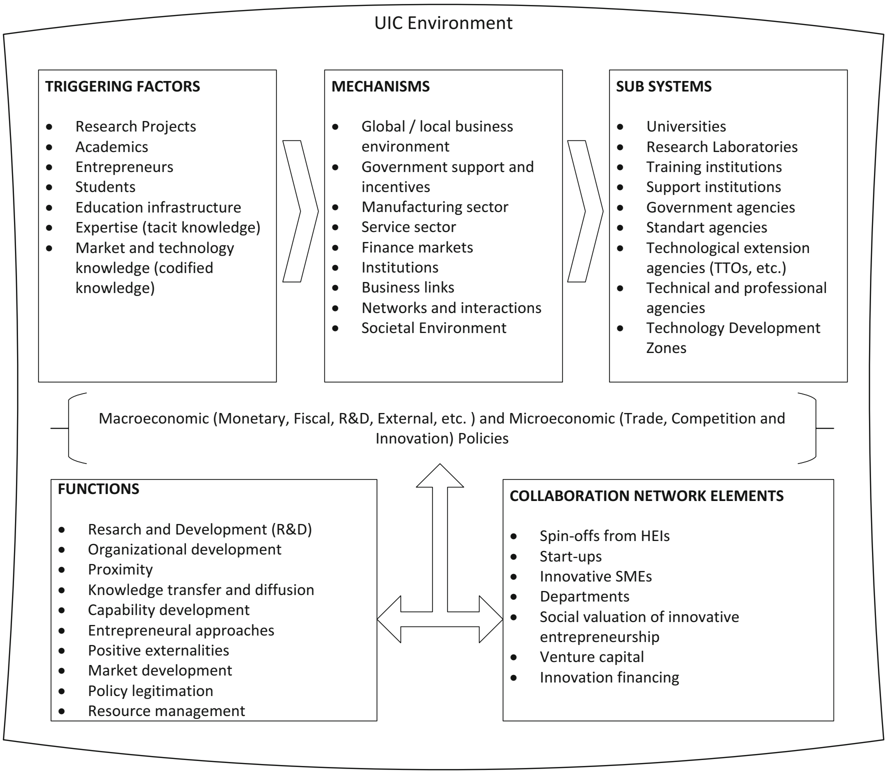


**Fig. 5.5** UIC environment. Source: Own construction

capability". In this regard, our basic hypothesis in terms of catch-up and convergence are to be tested to understand why European countries' sociocultural heritage and development potential technologies were the ones to catch up with the more developed countries (e.g. USA, Japan), innovativeness.

On the contrary, in emerging countries (for instance, in Turkey), studies regarding to technological development and innovation are sustaining its importance. However, it is *surprising* there are still *few* field studies that search for the roots of technological development and its potential economic effects. There exist some preliminary studies focus on the role of information technology. Some of these studies focus on the role and effect of research and development in technology domains, and some others just analyse the role of innovation systems in various country cases (see Lundvall 1992; Brundenius et al. 2009). However, in this study, we explicitly tried to determine the factors that are behind of the development process and to list different kinds of driving forces from the U-I relations point of view. Accordingly, the following chapter about Turkey, aims to contribute to the literature by providing a better understanding of technology policies for developing countries, which are applied in order to facilitate the catch-up process with the leading countries in the world.

## 5.4 University-Industry Interaction in Turkey: An Unresolved Puzzle

Collaboration between university and industry is critical for innovativeness and economic growth. This collaborative scheme is founded on the theory and application of knowledge generation and transfer (acquisition, and adoption of knowledge and technology) and the promotion of entrepreneurship (start-ups and spin-offs).

In the accordance with previous sections, we tried to clarify the issue that university-industry linkages are helpful mechanisms to coordinate R&D studies; and to stimulate public and private R&D investment; and to exploit new scientific and technological capabilities. Hence, in order to classify and clarify UICs, we must institutional arrangements and classifications for UICs. In this respect, Santoro and Gopalakrishnan (2000) suggested four main institutional arrangements and classifications for a successful analysis of UICs:

1. Research support (i.e. Endowment/Trust Fund)
2. Cooperative research (i.e. institutional agreements, group arrangements, institutional facilities, informal Intentions)
3. Knowledge transfer (i.e. hiring of recent graduates, personal interactions, institutional programs, cooperative education)
4. Technology transfer (i.e. product development and commercialization activities through university research centers)

According to the above classification, in addition, Kiper (2010) depicts that successful UIC depends on the structure of formation of a set of interfaces (suitable instruments) to create an environment enabling communication between both parties. In addition, for Turkey, we may list the relative interfaces and intermediaries that the considered to be currently effective for a successful UIC environment as follows:

- Technoparks—Scienceparks (TP)
- Scientific Research Programmes (SRP)
- Start-ups (StrU)
- Spin-offs (SPnO)
- Academic Research Centers (ARCs)
- University Laboratories (UL)
- Technology Transfer Offices (TTOs)
- Ministry of Science, Industry and Technology (MoSIT)
  – TÜBİTAK (Scientific and Technological Research Council of Turkey)
  – KOSGEB (Small and Medium Enterprises Development Organization)
  – Development Agencies (DA)

- University Revolving Capital (URC)
- European Union Framework Programme (FP7, etc.)

Moreover, we might depict that the functioning of UICs; to foster the commercialization of public R&D outcomes; implies various forms of institutional arrangements among aforementioned interfaces and intermediaries. In this sense, UIC may also be categorized to be formal or informal (Hagedoorn et al. 2000) (see Table 5.2).

In particular, UIC plays a major part in economic research in Turkey. The research on UIC is rooted by the increasing the stock of knowledge and human capital, triggering technological or methodological spinoffs, and influencing the formation of networks (Salter and Martin 2001; Etzkowitz et al. 2000). Hence, we may conclude that the concept of UIC contains all the systematic works in the field of scientific and technological development by combining the possibilities mainly for innovation, technology transfer, technology management consultancy and commercialization (IP and product) (see Yıldırım and Güven 2008).

In order to characterize UIC structures for Turkey, we draw intention on the work of Ankrah and Al-Tabbaa (2015) which posited six different organizational forms as generalizable determinants of inter-organizational relationships; which are originally defined by Oliver (1990): Personal Informal Relationships, Personal Formal Relationships, Third Party, Formal Targeted Agreements, Formal Non-Targeted Agreements, Focused Structures.

Moreover, from a systematic point of view, our evaluations indicate that the motivations for Turkish universities and industry engaged in UICs can easily be exemplified with these above described organizational forms or determinants. From this perspective, we might further argue that UICs might strengthen organizational linkages and development. Since the nature of knowledge and its creation process linked with organizational linkages and development are still very complex to exemplify, we further claim that research on social processes involving different levels of modalities of interactions (like tacit knowledge, codified knowledge, financial flows, personal flows and technological flows) is required. In this manner, according to these modalities of interactions described above, we clarified the levels of relationship whether which organizational determinant is correlated with the regarding modalities of interactions. Therefore, we also defined different modalities for each related institutions in order to categorize the support given or knowledge exchange/usage behaviour for a *successful* UIC structure. A *concise* classification is presented in Table 5.3.

Furthermore, academic literature also directed us to analysis of the formation of TTOs; as an important organizational intermediary for sustaining UICs; that have a key position to manage the technology and innovation within UIC. In Turkey, as similar to the findings in Babaa et al. (2009), we describe below a basic UIC support scheme formed by university TTOs' the point of view (see Fig. 5.6).

Determined organizational structure and forms for Turkey (see Table 5.3), we might argue that the structure and contingencies demonstrated in big cities, like Ankara, İstanbul and İzmir of Turkey, are to be entirely different endowments and *gaps* in terms of Higher Education Institutions (HEIs). Social and cultural

**Table 5.2** Institutional forms and arrangement of UIC in Turkey

| Institutional arrangement of UICs | Type of arrangement (formal or informal) | Supporting interface and/or intermediary | Definition/forms of arrangement |
|---|---|---|---|
| Research partnerships and cooperative research | Formal or informal | TP, ARCs, TTOs, URC, SRP | Inter-organizational arrangements for pursuing collaborative R&D, including research consortia and joint projects |
| Research support and services | Formal | MOSIT, TÜBİTAK, DA, SRP, UL, TTOs, KOSGEB | Research-related activities commissioned to universities by industrial clients, including contract research, consulting, quality control, testing, certification, and prototype development |
| Knowledge transfer | Formal or informal | MOSIT, TÜBİTAK, DA, SRP, UL, TTOs, KOSGEB | Access to new knowledge that allow achievement of competitive advantage inc. new capability development |
| Shared infrastructure | Formal | TP, SRP, ARCs, UL, URC, KOSGEB | Use of university labs and equipment by firms, business incubators, and technology parks located within universities |
| Technology transfer | Formal or informal | TP, SRP, ARCs, UL, UR, TTOs | Achieving a better intermediary involvement, technology management, combine R&D capabilities and scientific and technical cooperation, technology commercialization |
| Academic entrepreneurship | Formal or informal | TP, ARCs, TTOs, SpnO, StrU | Development and commercial exploitation of technologies pursued by academic inventors through a company they (partly) own (spin-off companies) |
| Human resource training and transfer | Formal or informal | TTOs, TP, ARCs | Training of industry employees, internship programs, postgraduate training in industry and research staff, adjunct faculty of industry participants |
| Commercialization of intellectual property | Formal | TTOs, StrU, SpnO, TÜBİTAK | Transfer of university-generated IP (such as patents) to firms (e.g., via licensing) |
| Scientific publications | Formal | ARCs | Use of codified scientific knowledge within industry |
| Informal interaction | Formal or informal | ARCs | Formation of social relationships (e.g., conferences, meetings, social networks) |

Source: Own construction (based on Hagedoorn et al. 2000)

**Table 5.3** Organizational forms of UIC according to different modalities[a]

| Organizational forms of UICs | Modalities of interactions: Financial flows | Technological flows | Codified knowledge | Tacit knowledge | Personal flows | Supporting interface and/or intermediary | Type of organizational forms |
|---|---|---|---|---|---|---|---|
| Personal informal relationships | + | ++ | + | ++ | +++ | ARCs, UL, TTOs | • Academic spin-offs and Individual consultancy (paid for or free)<br>• Conferences and publications<br>• Personal contact with university academic staff or industrial staff |
| Personal formal relationships | ++ | ++ | ++ | + | ++s | ARCs, Universities, Industry, Ministry of Education (MoE) | • Scholarships, Fellowships and postgraduate linkages<br>• Exchange programmes (e.g. ERASMUS)<br>• Student internships<br>• Students' involvement in industrial projects<br>• Joint supervision of PhDs and Masters theses<br>• Employment of relevant scientists by industry<br>• Use of university or industrial facility (e.g., lab, database, etc.) |
| Third party | + | ++ | + | + | ++ | TTOs, TPs, MoSIT, TÜBİTAK, DA | • Technology Transfer Services (in universities or industry)<br>• Government Agencies (including regional technology transfer networks)<br>• Industrial associations (functioning as brokers)<br>• Technopark Consultancy Services<br>• Technology Management Support |

(continued)

**Table 5.3** (continued)

| Organizational forms of UICs | Modalities of interactions: Financial flows | Technological flows | Codified knowledge | Tacit knowledge | Personal flows | Supporting interface and/or intermediary | Type of organizational forms |
|---|---|---|---|---|---|---|---|
| Formal targeted agreements | ++ | ++ | ++ | + | + | TTOs, TPs, MoSIT, TÜBİTAK, DA, Universities, Industry | • Contract research (including technical services contract)<br>• Patenting and Licensing Agreements (licensing of intellectual property rights)<br>• Cooperative research projects<br>• Joint research programmes<br>• Commercialization Agreements |
| Formal non-targeted agreements | ++ | + | ++ | + | + | TTOs, TPs, MoSIT, TÜBİTAK, DA, Universities, Industry | • Broad agreements for U-I collaborations<br>• Industrially sponsored R&D in university departments<br>• Research grant, gifts, endowment, trusts donations (financial or equipment), general or directed to specific departments or academics |
| Focused structures | ++ | ++ | + | + | + | TTOs, TPs, MoSIT, TÜBİTAK, DA, Universities, Industry | • Innovation/Incubation Relay Centers (IRCs)<br>• Start-ups, joint ventures, alliances<br>• Research, science and technology parks<br>• University—Industry Consortia<br>• University—Industry research cooperative research centers |

Source: Own construction (based on Oliver 1990)

[a]As presented in the Ankrah and Al-Tabbaa (2015) study, some of the motivation determinants are categorized under the related determinant as considered to be the most appropriate one

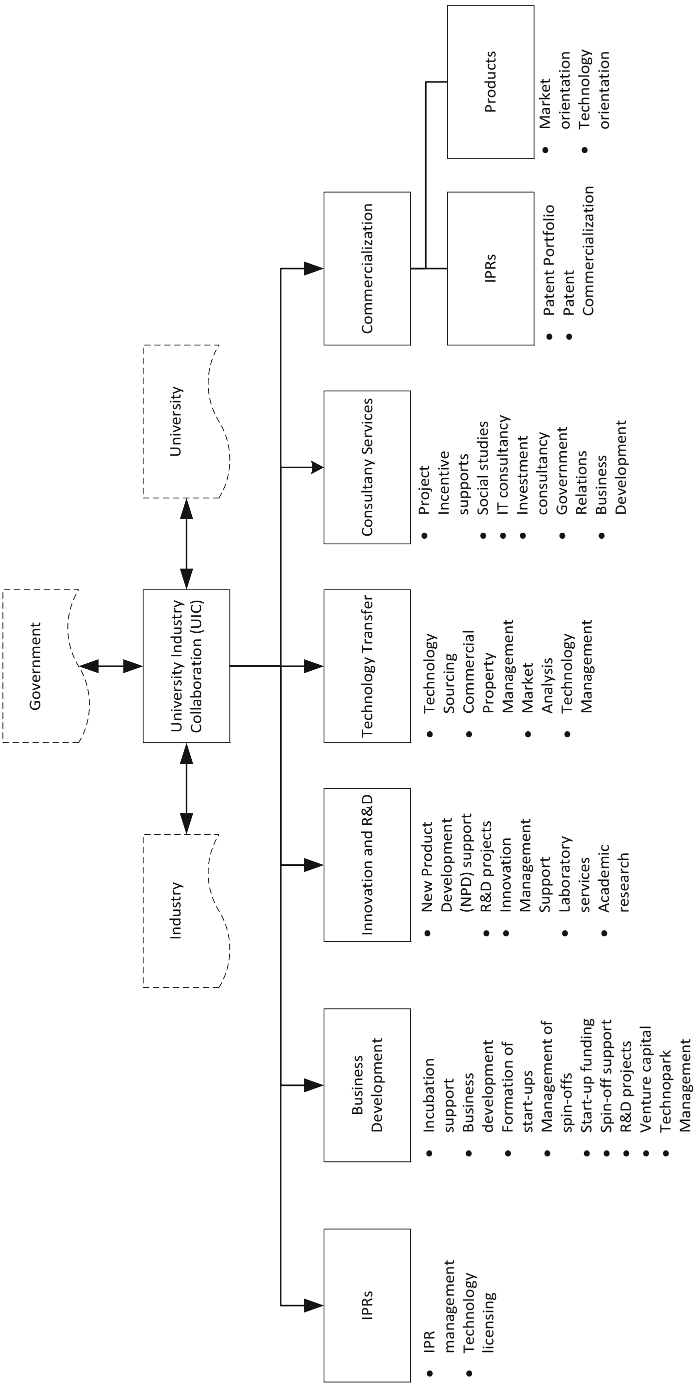


**Fig. 5.6** UIC approach from a Turkish TTO point of view. Source: Own construction

differences play an important role in defining this gap between other cities. Nevertheless, we claim to exhibit *cluster-like* features of UICs. For instance, in the case of Ankara, UICs are a critical source of the knowledge and entrepreneurs that have been fuelling up the creation of an IT and defence industry based cluster. Middle East Technical University and Bilkent University in particular have supported this UIC scheme with a remarkable constitution. We should also depict that, today, it is important to create attracting campuses with technoparks in universities; and it is the essential to create a *hive* for growing number of high-technology firms through UICs.

Clearly, the potential of UICs has also pave way to entrepreneurs into *sustainable* existence. In this perspective, the administrative support for researchers in the leading universities *eventually* opens up new opportunities for start-ups or spin-offs. Moreover, many start-up companies, which are increasingly dependent on innovation to sustain competitiveness, take the advantage of new capability development opportunities sustained by the universities, Academic Research Centers (ARCs) and Technoparks (TP) in Turkey. Already, these firms are perceiving additional advantages from a deepening of tri-lateral (triple helix) linkages. Turkish government encourage and subsidizes firms *continuously*[1] by offering new incentives to expand the scope and depth of their support. For instance, a *comparably weaker* innovation system is being induced to formalize the links between Turkish university researchers and firms. Besides, Turkish government are also supporting some *elite and research* universities and research institutions to expand *innovative capacities* and/or to commercialize *aggressively university-developed* technologies and products; concurrently, the government works *hard* to increase the demand for R&D through institutional and fiscal incentives.

In this respect, there also exists a substantial body of literature about the analysis on the role of several leading universities in Turkey that *eventually* create relative advantage for start-ups and spin-offs (in knowledge-intensive clusters) through techno-parks associated with university research institutions (see Hershberg et al. 2007; Lecuyer 2005; Siegel et al. 2003 for similar findings). Complementarily, the universities in Turkey are *mostly* a *major* player but not a direct catalyst compared to other global universities. For instance, ODTU Teknokent (as the first founded technopark in Turkey), was initiated and substantially propelled by university itself providing significant financial and technical inputs.

For instance, similarly, the emergence of *clusters* in the Ankara, Turkey, Teknokent Savunma Sanayii Kümelenmesi (TSSK),[2] is a good example for a *succesful* and *sustainable* defence industry cluster in order to demonstrate the outgrowth of funding and intermediary support from two different organizations; the Turkish government and Middle East Technical University (METU) Technopark (ODTU Teknokent), separately. In other words, we claim that innovation and technology diffusion, through licensing for example, may only be accomplished

[1] See http://www.worldstartupwiki.org/page/Turkey-Startup-Ecosystem for more details.

[2] For more information, please refer to TSSK official website: www.tssk.org.tr

properly with the presence of a strong university supported by government incentives. Of course, for the majority of this case, an empirical study is further needed to be planned in order to prove that business start-ups associated with a university are more successful than the ones in the industrial zones (industrial development zones—IDZs) having significantly weaker linkages to universities.

Finally, as an emerging economy and country, it is important to underline that most of the Turkish universities are encouraged to develop strategic collaborations with other foreign universities and International Research Centers (IRCs) to develop new R&D capacities, particularly those pertaining to new, emerging technologies.

In this regard, we might denote that the Turkish government proposes to achieve the goals of developing new R&D and innovative capacities through 4(four) main approaches:

- The implementation of more *attached* incentive programs with the industry, which will enable academicians to share their tacit and codified knowledge and ideas and thus raise the quality of their research.
- Encouraging the registeration of Intellectual Property (IP) and strenghtening the management of IP rooted in research projects which are sustained in universities.
- Strengthening the function of Technoparks (TPs) and spin-offs at the universities by creating more *sustainable* ways for business and industrial collaboration in R&D activities
- Formation of new R&D centers and sustaining new tax incentives as an essential—inseparable sub-part of industrial development policy to sustain competitive advantage.

Moreover, in order to support and accelerate the commercialization of innovations and new technology, Turkish government acts to construct active collaboration between the government, university and industry (G-U-I) as this scheme is expected to promote *positive* effects on the Turkish economy. Recently, the government has launched a specific development and transformation programme by TÜBİTAK for Turkish universities' TTOs, aiming to subsidize and transform the roles of these offices to be *hubs* for transmitting academic research and Intellectual Property Rights (IPRs) into the industrial actors (entrepreneurs, start-ups, etc.) that will contribute to revenue generation and profitable development by IPR commercialization.

Finally, we may argue that as Turkish universities are considered to encounter more cooperative environments into practice that will eventually foster connections between academy and industry, UICs and corporate partnerships will allow all actors to tackle with the transition ongoing in Turkey. The partial review and framework presented in this article for the Turkish UIC scheme is expected to make *valuable* contribution to the literature. Besides, in addition to our empirical analysis, we claim that there is *still* a need to investigate *deeply* and empirically to measure the effectiveness of UIC; for instance, researchers tend to analyse the extent of new products, patent and publications to reflect the real value of the UIC and justify the mechanisms' effect on catch-up.

## 5.5 Challenges for Catch-up and Mitigation

In academic research, collaboration between U-I research and related technical endowments in industry can often be *useful* in terms of different academic reference. The preliminary findings of this paper show that barriers to development exist to catch-up but that they can be overcomed by using different mechanisms and adequate policies including the development of UICs leading to catching up.

The review and proposed framework in this article is expected not only to provide a substantial contribution with a directed analysis of UIC schemes for developing countries but also is expected to indicate areas that require further investigation. First, we might depict that the observed scheme for UIC through our reviews might also indicate that actors from the industry and universities may vary in definition of the success of the interaction and its outcomes (see Barnes et al. 2002).

In addition, we propose *by no means* that the process of catching up is not a *sole* outcome of successful UICs nor automatic or homogeneous. Actually, we require critical changes in the policy perspective with regard to the challenges equivalent to those of university—industry interaction. For instance, by encouraging firms to gather *qualified* human capital from the universities (starting from the very beginning of their foundations) must *strategically* be planned by improving the quality of education in universities compensating the industrial needs; or by reducing barriers to entry for firms to collaborative academic research. Unfortunately, in Turkey, such policies are *usually* constructed in *narrow* industrial development point of view.

We also propose *by technical means* that start-ups, new industries, institutions need to be conjunct in a collaborative environment taking also into account its social endowments (basis of quadruple helix model). This preposition, of course, requires up a high degree of capacity building path dependent policy making including all factors and actors in a suitable UIC environment.

Finally, the expected outcomes of this study may lead us to understand the gap and differences in a better sense amongst different emerging countries in spite of common constraints and risks *specifically* listed for Turkey below:

- The limited and asynchronous flow of information in between G-U-I
- Disjunction of technical needs for industrial development and Higher Education Institutes (HEIs)
- Low levels of universities' involvement to industry and risk of confronting potential conflicts of interest with industrial practice
- Weak technology transfer linkages among intermediaries
- The weak and rare engagement of graduate students to start-ups and spin-offs
- Misinterpretation of UIC drives and constraints

- Inexperience of academicians affiliated to universities that engaged with the industry
- Weak technological learning structures construed upon different institutional schemes
- Creating false and inefficient agencies
- Weak commercialization support from TTOs or ARCs
- Insufficient industrial research bases and insubstantial management and technical coordination support at technology parks
- Complex and bureaucratic government funding and aid programs
- Misleading laboratory infrastructure
- Counter-cultural and societal conflicts

It is also the generic view of this paper that, through appropriate forms of capacity building, it is almost impossible to predict how quickly UICs will affect the economic growth and catch-up; and how much of a difference this might make to capacity building, technology development, its transfer and to the process of commercial innovation. We are aware that it is difficult to predict *how* and *to what degree* actors will benefit and engage with applied research. However, our empirical analysis predicts how certain achievements in leading universities and research institutions are to be developed through a suitable evaluation of required UIC motivations. Similarly, in the case of Turkey, UIC is *still* a weak determinant for developing the required collaboration skills to benefit from academic research (for instance, contracting misleading research to universities or ineffective alliances with research institutes, etc.).

Finally, the preliminary results out of this paper show us that there exist barriers for development; but these barriers can be indoctrinated by leading strong UICs; finally leads to catching up by adequate policies. Aforementioned, we claim that governments may achieve changes through adequate policy changes. For instance, governments may encourage firms to use academic capital, human capital, knowledge capital intensely by improving the quality of education or by reducing barriers to entry for start-ups and spin-offs. It is also notable that new industries and universities are to be coordinated and followed with *care* taking into account of its natural and social endowments. Here, in spite of common global and economic constraints, we might also claim that this sort of G-U-I collaboration environment require a high degree of path dependence and can be expected to lead to different schemes of economic catch-up amongst emerging countries.

## 5.6 Concluding Remarks

From an evolutionary perspective, we see that many developing countries tend to build up a sustainable basis for economic growth. Of course, some of them will succeed, yet the rest are not expected to be successful as the same levels as the suppressor. Hence, from an alternating perspective, we claim that *strong and dense* interactions between G-U-I might also help to close these *gaps* for Turkey as an emerging economy. In this sense, several indicators strongly suggest that Turkey has a *relative* financial and technical advantage based on its economic and social welfare settings.

Furthermore, we propose that Turkey might close the gaps in the mid-run by sustaining a wide range of visionary technology and development policies and programs that may be constructed upon a successful UIC regime. In order to achieve this goal, among some other policy and program constitutions, we may also counsel over some *key facts* and *needs* in order to sustain a strong basis for a developing-regime UIC scheme:

- Inter-industry (industry-linked) education programs in the UIC environment
- Government incentives and funding for basic and applied research, supplemented at the level by R&D investments by industry
- Sustainment of know-how and funding for start-ups/spin-offs in order to scale-up of new businesses
- Enhancement of advanced institutional basis for G-U-I collaboration environment
- Strong capability building programs and policies for leading research universities to be the pioneer for industrial development
- Robust policies for knowledge and technology transfer and IP protection/commercialization

In addition, from the developing countries' perspective, we assume that industries are the driving force for the UICs, where both university and government have *limited* roles. In this article, we tried to inspire a deeper understanding of one of the critical research topics: the role of government in UICs. In developed economies, most of the academic research indicate that government is a key player in facilitating the establishment and development of such collaboration.[3] However, it is still not clear in academic literature that the governments in developing countries, where universities are considered to be at the *center* of economic research, might intervene at all collaboration stages the UICs by defining the appropriate rules and objectives. Same perspective is applicable since there is a need to conduct comparative studies across different countries in relation to UICs.

In the end, since our study reveals only a small part of the majority of UIC studies, we claim that further applied *econometric* research may prove approved insights in this article. In order to define new UIC determinants for applied research, finally, we may propose that researchers might ensure investigating the effect of independent and strong connections to government and *sufficient* knowledge flows from universities through industry *may* help in transforming academic research into *value added* products.

[3]Refer to Perkmann et al. (2011) for a detailed methodology.

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# Higher Education Institutions in the Knowledge Triangle

# 6

Mario Cervantes

**Abstract**

This paper discusses some of the policy issues and best practices aimed at enhancing HEIs performance and improving their impact on society and the economy within the knowledge triangle. The knowledge triangle concept aims at exploring ways to better align and integrate the research, education and innovation functions of HEIs. The paper describes the contents of the knowledge triangle, HEI performance through the lens of this concept, policies to promote the knowledge triangle in HEIs, as well as potential contradiction in relation to other knowledge producers—public research centres and companies.

The conclusion is that there is no single model of universities and knowledge triangle. This is due to the country-specific peculiarities of educational systems, diversity within HEIs themselves and the functions they perform, as well as the specifics of regional ecosystems. Accordingly, the key to the efficiency of the knowledge triangle tools is their place-based adjustment. In order to achieve a tangible contribution of universities to the development of regional and local innovation, it is necessary to ensure complementarities and a balance between their missions.

**Keywords**

Knowledge triangle · Research · Education · Innovation · Third mission · Regional ecosystems · Place-based policy · Higher education institutions (HEIs) · Universities · Knowledge transfer

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## 6.1 Introduction

Higher education and public research systems are undergoing a system-wide transformation in OECD countries (OECD 2016). Decades of policy reforms in tertiary education, public research and innovation policy intersect, and sometimes clash, in the context of higher education institutions.

On the *research* side, global competition for scientific excellence and decades of disengagement in basic research on the part of companies has made HEIs the locus of national public research efforts. The mergers and reorganisations of public research organisations (PROs)—many of which are focused on "mission-oriented" research—has also benefited HEIS, which have absorbed some PRO institutes. Denmark for example decided to integrate several government research institutions into its universities. In the UK as well, some institutes have also been absorbed by universities (OECD 2011a, b; Ponchek 2016; Vargiu 2014). Project-based research funding schemes have also increased in recent years as a way for governments to try to steer research priorities at HEIs and improve accountability. Specialised centres of competencies/excellence have also been financed and positioned at HEIs in order to capitalise on existing strengths or to explore new areas and increase institutional differentiation.

On the *education* side, the conversion or upgrading of technical colleges into universities or universities of applied sciences has also expanded the higher education landscape and forced institutions to better differentiate themselves and their education market offerings. Meanwhile, firm-based activities and structures have evolved considerably in recent years (e.g., the rise of open innovation and global value chains, big data and dis-intermediation) creating new demands on HEIs in terms of talent and skilled graduates, but also in terms of the industry-relevant research to improve firm competitiveness (Gackstatter et al. 2014; Gokhberg et al. 2016; Meissner et al. 2016).

On the *innovation* side, innovation policy has become a networked and decentralised government policy where innovation agencies or regional development bodies take on a greater role. Collaboration with public research, whether in the form of the science–push transfer of public research results to industry or demand-pull initiatives such as through public-private partnerships, has become the dominant discourse and a key focus of innovation policies. Even fiscal policies to support business increasingly target R&D collaboration between public research and large and small firms. Furthermore, the delegation of competences and innovation policies to agencies and regions has naturally brought innovation policies closer to the world of higher education policies, which has long had a strong regional or place-based dimension.

Entrepreneurship policies have also entered the fray as HEIs are being encouraged not only to educate and train entrepreneurs, but also to locate entrepreneurial activities on campus. In Norway, for example, all HEIs have entrepreneurship education, either as a special study programme or as a course embedded in other programmes (Borlaug et al. 2016). This is a rational development as Schumpeterian entrepreneurship is the main channel through which knowledge developed at HEIs finds its way into innovation (Carayannis et al. 2017; Proskuryakova et al. 2015). This can be considered a consequence of the concept of the “entrepreneurial university” put forward in the early 2000s when Etzkowitz and Leydesdorff (2000) described the Triple Helix and concluded that the university model is changing towards an entrepreneurial model, which stresses the application and exploitation of research.

But if much of the support for basic research and tertiary education that is performed by HEIs comes from public coffers, government support to business R&D has also increased in the period following the financial crisis such that the amount of public investment that in some way or another is channelled through HEIs represents several percentage points of GDP: in 2011, 1.6% of GDP on average was dedicated to tertiary education institutions in the OECD in 2011 and 0.44% of GDP was spent on higher education R&D (HERD). Public support for business innovation that involves HEIs takes various forms such as:

- Tax credits for companies collaborating with universities
- SBIR-type of schemes
- Industry Ph.D. programmes and student internships at companies
- Innovation vouchers to help small firms wishing to purchase university research or consulting services, often funded by regional authorities.

The amount or proportion of this stream of public support to innovation is unmeasured, but anecdotal evidence suggests that it is important to certain HEIs and to certain regions/countries.

For these reasons alone, it is important to understand the following questions. How do HEIs position themselves on the KT and what are the implications for national innovation policies? To what extent do funding and governance policies support KT activities? Are “silo” funding streams for research, education and innovation a barrier for KT activities and what can be done to overcome this? How should one design policies for HEIs in countries with different industrial and higher education structures? Are there ways to link HEIs effectively with regional enterprise and social actors? And finally, what are the new institutional models and good practices to overcome these obstacles? These are some of the questions that the article aims to answer.

## 6.2 Importance of HEIs for Innovation, Education and Research

HEIs matter for innovation for several reasons. First, HEIs play a mediating role between capital and labour in economic growth. HEIs train and develop productive human capital through teaching activities. Human capital accumulation has been an important driving force behind aggregate economic growth (OECD 2008). Compulsory education remains the first channel for human capital accumulation, especially in developing and emerging economies. In advanced countries, however, which are closer to the technological frontier, investment in tertiary education provides high social returns from the accumulation of knowledge capital and spillovers in the economy, which justify the fact that governments directly or indirectly subsidise 70% of tertiary education in OECD countries. Over the past decades, OECD countries have supported the increasing participation of students in tertiary education, mainly at universities. Of course, there are also high lifetime private returns from tertiary education which increases demand for HEIs. There are also distributional effects on equity and income inequality that arise from access or lack thereof to higher education. These effects, however, are outside the scope of this paper, which focuses on the contribution of HEIs to innovation systems.

The second reason HEIs matter is that they carry out a large share of public research, both basic and applied. A properly organised higher education system can increase the efficiency of research activities, which in turn increases the stock of knowledge capital—as distinct from human capital—which is the basis for technological progress. In endogenous growth theories, knowledge capital is suggested to have a greater potential for constant, rather than diminishing, returns, thus providing a mechanism for permanent growth effects from increases in capital. In these models, HEIs are part of the knowledge-producing sector, the other part being R&D-intensive firms. In many OECD countries, half of the national efforts concerning research are carried out by HEIs and public research organisations (HEIs). However, one fundamental difference between the knowledge capital created in HEIs and the knowledge capital created in firms are the incentives. Firms have the incentive to invest in research when the outcomes of the R&D can generate market power (through intellectual property rights, IPRs) and higher profits.

The third reason that HEIs matter is that they contribute to local economic development through so-called "third mission" activities or "community engagement". The third mission is a broad concept that groups together the concepts of the entrepreneurial and commercial activities of HEIs, their social and cultural relevance, and knowledge transfer. The term is generally used in science and innovation policy to capture knowledge exchange activities; in the education community, the term is used more frequently to refer to the role that HEIs play within their community. This concept is not new; both knowledge exchange and community engagement are long-standing characteristics of HEIs in most OECD countries. However, during the dual move towards increased autonomy and accountability for HEIs in most countries, many countries have acted to strengthen and formalise the social and knowledge transfer role of HEIs. Third-mission activities include, but are not limited to:

- Informal engagement with industry
- Consulting and advisory activities of academics
- Inputs for public policymaking
- Support for entrepreneurship skills among students and researchers,
- Exploitation of the results of research activity
- The creation of links between universities and vocational colleges
- Contribution to community interaction (e.g., classes for non-students).

Goddard and Puukka (2008) note that many third-mission activities are often confined to the periphery of management and leadership of the higher education system. The notion of a third mission varies across countries, but in many cases, it is an unfunded mandate and expectation placed on HEIs and, to a lesser extent, on PROs. While the traditional core focus of leadership of research universities is on research excellence, teaching (and the appearance of both in published rankings), and third-mission targets mandated by central and regional governments, many other activities do not have the same incentives. The drivers and incentives for teaching, research and external engagement are often unrelated and competing.

The fourth reason that HEIs matter has to do with their contribution to local economic development. Knowledge is created locally and while some of this knowledge can be codified and diffused globally, much of the tacit knowledge generated by students, faculty and firms is “sticky” and remains so that the spillovers are localised. Furthermore, highly skilled graduates contribute to the quality of the local workforce. HEIs are themselves large employers and provide services to companies and public agencies (e.g., university hospitals) in the regions. They are also factors of “attractiveness” for national and local economic development strategies, drawing in faculty, students but also companies from outside regions or countries to co-locate around universities in order to obtain access to the talent and cutting-edge research.

Finally, and as a result of the above functions, HEIs have become central actors in innovation systems. The national innovation systems theory considers HEIs key actors in the performance of national innovation systems given their important functions. However, HEIs are also under tremendous pressure from governments and other stakeholders to transform themselves in order to cope with the realities of the globalisation of higher education and research, the expansion of tertiary education and the increasing demands for equity and access. HEIs also continue to face budgetary pressures in light of the decentralisation of higher education funding in many countries as well as the competition for research funding. The transition to the digital age in education (e.g., Massive Open Online Courses—MOOCs) is another challenge, but also an opportunity for HEIs. Indeed, research and education ministries in many OECD countries are looking towards the “knowledge triangle” as a framework to help HEIs improve their impact on society and the economy.

## 6.3 What Is the Knowledge Triangle?

Traditionally, the linking of research to innovation has been encouraged by governments and industry. In addition, in HEIs with a Humboldtian tradition (e.g. in Germany, the US and northern Europe) the linking of research with education has been well established since the nineteenth century. However, this link has continued to evolve as governments channel greater amounts of research

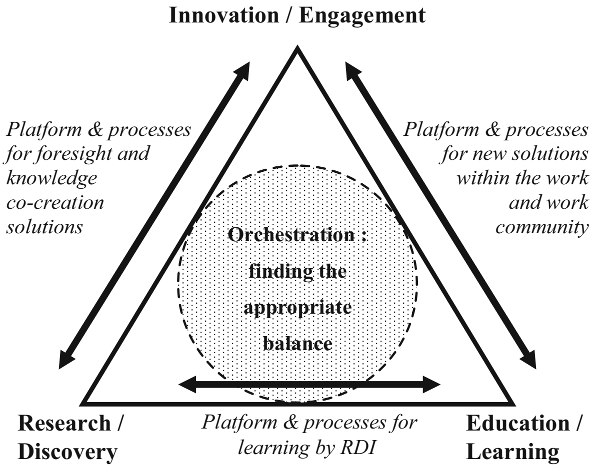


**Fig. 6.1** The knowledge triangle. Source: Sjoer et al. (2011)

funding to HEIs. In contrast, links between education and innovation have been less the focus of national policymakers or institutional leaders until recently.

The knowledge triangle is a policy framework that stresses the need for an integrated approach to research, innovation and education policy with a focus on HEIs as knowledge creating institutions. It was conceived in 2000 as part of the European Union's Lisbon Strategy in response to a lack of innovation and entrepreneurial culture in research and higher education; a lack of investment, in particular private investment, in research and development (R&D); and the difficulty European countries face in translating R&D results into commercial opportunities.

The Knowledge Triangle postulates that knowledge generated by HEIs is the result of three core elements (the vertices) which are: (i) education; (ii) research and (iii) innovation. Each of these elements influences the others. These bi-directional or circularly-caused knowledge flows between the three core elements of the knowledge building process constitute the Knowledge Triangle (Fig. 6.1).

At the centre of the triangle, orchestration tools, understood as the tools to mobilize and integrate resources to create value for the members of the knowledge network (Wallis 2006), are set-up in order to provide an overall articulation and achieve balance between the different components of the knowledge creation system (Sjoer et al. 2011). In practical terms, they typically correspond to multi-stakeholder platforms (virtual, in-person and/or mixed), bringing together actors from the public, private and academic sectors around joint research and educational collaboration. The model stresses the equal importance of each of the elements of the knowledge creation process (an equilateral triangle) as well as on the need for an integrated, holistic approach that focuses not only on each of the single vertices, but especially on the two- and three-way interactions between education, research and innovation (Markkula 2013). In such interactions, there are positive externalities that spill over to each dimension (Hervás Soriano and Mulatero 2010). Each of the linkages in the triangle can be strengthened by means of platforms and processes that build bridges between education, research and innovation, thus facilitating the circulation of knowledge (Sjoer et al. 2011).

The novelty of the knowledge triangle concept, however, is that it draws attention to the contribution of education to research and that of education to innovation. Traditionally, policy has been concerned with the contribution of education to labour market success or the training of highly qualified graduates for research activities. With regard to the innovation function, most policies have focused on increasing the contribution of research to innovation through legislative reforms (e.g., the Bayh Dole Act) and the establishment of technology transfer offices (TTO) or other interfaces between research and innovation at firms.

### 6.3.1 The Link Between Education and Research

In terms of the linkages between education and research, the importance of skilled human capital for successful R&D activities has long been internalised by science and research policies. Currently, many countries have science development policies based on a combination of postgraduate training, scientific (fundamental and applied) research funding and advanced human capital insertion programmes. The current financial pressure on HEIs has, however, increased concerns and interest in the cost-benefits of such instruments.

### 6.3.2 The Relationship Between R&D and Innovation

The other most policy-dominant side of the KT is the relationship between R&D and innovation. The poor performance of innovation systems in turning R&D efforts into innovations has motivated the implementation of a wide range of policy instruments for increasing the transfer of knowledge from universities to the productive sector. Some initiatives include: (i) legislative reforms (the Bayh Dole Act), (ii) public-private partnerships; (iii) university-industry research contracts; (iv) intellectual property rights (IPR); (v) university spin-offs; (vi) knowledge transfer offices; (vii) business incubators (viii) labour and student mobility; (ix) consultancy activities; (x) conferences and (xi) electronic collaboration platforms.

Geuna and Muscio (2009) provide a comprehensive critical analysis of the current approaches to and mechanisms for the institutionalisation of knowledge transfers from academia to the productive sector in Europe and the US. After 30 years of experimentation in knowledge transfer policies, the authors conclude that there are more failures than successes, largely due to the incapacity of knowledge transfer policies to manage the trade-offs between the university's more traditional roles of teaching and knowledge generation with the increasing pressures for greater knowledge transfer. Some problems identified by the authors include the partially tacit nature of knowledge (not easy to transfer), the costs of network building and the difficulty of pricing knowledge. As pointed out by Hervás

Soriano and Mulatero (2010), despite the fact that innovation can increase the efficiency and scope of R&D activities, innovation policies still suffer from a unidirectional approach going from research to innovation, rather than from innovation to research or education and then back into innovation.

### 6.3.3 Link Between Innovation and Education

Finally, in terms of the link between innovation and education, the KT perspective is interesting. Two aspects emerge as critical. In first place, the push to develop an entrepreneurial attitude among students has motivated a range of entrepreneurship education programmes (Oosterbeek et al. 2010). Second, there has been an effort to adapt educational programmes to meet the needs of the productive sector or at least to involve industry on university boards. Although there are successful examples of universities that have succeeded in engaging with industry, the complex governance of the HEIs and entire higher education systems is a barrier in many cases (Maassen and Stensaker 2011). Yet, it is possible to find some cases that service as interesting examples of HEIs that have internalised the KT principles in their educational and business models. Some examples include the Aalto University (Markkula 2013; Pirttivaara et al. 2013) or the Catholic University of Leuven (KU Leuven) in Belgium (Van Petegen 2013). The particular initiatives undertaken by universities and public authorities are varied, including:

- The Living Labs model in Laurea University of Applied Sciences (Finland) (Hirvikoski 2013)
- Tailor-made Continuing Engineering Education (CEE) programmes at Delft University (the Netherlands) and Aalborg University (Denmark) (Sjoer et al. 2013)
- Life-long learning programmes in KU Leuven (Belgium) (Van Petegen 2013)
- The Aalto Camp for Societal Innovation (ACSI) of Aalto University (Finland) (Pirttivaara et al. 2013)
- Eco-system networks in the Netherlands such as Brainport and Twente, which promote the knowledge triangle from a place-based perspective (Stam et al. 2016).

Again, we know very little about the reverse relationship, from innovation to education. In this regard, KT policies have been limited to the promotion of some innovations (mainly ICT's) for educational purposes (Hervás Soriano and Mulatero 2010). The knowledge triangle approach calls for an articulated approach based on both strengthening education, research and innovation, but above and beyond that, on reinforcing the interactions and positive externalities that are established between them. Thus, it implies a departure from the traditional view of knowledge production as a linear and sequential process and instead calls for a more systemic approach to research, education and innovation policies.

While its comprehensive focus makes the KT an appealing framework for policies aimed linking knowledge creation to innovation, it provides limited insights on the specific ways such interactions unfold and on how they should be governed. This is because of the diversity of countries' economic structures and the roles HEIs play in various countries. This suggests there is no single model to which countries should aspire.

## 6.4 HEI Performance in the Context of the Knowledge Triangle

Higher education systems vary widely across countries. The position and structure of HEIs is closely linked to long-term cultural and historical factors in different countries (Hartl et al. 2014). While HEIs broadly perform the same role across different countries, their perceived cultural and historical significance varies. In some countries, HEIs have historically been very close to the state; in others, they have tended to be more independent and subject to competition. This context is likely to affect the characteristics and activities of HEIs across countries, as well as the collaboration activities they form. For instance, research is embedded into the mission of the HEIs in some countries, whereas in others it is a more recent activity of the sector. Higher education systems also vary in the degree of government intervention. Even in market-based education systems, the state normally intervenes and regulates to ensure quality and to set standards. In addition, through its role as a key funder of research in most countries, the state maintains some influence over research practices, as well as being a major source of incentives for HEIs. However, the levels of government oversight vary significantly across countries and, as a result, institutions have different levels of accountability and freedom to decide their own practices. Autonomy in higher education can take many forms. Decision-making and revenue-raising autonomy differ from academic autonomy, meaning different actors within HEIs may experience different forms of independence.

### 6.4.1 HEI Diversity

HEIs encompass a range of different types of institutions. A broad definition of HEIs includes not only universities but colleges, academies, institutes of applied sciences, professional institutes, trade schools, and other organisations awarding academic degrees or professional certifications (IPP 2015a). The balance between different types and sizes of HEIs varies significantly between countries. Universities of applied sciences are a common feature of some higher education systems in Europe, but other countries only distinguish between university and other non-university institutions. Similar variation can be seen when looking at countries in Asia (Altbach and Umakoshi 2004) and North America (Davies and Hammack 2005). In terms of their activities, diversity in the population of HEIs can be characterised as horizontal or vertical. Concerning education, horizontal diversity implies that different courses and institutions serve different objectives and different streams of students (OECD 2008). However, horizontal diversity also applies to research and knowledge exchange activities, for instance, based on the intended audience for research outputs (Daraio et al. 2011). Vertical diversity implies some degree of hierarchy of institutions (e.g., between "elite" research universities and vocational colleges), either in terms of reputation, or often in terms of the rewards built into government policies on accreditation, autonomy and funding allocation. The degree of vertical HEI diversity depends greatly on national policies and practices.

Research activities and research quality are major elements of diversity and differentiation between HEIs. While almost all HEIs teach students, the extent of research activities varies considerably. There are more readily available measures for vertical differentiation in research activity. By contrast, measuring and comparing teaching quality and human capital at the higher education level can be problematic. Another common component of diversity among HEIs concerns their activities outside of education and research. Such activities are often referred to as the "third mission" of HEIs and include, but are not limited to: informal engagement with industry, consulting and advisory activities by academics, contribution to public policy, support for entrepreneurship skills among students and researchers, the exploitation of research activity, links between universities and vocational colleges, and the contribution to community engagement (e.g., classes for non-students). The intensity of these types of activity among HEIs also varies according to historical factors and national policies.

The concept of HEI missions is not universally agreed-upon. As an alternative, Laredo (2007) proposes an alternative three "functions" of universities, all of which involve different ways of interacting with society: mass tertiary education; the professional training of specialists and research activities with close ties to non-academic actors; and conduct of fundamental research and the training of research personnel.

### 6.4.2 Diversity Within HEIs

Another important dimension of diversity concerns differences within HEIs. In particular, different fields of study are associated with very different types of education, research and other activities. Faculties within the same institution often have their own budgets and sources of funding and, as a result, may form a variety of different types of external relationships. These differences can have institution-wide implications, depending on the degree of subject specialisation of the HEIs. In addition, academic freedom often means that researchers and staff within the same institution undertake a wide range of practices and hold a wide range of sometimes contradictory values. Diversity within HEIs raises a number of questions and challenges for the tools and strategies concerned with the knowledge triangle.

### 6.4.3 Funding

One manifestation of this diversity is that the patterns of public and private expenditure on higher education vary greatly across countries. In many systems, HEIs are highly dependent on public financing. In others, private expenditure (including from tuition fees and non-public funding of R&D) is a more prominent feature of higher education. In three of four OECD countries, which spend the highest proportion of national wealth on HEIs, private sources account for at least 65% of the total investment, whereas private sources account for only around 5% for the fifth and sixth biggest spenders on higher education. There is also a regional element to expenditure patterns; in general, the proportion of private expenditure is higher in non-European countries. The share of private expenditure on tertiary institutions increased between 2000 and 2011 across OECD countries, and a number of countries substantially increased tuition fees for students during this period (OECD 2008). The general decline of public research funds has led to an increasing reliance on alternative sources of funding by universities (including the revenues from an increasing number of students, consultancy activities, funding from non-profit organizations, etc.) (Geuna and Muscio 2009).

A second important implication is a more targeted allocation of research funds to top-research universities (Maassen and Stensaker 2011). A consequence of both concurrent trends would be the growing segmentation of the HEI market between teaching and research universities. While some authors have argued that such segmentation is actually efficient from a resource allocation point of view (e.g. Aghion et al. 2009), others claim that it may bring problems to the whole university system. Massen and Stensaker (2011) for instance, argue that the university's market segmentation may lead to an undesired break between education and research, undermining academic standards, particularly at the undergraduate level. According to the authors, the focus on knowledge transfer in current EU policy may accelerate the process.

A far less understood relationship is the reverse link, from research to education. Hervás Soriano and Fulvio Mulatero (2010) argue that a rapid update of university curricula to ensure they include recent results from research should be a natural process at universities, but in practice, it is curtailed by the "hysteresis" of higher education institutions. In any case, it is hard to find specific examples of policies aimed at increasing the feed-back from research to education from which one might draw some lessons.

### 6.4.4 HEIs' Role in National Innovation Systems Varies Across Countries

Given the diversity of HEIs at the system and institutional level, the roles of universities within national innovation systems depend on a range of factors. HEIs do not operate in isolation in science and innovation systems. Rather, they act alongside government research, public research organisations (PROs), various forms of innovation bridging institutions (technology transfer centres, incubators, etc.), and national intellectual property protection laws, the structure of which all vary across countries. In addition, a diverse set of knowledge sharing agreements, institutions, social relations, networks and infrastructures grouped under the term knowledge networks and markets (KNMs) provide a number of critical services to firms, organisations and individuals to engage in the meaningful exchange of knowledge and associated rights (OECD 2011a, b).

The successful contribution of HEIs to innovation also requires a demand for the knowledge they produce, both from firms and the government sector. Indeed, many countries have policies to encourage firms to collaborate with universities or PRIs and use their research services (IPP 2015b). However, the nature of this demand depends on factors such as industry structure and specialisation—evidence suggests that most firms typically look for new solutions within their existing areas of expertise (Fagerberg and Godinho 2005). Variations in industry structure may, therefore, also have an influence on the role that HEIs play in national innovation systems. As a result, the place that HEIs occupy within national innovation systems can be argued to be inherently tied to long-term, structural economic factors in a path-dependent process (Mowery and Sampat 2005). Indeed, a recent OECD presentation (OECD 2015) showed how some innovation systems are more HEI-dominated than others. Therefore, from an innovation system perspective, there is no single success model for HEIs or for the knowledge triangle. The 'optimal' structure of institutions that support innovation is likely to vary across countries. Equally a range of different types of institutions can contribute to innovation via their education, research and other activities, in conjunction with other actors, institutions and networks. For example, applied technological and clinical research often has the clearest links with industrial innovation, especially the measurable indicators of patents. Curi et al. (2013) show that the efficiency of technology transfer offices positively depends on the size of the institution, the degree of science and engineering specialisation, and the amount of privately-funded R&D activities. That said, HEIs specialising in fundamental science help provide the knowledge for applied sciences to operate at the knowledge frontier. Further, small teaching-only institutions may play an important role in developing the technical, creative and managerial skills that contribute to innovation. Moreover, HEIs are part of international networks, meaning country systems may specialise in particular fields.

Well-functioning education, research and innovation systems may therefore rely on the contributions of different types of HEIs. Diversity and differentiation implies that HEIs cater to different audiences in their education, research and innovation activities. They are therefore subject to different expectations. The "reach" of an institution's activities is, therefore, another measure of diversity. Large leading research universities are connected to global scientific networks, whereas small colleges are often focused on the needs of their local communities.

### 6.4.5 Diversity and the Concentration on HEI Performance

Understanding the diverse contributions of universities to innovation is critical in the design of research policy. Statistics show that, in a sample of the US and a number European countries, a small number of large institutions are responsible for a significant share of higher education student enrolment. The concentration of research and innovation activities appears even more concentrated, however the concentration of activity is not homogenous across systems. National university systems include a large variety of institutions, with a few large institutions and a much larger number of small universities.

What are the advantages and disadvantages to concentration? This is a critical issue from a policy standpoint as government research support programmes often directly influence the extent of concentration. The fact that more money might go to the HEIs that are deemed the best according to certain criteria would mean that they would grow in line with their quality, generating a concentration of resources at the best performers. The initial descriptive evidence suggests that, on average, HEIs with a larger student enrolment do not receive clear advantages. In the United States, institutions that have larger student enrolment have higher graduation rates, on average, and those that conduct more research and engage more in innovation have higher graduation rates than those that do not. But the best institutions are also attracting students with the highest test scores, and once taken into account, the correlation between enrolment and graduation rates is weakened. Possible advantages of the concentration of activities within a few universities would arise if there are gains in size. These may be economies of scale in university outcomes, i.e., if larger institutions can produce better outcomes relative to their resources compared to smaller institutions (Cohn et al. 1989). Another possible advantage from concentrating resources in only some institutions is the economies of scope that arise if the production of one output improves that of another output or its quality. For instance, engaging intensively in research might support innovation or education outcomes (Chavas et al. 2012).

However, at a certain point, there could also be diseconomies of scale in education arising from factors such as overcrowding or low levels of personalised learning (Robertson and Bond 2005). Diseconomies of scale could also affect research and innovation activities. Moreover, engaging in one activity may negatively affect engagement in another activity as for instance, innovation activities that may negatively impact the quality of research.

## 6.5 Policies to Promote the Knowledge Triangle in HEIs

### 6.5.1 Governance, Autonomy and Competitive Funding

The central issue in the governance of the knowledge triangle is to understand where the responsibility for the knowledge triangle framework lies, which governmental and institutional actions and policies must be put into place so that the HEIs can link the different functions of institutions. A second issue is to determine what barriers are in place, impeding good governance between government and institutions as well as within institutions. Further" which governance arrangements are more conducive to high-quality KT interactions and overall impacts? What interesting lessons in terms of success or failures have emerged from the experience of institutions that have undertaken or adopted the KT approach?

National higher education policies have changed considerably over the past few years. In line with changes to cross-government public management processes towards a market orientation and efficiency, there have been a number of prominent efforts to modernise higher education for the knowledge-based society. One of the most significant trends has been a move towards greater autonomy for HEIs (Estermann et al. 2011), and more focus on competition between institutions for funds, students, staff and reputation. Institutional autonomy is an important ingredient for high performing universities. One issue that has been explored in the literature is the link between autonomy and third mission activities. Aghion and Howitt (2008) find that more autonomous institutions in the US and Europe are, the more successful they are in establishing formal and informal ties to industry and other organisations. Furthermore, autonomy appears to increase research universities' productivity and one sees that research universities are more useful in places closer to the frontier of science and discovery. However, the difference in productivity between autonomous and non-autonomous research universities is just as significant away from that frontier as it is close to it. The aforementioned authors postulate that this may be because autonomy allows a university to direct resources toward more productive research and researchers. Results for the US also convincingly demonstrate that more financial investments are translated into degrees at a higher rate at more autonomous universities.

Autonomy and competition can influence the incentives faced by HEIs in both positive and negative ways. Using data from international university rankings, Aghion et al. (2008) find that budget autonomy has a large impact on the research performance of universities, controlling for other factors, but other indicators of autonomy have no statistically significant effect. Increasing the competition for students (though a long-running feature of some systems) may increase incentives to improve student outcomes and employability. This could result in teaching practices and other training that are closely aligned to those valued by students or employers. However, competition can also take on more perverse forms, such as offering a wide range of ancillary services, grade inflation or attracting international fee-paying students (Abbott and Doucouliagos 2009), which have less clear benefits for education, research and innovation. Furthermore, competition is skewed by the nature of higher education as a 'positional good' (Marginson 2006).

Therefore, ensuring competition leads to socially beneficial changes is a challenge for the new accountability and governance mechanisms. The high degree of autonomy and strong traditions, especially within specific academic departments, can also be a barrier to greater engagement with industry and the broader community. One key finding is that autonomy also requires the creation of leadership and strong incentives (including financing) in transforming university missions and performance (Goddard and Puukka 2008).

In case of institutional core funding, HEIs usually have a large degree of autonomy in deciding whom and what to fund. In contrast, research funds that are provided on a contractual basis by the government and industry often come with conditions that define the boundary of use. The extent to which governments place conditions on public funds is one of the most important issues for both policymakers and HEIs, as they may affect the governance of institutions and the behaviour of individuals at those institutions; as will be discussed later in this paper.

#### 6.5.1.1 Multi-level Governance

Increased autonomy from government has often been accompanied by increased formal accountability mechanisms. The influence of government policy on higher education has become increasingly indirect in nature. This trend has manifested itself in a variety of new multi-level governance systems for HEIs. There has been a general shift away from negotiated budgets for HEIs towards explicit performance agreements (Salmi 2007). In many countries, priority-based funding formulas for teaching have been introduced, which focus on labour force needs or performance measures such as graduation rates. Almost without exception, increased autonomy has been accompanied by more robust quality assurance mechanisms, which are overseen by a national agency (OECD 2008). The processes involve a mix of accreditation, assessment (or evaluation) and audit (IPP 2015a).

#### 6.5.1.2 Competitive Funding

Competition for research funding, for example, has increased. There is evidence across the OECD of a relative shift away from core research (block) funding for institutions towards competitive project-based funding (OECD 2008; Poti and Reale 2007). However, block funding has become more common than itemised funding as a means of government financing of HEIs' teaching and administration tasks (OECD 2008), although often by means of a formula based on quasi-competitive variables such as the number of students. These changes have been intensified by the massification of higher education and by global competition for researchers and students. More competitive funding systems are likely to affect the incentives of researchers. In the face of a more competitive environment, the purpose of HEIs has come into question. Many countries have witnessed the rise of HEIs as competitive, more business-like institutions with less easily defined missions (Marginson and Considine 2000). They have become hybrid institutions with both a public mission and a private one. These trends have given rise to terms such as "entrepreneurial universities" and "academic capitalism" (Bramwell and Wolfe 2008). Internal governance and institutional management has also changed. HEI leadership has moved towards an increasingly top-down model, where department heads and university presidents have greater management and coalition-building responsibilities, and they have been given direct power over nominations and strategic focuses in education and research. The implicit contradictions between private missions and public ones can have a bearing on research and education; using data from university collective bargaining agreements in the United States, Rhoades (1998) found that academics' autonomy with respect to activities such as designing curricula or introducing new instructional innovations was declining as university management became increasingly centralised.

Competition for students, funding and reputation may have pushed HEIs to broaden their activities beyond their traditional remit. There is evidence in some countries that university and non-university distinctions are blurring, with the latter group starting to conduct more academic research (Lepori 2008). This process is sometimes known as 'academic drift'. In the context of the massification of higher education and higher competition, and given sufficient flexibility, revenue-seeking universities also have an incentive to expand their role—for instance, by bringing in students that may otherwise have recieved vocational education. In this sense, HEIs have diversified their educational offerings in the face of competition. Indeed, whole new institutional models have arisen in response to the changing higher education environment (OECD 2008). Competition for students and researchers at the global level may encourage HEIs to become active players in international networks and seek ways to enhance their international reputation.

#### 6.5.1.3 Industry Funding of HEIs

In the face of budgetary constraints faced by most countries, HEIs have changed their attitudes towards business as an additional source of funding, encouraged by reforms and government policies. Industry funding for HEIs varies across OECD countries. Data shows that industry is a more important funder of higher education R&D (HERD) in some countries than others. In France and Japan, industry accounted for 2.7% of HERD in 2012, compared to 14% in Germany. Across OECD countries, the percentage of HERD financed by industry rose strongly during the 1980s, but has been more stable since, declining after the start of the 2008 global financial crisis. One must note, however, that industry is not the only private source of funding for the activities of HEIs; non-profit foundations, philanthropic organisations and citizen initiatives (community funding, crowdfunding) are also sources of non-state funding for research and education. The drivers behind these trends are a topic of interest for the positioning of HEIs in the knowledge triangle.

The relationship between HEIs and industry is more crucial in some fields than they are in others. In the US, medical sciences and engineering departments receive much more funding from the business sector than other scientific fields. An empirical study of Italian universities found that departmental differences had an effect on the extent of engagement with industry. The study also found that private funding is more of a complement to public funding than a substitute (Muzio et al. 2013). Furthermore, as industry funding is usually provided through contractual arrangements with explicit objectives and demands on research, the increasing role of industry in funding might have negative effects on the autonomy of research, and result in an increase in applied research relative to basic research. At the same time, the negative, neutral or positive effects may depend on the *quality* of basic research or the *quality* of researchers co-operating with industry. The industrial sector of the co-operating firm, its R&D intensity or its human capital structure may also have an impact on changes in the direction of public research.

A more general question is whether industry funding of higher education "R&D" is the correct metric for assessing the impacts of university engagement with industry. As stated at the beginning of this paper, the relationship between HEIs and businesses has been focused on the research link, i.e., the R&D connection and therefore, the role of businesses funding higher education R&D. The educational linkages between HEIs and industry may be a more fruitful area for studying the effects of industry and academic co-operation from the standpoint of the knowledge triangle.

Another issue concerns the nature of the links between HEIs and industry and the effects these may have on research areas. Industry-science relations are often stronger in some fields (e.g., engineering, ICTs, life science) than others (e.g., sociology, political science). Indeed, research has found departmental differences have an effect on the extent of Italian HEIs' engagement with third party funding. In the US, medical sciences and engineering departments receive much more funding from the business sector than other academic fields. At the same time, as industry funding is usually channelled through contractual agreements with explicit objectives, there is a risk that industry funding could reduce the autonomy of institutions and result in shifting public research towards more applied research. Although this has been a long-standing concern, the available evidence on this is not conclusive, despite some evidence of HEIs' increased inclination to undertake applied research.

#### 6.5.1.4 International Sources of Funding

International funding also has important implications for the steering and performance of research. In the European context, supranational funding for research through the EU's Horizon 2020 programme is not only an important source of research funding, but it also shapes and "influences" national research agendas, notably through the emphasis on operational research funding directed towards the grand challenges. This in turn has an impact on the bottom-up orientation of research at HEIs. Similarly, the EU's Smart Specialisation Strategy provides an additional source of funding from EU structural funds that is used for research infrastructure and human resource development at the regional level. In smaller EU countries, this funding is a large source of HEI funding, representing 24% in the Czech Republic, for example (Kostić and Čadil 2016).

#### 6.5.1.5 Other, Non-governmental Research Funding Schemes

Foundations, alumni, wealthy individuals, charitable trusts and crowdfunding are increasingly important and growing sources of research funding for HEIs. Philanthropic funding accounts for almost 30% of the research funding of leading research universities in the United States and represents more than US$4 billion a year (Murray 2012). The United Kingdom is another example of where philanthropic funding represents a notable share of the revenue of HEIs. Some research universities in the United Kingdom earn almost 10% of their total income from philanthropic sources (Estermann and Pruvot 2011). Philanthropic funding is partially encouraged by the policy of the UK government to provide additional research funds to HEIs depending on their charity income; the charity support funding was approximately £198 million in 2015–2016 (HEFCE 2011).

#### 6.5.1.6 Autonomy in Financing

The diversification of funding sources and channels might have a direct bearing on the autonomy of HEIs. Firstly, more diversified funding sources and channels of HEIs may imply that they are less dependent on a specific funding channel, particularly on government funding; which provides HEIs with a sense of increased autonomy in research and education. This kind of argument is often used to encourage HEIs to make efforts to diversify their funding sources. However, in a context where the diversification of funding sources is usually accompanied by an increase in competitive-based funding and contractual arrangements, the effects of funding diversification should be analysed using empirical evidence.

The more autonomous HEIs are in financing can potentially enhance the diversification of funding channels as HEIs try to enlarge their sources of funding. This aspect can raise an issue for policymakers about the degree of autonomy that should be granted to HEIs. Currently, the authority of HEIs to make important decisions on financing varies across countries. For example, universities in Italy, Portugal and the UK can decide the level of tuition fees under a ceiling, which is decided by governmental authorities, while the government sets the fixed amount of tuition fees in France, the Netherlands and Spain. Furthermore, autonomy in financing encompasses various issues concerning one's ability to retain a potential surplus from state funding, the ability to raise money on financial markets and the ownership and sale of real estate (Estermann et al. 2011).

### 6.5.2 Place-Based Policies and HEIs: Challenges, Obstacles and Open Questions

In a place-based context, municipal governments must invest in the knowledge base of HEIs but they must also encourage co-operation between HEIs and the local eco-system in order to encourage firm competitiveness and structural change through new firm growth. However, in many countries, higher education and research policy lacks an explicit territorial dimension. Academics and their universities are generally rewarded on the basis of the quality of their research activities or whether they collaborate with businesses, irrespectively of where companies are located. The lack of explicit territorial dimension is often reflected by funding and incentive mechanisms defined by national agendas that generally provide little support for regional engagement. In some cases, there might be a lack of co-ordination at the government level: ministries or departments responsible for higher education and research might tend to promote a national or even international excellence agenda, at the same time the departments responsible for territorial development might encourage universities to maximise local knowledge spillovers.

An additional challenge in promoting regional engagement is the lack of appropriate and reliable metrics. The impact of regional engagement is difficult to measure. It is very challenging to measure how much HEIs have impacted the regional and local economic performance after the fact. Evaluation practices for research and education activities—instead—are much more well-established. For this reason, evaluations of HEIs often take these two missions into account and only partly consider the third mission or regional engagement.

Whether to expect most institutions to undertake all forms of academic activity including research, teaching and community service or to designate some as mainly teaching-only institutions and to concentrate research in a few world-class research-intensive institutions is an open question. Depending on the region, the critical mass of researchers, the economic specialisation as well as other factors, different HEIs profiles and strengths may benefit the local ecosystem in different forms. In addition, on the local demand side, even if a leading university is located in a particular region, there may be limited absorptive capacity in local enterprises, especially SMEs or the branches of multinationals that do not perform local in-house R&D activities (Goddard and Puukka 2008).

To overcome some of the challenges described above, some countries have introduced "third-mission"-related activities in the performance contracts between the state and universities. In Austria, 15 out of 22 public universities agreed to introduce elements of place-based innovation in their 3-year performance contracts. This strengthened the role that universities played in the design of Smart Specialisation Strategies in Austria (OECD 2014).

Boundary spanning organisations such as "technology transfer offices" and "research and development units" within universities themselves have often been encouraged and supported by regional and national policy initiatives. Regional governments, in particular, have adopted many initiatives to establish "intermediary bodies" to act as a catalyst between universities and businesses to incentivise their collaboration. The European Institute of Technology (EIT), which is promoted by the European Commission, is just one example of such an initiative at the European level.

Capacity building in regional innovation systems requires not only the research and talent in universities (generative capacity), but also an absorptive capacity in the private sector and clusters; a collaborative capacity in networks, associations and joint facilities; and leadership capacity from boundary-spanning organisations with a guiding vision. Improving innovation systems at the local level can be hampered by, among other things, a lack of political leadership on the part of local government, low demand from the private sector, narrowly focused academic research and teaching at HEIs, and a lack of "boundary-spanning" organisations. For these reasons, traditional place-based policy approaches have largely underestimated the educational role of universities and other HEIs in strengthening regional innovation ecosystems and fostering structural change (OECD 2015).

Given the large heterogeneity of regional innovation ecosystems and the importance of place characteristics for the innovation process (reviewed in the first section), place-based innovation policies in support of the KT seem well-warranted. The diversity of regions, their various levels of economic development, and industrial specialisation all call for tailored approaches.

### 6.5.3 Third Mission Activities

Knowledge exchange and community engagement are long-standing characteristics of HEIs in most OECD countries. However, during the move towards increased autonomy and accountability for most countries' HEIs, many states have acted to strengthen and formalise the social and knowledge transfer role of HEIs. In Sweden, for example, the third mission is officially recognised as a mission of HEIs in the Higher Education Act. Third mission policies therefore partially represent a more active state role in reorienting higher education towards social concerns and innovation. Some countries have dedicated innovation funding schemes to encourage knowledge exchange activities such as interaction with small- and medium-sized enterprises (SMEs). Some OECD countries have also made efforts to measure and record collaboration and dissemination activities. Such policies can also be seen as a response to the "innovation paradox" and concerns in many countries that high-quality research has not been translated into innovation performance (IPP 2015a).

As a result of increased policy attention, these activities, or at least their measurement, may have become more widespread. For example, Marginson and Considine (2000) remark upon the increase in community service and engagement among Australian universities since the 1990s. However, another reason for the increase may be that certain collaboration activities provide an important revenue stream for HEIs. Income from contract research, for example, has become an important source of income for a number of HEIs (OECD 2008). Some countries have attempted to increase the capacity of HEIs to engage in knowledge exchange activities by providing dedicated funding (see, for example, the Innovation Policy Review of Sweden, (OECD 2013)). A detailed evaluation of knowledge exchange funding for HEIs in England found that the policy has generated significant additional knowledge exchange income for institutions, as well as strengthened aspects of the link between teaching, research and knowledge exchange (HEFCE 2011).

## 6.6 Policy Contradictions and Open Questions

Many governments are interested in enhancing HEIs' contributions to the innovative process, economic growth and social development. Rather than being seen as separate missions, education, research and innovation should be seen as part of an overall system encompassing a range of economic and social objectives. Research policies, education policies and innovation policies can be mutually reinforcing, but country diversity shows that there is no single model for alignment. Policies designed to promote innovation directly can have adverse effects on those that promote innovation indirectly. In the context of the knowledge triangle, these interrelationships are an important consideration for policy and governance mechanisms concerning HEIs.

A key issue from the perspective of the knowledge triangle is the potential complementarity or trade-offs between the different missions of HEIs, and the implications for innovation. Some of the broad changes affecting STI policy and HEIs can have a number of effects on these relationships. The following section sets out some potential and tentative implications.

### 6.6.1 Tensions Between Universities and PROs

In many OECD countries, the focus on universities as hubs of knowledge creation, entrepreneurship and innovation has challenged the traditional division of labour between universities and government labs or institutes that fall under the broad heading of "public research organisations". PROs often undertake longer term research that goes beyond the 3- or 5-year funding cycles that are typical for research programmes at universities. In some cases, institutes have been merged with universities (e.g., the Rosline Institute at the University of Edinburgh). While the trend of transferring labs to universities helps in retaining knowledge creation capacity, this can also create tensions between academic departments which must seek short-term competitive funding and centres and institutes which have ring-fenced funding.

### 6.6.2 Potential Trade-offs in Knowledge Production and Diffusion

The increased commercialisation-based and profit-seeking attitude associated with financial autonomy may have competing effects on an HEI's research activities. For instance, a push for commercialisation could impinge on an HEI's willingness to extend informal expertise. Faculty that could earn money from consulting activities might also have fewer incentives to engage in community outreach. The formalisation of knowledge transfer activities creates benefits but also problems for companies. For most HEIs, informal and formal linkages with industry, as well as student and staff mobility, are the most important sources of commercialisation and knowledge transfer (OECD 2011a, b). Increased industry-HEI collaboration and formalisation of knowledge transfer raises the potential risk of negative effects on basic research spending, scientific inquiry for its own sake and the free dissemination of discoveries would decline (Mendoza 2015). More speculatively, the incentives created by research funding schemes oriented towards academic excellence could potentially discourage activities linked to the third mission unless there were strong monetary or altruistic incentives to perform these activities in place. At the very least, faculty are limited in the amount of time they can devote to third mission activities insofar as career advancement depends more on publishing and teaching. At the same time, a more competitive and market-driven environment may encourage HEIs to build linkages with external partners as a potential source of research funding and income. Linkages with industrial, government and community partners can be a source of ideas for researchers.

### 6.6.3 Relationship Between Education and Research

Debates over the relationship between research and teaching are long-running. There are reasons for teaching and research to be complementary—knowledge of up-to-date research can improve the quality of education and the relevance of investments in human capital, while the movement of students into the workplace allows knowledge from research to be disseminated more effectively. Feedback to research universities from students and prospective employers can help maintain the social relevance of research. Yet the long-running increase in the rewards to research relative to teaching is often argued to have weakened the relationship between the two. Empirical evidence at the student/academic level, predominantly in the United States, tends to find no or limited evidence for a positive relationship between research productivity and teaching effectiveness as judged by students (Centra 1983). The research-intensive units that are most successful at winning competitive grants, such as medical schools, may not be responsible for extensive education and training. In addition, if research increases in complexity over time it may become less closely connected with education. The nature of the relationship between education and research is likely to vary by fields of science and education.

### 6.6.4 Relationship Between Education and the Third Mission

Similarly, a number of factors could affect the relationship between third mission activities and education. Interactions between researchers and industry or the local community can help them relate their research and teaching to real-life problems. Vocational education colleges, in particular, may face a challenge to keep their programmes up-to-date with technology and innovation (Toner and Dalitz 2012). Thorn and Soo (2006) show how a 'third-mission' orientation has had spillover effects on the advanced training activities of universities in Latin America (e.g., real-life problems in university courses and collaborative doctorate research projects). Education can affect innovation too—Thune and Børing (2015) show that the industry placement of Ph.Ds is used by firms for a range of purposes including developing broader competencies, knowledge in core technological areas, R&D competencies and innovation capability. But here there could also be negative effects. One concern is that an outward-looking focus encourages HEIs to focus education and training on short-term employer needs, and potentially become less well-aligned with the unpredictable skill needs of the future. The impact of industry-academia linkages on students requires more research (Mendoza 2015). The governance mechanisms associated with the formalisation of the third mission, such as performance agreements and new evaluation methods, may also have their own effects on teaching and training.

### 6.6.5 Fragmented Governance

At national level, policy co-ordination is important for organising and implementing the policies towards education, research and innovation. In many countries, policy co-ordination takes place through inter-ministerial councils or through more informal means such as strategy documents and white papers. At regional level, economic development agencies also exert an influence on HEI activities. The corollary of greater autonomy is that task of co-ordinating and integrating the multiple missions of universities falls on the institutions themselves. However, the silo model of funding and regulations for the different missions do not facilitate the tasks for institutions. This altogether places large expectations on universities to align the missions and create interactions between these different tasks (Benner and Tushman 2015). This results in a dual and sometimes fragmented governance system whereby institutional choices are determined by internal governance structures (e.g., rectors, faculties and departments) that are only partly influenced by national policies (legislation, funding) or regional actors. Furthermore, governance mechanisms such as performance agreements and evaluation criteria may inadvertently include a bias towards one or the other element of the knowledge triangle.

### 6.6.6 Place-Based and HEI Ecosystems

HEI are important employers and service providers that are an integral and permanent part of most regional economies. In some regions, co-operation between universities and external partners has a long history and has been supported by existence of industrial and scientific infrastructure in the region (e.g., science and technology parks) as well as clusters and regional support structures to foster innovation. In others, this collaboration was promoted by (supra-) national or regional-level policies and by the availability of increased funding to foster research, innovation and knowledge transfer. The availability of public funding programmes aiming directly at the exploitation of research results and at closer linkages between universities and companies has also brought regional governments and HEIs closer together. However, while HEIs are increasingly engaging local stakeholders on university boards or for fund raising, the corollary is also important. Economic development agencies can arguably do more to engage HEIs in their public service delivery missions, economic development, urban planning or “smart city” initiatives (Meissner 2015a, b; Schiavone and Simoni 2016; De Grande et al. 2014). The role of HEIs in the regions also depends on the relative power and motivation of the actors. In a government-pulled model, entrepreneurial universities assist the development of existing industries and the creation of new industries in response to incentives from the government, such as budget funds. In an industry-pulled model, universities respond to opportunities for co-operation with industry on specific problems.

## 6.7 Conclusion

Higher education institutions (HEIs) play a central role in the innovation systems of OECD countries. Much of the government funding that is channelled for education and research is performed by HEIs. Firm innovation increasingly relies on the science base that is generated at HEIs as evinced by data on patent-science linkages and industry-university collaboration. HEIs are also major employers of researchers in OECD countries and provide services to local and national economies. In addition, HEIs provide many public goods to society from knowledge spillovers, well-trained graduates, to scientific advice to policymakers as well as private goods such as consulting services, patented inventions and contract research. For these reasons, an understanding of how national policies and institutional practices can enhance the contributions of HEIs to society and the economy is critical.

In light of the decentralisation of funding of HEIs in many countries and high competition for support for research projects, these institutions currently experience colossal pressure from the government and other stakeholders. In order to meet modern requirements as well as the demand for more inclusiveness and accessibility, higher education institutions must be reformed. Raising the social and economic significance of HEIs is a key point of national policy, which requires new approaches. Therefore government agencies in the OECD place great hope in the knowledge triangle concept, which aims at exploring ways to better align and integrate the research, education and innovation functions of HEIs through national policies and institutional activities. Traditionally, the linking of research to innovation has been encouraged by governments and industry. In addition, in HEIs with a Humboldtian tradition (e.g., in Germany and the US and Northern Europe) the linking of research with education has been well established since the nineteenth century. However, this link continues to evolve as governments channel greater amounts of research funding to HEIs. In contrast, links between education and innovation have been less the focus of national policymakers or institutional leaders until recently.

The novelty of the knowledge triangle framework is that it encourages mechanisms to link education to innovation *via* entrepreneurship, for example; or innovation to education and research, for example, by permitting professors of practice from industry to lecture at universities. The goal of knowledge triangle targeted policies is to generate qualitative and quantitative effects from these interactions that are greater than sum of the individual outputs of HEIs (e.g., academic articles, graduates or academic patents, local employment effects).

However, HEIs are diverse actors with diverse missions. The ‘optimal’ structure of HEIs in relation to innovation is likely to vary across countries. It follows that there is no single model of HEIs or of the knowledge triangle. A range of different types of HEIs can contribute to innovation via their education, research and other activities, in conjunction with other actors. For example, while leading universities may excel in the number of highly cited academic articles and academic patenting, small teaching-only institutions can also play an important role in developing the technical, creative and managerial skills that contribute to innovation in the surrounding regional economy.

Yet, despite the diversity of HEIs, data shows that education, research and innovation activities at HEIs are concentrated within a few large institutions in OECD countries. Concentration may reflect a combination of historical factors, size-scale factors, but also government policies, such as performance-based contracts and increases in research funding relative to education, etc. New institutional policies related to new public management ethos that raise institutional profiles or recruit “star” faculty to attract additional funding for students, research and business collaboration would strengthen competitiveness.

The conclusion is that there is no single model of universities and the knowledge triangle. This is due to the country-specific peculiarities of educational systems, diversity within HEIs and the functions they perform, as well as the specifics of regional ecosystems. Accordingly, the key to the efficiency of the knowledge triangle tools is their place-based adjustment. In order to achieve a tangible contribution by universities to the development of regional and local innovation, it is necessary to ensure complementarities and balance between their missions.

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# Part III

# Local and Regional Strategies

# 7 High Growth Firms: A Policy Option in Turkey

Murat Demirez

**Abstract**

HGFs increasingly draw attention of policy makers with their outstanding performances as novel policy instruments. However, the heterogeneous nature of firm growth and its erratic patterns make them questionable. In addition, there is not any consensus about the definition and measurement method for high growth, which makes it difficult to compare different studies. The main research questions of this study are, whether HGFs in Turkey share common characteristics with HGFs in other countries and how the cohort of HGFs changes by using different definitions. In empirical part, the firm data is drawn from the SME Support Organization of Turkey (KOSGEB), in two consecutive 4 year periods. Our findings show that HGFs in Turkey have some common characteristics with other countries; they are relatively young and small. Whilst, firms with less than twenty employees comprise the majority of HGFs in this study, they are usually excluded out of the definition of HGFs in other studies. Furthermore, contrary to other studies, high growth is not one-time event and a significant amount of HGFs sustain their outstanding performance in the next periods. Consequently, each definition of high growth leads to a different cohort of firms. Whilst, a firm demonstrate high growth in one variable, it might have negative performance in others. Therefore, policies makers need to adopt their own definition in order to discriminate the outstanding performer firms from the modest ones.

**Keywords**

High growth firms · Fast growing firms · Entrepreneurship policy

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## 7.1 Introduction

In modern economies, developed or developing, entrepreneurship has been regarded as a key source of new jobs and wealth generation. An entrepreneur is a revolutionary heroic figure that identifies the imperfections and bottlenecks of the market and introduces innovative solutions for consumers or business (Schumpeter 1934). By doing so, entrepreneurs destruct the stationary equilibrium of the market by opening a new way of production or operating in the market. In his seminal work, Schumpeter clearly distinguishes the role of "the (innovator) entrepreneur" from other business owners in economic growth.

Policy makers and scholars are still in search of the best entrepreneurship policies. As the discrimination previously made by Schumpeter shows, not all enterprises but "the innovator entrepreneurs" generate growth; therefore, the challenging issue is to answer the question: which type of business generates more jobs and growth? Is it incumbents or new entrants, small or large enterprises, high-tech or low-tech enterprises? Another equally important question to be answered is how can governments effectively intervene and stimulate the natural progress of entrepreneurs?

In this study we focus directly on a relatively new phenomenon of entrepreneurship literature, namely high-growth firms (HGFs). In this domain, the main premise is that not all firms but a small percentage of firms generate disproportionately high levels of jobs and economic growth (Henrekson and Johansson 2010). Thus, it implies that rather than promoting ordinary entrepreneurs, targeting those high-growth ones would be better for all economies.

The literature on HGFs begins with the provocative report "The Job Generation Process" by Birch, who claimed that small companies were responsible for the majority of new jobs in the US (Birch 1979). In fact, at the time the report was published, the US and the world economy were undergoing a major transformation, with economic recessions, oil crises, and high unemployment rates. Thus, the report had a high impact on economic policy and studies. Small businesses were regarded as principal tools for regenerating growth and jobs, especially by Regan and Thatcher in the US and in the UK, respectively. However, Birch then revised his main argument and stated that not all small firms but only an exclusively small number of high-growth small firms, which he metaphorically termed "gazelles", were responsible for the most job generation (Landstörm 2005).

Apart from the metaphorical terms, there are various definitions, terms and measurements, adopted by scholars and institutions around the world, related to HGFs. In fact, in this differentiated complex world, comparison of the studies or the policies has become a challenging issue for those to discover how HGFs behave, grow and are supported.

From a policy perspective, if HGFs are to be used to drive economic growth, their common characteristics and growth factors have to be identified first. Almost four decades after Birch's introductory work, studies are now available to draw some familiar characteristics and patterns of HGFs from. These studies and publications have increasingly brought HGFs to the fore, both in developed and developing countries, as a novel policy tool.

In Turkey, as a developing country, HGFs also have been put at the core of small and medium enterprise (SME) policies. In the principal national strategic plan of Turkey (The 10th Development Plan, 2014–2018), the main objective of SME and entrepreneurship policies was defined as prioritising fast growing firms, firms with growth potential, and also innovative SMEs, while supporting them (Ministry of Development 2013). Thus, in the planned period, specific programmes are to be prepared to support HGFs. Yet, there are few studies in this field in Turkey. During the preparation of this paper, only two studies on HGFs were identified in Turkey. In the first, Güzel and Giray (2014) compiled literature on and policy implementations from other countries and OECD publications. In the latter study, Cansiz (2013) analysed the social backgrounds of 32 high-growth entrepreneurs in technology development regions in Turkey. Yet, there need to be further studies to analyse the characteristics of HGFs in Turkey and whether HGFs in Turkey share common characteristics with other HGFs in other countries. In this regard, this paper contributes to the literature through a comprehensive research on HGFs in Turkey.

The main research question of this paper was whether the HGFs in Turkey have similar characteristics to those in other countries or not. However, both the literature review and the empirical analysis conducted for this study showed the fact that the group of firms identified as HGFs in a study is likely to be changed by a different variable and measurement technique. Therefore, it is more essential to demonstrate how the cohort of HGFs changes by using different methodologies and variables.

In the empirical part of the study, the data, comprising 7950 SMEs for 2006–2009 and 14,372 SMEs for 2010–2013, will be analysed. Two periods are chosen, first, to test the economic crisis and the recovery period's impact on HGFs and, second, to demonstrate persistence of growth in the long run. We will first analyse whether our findings and the HGFs common characteristics are consistent, and then we will study the persistence of high growth within and between 4-year periods. This will demonstrate how HGFs can be used as a policy tool.

This paper proceeds as follows. In second section, we will show how the concept of HGFs arose, and progressed and what the main views are and how these findings will be addressed. The very nature of the HGFs concept, the heterogeneity among definitions, the measurements and the variables are also discussed. The third section will be the part for the methodology, data and the measurements of this study. In the fourth section, findings of this research will be illustrated and compared with other country findings. In the final section, all the findings of the research and literature review will be evaluated to give a conclusion and recommendation, in particular for HGFs in Turkey.

## 7.2 Theoretical Background and Heterogeneity Among Definitions

### 7.2.1 Theoretical Background

High-growth firm literature began with the seminal report "Job Generation Process" by David Birch in 1979. When he analysed Dun and Bradstreet data comprising 12 million records of firms from 1969 to 1976 in the US, he found that firms with 20 or fewer employees created four times as many new jobs as large firms with more than 500 employees (Burlingham 2012). Indeed, despite the fact that just 12 copies were sold, the report had an enormous impact on both the policy and the small-business research field. Actually, the 1970s were a time in which the oil crises and economic recession had made large companies questionable, and his report provided small business as a novel economic policy instrument for politicians such as Ronald Regan in the US and Margaret Thatcher in the UK (Landstörm 2005). However, the report also attracted a number of critics for using inappropriate data because they were data just for credit rating purposes and not representing all the firms in the US.

He then revised his argument to state that neither small nor large but a small proportion of firms create most of the jobs. He coined the metaphorical term "gazelles" for these high-growth firms, and their counterparts with steady growth performances were termed "mice" and "elephants" according to their size (Landstörm 2005).

Contrary to Birch's claims, Davis et al. (1996) found that smaller firms exhibit higher gross rates of job creation, but not in terms of net rates. Large firms dominate both net job creation and job destruction in the manufacturing sector in the US. They criticise the studies bringing small firms to the fore in terms of job creation by relying on unsuitable data to draw relationship between job creation and firm size. In essence, the relationship between net job creation and size is mixed and not robust. One of the important theories about size and the growth relationship is Gibrat's law (1931), which asserts that a firm's growth rate is independent of its size and random (Moreno and Coad 2015). In their study, Moreno and Coad (2015) tested Gibrat's Law, yet they could not easily reject or accept it. Rather, they concluded that most of the empirical evidence shows that smaller firms grow faster than large ones, but the theory has some explanatory points for large ones.

In a similar vein, Daunfeldt and Elert (2010) conclude that Gibrat's law is rejected when it is analysed on aggregate level; small firms grow faster than large firms. Yet, when they did their analysis on industry level (five-digit NACE codes), Gibrat's Law was confirmed in almost half of the industries. Thus, growth seems to be a rather random process in industry-level analysis. Linking to this, Haltiwanger (2006) found that the age of the firm rather than its size has a relationship with growth. He asserts that there is no systematic relationship between net employment growth and size when age is controlled. Newer firms are more likely to display high growth than their older counterparts (Mason et al. 2009); nevertheless, 70% of HGFs are at least 5 years old (Anyadike-Danes et al. 2009). In their comprehensive study, by applying different definitions of high growth, Daunfeldt et al. (2010) found that a firm's age has a significant negative impact on the likelihood of being an HGF in almost all regressions. It means that young firms are more likely to be HGFs than their larger counterparts.

In many respects, there is mixed evidence for the determinant role of age or size on growth, yet, when we turn to evidence from existing literature on HGFs, there are some common facts on size and age. In 2010, Henrekson and Johanson conducted a meta-analysis; they identified 20 studies from 1990 to 2010 and found some common characteristics among HGFs. In their analysis, they concluded that they are not necessarily small and young, yet, on average, HGFs are younger and smaller than other firms. Halabisky et al. (2006) found that most of the hyper- and strong-growth companies are small (fewer than 100 employees) and responsible for 63% of job creation in the study period 1985–1999 in Canada. However, large companies are prominent among slow or negative growth firms, accounting for 89% of them.

The main premise of HGFs is that the outstanding performers generate most of the jobs in an economy; therefore, most of the studies focused on identifying HGFs' proportion and their job contribution. In the research, in all the UK firms from 2002 to 2008, it was found that 6% of all firms generated 54% of the jobs, which were later symbolised as the "Vital Six" (Anyadike-Danes et al. 2009). In line with the Vital Six, HGFs account for 4% of all firms and create 70% of jobs (Birch and Medoff 1994). In sum, the proportion of HGFs, in a number of studies, changes from 1 to 10% of all firms, and their job contribution is 50–80% (Acs and Mueller 2008; Acs et al. 2008; Deschryvere 2008; Betbèze and Saint-Etienne 2006; Halabisky et al. 2006; Lopez-Garcia and Puente 2012).

Most of the studies were conducted on cross-sectional data sets and there are fewer studies on HGFs' attitudes in the long term. In this respect, Acs and Mueller (2008) analysed the employment effects of new firms in the long term. The empirical evidence indicates that the overall employment effect of start-ups is positive and very strong in the year they enter but this effect decreases and fades away in 6 years. They also found significant differences in terms of firm sizes. In accordance with HGF literature, most small firms, so-called mice (firms with fewer than 20 employees) stay small and have negative employment effects by the time. In addition, elephants (firms with more than 500 employees) have a negative U-shaped employment effect, in the initial 3 years, and then it turns to positive afterwards. However, gazelles (firms with 20–500 employees) are the only ones that develop a strong long-term employment effect after the entry year.

Prior studies have also focused on identifying some growth factors linked to high growth. OECD (2010) prepared a multi-country study in order to investigate the link between high growth and drivers such as innovation, business practices, networking, intellectual assets management and financing. First, innovation and the high-growth relationship was investigated. Although the previous OECD (2002) study had found a positive relationship between them, it was not supported because of lack of significant empirical evidence. The reason behind this conclusion was that different studies on this issue cannot be compared because of the diversity of their definitions of high growth and innovation; furthermore, firm-level effects of innovation found can be both positive and negative. Therefore, the report recommends that policy makers separate these two issues: innovation and high growth.

Baldwin and Gellatly (2006) found that high-growth entrants are twice as likely to innovate, to invest in computer-controlled processes for production, and to train. They also concluded that more successful firms are also more likely to have higher R&D sales and investments ratios. By the same token, Mason et al. (2009) investigated whether innovation drives growth and whether faster growth leads to higher spending on innovation and found that innovative firms who introduced innovations (process, product or wider innovations) grow twice as fast in both employment and sales as non-innovative firms.

It is a widely held opinion that high-tech firms are in greater proportion in the cohort of HGFs. In this respect, most government policies usually focus on R&D, innovation incentives and high-tech start-ups. Contrary to this view, almost all HGF studies conclude that HGFs exist in all industries and are not over-represented in high-tech industries (Halabisky et al. 2006, Henrekson and Johansson 2010). HGFs can be found in all sectors, but Mason et al. (2009) showed in their findings that while business service firms are significantly over-represented manufacturing firms are under-represented in the group of HGFs.

Another topic studied in HGF literature is their regional effects. Mason et al. (2009) found that if two regions have the same level of firm growth, the region with a greater proportion of HGFs will generate more jobs.

In addition, HGFs do have an effect on industrial growth performance. Although HGFs can exist in all industries, regardless of technological level, it is crucial to know how they affect overall industry growth. Bos and Stam (2013) investigated young HGFs (gazelles) in the Netherlands in a 12-year period. They found that an increase in the prevalence of gazelles in an industry has a positive effect on subsequent industry growth. Yet, they could not find any relationship between over-representation of gazelles and subsequent industry growth.

One of the growth factors is the background of high-growth entrepreneurs. Mason and Brown (2013) studied 22 high-growth firms in Scotland. They found that business experience is a very essential factor in firm success; 13 of them had already pre-incubated in business and novel entrepreneurship was relatively rare in the HGF group. Like Mason and Brown, Cansiz (2013) analysed the social backgrounds of 32 HG entrepreneurs in technology development regions in Turkey. According to that study, HG entrepreneurs are more likely to have prior business experience and to be highly educated, preschool educated, exporting, active social network application users and open to cooperation.

On the whole, first, the large part of literature is on the proportion of high-growth firms and their outstanding job-growth shares in economies. Most of the studies are focusing on illustrating the outstanding performance of a small proportion of firms in different countries. Then, some of the studies focus on finding out some common characteristics and growth factors of HGFs. In line with general expectations, some studies analyse the relation between high growth and innovation or R&D. Few of them study HGFs' regional or industrial affects. In fact, if HGFs are to be used to stimulate new job creation and the wealth-generation process, more light needs to be shed on the nature of HGFs and growth factors. However, it is outside the scope of this study.

### 7.2.2 Heterogeneity in HGF Definitions and Methods

Indeed, HGFs are outstanding performers; nevertheless, it is hard to compare and contrast the findings of studies because of the heterogeneity among terms and definitions used in this field. Almost every study adopts idiosyncratic definitions, terms and measures to identify HGFs.

There is even a rich diversity in the terminology of high-growth firms. Here are some: *high-potential entrepreneurship* (Lerner 2010) *high growth enterprises* (Eurostat-OECD 2007), *high impact firm* (Acs et al. 2008), *Gazelle* (Bos and Stam 2013), *hyper and strong growth firms* (Halabisky et al. 2006), *fast-growing enterprises* (Europe 2020), *High Growth Innovative Enterprises HGIE* (Kolar 2014).

Though, Eurostat-OECD (2007) has introduced a practical definition for both HGFs and gazelles, there is not any consensus about the definition and measurement method for HGFs. Indeed, growth in a firm can be calculated with different variables such as employment, revenue, and productivity and with different methods (absolute, relative, organic etc.) in accordance with the purpose of study. Thus, while HGFs in a study may refer to a particular cohort of growing firms, it may refer to a very distinct group of firms in another study. Even within the same study, a different cohort of firms might be found to be HGFs because of the methodology that is adopted.

Growth can be measured in absolute or relative terms. Moreover, some studies preferred to combine both of them. While absolute growth indicators bring large firms to the fore, relative growth indicators give a greater chance of taking part in the cohort of HGFs to small firms.

The definition for HGFs suggested by Eurostat-OECD is as follows.

> All enterprises with average annualised growth greater than 20% per annum, over a three year period should be considered as high-growth enterprises. Growth can be measured by the number of employees or by turnover. (Eurostat-OECD 2007, p. 61)

In the same manual, it is also recommended that the size threshold for firms be set to avoid negligible increases, such when a firm with solely one employee has an increase of one employee. If it is measured, it will be calculated as a 100% increase, which is greater than growth threshold for HGFs. Therefore, firms with fewer than 10 employees at the beginning of the period should be excluded from the measurement of high-growth firms, which is measured in terms of either employment or sales.

In general, the terms gazelles and HGFs are being used interchangeably, but the Eurostat-OECD manual splits young ones from other HGFs and terms them gazelles. Although, Birch, has never referred to gazelles as young or start-ups, the

Eurostat-OECD manual split the definition into two groups of firms. The recommended definition of gazelle in this manual is as follows:

> All enterprises up to 5 years old with average annualised growth greater than 20% per annum, over a three year period, should be considered as gazelles. (Eurostat-OECD 2007, p. 63)

In fact, some studies adopted the Eurostat-OECD definition, for example Deschryvere (2008), Anyadike-Danes et al. (2009), Hölzl (2011), and Mason et al. (2009). Nevertheless, this manual has not brought about general agreement on the definition of HGFs. Unlike in the Eurostat-OECD definition, in the study of Bos and Stam (2013) a firm has to have at least 20 employees and generate at least 20 employees in the period in question to be identified as a gazelle.

Birch and the Eurostat-OECD manual define relative growth as annual growth of more than 20%, yet in some studies different relative growth thresholds have been used. In the study of Halabisky et al. (2006), more than 150% of growth over a 4-year period was defined as hyper growth and 50–150% growth was defined as strong growth. Moreno and Casillas (2007) prefer another way to identify high growth: 100% higher than the sector median in three consecutive years. In the European Commission report (2013), fast-growing firms were defined as firms with more than 10 employees and growing annually by more than 10%.

Furthermore, some studies also used a combination of different variables. In their research, Acs et al. (2008) identified high-impact firms as enterprises with sales that doubled over a 4-year period and an employment growth quantifier (combination of absolute and relative change) of two or more over the same period.

Another tendency in defining HGFs is selecting the X% of the best performers in a population of firms. Daunfeldt and Halvarsson (2012) have taken 1% of the fastest growing firms for different measurements of growth. Coad et al. (2014) classified four groups of HGFs into 1% and 5% of the fastest growing firms in terms of employment or sales. In Delmar et al. (2003) a high-growth firm had to be among the top 10% of all firms in terms of an annual average in one or more of six categories. Schreyer (2000) focused on 5% and 10% of the fastest growing firms so as to identify HGFs.

Furthermore, another differentiation point in studies is using excluding thresholds for the population of firms in question. Birch, in 1994, excluded firms with revenue of less than USD100,000. In the Turkey 100 project, in the study by Autio et al. (2007) and in the study by Littunen and Tohmo (2003) firms with a revenue of less than USD500,000 (TOBB-TEPAV 2014), firms with less than 1 million FIM, and firms with less than 500,000 FIM were excluded, respectively. While the Eurostat-OECD (2007) manual recommended that firms with fewer than ten employees need to be excluded from the measurement of HGFs, Delmar et al. (2003), Bos and Stam (2013), Schreyer (2000) and Betbèze and Saint-Etienne (2006) excluded firms with fewer than 20 employees from their analysis.

The definition or the method adopted in a study might give very different results. For instance, Mason et al. (2009) highlight how their findings change in terms of number of HGFs. They adopted the OECD HGF definition, and, if the growth is measured in terms of employment, the proportion of HGFs in the overall population is 6%, but it rises to 12% in terms of turnover growth and to 17% if growth is measured by turnover per employee TPE.

Daunfeldt et al. (2010) tested the impact that the different use of definitions has. They applied four different indicators of growth: employment, sales, productivity and value added. Moreover, for each indicator they applied absolute and relative numbers and a combination of them. Consequently, the correlation between nine groups of HGFs is low, which means that the HGFs in each group are distinct from others. HGFs in relative terms are more likely younger and smaller than those in absolute terms. Yet, the most significant result of their research was identifying the diversity of their economic impacts due to the use of different growth indicators. Accordingly, while fast growers in employment give negative or small contributions to productivity growth, fast growers in productivity growth give small or negative contributions to employment and sales growth. It implies that there is a trade-off between these indicators.

"*All HGFs do not grow in the same way*". Delmar et al. (2003) put the heterogeneity of the growth patterns of HGFs in this way. They analysed the data of 11,748 firms, in Sweden, with at least 20 employees. By using 19 different measures of growth (absolute/relative, employee/sales, organic/acquisition etc.), they identified seven different types of firm growth. Similarly, in their study, Acs et al. (2008) classified the firms' growth patterns into six groups to show the heterogeneity of growth patterns of firms, such as c*onstant growers, mixed growers, non-changers, volatile non-changer, mixed decliners, and constant decliners.*

On the whole, even if firms were identified with the same measurements, HGFs and non-HGFs do not indicate two sharply discriminated homogenous groups of firms. Rather, there is heterogeneity and a stratified level of growth attitudes.

## 7.3 Methodology

### 7.3.1 Data

We used secondary data, which have been drawn from the database of KOSGEB, SME Development Organization of Turkey. SMEs who want to apply for the support programmes or services of the agency have to fill in and submit a statement, namely the "SME Statement". This statement is a legal form consisting of annual sales, employment and balance-sheet information of the SME. Our data set comprises all those SMEs which regularly submitted their SME statements during the two consecutive 4-year periods in question. In the first period, from 2006 to 2009, there are 7950 firms and, in the second period, from 2010 to 2013, there are 14,372 firms. These firms are all the firms in KOSGEB database which regularly submit their statements.

In this study, two consecutive time periods were chosen in order to analyse the persistence of high-growth performance and change of HGFs figures in different macroeconomic conditions. Most of the previous studies analyse high growth in a cross-sectional data set, in one specific period. Yet, these studies do not provide any information about how these HGFs performed in previous or subsequent periods. This point is very important for policy concerns because, if these firms do not continue their outstanding performance in the next period or demonstrate low growth, public funds allocated to these firms will be a waste of money. In order to set policy interventions on HGFs, their previous and subsequent performances need to be known. In this respect, two consecutive periods were chosen to show how HGFs perform in the long run. Furthermore, the longitudinal time set allows us to analyse how the firms' performances changed in the economic crisis and the recovery period. The first period in this paper covers the global economic crisis and the second period covers the recovery period. Because it is so, we can compare the results during crisis and afterwards.

### 7.3.2 HGF Measurement

In line with the Eurostat-OECD manual and the most commonly used growth level for HGFs, an annual growth threshold of 20% and over was chosen to identify a firm as an HGF. Thus the aggregated growth in a 4-year period corresponds to 72.8% in total. The firms that had a 72.8% growth in terms of sales or employment levels were marked as HGFs with this assumption in this study.

$E_t$ = firm total employment in year (t)
$E_{t-3}$ = firm total employment in year (t−3)
$S_t$ = firm sales in year (t)
$S_{t-3}$ = firm sales in year (t−3)
Measurement of Employment Growth in relative terms

$$\mathrm{HGF_{Emp}} \quad (E_t – E_{t-3})/E_{t-3} \geq 72.8$$

Measurement of Sales Growth in relative terms

$$\mathrm{HGF_{Sales}} \quad (S_t - S_{t-3})/S_{t-3} \geq 72.8$$

**The Birch Index is measured as shown below:**

$$\text{Birch Index } \left(\mathrm{BI_{Emp}}\right) \qquad (E_t/E_{t-3})^* (E_t - E_{t-3})$$
$$\text{Birch Index } \left(\mathrm{BI_{Emp}} \text{ and } \mathrm{BI_{sales}}\right) \qquad (S_t/S_{t-3})^* (S_t - S_{t-3})$$

In the main text, we identify HGFs in relative terms and with the Birch Index, which is a combination of absolute and relative measures. Relative means the percentage change in 1 year or within the 4-year period. With the relative measurement, small firms will have a greater presentation among HGFs than large firms. To avoid over-representation of small firms, the definitions of HGFs use some thresholds to exclude small firms from the calculations, such as more than ten employees or above specific turnover figures in initial years. Another way to do that is to combine absolute and relative change in one formulation. In this study, the

Birch Index (BI) will be used to combine relative and absolute change. By doing so, we try to create a balance between small and large firms in our HGFs measurement. The Birch Index calculation gives us a value, so it has to be ranked to select the highest ones. Researchers may define a cut-off point to identify HGFs in their study; it can be a threshold BI value or X% of the highest values. In this study, firms' BI values have been ranked and the highest 1%, 5% and 10% of them were denoted as HGFs. This preference aims to demonstrate how various thresholds can be used and how they change the results.

High growth is a phenomenon that cannot be well understood by solely dividing firms' growth into two groups, such as HGFs and non-HGFs. Yet, nearly all of the HGF studies show only HGFs and non-HGFs in their findings, implying that other firms do not grow. As mentioned above, Acs et al. (2008) identified six groups of firms in terms of growth patterns such as constant growers, mixed growers, non-changer, volatile non-change, mixed decliner, constant decliner. Their taxonomy implies that it would be better to classify firms into more than the two groups HGF and non-HGF. Therefore, first, in order to show how the different use of definitions (more than 10% or 20% annual growth) will change the distribution of HGFs and in order to stratify the growth of firms, firms in this study are classified into four groups of growth. Some definitions define high growth as more than 10% annual growth and some define annual growth as more than 20%. This may help us to see the real distribution of firms and their relations with other variables.

In the relative measurement, we split *annual growth* of firms into four groups as follows:

| | |
|---|---|
| Negative growth (NG) | $G < 0\%$ |
| Steady growth (SG) | $0\% < G < 10\%$ |
| Modest growth (MG) | $10\% < G < 20\%$ |
| High growth (HG) | $G > 20\%$ |

In our data set, there are no large companies, all the firms are SMEs. The sizes of the firms were also divided into four groups (0–9, 10–19, 20–49, 50–249) in the tables, in order to demonstrate how the size thresholds in the definitions of HGFs, such as more than 10 or 20 employees, affect the result and cohort of HGFs. In this study, a descriptive analysis will be done in order to illustrate HGFs' age, size, industrial and geographic distribution. By using different measures, we try to show how the common characteristics and growth persistence will change.

The following issues are descriptively analysed in this study:

1. Relationship between HGFs and Age
2. Relationship between HGFs and Size
3. HGFs' proportion among overall firms and job creation, with different measurements and in two periods
4. HGFs' industrial distribution
5. HGFs' geographical distribution
6. Persistence of high growth in two 4-year periods and within periods.
7. Do HGFs exploit KOSGEB support more than their counterparts?

**Table 7.1** Average age of firms according to the growth levels

| Growth levels | Average age in 2006–2009 | Average age in 2010–2013 |
|---|---|---|
| Negative-growth firms | 13 | 12 |
| Steady-growth firms | 12 | 13 |
| Modest-growth firms | 11 | 11 |
| High-growth firms | 8 | 6 |

## 7.4 Findings

In this section, using different indicators, we show that the number of HGFs is sensitive to the definition of HGF. In addition, we also test whether our findings are consistent with previous studies.

### 7.4.1 Average Age of HGFs

As mentioned above, firm growth has frequently been associated with age or size. Despite the fact that there is mixed evidence for the correlation between age/size and growth, in particular, HGF studies concluded that HGFs are relatively young and small compared to their counterparts.

Acs et al. (2008) found that the average age of high-impact SMEs was 25 years old in their study; yet, in this study the average age of HGFs changes from 6 to 9 years old, fewer than four different measures and periods. Table 7.1 illustrates that HGFs are younger than their counterparts, in terms of both relative employment and sales growth levels of firms, in two periods. Different measures of growth do not change this fact. Thus we conclude that our findings are consistent with other HGF studies.

In most of the previous studies, HGFs were found to be relatively young, but gazelle (those less than 5 years old) representation is lower. In Kolar (2014), only 1% of HGIEs were younger than 5 years. In our study, we found this ratio to be 28.4% in the first period and 31.5% in the second period. Young firm representation is not negligible, as Kolar (2014) pointed out. Their share increases very significantly in economic recovery periods.

In Table 7.1, the average ages of firms are given according to their growth levels in terms of employment. It is clear from the table that with the increase in growth levels, the average ages decrease. It is notable that the average age of HGFs decreases dramatically in the second period, which a high number of young and high-growth firms are entering because of economic recovery. In other words, it can be concluded that during economic crises young firms are exposed to crisis effects more than other firms. Therefore, in recovery periods more young firms have growth opportunities.

### 7.4.2 Average Size of HGFs

Another common point in HGF studies is the relationship between size and growth of the firm. In most cases, the smallness and newness may affect growth performance of a firm together and it is difficult to separate their sole effects. Thus most of the studies found that HGFs are younger and smaller than their counterparts. We also addressed the average size of firms according to the growth levels of employment. Our findings in Table 7.2 are consistent with previous HGF studies. The average size for $HGF_{Emp}$ is nine employees, and this is exactly the same in the two periods.

### 7.4.3 HGFs in the First Period (2006–2009)

The growth of firms was calculated first in terms of employment and then in terms of sales to show the differences between two measures. Table 7.3 presents the firms' distribution according to their employment growth in first period with relative terms. In most of the previous studies, HGFs account for a small proportion of the firms. For instance, the percentage of HGFs is 4% in Birch and Medoff (1994), 5.4% in Deschryvere (2008), 6% in Anyadike-Danes et al. (2009) and 7% in Halabisky et al. (2006). Unlike in those studies, HGFs represent 30% of the firms in our findings. The reason behind this high ratio is that it represents all firms, while other studies take some part of the firm population out of measurement according to their HGFs definition, as mentioned above. If the firms with fewer than 10 or 20 employees are excluded, HGFs will represent 8% and 4% of all firms, respectively, which is consistent with previous studies. Yet, the studies exclude 74% or 88% of HGFs respectively.

However, this might be interpreted that, despite their high number in the HGFs group, small firms do not contribute a significant amount of jobs. In Table 7.4, the number of HGFs and their job contribution are given to illustrate the share of firms in terms of size.

By taking out solely the firms with fewer than ten employees, 74% of the HGFs and 46% of their job contribution will be left out of the measurement. By adopting the Eurostat-OECD definition, in which the firms with fewer than 20 employees are taken out of the HGFs calculation, 88% of the HGFs and 75% of their job contribution will be left out of the measurement. On the contrary, size thresholds might be used to distinguish firms with more than 50 employees. In Table 7.4, medium-sized firms (more than 50 emp.) account for merely 2% of the HGFs and 11% of job creation. In addition, medium-sized firms are responsible for 54% of all job losses in this period.

Turning to relative sales growth measurements, the picture is almost the same as when measured in terms of employment growth. Most of the HGFs (54%) are micro-sized firms and if the definition of HGFs excludes micro-sized firms or firms with fewer than 20 employees, 54 or 74% of them will be ignored.

Turning to job creation, we see that, while the net total job creation was 32,231, HGFs created 38,667 new jobs in the first 4-year period (Table 7.3). Thus, it can be

**Table 7.2** Average size of firms according to the growth levels

| Growth levels | Average size in 2006–2009 (# employees) | Average size in 2010–2013 (# employees) |
|---|---|---|
| Negative-growth firms (NGFs) | 35 | 27 |
| Steady-growth firms (SGFs) | 27 | 29 |
| Modest-growth firms (MGFs) | 19 | 24 |
| High-growth firms (HGFs) | 9 | 9 |

**Table 7.3** Firm grouping and job creation according to growth levels in employment

| Firm size (# Employees) | NGFs | SGFs | MGFs | HGFs | Total |
|---|---|---|---|---|---|
| | Job creation | Job creation | Job creation | Job creation | Job creation |
| 1–9 | −911 | 445 | 1459 | 17,702 | 18,696 |
| 10–19 | −2045 | 1006 | 2309 | 7374 | 8644 |
| 20–49 | −8847 | 3005 | 5196 | 9455 | 8808 |
| 50–249 | −13,720 | 2517 | 3149 | 4136 | −3918 |
| Total | −25,522 | 6973 | 12,112 | 38,667 | 32,231 |

**Table 7.4** HGFs and job creation by firm size

| Firm size # of employee | # HGFs | % in HGFs | Job creation | % Job creation |
|---|---|---|---|---|
| 1–9 | 1766 | 74 | 17,702 | 46 |
| 10–19 | 337 | 14 | 7374 | 19 |
| 20–49 | 227 | 10 | 9455 | 24 |
| 50–249 | 52 | 2 | 4136 | 11 |
| Total | 2382 | 100 | 38,667 | 100 |

concluded that HGFs created 120% of the new jobs. Nevertheless, the net total job creation numbers consist of both total job creation and job losses in the same period. Therefore, in order to find out the real job contribution of HGFs, job losses are to be excluded from total job creation. In Table 7.3, the total job creation is 57,752, and, when it is divided by the number 38,667, HGFs' job creation will be 67%. In this period, modest-growth firms and steady-growth firms account for 21% and 12% of total job creation, respectively. These explanations are made as a cautionary note to studies in which the HGFs' share of job creation is calculated with net job creation, rather than merely job creation numbers. In case of such an assumption, the proportion of HGFs in terms of total job creation will probably be unrealistically high.

Our central premise is that the cohort of HGFs will change with the use of different variables and measures. To do so, in Table 7.5, the firm growths are measured in terms of sales. Accordingly, HGFs constitute 39% of all firms, which is nine points higher than HGFs proportion in terms of employment growth. It is clear that high growth is more common in sales growth than employment growth. Yet, it is not easy to mark this as an outstanding growth because nearly half of all firms had over 20% annual growth, even during economic crisis times. In this respect, in order

**Table 7.5** Firm grouping according to growth levels in sales

| | | | | HGFs | | |
|---|---|---|---|---|---|---|
| Firm size (# employee) | NGFs (%) | SGFs (%) | MGFs (%) | #firm | % | Total (%) |
| 1–9 | 32.47 | 30.45 | 31.09 | 1640 | 54 | 40.34 |
| 10–19 | 19.66 | 20.51 | 22.65 | 613 | 20 | 20.58 |
| 20–49 | 34.48 | 34.77 | 34.09 | 624 | 21 | 29.05 |
| 50–249 | 13.39 | 14.27 | 12.17 | 148 | 5 | 10.02 |
| Total | 100 | 100 | 100 | 3025 | 100 | 100 |

to detect outstanding growth, annual growth thresholds have to be differentiated by the variable used in measurement. Unlike prior studies, and recommendations by Eurostat-OECD, use of a threshold of more than 20% annual growth in sales does not provide a selection of outstanding HGFs. In addition, the size distribution is similar to that measured in terms of employment growth; 74% of HGFs are firms with less than 20 employees. In line with relative employment findings, use of firm-size thresholds, such as more than 10 or 20 employees, will result in exclusion of the majority of HGFs, which has to be considered in identifying HGFs.

These two measurements show the differentiation of HGFs by using different variables in relative terms and how exclusion of firms with fewer than 10 or 20 employees will ignore the majority of HGFs. In a similar vein, in this part we try to incorporate relative and absolute growths of firms into our enquiry. In doing so, the Birch Index will be used, which is detailed in the methodology section.

Table 7.6 illustrate HGFs and non-HGFs in terms of employment growth. Birch Index values are ranked from highest to lowest, and the highest 1%, 5% and 10% of firms are denoted as HGFs. Each study can choose a cut-off percentage in order to define and identify HGFs. In this study, we prefer to show each of the three cut-off points to demonstrate how the proportion of HGFs and their job creation value will change. At first sight, it can be concluded that 1 or 5% of the highest BI values are not adequate to distinguish the HGFs that create most of the new jobs, because these firms constitute merely 5% and 27% of total job creation, respectively. Hence, the highest 10% of $BI_{emp}$ is more plausible than others for identifying HGFs. Those firms constitute 46% of total jobs created in this period. However, if our analysis aims to exaggerate the job creation of HGFs, we would use total net job creation (32,231 jobs) rather than total job creation (57,752 jobs), and by doing so the proportion of HGFs would be 82%.

Consistent with the relative measurement of growth, micro firms and firms with 10–19 employees constitute the majority of HGFs in the $BI_{emp}$ measurement. In the highest 10%, micro firms constitute 63%, and firms with 10–19 employees constitute 11% of HGFs. However, a more important point is the proportion of micro firms in the highest 1%, which is almost 100%. As mentioned above, in the relative measurement of growth, it is naturally expected that small firms will have higher growth levels than their counterparts. The Birch Index, as a combination of relative and absolute growth, is, therefore, used to balance this advantage of small firms. Yet, in our findings, almost all in the highest 1% of $BI_{emp}$ are micro firms. This

**Table 7.6** Firm grouping and job creation with Birch Index

| Firm size # of employee | Non-HGFs | HGFs 1% | HGFs 5%[a] | HGFs 10%[a] | | Total |
|---|---|---|---|---|---|---|
| | Job creation | Job creation | Job creation | # firms | Job creation | Job creation |
| 1–9 | 8660 | 2896 | 7321 | 499 | 10,037 | 18,696 |
| 10–19 | 5087 | – | 1815 | 87 | 3557 | 8644 |
| 20–49 | 1682 | 173 | 3661 | 131 | 7127 | 8808 |
| 50–249 | −9678 | – | 2663 | 78 | 5760 | −3918 |
| Total | 5751 | 3068 | 15459 | 795 | 26,480 | 32,231 |

[a]HGFs 5% and 10% are cumulative numbers, 5% encompasses 1% and 10% encompasses the highest 1% and 5% firms

**Table 7.7** Comparison of HGFs in terms of different measures

| Firm size # Empl. | HGF (Employment) | | | HGF (Sales) | BI (Employment) | | |
|---|---|---|---|---|---|---|---|
| | # HGF s | Job creation | | # HGF s | # HGFs | # Jobs creation | |
| | % | #jobs | % | % | % | #jobs | % |
| 1–9 | 74 | 17,702 | 46 | 54 | 63 | 10,036 | 38 |
| 10–19 | 14 | 7374 | 19 | 20 | 11 | 3557 | 13 |
| 20–49 | 10 | 9455 | 24 | 21 | 16 | 7127 | 27 |
| 50–249 | 2 | 4136 | 11 | 5 | 10 | 5760 | 22 |
| Total | 100 | 38,667 | 100 | 100 | 100 | 26,480 | 100 |

finding is again contrary to the assumptions that micro firms might have high growth in relative terms but negligible absolute growth numbers. That is why most of the HGFs studies prefer to exclude micro or small firms from their enquiry.

In Table 7.7, each method is given to compare the differences in results. Each of the three measurements confirms the importance of micro firms and firms with 10–19 employees, both in terms of firm number and job contribution. Moreover, in each measurement, the cohort of HGFs, the number of HGFs and their job contribution changes dramatically. Therefore, in comparing and interpreting the result of various studies, these differences have to be considered.

Different measures result in different cohorts of HGFs; for instance, 2382 HGFs were identified with relative employment growth. Of these firms, 769 were also found to be HGFs according to the Birch Index and 1438 were also identified as HGFs in terms of relative sales growth. In total, only 486 firms were identified as HGFs in three measures of growth (relative employment growth, BI and relative sales growth) at the same time.

To highlight the difference between the measurements, the HGFs, identified by relative employment, were classified in terms of their sales growth in Table 7.8. Two hundred forty-nine out of 2382 HGFs have had negative sales growth. Most have had steady or modest sales growth, but only 1438 have had high growth in terms of sales growth at the same time. This figure confirms the statement by Delmar et al. (2003) that "*All HGFs do not grow in the same way*". By selecting

**Table 7.8** $HGF_{emp}$ grouping in sales growth levels

| Growth grouping | # $HGF_{emp}$ |
|---|---|
| Negative growth | 249 |
| Steady growth | 242 |
| Modest growth | 282 |
| High growth | 1438 |
| NA | 171 |
| Total | 2382 |

one variable to identify HGFs, it has to be considered that some HGFs in terms of other variables will be excluded.

### 7.4.4 HGFs in the Second Period (2010–2013)

In the first 4-year period (2006–2009), there was a global economic crisis, which may cause a deviation in our findings. Therefore, the same analysis is applied in the next period. Table 7.9 shows number of $HGFs_{emp}$ and their job creation in the next period. At first sight, the distributions are very similar to those in the prior term.

In the first term, there was an economic crisis and 2493 firms had 25,522 job losses. Eighty-eight per cent of these job losses are coming from the firms with more than 20 employees. The job loss per firm is 10.2 employees. In this recovery period, 3038 firms had 22,255 job losses. This is relatively few compared to the losses in the first period. The job loss per firm is 7.3 employees. In this period, firms with more than 20 employees are responsible for 80% of job losses. These figures imply that, during economic crisis, job losses per firm rise and that the share of firms with more than 20 employees also raises job losses.

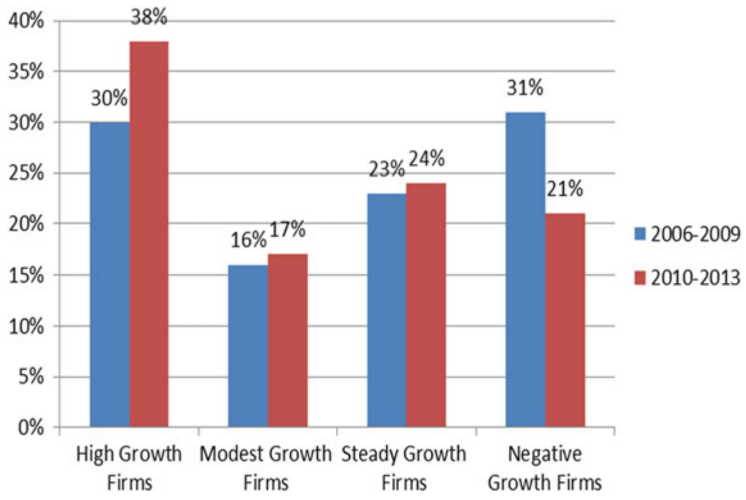
In Graph 7.1, the distribution of firms is given by the comparison with the prior period. In general, figures show economic recovery, through increasing growth levels of firms and decreasing level of negative growth firms. The share of HGFs in the second term is significantly higher than that in the first term. Accordingly, 38% of all firms had high growth in this period, which is also very high compared to figures in previous studies. In fact, this high share invites us to revisit the definition of outstanding growth. Nevertheless, these HGFs created 69% of all jobs, which is almost the same figure as in the first period (Graph 7.2).

On the whole, our findings suggest that 20% annual growth is not a reasonable threshold to distinguish outstanding performers; rather, it gives us nearly one third of all firms, which makes policies relying on HGFs very problematic or impractical. However, size thresholds such as more than 10 or 20 employees can be considered, but the size distribution of HGFs and their significant job creation restrain us from doing so.

Table 7.10 shows the share of HGFs by size and their job contribution in comparison to the share in the prior term. Accordingly, the size and job contribution distribution are almost the same as those in the previous term. Moreover, both in

**Table 7.9** Firm grouping and job creation according to growth levels in employment

| Firm size (# employee) | NGFs | SGFs | MGFs | HGFs | | Total | |
|---|---|---|---|---|---|---|---|
| | Job creation | Job creation | Job creation | # firms | Job creation | # firms | Job creation |
| 1–9 | −1583 | 795 | 2407 | 4016 | 46,832 | 7031 | 48,450 |
| 10–19 | −2900 | 1650 | 4445 | 689 | 16,885 | 2701 | 20,080 |
| 20–49 | −7582 | 5532 | 10,423 | 578 | 25,934 | 3334 | 34,308 |
| 50–249 | −10,190 | 7674 | 12,625 | 162 | 13,169 | 1306 | 23,277 |
| Total | −22,255 | 15,650 | 29,900 | 5445 | 102,820 | 14,372 | 126,115 |

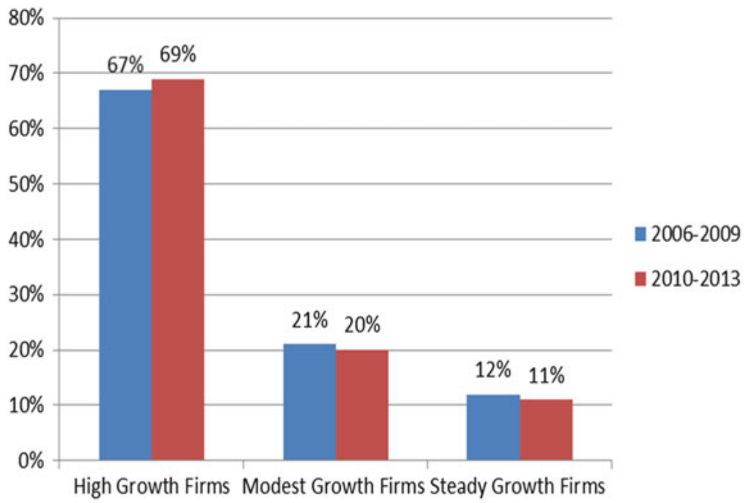



**Graph 7.1** Comparison of firm groups in terms of employment growth

number and in job creation value, the micro size firms and firms with 10–19 employees constitute the majority. This similar finding shows the robustness of our study. The size or job creation distribution does not significantly change in different periods, which suggests a constant fact in the firms' growth trajectory.

Having compared relative employment growth in two periods, we do the same comparisons with relative sales growth and Birch Index employment growth. Table 7.11 shows the size distribution of HGFs in terms of sales growth. By the same token, the size distribution of HGFs in the second period is almost same as that in the first period.

Turning to the Birch Index, Table 7.12 shows the results of two periods. At first sight, there is a significant increase in the proportion of micro firms: while it was 63% in first period, it increased to 76% in the next period. In line with this increase, their share in job creation also rose from 38% to 50%. While the size distribution of HGFs is almost the same in the two periods both with relative employment and sales growth, this significant increase in the share of micro firms with the Birch




**Graph 7.2** Firm groups in terms of total job creation

**Table 7.10** $HGF_{emp}$ and job creation proportions by firm size

| Firm size # Employee | % in HGFs | | % Job creation | |
|---|---|---|---|---|
| | 2006–2009 | 2010–2013 | 2006–2009 | 2010–2013 |
| 1–9 | 74 | 74 | 46 | 46 |
| 10–19 | 14 | 13 | 19 | 16 |
| 20–49 | 10 | 11 | 24 | 25 |
| 50–249 | 2 | 3 | 11 | 13 |
| Total | 100 | 100 | 100 | 100 |

Index implies important facts about HGFs. This is attributable to the fact that during economic recovery times, a small number of micro firms employ significant numbers of employees that can be marked as outstanding performers. In all the other sizes, shares of HGFs decreased both in number and job creation. In this respect, our finding suggests emphasising the importance of micro firms as outstanding performers. These real outstanding performers cannot be identified with general levels of growth such as 20%. In essence, in Tables 7.10 and 7.11, these outstanding micro firms are masked by modest high-growth firms when using the annual 20% growth threshold. Therefore, novel approaches are needed to define HGFs in order to find the real champions, not ordinary firms. It is really an important point for further studies because all these studies are being conducted to enhance business policies to become more efficient. It is clear that limited public funds and government sources are not adequate to deal with all ordinary high-growth firms, not only in the developing world but also in developed countries. Thus studies have to feed policy makers with more insights and compact findings.

**Table 7.11** Size distribution of HGFs in terms of sales growth

| Firm size<br># Employee | 2006–2009 (%) | 2010–2013 (%) |
|---|---|---|
| 1–9 | 54 | 50 |
| 10–19 | 20 | 19 |
| 20–49 | 21 | 22 |
| 50–249 | 5 | 8 |
| Total | 100 | 100 |

**Table 7.12** HGFs and job creation with the Birch Index in terms of employment growth

| Firm Size<br># empl. | # of HGFs | | | | Job creation | | | |
|---|---|---|---|---|---|---|---|---|
| | 2006–2009 | | 2010–2013 | | 2006–2009 | | 2010–2013 | |
| 1–9 | 499 | 63% | 1097 | 76% | 10,036 | 38% | 28,479 | 50% |
| 10–19 | 87 | 11% | 82 | 6% | 3557 | 13% | 5819 | 10% |
| 20–49 | 131 | 16% | 159 | 11% | 7127 | 27% | 12,549 | 22% |
| 50–249 | 78 | 10% | 99 | 7% | 5760 | 22% | 9969 | 18% |
| Total | 795 | 100% | 1437 | 100% | 26,480 | 100% | 56,816 | 100% |

In this respect, the role of outstanding micro high-growth firms needs more attention.

Apart from this novel finding, and as was done for the first period, we question how HGFs in terms of one measure perform under different measurements for the second 4-year period. Accordingly, **5445** HGFs were identified with relative employment growth. Of these firms, **1433** were also found to be HGFs according to the Birch Index and **3607** were also identified as HGFs in terms of relative sales growth. In total, **830** firms were identified as HGFs in three measures of growth (relative employment growth, BI and relative sales growth).

### 7.4.5 Persistence of HGFs

Across the world, policy makers need more evidence and instruments to establish the best policies with fewer public resources. Policies targeting or promoting HGFs sound like very plausible options for economic policies, but the crucial point in this approach is ensuring the growth of targeted firms. A firm considered to be promoted under any high-growth firms programme should provide high growth in a definite period or has to give some signals to detect its exante high growth. Otherwise these support programmes will be a waste of money. Therefore, studies focusing on persistence of HGFs' performance have a key role in HGFs policies. In this paper, persistence of high growth is tested both within each 4-year period and between periods.

**Table 7.13** HGFs' persistence within 4-year period

| | 2006–2009 | | 2010–2013 | |
|---|---|---|---|---|
| | $HGF_{emp}$ (%) | $HGF_{sale}$ (%) | $HGF_{emp}$ (%) | $HGF_{sale}$ (%) |
| 1-Year high growth | 27 | 21 | 24 | 19 |
| 2-Year high growth | 61 | 61 | 56 | 57 |
| 3-Year high growth | 12 | 18 | 20 | 24 |
| Total | 100 | 100 | 100 | 100 |

#### 7.4.5.1 Persistence of High Growth Within Periods

Some prior studies conclude that high growth is an extraordinary performance, Daufeldt and Halvarsson (2012) coined the term one-hit wonders, which is confined to 1 or 2 years in a firm's life. However, we found a contrasting result in that most of the HGFs, 73% of $HGF_{emp}$ and 79% of $HGF_{sales}$, sustained their high growth for 2 or more years (in Table 7.13). This is a significant result that gives an opportunistic view and suggests targeting HGFs according to their past growth records, or, at least, we can conclude that this is not a "one-hit event". In a similar vein, 76% of $HGF_{emp}$ and 81% of $HGF_{sales}$ sustained their high growth for 2 or more years, in the second period, which is slightly higher than in the first period. This difference is attributable to the economic crisis.

#### 7.4.5.2 Persistence of High Growth Between Two Periods

Most of the studies investigated the persistence of high growth between periods, thus, in this study, this issue is also investigated. To do so, this study takes the proportion of HGFs, identified in two periods with three measurements such as the Birch Index in terms of employment (**$BI_{emp}$**), relative growth in terms of employment (**$HGF_{emp}$**) and sales (**$HGF_{sale}$**) as indicators (Table 7.14). Accordingly, the highest persistence ratio is found in relative sales growth, 55.4% for **$HGF_{sale}$**, and then relative employment growth, 24.2% for **$HGF_{emp}$** and 7.8% for **$BI_{emp}$**. In line with persistence patterns of **$HGF_{sales}$** and **$HGF_{emp}$** within periods, sales growth is more likely to be sustained between the periods which have higher persistence than measures of employment growth. There is also a difference between relative and BI calculations. The persistence of HGFs measured with BI is lower than that of HGFs measured in relative terms. In sum, the persistence tendency of HGFs is not consistent with previous studies. In the study of Daunfeldt and Halvarsson (2012), just 10 out of 1210 HGFs have had high growth in the second period, which corresponds to 0.8%. Our findings are significantly distinct from 0.8%, implying that high growth is not a one-hit event. For robustness, we excluded micro firms and then recalculated persistence between periods. The persistence ratio is 55% for $HGF_{sale,}$ 22% for $HGF_{emp}$ and 8% for $BI_{emp.}$ These figures are not significantly different from the figures calculated with micro-sized firms included. Therefore, we can conclude that our persistence ratios are significantly higher than those of previous studies.

**Table 7.14** HGF persistence between two periods

| | $BI_{emp}$ | | $HGF_{emp}$ | | $HGF_{sales}$ | |
|---|---|---|---|---|---|---|
| | #HGFs | % | #HGFs | % | #HGFs | % |
| HGFs in two periods | 20 | 7.8 | 167 | 24.2 | 540 | 55.4 |
| Total HGFs | 255 | 100 | 689 | 100 | 975 | 100 |

**Table 7.15** Subsidy payments according to growth levels in employment and sales

| Growth grouping | Growth in employment (Average) | Growth in sales (Average) |
|---|---|---|
| Negative-growth firms | 24.332 TL | 22.652 TL |
| Steady-growth firms | 30.502 TL | 24.785 TL |
| Modest-growth firms | 31.122 TL | 29.832 TL |
| High-growth firms | 31.257 TL | 30.738 TL |

### 7.4.6 Use of Public Subsidy (KOSGEB)

In the literature review, we have not recognised any studies examining how HGFs do benefit from government support or their attitudes towards subsidies. Therefore, we have no chance of comparing our findings with other studies. Our data set includes total payments to SMEs that KOSGEB supports, in the period 2010–2013. However, these figures do not provide any other information about this support, such as type, duration, conditions, etc. KOSGEB support payments were divided into groups of firms according to growth levels. In Table 7.15, firms' growth levels are measured in terms of relative employment and sales growths. In every measurement, the use of support increases with the growth level in the firms. Negative growers are less likely to benefit from support than high growers are. This can be interpreted in two ways: first, slow or negative growers may not need government support; second, government programmes are designed to support much more successful firms rather than declining or modest growers; third, firms are more likely to seek external financial resources while growing.

In addition, there are differences between two measures of growth, employment and sales. The average subsidy payments are slightly higher for firms measured in terms of employment than for those measured in terms of sales. This may mean that government, in this case KOSGEB, may provide much more finance for growth in terms of employment or that firms which are growing in terms of employment may need more external finance than their counterparts.

**Table 7.16** Comparison of findings in with previous studies

| Common characteristics of HGFs in other studies | Common characteristics of HGFs in this study |
|---|---|
| HGFs are relatively young and small, but rarely start-ups | HGFs are relatively young and small. While most of the growth is generated by firms with fewer than 20 employees, larger firms are responsible for most of the job losses |
| Small proportion of firms disproportionately create most of the jobs and wealth (1–10% of firms generate from 50% to 100% of *net job* creation) | Small proportion, but significantly higher than in previous studies results (10–39% of firms generate from 50% to 100% of net job creation) |
| HGFs can be found in all industries and regions | HGFs exist in every region and industry and are proportionate to the overall industrial and geographic distribution |
| High-tech firms are not over-represented in the HGFs group | HGFs' representation in High-tech industries is slightly higher than overall firm representation, but notably higher in service industries |
| High growth is not linear but erratic | High growth is not linear, but not that much of a one-time event as found in prior studies. HGFs in this study tend to have higher persistence in their outstanding performance |

## 7.5 Conclusion and Recommendations

Entrepreneurship is the most important source of wealth generation and job creation. Yet, most firms do not grow or create jobs. Policies aimed at fostering economic growth have to consider this fact and discriminate between typical firms and growth-oriented ones.

Studies of high-growth firms provide fruitful insights that seem to dramatically change entrepreneurship and business support policies. As mentioned above, the first focus of this study is the comparison of the main characteristics of HGFs in this study and other studies (Table 7.16).

With their outstanding growth potential, they increasingly attract the attention of policy makers and researchers. However, there are crucial challenges for those considering HGFs as a policy instrument:

- **Heterogeneity of Definitions**; almost all studies or institutes adopt different and specific definitions. Each variable and measurement method results in a different cohort of HGFs which makes it difficult to choose the optimum solution.
- **Heterogeneity in Nature**; findings of the previous studies provide a mixed picture of their characteristics. From a policy perspective, there need to be many more common characteristics in order to help high growth performance.

- **Erratic Growth Pattern**; in order to use HGFs as a policy instrument, their future growth performances have to be predicted exante. Yet, non-linear growth performance makes predictions unreliable.

As a result, in policy discourse, there are two main factions; on the one hand, authors advocate for abandoning traditional and generic business policies and focusing on HGFs (Shane 2009); on the other hand, authors claim that despite high growth potential HGFs are unreliable sources which are theoretically great but impractical agents for economic solutions (Moreno and Coad 2015).

In this study, in order to show the heterogeneity of definitions, we applied the OECD definition without micro-sized firms' exclusion and the Birch Index, which is a combination of relative and absolute growth. Each definition method provided a different cohort of HGFs, thus policy makers have to adopt the optimum definition for their objective. In this regard, existent definitions, even the Eurostat-OECD definition, are not practical and suitable for every economy and policy objective. In the light of the findings in this study, these are some propositions:

1. Do not exclude micro firms from the measurement of HGFs. If necessary, it is recommended that firms with more than 20 employees be excluded, because they are more likely to lose jobs. This may mitigate risks for policies targeting HGFs. Even in the Birch Index figures, micro firms especially account for a significant proportion of HGFs.
2. An annual growth rate of 20% is not adequate to identify outstanding performance. In our analysis, nearly one third of firms attain this threshold, and it is much easier in sales growth than in employment growth. Thus for each variable (employment, sales, productivity etc.) specific growth rate thresholds have to be defined in order to eliminate typical firms from focus.
3. The Birch Index might be more practical in policy applications and identifying outstanding growth than relative growth measures.

In previous studies, there is a generally held view that high growth performance is a one-time event and sustaining persistence is much rarer than being a HGF. In this study, the persistence performances of HGFs are not that much of a one-off event. These findings provide much more room for HGFs policies. Records of HGFs may be used to predict their future growth or, at least, to eliminate typical firms from the scope of supporting programmes.

On the whole, generic entrepreneurship and SME policies do not distinguish typical firms from high-potential ones. In general, policies are focusing on high tech start-ups or R&D/innovation support, but HGFs studies show that R&D or high-tech does not guarantee wealth generation. Most research does not satisfy customer needs, thus resulting in unsuccessful commercialisation. Therefore, rather than generic SME and entrepreneurship policies, HGFs or firms with high growth potential have to be brought to the core of SME and entrepreneurship policies. Policies targeting firm growth need to focus on managing the growth or transforming R&D projects to commercially successful products. Beside the technical assistance, universities might have key roles at cooping the growth oriented managerial problems of HGFs.

There is no doubt that it bares high risks for governments while targeting and selecting potential HGFs in support programmes, but these risks can be defined at the beginning of these types of programmes, in order to sustain public acceptance for policies. Storey (2011) cites from the study of Alex Coad that only 15% of firm growth can be identified through analysis. In addition, Venture Capital reports also give similar success ratings for their firm portfolios, accordingly only 3 out of 20 VC backed firms can generate high returns. In the light of these facts, 85% of failure risk can be initially identified and accepted by the policy makers in advance. Today, many programme implementations across the world provide useful insights for policy makers who aim to launch high-growth support programmes. Their selection criteria, support tools, scopes, and methodology can be used as guidance to develop local ones. Nevertheless, all the growth definitions, methods and policies have to be designed according to regional or national specificity, to set successful HGFs policies.

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# Stakeholder Relationship Building Processes of R&D Based Startups: The Case of Techno-entrepreneurs in Turkey

8

Elif Kalaycı

**Abstract**

Founding an R&D based startup is a risky challenge, one requiring balance between a technological search process and business capabilities. Stakeholders' role is critical here as they help the entrepreneur in this endeavor. Our aim is to explore the stakeholder relationship building processes of R&D based startups. To this end, we conducted in-depth interviews with Turkish startups that were founded with the state's 'techno-entrepreneurship grant' on the condition of conducting R&D. A common scheme emerging in all three cases was the presence of challenging and supporting stakeholders in the gestation stage. The predominant finding in the literature was the supportive role of the family; however we found a profoundly opposing role in one case. Secondly, the logic of the state's techno-entrepreneurship fund monitoring staff seemed to be a vital factor in the sustainability of the startup. Finally, the ethical and passionate conduct of business by these startups could be a factor drawing third parties into becoming stakeholders. Based on these findings three propositions are stated to be studied in the future.

**Keywords**

Techno-entrepreneurship · Stakeholder relationship building

## 8.1 Introduction

R&D based startups are taken by many governments as significant contributors to economic growth (Scottish Executive 2001; OECD 2003). Their experiences need to be analyzed to understand how they are established and what kind of problems

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they go through while (hopefully) turning into large corporations. Such analysis could be of use to two different audiences: governments and entrepreneurs. By learning the 'stories' of these startups, governments could develop more suitable support programs for future startups and the founders of new R&D based firms could see some potential pitfalls of R&D based entrepreneurship which could enable them to take more cautious actions in their own experience.

Founding an R&D based startup is a risky challenge, one requiring balance between a technological search process and business capabilities. Not only should the entrepreneur be focused in R&D activities to come up with a technologically feasible product, but he/she should concurrently create a commercially viable product and a sustainable organization (Gans and Stern 2003). Most of the time R&D capabilities and business capabilities are found in different people (Daniels and Hofer 1993). The significance of stakeholders emerges right at this point as providers of resources. An entrepreneur founding an R&D based startup needs to spend deliberate effort to turn third parties into stakeholders (Sarasvathy and Venkatamaran 2011). In the literature, it is asserted that 'Almost the entirety of social networks research takes networks as mostly given and outside the control of human action' (Sarasvathy and Venkatamaran 2011, p. 126). Yet as negotiation research has shown, it is not easy for people to reach mutually beneficial agreements (Bazerman and Neale 1992). Building a cohesive and committed relationship relies on an endogenous process of persistent interaction between parties (Lawler and Yoon 1996; Thompson et al. 2000).

When we look at the literature to study the stakeholder relationship building processes of R&D based startups, two theories come to the fore: the resource dependence theory and the stakeholder theory. The resource dependence theory states that an organization is dependent on resources in its environment for its survival (Pfeffer and Salancik 1978). The extent of this dependence is directly proportional to the significance of a particular resource for the organization. Those who control the resource act like a monopolist, and select the users of the resource (Frooman 1999; Pfeffer and Salancik 1978). In the case of R&D based startups, scientific knowledge and commercial knowledge are the main resources they need. Thus the owners of those resources are the people, the entrepreneur needs to reach and ask for help.

The stakeholder theory defines stakeholders as "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman 1984, p. 46). The stakeholder theory states that the salience of stakeholders depends on three main concepts: power, legitimacy and urgency (Mitchell et al. 1997). Power of a stakeholder emerges from the dependence of the firm on stakeholders for resources (Mitchell et al. 1997). As the dependence of the organization on the resource increases, the power of the stakeholder on the organization also increases (Frooman 1999). Legitimacy of a stakeholder has to do with the contractual relationship the stakeholder has with the managers. Those who have a claim on the startup have legitimacy. Most of the time, power is assumed to be coupled with legitimacy, yet, not every legitimate stakeholder has power such as the case of 'minority shareholders'. The opposite also holds, illegitimate stakeholders could have power as in the case of ‘corporate raiders’. Urgency is defined as “the degree to which stakeholder claims call for immediate attention” (Mitchell et al. 1997, p. 867). When legitimacy and urgency happen to be concurrent, the need to reach the decision-making units is promoted. When power and urgency are simultaneously present, then stakeholder takes action. In case power, legitimacy and urgency are juxtaposed, both parties, the entrepreneur and the stakeholder, acknowledge the situation and take action in a reciprocal manner.

As these theories are mainly conceptualized for existing firms, not startups, they fall short of identifying who the stakeholder should be in the case of startups. Although, the theory of effectuation proposed by Sarasvathy (2001) is developed to explain entrepreneurship, it lacks explanation regarding the stakeholder relationships. Thus, there is a void in the literature on how stakeholder relationships are formed at the time of startup formation. Sarasvathy (2001) asserts that in the gestation stage, entrepreneurs choose to invest in stakeholder relationships that help them make their startup dream a reality. A fresh engineering graduate, who wants to turn his class-project into a commercial product may be aware of what knowledge he lacks but he may not know which knowledge sources he should approach for help. Furthermore, if he approaches a professor, will the professor spare his precious time on him? Assuming, he somehow comes up with a technologically feasible prototype, who should he turn for help to market the product, set up a work environment, and finance the venture?

Coming from this perspective, the research question we pursue is ‘how do entrepreneurs build relations with third parties to turn them into stakeholders while pursuing an R&D based startup?’ Our goal in this chapter is to explore the relationship building processes of new techno-entrepreneurs, particularly the case of Turkish techno-entrepreneurs. Since 2010 Turkish government has been providing increasing amounts of seed funds to university graduates who intend to establish a startup with the goal of developing an R&D based product and commercializing it.[1] The name of the program is ‘techno-entrepreneurship’. Since the case of Turkish techno-entrepreneurs comprises both R&D and commercialization aspects, it sets the stage for our research purposes. Furthermore, to the best of our knowledge, as of 2016, no qualitative research on the startup experiences of these techno-entrepreneurs has been published.

In Sect. 8.2 we begin with the methodology, coding and analysis indicating the reasons for employing a qualitative approach. Section 8.3 exhibits the case profiles while Sect. 8.4 provides an analysis under the following subheadings: the counterbalancing of stakeholder power, learning of the entrepreneur as a by-product of stakeholder interactions, earning of reputation through ethical and passionate business practice. Building upon the preliminary findings, Sect. 8.5, draws three main propositions that could be researched further and Sect. 8.6 concludes the chapter.

[1] http://sagm.sanayi.gov.tr/userfiles/file/Teknogiri%C5%9Fim%20Sermayesi%20Deste%C4%9Fi/TGSD%2009-14%20D%C3%96NEM%20RAPORU%20REV%C4%B0ZYON%200409.pdf

## 8.2 Methodology

Evers et al. (2012, p. 55) indicates “the CEO/founder entrepreneur is the key decision maker for driving the companies forward from inception and leveraging their stakeholder relationships”. On the other hand, Steyaert (1997) claims that in order to comprehend entrepreneurship as a process, one has to study ‘stories’ of startups because they are context-dependent. Thus in this work, we choose to take a qualitative approach and collect local stories of R&D based startups by conducting in-depth interviews with founders of R&D based startups. As a means to reach R&D based startups, we used a list of startups attending a project fair organized by Ankara Development Agency in 2012. The common feature of these startups is that they are all founded in 2011 upon receiving a seed capital of 100,000 TL[2] from the Ministry of Science, Industry and Technology on condition of performing R&D. We took only those startups in the manufacturing sector so that we can have common ground in the sample. Thus we used criterion sampling (Patton 2002). The criterion was those manufacturing sector startups that attended the project fair of Ankara Kalkınma Ajansı (Ankara Development Agency) in 2011. The attendants in the project fair were announced in the form of a list covering the names and contact details of the entrepreneurs, the industry and some information about the product they intended to promote at the fair. One downside of using such a list is that not all entrepreneurs who received the techno-entrepreneurship grant from the Ministry of Science, Industry and Technology would be attending this fair. Therefore, there might be a bias towards those who were able to successfully develop a prototype at the end of the 1 year after receiving the grant. However, since there was no other way to reach the contact information of these techno-entrepreneurs, we had to do with what information was publicly available. Between the months of June and August 2015, we contacted 12 different entrepreneurs in the manufacturing sector to conduct in-depth interviews. Since our aim was to explore the period of stakeholder relationship formation, and not to generalize the findings, a small number of cases could be used to derive rich and deep information (Coviello and Jones 2004). According to Patton (2002, p. 245), “The validity, meaningfulness, insights generated from qualitative inquiry have to do more with the information richness or the cases selected and the observational (analytical) capabilities of the researcher than with sample size”. Thus, we picked three cases for this study as they were the most information-rich ones.

### 8.2.1 Coding and Analysis

Grounded theory is a methodology for developing a theory that is derived inductively. It is developed out of data (Strauss and Curbin 1990). According to this

[2]100,000 TL was about 48,000 Euro and $65,000 in 2010 as per the Turkish Central Bank exchange rates. http://www.tcmb.gov.tr/kurlar/201012/31122010.xml

theory, the research questions that initiate the study are taken as tentative and are expected to change with the findings from the field. Since before the research, the researcher observes the outcome of what has taken place but not how it happened, the research questions take shape as he/she finds out the whole story from the eyes of the subjects (Maxwell 1996). A guiding principle of grounded theory is constant comparison which means the components of the theory are developed and refined throughout the study. As concepts emerge, they are compared with new data and refined until saturation takes place. In this study, the data was collected with semi-structured and open-ended interviews (Eriksson and Kovalainen 2008), with founding entrepreneurs. The interviews were conducted at the interviewee's premises and revealed visual data on the work environment of the entrepreneurs. Voice recordings were transcribed as soon as possible after the interviews and reviewed for any errors by the researcher. Coding was performed by the QDA Miner Lite software program.

### 8.2.2 Trustworthiness

After each case was written, they were sent to the entrepreneurs or founding partners who read them. In one of the cases, the entrepreneur added some extra information. All three approved of the unbiased approach of the researcher. To provide investigator triangulation, two evaluators reviewed the material in each case. This approach was taken in order to compare and contrast independent judgments and interpretations about the content of the material.

## 8.3 Case Profiles

Firm A is founded by a chemistry majoring student from a foundation university in Ankara, in 2012. This is the founder's second startup. In 2011, the founder received the techno-entrepreneurship grant and set up a lab in his family's summer house in Kazan, Ankara. Upon working for 3 months with a single employee, a classmate from the university, they were able to develop the prototype. Yet, they could not complete all of the tests required in the project. One of the tests was not applicable to the material they were using. For another test, there was not enough time to apply to Turkish Standards Institute (TSI), so instead of the TSI testing, with the help of a friend, the entrepreneur developed his own test device and tested the prototype. However, the academic monitoring person appointed by the Ministry required word-by-word compliance to the project guidelines and finding a missing test, filed a negative report to the Ministry. As such, the activities of the firm were suspended. In 2012, after meeting his employee's boyfriend at a barbeque party and learning that his area of research in PhD was laser, he asked if it was possible to develop a new 'laser hair removal device'. Upon receiving an enthusiastic 'yes', the founder and his new partner started working on this project, applied for the techno-entrepreneurship grant and received it one more time. The founder had high hopes for this product because the founder's aunt was running a beauty parlor and the founder knew the laser hair removal devices in the market burned the skin along with the hair, so a device that was not harmful to the complexion had a high chance of success in the market. While developing the laser hair removal device, the founder and his partner published two articles in a medical journal, and got one patent. However, they ran out of cash and applied to a subsidy from TUBITAK, the Scientific and Research Council of Turkey, in 2013. Although they were granted the right to the subsidy in March, cash did not arrive until after 8 months in September. Meanwhile the founder asked for help from his parents and they mortgaged their flat they were living in, which financed the firm for the interim period. Two days before the flat was about to be sold, the cash they expected from TUBITAK arrived which saved the apartment.

As of July 2015, the firm had nine employees, owned a patent and two more applications were pending. The firm has received investment from an angel investor in return for 30% of the firm's shares. With the new investment, its current goal is to launch the product in the domestic and two different foreign markets.

Firm B firm has two partners; E.Ç and H.K. Both of them were majoring in mechanical engineering in 2003 when they had met while working on the design and development of a solar-powered-car project. By 2010 September, the time they applied to the techno-entrepreneurship support for two different business ideas, they had also accumulated work experience. Having won two R&D grants for both business ideas, they first started out with two firms but after seeing that both products' markets consisted of municipalities, whom were almost impossible to sell their products, they stopped both projects and spotting a need in the market, they set up a 'design' based manufacturing firm specializing in illumination equipment. Previously one of the partners, H.K. had worked with an Austrian firm and was still in contact with it. Upon demand from that firm, they made their first custom-made chandelier which was installed on an intercontinental cruise line, from U.S.A. The cruise-line, a client of the Austrian firm was delighted with the product. Thus, came a second order and with a 44 $m^2$ office at a technopark the founders felt they needed a larger space to go into manufacturing in addition to design. In addition to the office, they had rent a four story building with 800 $m^2$ closed area and 100 $m^2$ open area in OSTİM, the Organized Industrial Region in Ankara. In the ground floor manufacturing took place, the first floor hosted the office space, mechatronics works, and a dormitory. The basement and the second floor were allocated for storage, assembly lines and testing space. E.Ç. explains the need for a dormitory as

> . . . We get exhausted from work. Lose track of time. Need to look at the calendar to know which day it is but I certainly know in seven days this chandelier needs to be manufactured, assembled, installed, shipped, etc. . . For the past one year, I literally lived in this place.

All of their sales have been exported and they have not sold a single product to the domestic market. Their products are unique, because they are custom-designed and manufactured as per 'the dream' of the customer. They have suppliers from local and international arena: i.e. from Egypt, Slovakia, U.S.A, China, and Austria. In order to decide whether to work with an international supplier or not, they fly to the country, visit the firm, see the products and then make their mind up. Thus, when H.K. leaves home to check out suppliers he 'could leave for one or two weeks with a single luggage, but may end up spending one to two months with the same luggage.' As of July 2015, the firm has 15 employees. The financial worth of the project they have been working on as of July 2015 is more than the total of what they have earned in their history.

Firm C is founded by an Electricity and Electronics Engineering major from a foundation university in Ankara. In 2010, while she was a graduate student working on her graduation project under the auspicious of a professor, she developed a product. At the time this product was not being produced in Turkey. She developed the design of the product and wrote an academic paper on it. This paper was submitted to an academic conference in Turkey where it received the best student paper award. After application to the techno-entrepreneurship grant and reception of 'this free money' (as stated by the founder), the firm was founded in April 2011 despite strong objection from her father. Her father, a civil servant-turned entrepreneur disapproved of her startup efforts declaring 'you will be a civil servant, entrepreneurship is unbearably difficult, and you will have to sacrifice too much. If you take this grant, I will not talk to you'. Her mother also sided with her father. However, her elder brother supported her so she started her own venture and her father stopped talking to her. Initially she had no partners but her professor who was the advisor of her graduation project supported her full heartedly. The rector of the university also was a professor of hers when she was a student, and upon hearing her success in receiving the seed fund (among all the grant receivers she was the single grant receiver in her university), the rector offered her a free office with all utilities paid. By the time she had started working, she had three fellow classmates who were looking for employment and could not find any, so she offered them jobs. Together, they developed different versions of the first product. When it was time to find customers, they literally started knocking on doors around the campus to tell potential customers that they were students who had made a product, wondered if they would be interested in buying it? As they acquired customers and started manufacturing, they also started earning good sums. After deduction of the expenses and taxes, the entrepreneur used to distribute all earnings equally with the employees, just like they were her partners. However, one of her employees left for military service while another decided to be a civil servant and took off. In the meanwhile, the entrepreneur finished her master's degree studies and started PhD both of which were on electronics related topics. Her professor stood beside her at all times. Unfortunately, the university's support was not reliable. There were a couple of times the university administration decided to ask her to leave and she started looking for a new place. The university administration either retreated or asked her to change her office to another building, which cost her as each time she moved she had to change her legal address. As a result of these swings, she bought an office building just to be on the safe side in case the university administration could not host her business anymore. Yet, in her office at the university, with the third employee, she worked very hard (i.e. there were times when they worked for 20 hours in a day. Together they acquired increasing amounts of business and accumulated sound references but after a year or so, to her surprise, the entrepreneur found out that this person has been doing business behind her back. This incident hurt the entrepreneur so much that she developed diabetes due to sorrow. After parting her ways with that employee and dealing with health issues, she had to face pressure from her father once again, who was saying, 'I will not die in peace, before I see you as a civil servant'. Thus, she decided to switch paths and found a teaching job at a state university, but could not stand the idea of closing down the firm. As a means of truce with her family, she took the teaching job as a civil servant and made her mother a partner since she could not both own a firm and be a civil servant at the same time. By that time, she had developed sound enough relations with a manufacturing firm which took over her manufacturing work, reducing her dependence on employees. In return, she started undertaking R&D projects for that firm. She started working part-time at the firm along with her teaching job. As of 2015, with one pending and one new patent application in process, the firm was a partnership with the entrepreneur in charge of R&D and manufacturing outsourced to a 50 year old local firm. As of July 2015, the firm had developed 150 different products and accumulated sound references through which new customers were coming to the firm.

## 8.4 Analysis

### 8.4.1 Entrepreneurs Benefit from the Counterbalancing Power of the Stakeholders

The 'story' of each startup is unique but a common point emerging in all is the evolution of the startup in the middle of, crudely speaking, two opposing forces. Table 8.1 presents a chronological summary of the milestones as these opposing forces take action. The aim here is to see when each stakeholder emerges in the timeline and the events defining the stakeholder's relationship with the entrepreneur.

On one side, there are the challenger stakeholders and on the other side are the supporter stakeholders. In each case, the challenger stakeholder is a different one, but to alleviate the pressure from the challenger stakeholder, the entrepreneur relies on support from other stakeholders. For instance, the entrepreneur in Case C has to face her father's strong opposition when she wins the seed fund. In this first instance of pressure from her father, she relies on three other stakeholders: her professor, her elder brother and the university rector. Her professor at the university supports her by saying, "My father did not allow me to start my own business. Had I given it a try, I may have been in a very different place. I am a professor now, fine, but you go ahead and try. If you fail, you fail, but at least you will know you have tried." Her elder brother supports her saying, "Don't listen to them (parents), go ahead found your venture". The rector of the university she was attending at the time also backs

**Table 8.1** A structured summary of the case profiles as far as stakeholder building processes are concerned

| Period | Challenger stakeholder | Supporter stakeholder |
|---|---|---|
| Case A | | |
| I | 5. Technical performance monitoring academician appointed by the Ministry expects full compliance with the predefined tasks in the R&D project proposal, which turn out to be unattainable due to technical reasons.<br>7. Ministry suspends the project. | 1. Professional ex-banker teaches the entrepreneur how to prepare project proposals.<br>2. Ministry provides the seed fund.<br>3. Friend from the university becomes the first employee.<br>4. Parents let the entrepreneur use their summer house for a laboratory to develop the prototype.<br>6. The project performance monitoring bureaucrat of the Ministry defends the entrepreneur vis-à-vis the negative report of the academician. |
| Major event | The entrepreneur finds another idea, gets another state grant starts his second venture. | |
| II | 9. State fund's arrival is overdue by 8 months. Entrepreneur has serious cash management problems in this interim period.<br>13. Employee management issues arise. | 8. Current partner joins the firm, bringing knowledge and extra financing<br>10. Accountant provides key financial information and saves from bankruptcy<br>11. Family apartment is mortgaged to finance the venture until the promised state funds arrive.<br>12. Second progress monitoring staff of the state fund provides practical information on where to purchase which material at affordable prices |
| Major event | New product is developed, a patent is taken, another application pending. | |
| III | 15. The investment negotiations take longer than expected. | 14. Business angel agrees to invest in the firm.<br>16. One of the partners in the business angel investment firm asks if they can survive this period. |
| Case B | | |
| I | 4. Potential customer of the prototype is the municipality, a monopsony, does not buy the product. | 1. Ministry provides the seed fund.<br>2. Performance monitoring staff of the Ministry eases their steering around bureaucracy<br>3. E.Ç. undertakes paperwork, H.K. carries out engineering work. |
| Major event | Partners change the business idea to one where their customer is ready. | |
| II | 5. Foreign customer asks for a custom designed product as per imagined by the end-user. | 6. Foreign customer orders a product<br>7. Local suppliers act as a knowledge source<br>8. International suppliers provide high quality material<br>9. Accountant helps with the deciphering of legal documents |

(continued)

**Table 8.1** (continued)

| Period | Challenger stakeholder | Supporter stakeholder |
|---|---|---|
| Major event | A manager joins the team | |
| III | 13. Foreign customer is the ONLY customer and the startup cannot afford to lose it, grows more and more dependent on it.<br>14. Employees do not care about workplace safety. | 10. Foreign customer brings in increasing amounts of business from all over the world.<br>11. Employees work overtime.<br>12. New manager reduces cost by cutting waste, improving inventory management and employee morale. |
| Case C | | |
| I | 2. Father strongly opposes the idea of the entrepreneur to establish a venture. | 1. Ministry provides the seed fund.<br>3. Elder brother and boyfriend and a professor provides emotional support.<br>4. Professor from her alma mater provides knowledge support.<br>5. University's rector provides incubation. |
| Major event | Another state grant is won which is used to hire some friends as employees. | |
| II | 9. Some of the employees leave, one cheats on the entrepreneur by doing business behind her back.<br>10. Customers' receivable collection takes time and is sometimes impossible.<br>12. Father applies pressure on the entrepreneur to shut down the business. | 6. New employees' help grows manufacturing.<br>7. University still provides incubation (free space and utilities)<br>8. Professor and boyfriend still provide emotional support.<br>11. New customers are made through liaisons made in a training for women entrepreneurs. |
| Major event | The entrepreneur develops diabetes, finds a job as a civil servant but continues the startup. | |
| III | 13. Father still objects the startup. | 14. Mother becomes a legal partner; father is proud of the entrepreneur's commercial success but never tells this to the entrepreneur's face.<br>15. Husband takes over night time installations.<br>16. The professor and the husband still provide psychological support.<br>17. Professor continues to provide knowledge support.<br>18. Local subcontractor takes over manufacturing.<br>19. Customer references' bring in new work. |

The first column on the left indicates the different periods in the lives of the startups as their relationships start, develop with the various stakeholders. Each period is indicated by a roman figure. A significant event marks the end of a period and the beginning of a new period. The stakeholders are classified as challenging and supporting. The instances with the challenging and supporting stakeholders are listed in sequential order by numbers. For instance, for Case A, the relationship with the supporter stakeholder starts first, followed by three other instances before the challenger stakeholder's act happens (indicated by number 5). Next the relationship with the supporter stakeholder is listed with number 6 her up saying, “I will provide a place of your fancy in the university premises, free of charge. Utilities will also be paid by the university.” However, as her business takes off and as she goes through serious employee related problems she develops diabetes, upon which the pressure from her father climaxes. This time, her father says, “I will not die in peace, if I do not see you as a civil servant before I die”. She believes her father wants to protect her from the harshness of the entrepreneurial world, so partly yielding toward his call, she finds a job as a civil servant in a state university, outsources manufacturing to a local subcontractor. From then on she carries out only R&D work both for her own venture and for the local subcontractor. However, she cannot bear the idea of closing down the business; therefore, her mother becomes the legal owner of the business. In this second instance of pressure from her father, she underlines the critical emotional support from her husband and knowledge support from her professor.

Another example of stakeholder power counterbalancing comes from Case A. During the course of prototype development promised to the Ministry, the startup in Case A faces a strong negative performance assessment report written by the academician who monitors their performance from a technical point of view. The academician expects full compliance with the pre-specified tests that are written in the project proposal form. However, as the research progresses the entrepreneur finds out those tests are inapplicable to the material they use. The progress monitoring academician does not accept this explanation and files a negative report to the Ministry. Yet, the bureaucrat monitoring their project’s progress at the Ministry defends their progress at the assessment meeting and alleviates the punishment the committee wants to give to the company to the ‘suspension of the payment to the project until the prototype is completed’. In this case, the startup survives the pressure from the Ministry by the help from a bureaucrat at the Ministry. In period 2, the same entrepreneur setting up another startup goes through a major financial crisis as the expected grant from the state runs overdue for 8 months. Although this pressure by the state is not an intentional one, the urgency of the matter exerts enough power on the entrepreneur to resort to the support of two major stakeholders. Following the advice of the financial advisor and relying on cash generated by the mortgage of the founding partner’s family apartment, the startup survives this period. This instance is a good case for supporting the stakeholder theory of Mitchell et al. (1997) where both, power, legitimacy and urgency are all in action.

Each startup develops different stakeholder relationships according to what the firm needs at the time but what is interesting is the change in a stakeholder’s position from a challenger to a supporter depending on what they expect of the firm. A stakeholder that was once a supporter could turn into a challenger or vice versa. Case B is a good example of a startup that adapts to the pressing circumstances at the initiation stage and changes the business and its stakeholders completely. At the time of the establishment of case B, the monopsony of the municipality exerts an excessive power to overcome. While the startup successfully develops the prototype they promise to the Ministry, during that first year, the progress monitoring staff at the Ministry helps the entrepreneurs in such a way that

E.Ç., one of the founding entrepreneurs admits his gratitude by saying, ‘I would carry him on my back’. However, as the municipality does not consider buying from them, the founding partners decide to act on an order from a foreign firm they know previously. This firm’s sustained demand gives life blood to the startup but as time progresses, this single customer becomes a challenge to the startup. E.Ç. says, “Our customer is a 200 year old firm in Austria…to this day, we have never marketed anything. The firm in Austria is a team for us. We cannot do this business without the Austrian firm”. Thus, the lifeblood provider stakeholder, can turn into a trapping stakeholder. As Schlange (2009) indicates, this is a case of a changing stakeholder relationship as the venture grows. The power of this single customer stems from the fact that if this customer stops orders, then the firm has no other customer to turn to. Thus it has considerable power over the startup and this power is counterbalanced with support from three other stakeholders: local suppliers, employees and international suppliers. Local suppliers provide knowledge and international suppliers provide high-quality materials and components for the custom-made products and last but not the least employees undertake overtime work to meet shipment deadlines. The evolution of this startup is also a case for dynamic capabilities theory which states that to meet the demands of dynamic marketplaces, firms need to develop capabilities to acquire resources and learn new ways to deploy those resources to meet the demands of the market (Zahra et al. 2006). Dynamic capabilities are defined as, “the capacity of an organization to purposely create, extend and modify its resource base” (Helfat et al. 2007, p. 1). The changing of the business in case B from one which has no market to one which has a customer order (indicating a potential market) is certainly a deliberate redirection of the firm towards a call in the market. After going through a number of periods with financial turmoil, eventually resorting to a business angel’s investment in return for 30% of the firm by case A is also a ‘purposely created resource base extension’. Thus, these cases indicate that these entrepreneurs were able to read the market and determine the needs of the startups before finding the relevant resources and new stakeholders as providers of these resources.

### 8.4.2 Learning Emerges as a By-Product of Stakeholder Relationships

The entrepreneurs’ approach to learning could be summarized in this one instance. One day, the founding entrepreneur’s partner in case A showed him an old photo and said, “Look, we are still not rich”. He objected saying, “On the contrary, we are awfully rich, we have learned so much. We did not know any of what we now know”. Interaction with stakeholders creates opportunities for learning. For the entrepreneurs in case B, designing somebody’s dream-chandelier requires both creativity and technical problem solving which is unique in every single customer order. Therefore to solve a different problem each time, they first start out with their own solution, then resort to local suppliers to refine the technical details of the complete manufacturing processes. E.Ç. says, “When we founded the firm, we were located in a technopark, but in time, we opened up a place in OSTİM.[3] Being located in OSTİM is the best thing when you need help with anything, for instance, welding. At the university I have seen welding as one chapter but here, there are people who have been welding for 30 years. We go and ask for their opinion and they say, 'if I did not like you, I would not help' but then they do. . .. In return, we help him choose the type of computer he needs to buy for his son. . .. For us this is a trivial thing". For the entrepreneur in Case C, her knowledge source is her professor. She says, "my professor is always there for me even when he is exhausted from work. When I ask for help, he drops everything else. This person is also a dean so he has administrative work in addition to academic work but he helps me. He does not even expect anything in return." As we see from these two cases, the interaction between the stakeholders and the entrepreneurs enables the entrepreneurs to access detailed knowledge in rather specific topics.

While having supportive stakeholders who are willing to share their knowledge with the entrepreneurs is a critical element, these entrepreneurs need to learn quite a lot on their own as well. For instance, the entrepreneur in Case C says, "Whenever I asked for help from my accountant, he would say you can find this out on your own, so I had to learn. Surely, he showed some guidance, but I learned tax and social security procedures, all those on my own. Now I know enough not to depend on anyone else on accounting or legal matters." E.Ç., one of the founding partners in Case B, also says, "We learned tax matters and other legal matters by making mistakes. They were not lethal mistakes. Thank God. . . Today we read all the laws and regulations that relate to us. . .. When we read a paragraph for the eighth time and still do not comprehend it, we resort to the financial advisor. He does not answer us for a couple of times, then, we take the material to him at night and tell him that if he does not read the material, we will find another financial advisor. Then he reads and advises". These issues of 'learning by doing' have to do with investing time but there are other instances where investing time is certainly not enough. These are 'people matters'. In both Case A and Case C, where university graduates were hired as employees, they were treated as equals by the founding entrepreneurs. However, both entrepreneurs indicate that such treatment was wrong and they learned this lesson in the hard way. The founding partner in case A says, "There is nothing technical that cannot be solved but human relations are tough. For instance, we used to distribute bonuses following the closure of a project. We should not have done this. Some people had worked only for the bonus. . .. What's more, they can regret their work with you in the absence of a bonus and blame you for not being fair". The entrepreneur in Case C, upon the incident with a cheating employee, could not take the matter to court as she had no contract with the employee who happened to be her 'friend'. After the fact, she says, "Co-workers should be people you can command and they should sign a confidentiality agreement and a non-competition agreement when joining the firm". These instances

[3]OSTİM is an organized industrial region in Ankara. Established in 1967, OSTİM accomodates 5200 SMEs employing 60,000 people in an area of 5 million $m^2$(http://www.ostim.org.tr/p/5244).

indicate that the entrepreneurs benefit from ‘learning by doing’ (Cope 2005) which consists of lessons learned from one’s own mistakes, or lessons learned after solving problems (Deakins and Freel 1998; Young and Sexton 1997). Dalley and Hamilton (2000) underline the importance of experience as in the following: “It seems accepted that there are no shortcuts in the learning process, that surviving various ‘trials by fire’ is almost a rite of passage, and that there can never be any substitute for experience” (Dalley and Hamilton 2000, p. 55).

Learning is such a key part of their venture that these entrepreneurs seek willingness to learn in their stakeholders, for instance their employees. The founding partner in Case A says, “. . .when we are recruiting, we try to see if this person is curious for learning. For instance, lately, we recruited a university graduate whom we found through his website where he exhibited a quadcopter completely made on his own. We were so excited to find such a person. He was eager to work with us. Then my partner assigned him a project to assess his abilities. This person could not do the project and was discouraged right away. Even though we tried to talk to him to make him stay with us, he went back to Adıyaman (his hometown). This taught us we should not push people too far . . .. What we care for is the employee’s interest in problem solving. . .. We pose a problem to him. If he is interested on his own, that is what we are after”. A similar approach towards employees is also present in case B where E.Ç., one of the founding entrepreneurs says, “We support our employees to further their education, by either helping them with their homework assignments or tutoring in some of their class work.” These instances indicate that they seek ‘curiosity’ and ‘willingness to work hard to learn’ in their employees. Yet, as these entrepreneurs are not experienced in ‘people management’ they learn from their own mistakes to manage the employees better because as E.Ç., in case B indicates, “Sometimes you may need to argue with your own staff to make them wear safety glasses. We do not want anything bad to happen to people we work with. Money is earned and lost, but you have to keep the team going.”

Learning takes place as incidents unfold with customers and suppliers. The entrepreneur in Case C says, “There are so many people from whom I still cannot collect my receivables. . .. For instance one day before my wedding, I delivered a product to a customer and did not ask for payment then. Later, when I asked for the payment, the customer said ‘You should not have delivered the product without receiving the payment’ and this was supposed to be a lesson to me. He has not paid to this day. . .. Today, I still deliver my products not insisting on payment, but at least make them sign a paper saying they received the items”. The founding partner in Case A says, “Previously, we were rather naive but now all these delays in cash collections, either from customers or from the state taught us to be extra-cautious. . . Although, we signed an agreement with a business angel, I am preparing my budget as if that I will never receive that financing. . ..” The firm in case B suffers from suppliers’ overcharging. E.Ç. from case B complains, “Let’s say I bought a component from you and then I check the price in the market and realize, the market price is a third of what I paid to you. This happens all the time. Even the people you trust can do this once you stop price scanning.” In literature, these experiences are referred to as the "affective" mode of learning which is 'a personally experienced type of learning'. "Affective mode of learning' finds expression through 'being there' through immersion in an experience" (Postle 1993, p. 33). The different learning schemes of entrepreneurs are summed up in the words of Gibb (1997) as "The predominant contextual learning mode in this environment is that of...learning from peers; learning by doing; learning from feedback from customers and suppliers; learning by copying; learning by experiment; learning by problem solving and opportunity taking; and learning from making mistakes. (Gibb 1997, p. 19).

### 8.4.3 Reputation Is Earned Through Ethical and Passionate Business Practice

Some of the entrepreneurs' business practice gains good reputation in the eyes of their stakeholders, particularly customers. The entrepreneur in case C underlines the contribution of ethical business practice to her firm's reputation as: "...a customer comes asking for the development of a product. If we find the product in the market, we refer the customer to that firm. Most people do not act this way. They purchase the item and resell it to the customer. However, our behavior leaves an impression as a 'trustable' firm and this always has a positive return". The entrepreneurs in case B recall the first time they shipped their first order of 32 chandeliers abroad. While expecting an 'appreciation of their work' from the end-user, they got the news that all of the chandeliers were damaged during shipment. Therefore, they got all the products shipped back, fixed them one by one and this time genuinely packaged them for a safe trip. Eventually, the end-user was happy with the result and their behavior proved their 'trust-worthiness' in the eyes of their customer. The literature underlines the significance of ethical business practice as "personal reputation is an important asset, because it reduces uncertainty concerning future behavior by signaling that the individual is trustworthy and has the necessary abilities to deal with workplace demands" (Neves and Story 2015; p. 172)

In his 8 years of research on entrepreneurs Sirolli (2003) concludes that the essential ingredient of entrepreneurship is 'passion'. E.Ç. in Case B states the following, "Have you ever seen a cat that would resist playing with a ball of wool? To us, that is how a new order is. We like solving problems... I can do any other job, like sweeping floors or working in the sewage or xeroxing at a bank but people would think I am a psychopath because when I am xeroxing a document, that paper has to be placed perfectly in the machine. We have a lot of obsessions like this. If something does not turn out as it is supposed to be, we continue to work on it until we are satisfied.... We are continuously in search of excellence...." Same passion for new product development is also visible in the entrepreneur in case C who says, "I do not sell an existing product just because there is a market for it. It is something that I can sell but I do not get any joy out of it. I like developing new products." The entrepreneur in case A says, "We have a notebook with my partner, in which we write down our business ideas. We like developing new things. Our goal in the future is to get a 10–20 acre land and start an R&D center there where people can live and work." Passion towards generating products, meeting technological challenges is a common driving force that is found in these three entrepreneurs. It is an internally generated energy.

## 8.5 Discussion

The predominant finding in the literature assumes families to be supportive of a new venture (Brüderl and Preisendörfer 1998). Family is seen as provider of emotional and financial support in the establishment stage of a venture and a source of tacit knowledge (Elfring and Hulsink 2003). The entrepreneur enjoys trusted feedback from family members regarding business idea (Rosenblatt et al. 1985). As entrepreneurs prefer to discuss their ideas in protected grounds, they feel secure to talk to their family members (Greve and Salaff 2003). Furthermore, family also acts as the provider of initial capital (Anderson et al. 2005; Greve and Salaff 2003; Conti et al. 2013). However, the findings of our work have two opposite cases. One is the case of a family as the key supporter of critical finance via mortgaging the family apartment. This case is in line with the literature (Bygrave et al. 2003), but the other case of a family standing as the biggest obstacle for the entrepreneur's startup does not find any place in the literature. A qualitative work by Anderson et al. (2005), states the case of an entrepreneur who would not let his son work in his firm thinking it would damage his son's development. Thus the following is proposed:

*Proposition 1* Strong opposition by the family members towards startup efforts of the entrepreneur could be in order to 'protect' the entrepreneur from the 'potential damages of entrepreneurship'. Yet such a proposition deserves further research because this specific case could be an idiosyncratic one.

First it should be researched if this is idiosyncratic or not and secondly, if this case is not a single one, then more data should be collected to dig into the reasons of such 'protective' behavior.

In Turkey, while the state aims to support entrepreneurship, the people who implement these well-intended policies may not be acting in compliance with the eventual aim. As the above cases indicate, the performance monitoring staff of the state, who are appointed to assess the performance of the startups may either pave the path for the entrepreneur clearing the road from bureaucracy, or may cripple a startup for not complying by the book of bureaucracy. Since these people are 'acting' stakeholders in the name of the state, the entrepreneur needs to perform according to the predefined success criteria of the project, which is expected by the state. In the literature the inflexible attitude of the state staff could be explained by the 'causation driven logic' while the problem-solving and creativity based approach of the entrepreneurs could be classified as effectuation driven logic (Sarasvathy 2008). Sarasvathy (2008) explains the difference between causal and effectual thinking by giving the example of two chefs. In the causal case, the chef starts out the cooking process by first picking a menu. Then he finds the recipes for each item on the menu. Next does the necessary shopping for ingredients, arranges the pots and pans, and all the relevant other material and finally cooks the meal. The causal process starts with the goal and proceeds with consecutive well planned steps to achieve the goal. In the effectual case, the chef first checks the kitchen to see what ingredients and materials are available. Then he designs the menus based on what he has on hand. As a matter of fact, the menu is created along with the meal. The effectual chef starts with what he finds in the kitchen, and 'designs' possible dishes according to the ingredients on hand. Dutta and Thornhill (2014) state that entrepreneurs "may become compelled to adopt a causation-oriented cognitive logic for the venture under pressure from external investors... that expect the entrepreneur to provide a detailed, incremental business plan with clearly articulated future scenarios for the venture ...." In the three cases that were presented in this chapter, the pressure from the state is exerted if the staff does not follow an effectuation logic and empathizes with the entrepreneurs in complying with the pre-specified plans that were made before the venture was started. Furthermore a study based on 6 years of longitudinal data by Honig and Samuelson (2009) finds no significant positive relationship between business planning and commercial performance.

*Proposition 2* A difference between the state staff's mindset and the entrepreneurs' mindset such as the one between causation and effectuation logics prematurely end potentially successful ventures.

Ethical and passionate conduct of business practice, are common traits these three entrepreneurs share. Ethical conduct of business reflects their stance in the business world and they believe this has a payback in the form of 'good reputation' which may bring future stakeholders i.e. customers. At this point, one wonders, what do the customers feel about the ethical practice of a no-name startup? How would the passionate attitude of the entrepreneurs affect the stakeholders? These two questions lead one to propose the following:

*Proposition 3* Ethical and passionate conduct of business practice leaves a positive mark on the third parties interacting with the startup and they may turn into future stakeholders because of these traits they witness before becoming a stakeholder.

## 8.6 Conclusion

The aim of this paper was to explore the stakeholder relationship building processes of R&D based startups that were established via receiving a techno-entrepreneurship grant in Turkey. To this end, in depth interviews with the founders of three startups were conducted and analyzed. When analyzed chronologically, the stakeholder formation process exhibited a structure where challenger and supporter stakeholders were present at two opposing sides of the startup and the entrepreneur benefited from the counterbalancing effect of these forces. At the initiation stage of the business two major stakeholder groups emerged: the family members and the state's grant-handling officers. The predominant finding in the literature is the supportive role of the family. Yet, in one of the cases, we found a profound opposing role by the family members. Is this opposing force of the family an idiosyncratic case or is it representative of a subset of techno-entrepreneurs in Turkey? This should be researched further. Secondly, the logic of the state's techno-entrepreneurship fund monitoring staff seems to be a vital factor in the sustainability of the startup and the stakeholder relationships the entrepreneurs choose to invest. Thus, such staff's flexibility in understanding the mindsets of the entrepreneurs should be studied further. Finally, the ethical and passionate conduct of business by these startups could be a factor drawing third parties into becoming stakeholders of these startups. Therefore, these propositions should be researched in the future.

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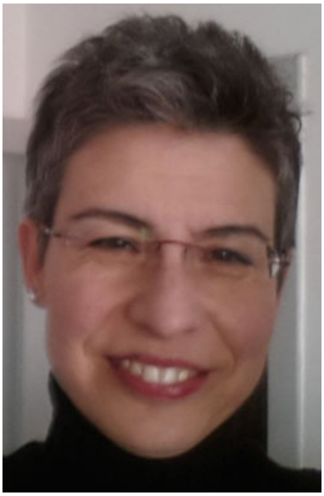

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# 9 Industry-University Collaboration for ICT and E-Government Service Development: Learning from Practice of Innovative Türksat-University Case

Tunç Medeni and Halil Yeşilçimen

**Abstract**

The chapter provides a general account of industry-university collaboration with successful results in Information and Communication Technology (ICT) and e-Government area in Turkey. Presented mostly from the perspective of the industrial institution this successful case hopes to provide certain insights and suggestions for improving the strength and effectiveness of industry-university collaboration. A complementary cross-cultural knowledge management model is also proposed to contribute to the conceptual discussions on collaboration models and interface designs. Accordingly, the paper provides firstly information of the industrial institution and related electronic services and project work on the practice side, then the suggested conceptual framework, and finally gained insights and suggestions for the practice.

**Keywords**

E-academic services · E-government · Türksat · Information and communication technology · Industry-university collaboration · Cross-cultural knowledge management · Reflection and refraction

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## 9.1 Introduction

Improving industry-university is a major issue in today's global knowledge economy and society. It was tried to be addressed by countless works and authors from practice and academia. For instance, Perkmann and Salter (2012) underline that working with universities poses considerable challenges for managers such as the conflict (1) *between* open nature of academic science *and* companies' need to protect technologies they use, or (2) *between* slow motion academic research and its focus on long-term challenges *and* industrial R&D drive by time-sensitive product development projects and day-to-day project solving. As a consequence, industrial entities can consider universities too tardy and too bureaucratic to collaborate.

Thus, interface designs or collaboration models are suggested to bridge these different sides of innovation and development. For example, MIT suggests Action Learning Labs. Triple, Quadruple or Quintuple Helix Models are suggested to address incorporation of all stakeholders including public sector, Civil Society and Natural Environment in addition to Higher Education and Business Sector institutions for innovation, knowledge-creation and sustainable development (Etzkowitz and Leydesdorff 2000; Carayannis and Campbell 2006, 2009, 2010; Barth 2011). The systemic approach provided by these models are also enriched with theoretical concepts and context, including non-linearity and evolutionary self-organizing character (Goguen and Varela 1979). On the practice side, interfaces have also been subject to numerous analysis and reports in different times such as the one published by UNESCO (Martin 2000).

In Turkey, various authors also research the industry-university collaboration practices, models and policies with analysis of problems and improvement suggestions for the country. For instance, Kaymaz and Eryiğit (2013) states that there has been yet no suggested scientific model which can define the effective collaboration processes for the interfaces In Turkey. Erdil (2015) also provides a general critique of the problem for developing countries and Turkey with certain suggestions for solution: university-industry interaction is not strong and the interface mechanisms and channels are not effective enough.

This paper put forwards a general account of industry-university collaboration with successful results in Information and Communication Technology (ICT) and e-Government area in Turkey. This successful case presented mostly from the perspective of the industrial institution is expected to provide certain insights and suggestions for improving the strength and effectiveness of industry-university collaboration. Inspired by this case, a complementary cross-cultural knowledge management model is also proposed to contribute to the conceptual discussions on collaboration models and interface designs.

The paper firstly gives information on industrial institution and related electronic services and project work on the practice side. Then, it suggests the complementary conceptual framework, and ends after gained insights and experiences from, as well as suggestions for the practice within this framework.

## 9.2 TÜRKSAT

As a semi public semi private institution, TÜRKSAT is the sole communications satellite operator in Turkey, and the leading technology solutions provider to public institutions in Ankara and the country. TÜRKSAT's field of activities may be divided into three main areas, employing more than 1000 staff: (1) Satellite Services, (2) Cable Services, (3) Information and Communication Technologies Services.

As part of these activities, duty of establishing, operating and managing e-Government Gateway has been assigned to TÜRKSAT under the coordination of the Ministry of Transportation, Maritime and Communication (turksat.com.tr). Currently approximately almost 25 million citizens benefit from more than 1300 services from 200 government agencies at the E-Government Gateway. According to Alexa data metrics, it is the most visited gov.tr site in Turkey (Alexa 2015) (Fig. 9.1). The E-Government Gateway is designed and implemented as a publicly-owned initiative. Created out of a national competition for logo (and motto) design, the spiral logo (at the top left of the Fig. 9.1) captures this design concept and identity, and is widely used for publicity purposes.

TÜRKSAT has also been involved in EU-funded CEES, UbiPOL, Gen6, STORK 2.0 and EMYNOS projects in the ICT field as successful innovative research and development (R&D) cases of industry-academia collaboration in order to develop and utilize technologies for citizen use, participation and engagement. The innovative potential of the institution's service development and provision has also been recently recognized by EFMA and Accenture, granting the Second Prize in "Most Disruptive Innovation" category with the project that provides direct identity authentication method for accessing to E-Government Gateway via Internet Banking system, achieved in collaboration with Denizbank (EFMA 2015), in addition to other financial institutions (Fig. 9.2). Internet banking method complements other methods such as personal e-Government password, e-signature, m-signature and identity cards, supporting the take-up of e-Government services and diffusion of e-Government to the society.

## 9.3 E-Academic Services

With respect to a life cycle perspective of service development and provision for individuals and institutions, e-academic services can be considered as part of educational services. Among many electronic services available within a large spectrum can be e-school services provided by Ministry of Education for K12 level students and their families, or applications developed by SMEs for supporting administrative affairs of university management. Meanwhile, the focus of this work is the services provided for higher education institutions, developed and provided by E-Government Gateway, which can also be classified into these sub categories:


**Fig. 9.1** E-Government Gateway

- Government-to-Citizen (G2C) services for individual end users such as university registration, application for financial and accommodation support, transcript, and acknowledgement certificate of studentship.
- Government-to-Government (G2G) services for public servants such as military service procedures for university students based upon data sharing between responsible agencies
- Single-Sign-On (SSO) services using Gateway infrastructure, even if they are not integrated such as application for associate professorship to Inter-University Board managed by the Higher Education Board system (YÖKSİS)

The following provides a brief history of the development of the selected G2C services, as a result of interactions between TÜRKSAT and YBU:

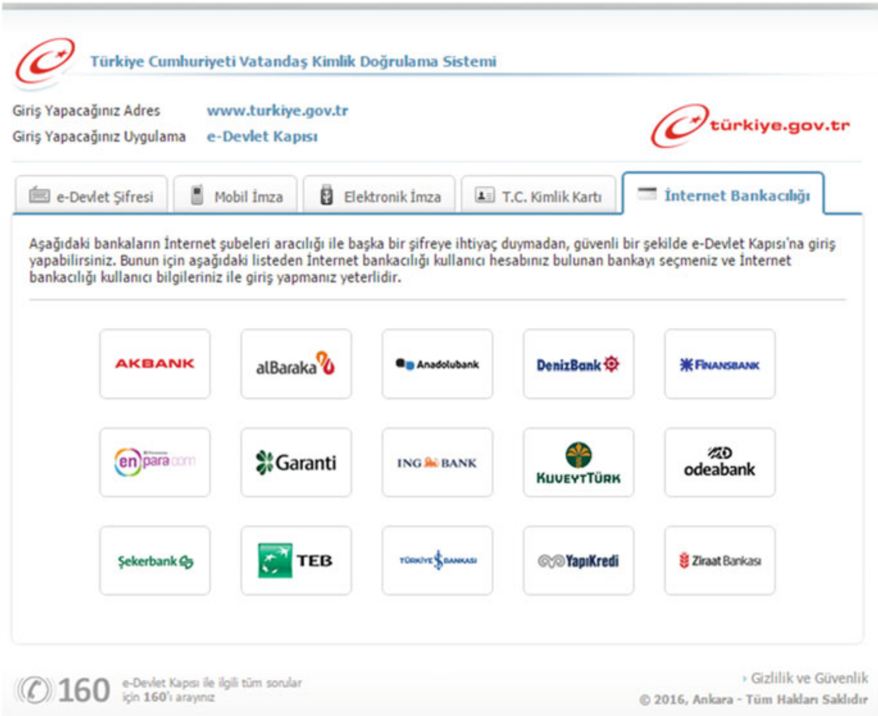


**Fig. 9.2** Direct identity authentication for accessing to E-Government Gateway via internet banking

- Visit of TÜRKSAT to University Rectorate in 2013 initiated the development work of e-academia services as part of a general endeavor of increasing dissemination and take-up of e-Government services and of ongoing project activity.
- In 2014, students of Management Information Systems, part of the Management School of Yıldırım Beyazıt University used the G2C student services (generation of student documents such as student certificate and transcript) for the first time (Fig. 9.3).
- Since 2015, students can e-register to almost all state universities, in addition to student document generation and confirmation.

New services are expected to be added to the current and active services in the near future, depending on priorities determined together by politicians, managers and citizens. The service portfolio has actually been extended with recently-established services that can be used not only by citizens but also non-citizens with the purpose of taking advantage of cross-country transactions and data or document exchanges, which will be explained further as part of the STORK 2.0 project, of which TÜRKSAT is a partner.

**Fig. 9.3** First use of end user for student services in 2014

## 9.4 STORK 2.0 Project

STORK (Secure idenTity acrOss boRders linKed) 2.0 project contributes to the realization of a single European electronic identification and authentication area, establishing interoperability of different approaches at national and EU level, eID for persons, eID for legal entities. E-Learning and Academic Qualifications Pilot of the project provides a set of cross-border academic services, which facilitates the use of academic information by citizens, government and companies, involving the exchange of identity attributes. The stakeholders are not limited to the academic world, but also include legal entities from the private sector that can access academic attributes which are of value to them to accomplish their goals (Fig. 9.4).

The development of the Turkish e-academia services as part of this STORK 2.0 pilot by TÜRKSAT was not a simple and an easy task. The initial proposal had to be changed in order to accommodate the demands and requirements of university administration, TÜRKSAT management, and project and pilot coordination. The changes took a long time and important effort to adjust and implement, nevertheless was still possible to fit them into the work schedule.

The resulting TADS (Trusted Attribute Display Service) application offered by TÜRKSAT, in addition to TÜBİTAK as the other Turkish partner of the project, allows users to recover trusted attributes and displays them in a PDF document. The service then enables to create different documents depending on the required

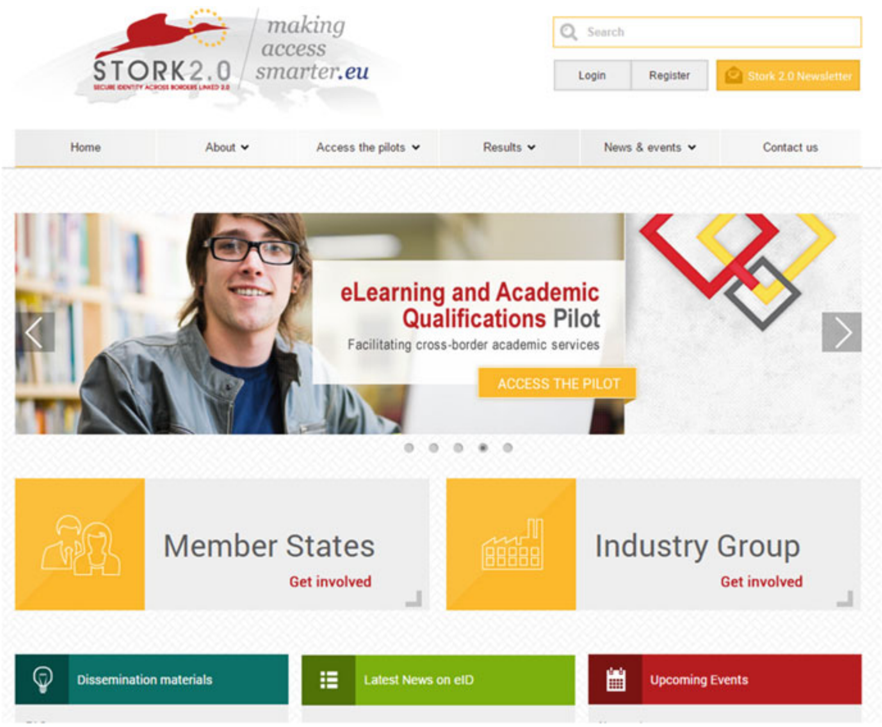


**Fig. 9.4** STORK 2.0 e-learning and academic qualifications pilot

attributes, manage these documents and also verify them via QR code that can be found in the documents (Fig. 9.5). As a result, for instance, Turkish undergraduate students can create transcript documents, retrieving the data from Yıldırım Beyazıt University, which can be verified by a graduate institution or company in a participating EU country. Similarly, international students applying to the Turkish university can get their academic documents verified. Once the initial pilot results are assessed, this application, which is also the first cross-border electronic service to be provided via the E-Government Gateway, has a potential to be spread into all universities for country-wide impact.

The project and pilot outputs prove a significant capacity development for cross-border service provision on Turkey side, as a significant parameter of EU benchmarking in the recent years. Currently, however, it is not certain to what extent the available infrastructure and application will be used practically. One of the main reasons for this uncertainty is the development of a new national graduation diploma authentication system by Higher Education Council (The service illustrated in Fig. 9.1).

The STORK infrastructure is also being adapted by TÜRKSAT for the National Agency in order to facilitate the application of international legal entities such as educational institutions or non-profit organizations to the calls for EU-funding that


**Fig. 9.5** TADS document verification

are to be used in Turkey for (among others) knowledge transfer and local development purposes. TÜRKSAT has also been involved in other EU-funded projects (CEES, UbiPOL, GEN6, EMYNOS) since 2008. This acknowledges a significant capacity development for innovative collaboration projects. Number of these cases involving other different national and international partners as well, can be increased, as good examples of university-industry collaboration that develop and sustain ICT tools, with a potential to enhance this collaboration itself and can be used for utilizing specific innovative implications for academic mobility, public transformation or regional development.

## 9.5 The Conceptual Framework: Cross-Cultural Knowledge for Managing Industry-Academia Work

Reflection is an important concept for management of knowledge. For instance, it can be incorporated into the conversions between tacit and explicit knowledge among different societal entities (as individual, group and organization and with environment)

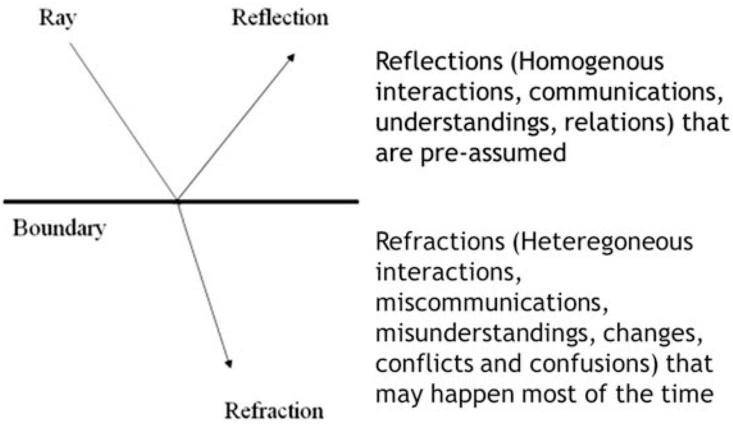


**Fig. 9.6** Reflections and refractions in life

as part of the Socialization-Externalization-Combination-Internalization [SECI, Nonaka and Takeuchi (1995)] processes of knowledge creation (Medeni 2008).

Medeni (ibid.) respectfully attempts to complement concept of reflection with a new conceptualization of refraction. Suggested as an important phenomenon in cross-border interactions among different societal entities, refraction is identified as more cross-cultural, creative and critical types of reflection mostly neglected missed in cross-cultural management and transfer of knowledge (Fig. 9.6). In other words, while reflections can be conceptualized as homogenous interactions, communications, understandings and relations within the same cultural setting; refractions can be understood as heteregoneous interactions, miscommunications, misunderstandings, changes, conflicts, and confusions that may occur during the flow of knowledge between different cultures. The metaphor and analogy come from the flow of incident ray, and its reflection and refraction at the boundary between two different environments. Accordingly, reflection and refraction exists together and complement each other in both natural and social life, although reflections are the ones mostly preassumed and refractions are the ones that may happen in reality many times in the social life. This is mostly apparent in the cases of cross-cultural interface interactions among different societal entities (countries, industries, institutions and units) that refract, while passing the boundaries in-between (Fig. 9.7).

According to the organizational knowledge creation model of Nonaka and Takeuchi (1995), the continuous and dynamic interaction between tacit and explicit knowledge occuring at the individual, group, organizational, and inter-organizational levels can also be significant for the sustainable development of any social setting. At the foundation of Nonaka and Takeuchi's modeling lies the Japanese philosophical concept ba (場): the context that knowledge needs in order to exist, in which it is shared, created, and utilized. This shared space/context for relationship building and knowledge creation, which could be real, virtual or

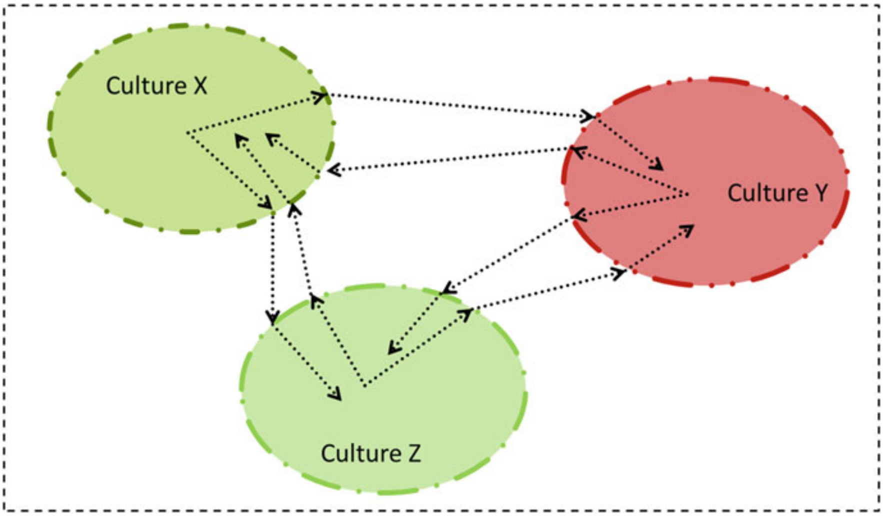


**Fig. 9.7** Cross-cultural interface interactions among different societal entities

mental, with physical, relational, and spiritual dimensions. Moreover, depending on their definitions, these real, virtual, mental aspects of space-time have both variations and overlaps, as virtual also have connotations related not only with technological (in the sense of information-communication technology) but also mental, imaginative, metaphorical, projective and fantasy aspects; as well as virtual and mental aspects are also part of the real life after all. Meanwhile, concept of ma (間) in Japanese culture has the function of combination and separation of space and time. Ma is the in-between-ness, or 'interval' conveying both time and space as a conceptual and perceptual unity. It is a tension between things allowing for different patterns of interpretation, a constant flow of possibilities, awaiting or undergoing transformation by the availability of physical components and potential uses. Ma conceptualizes and perceives the interval and in-between-ness that emerges with the unity of time and space, thus capturing also the spatial emphasis of ba, standing at the foundation of knowledge creation (Medeni 2008). In other words, ba can be conceptualized as a creative and collaborative space, which could be Real/Physical, Digital/Virtual or Mental/Intellectual; and ma as a spatio-temporal interval, in-between-ness for creative and collaborative interaction, separating and connecting as a permeable membrane and acting as a seam for interface interactions.

While the real, virtual and mental space of ba matches very well with the concept of reflection, the in-between-ness and interval of time and space that ma provides can be used for the facilitation of refraction, as another important concept which complements reflection. In return, these concepts of reflection, refraction, ba and ma can be handled from the perspective of cross-cultural knowledge management.

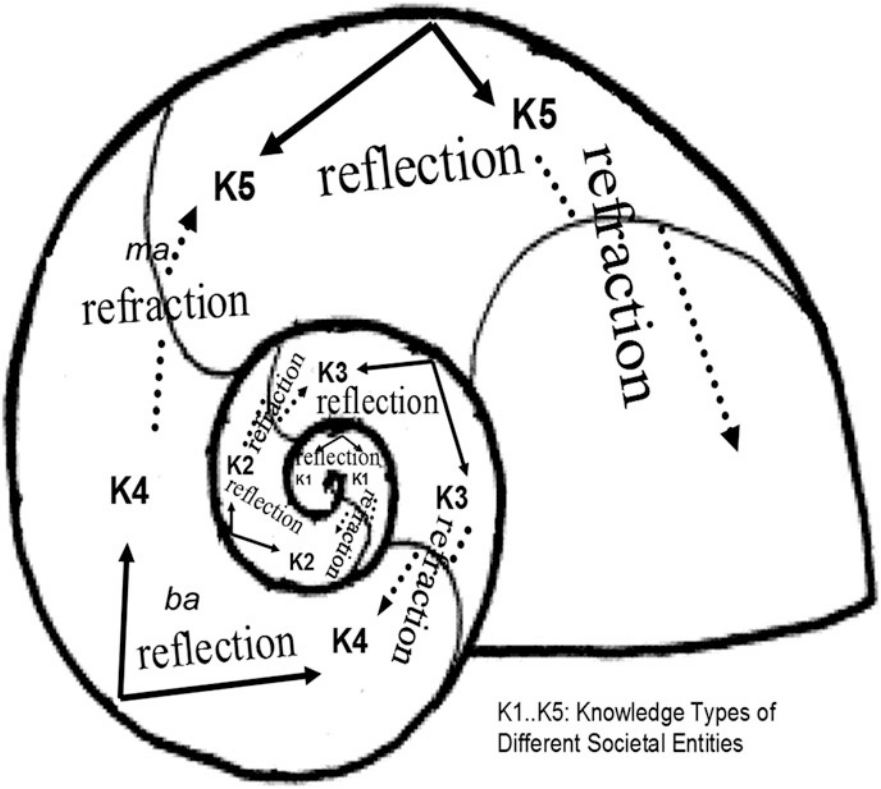


**Fig. 9.8** Knowledge Amphora modeling for cross-cultural informative—communicative interactions (adapted from Medeni et al. 2009)

Then, the concepts of refraction and reflection as cross-cultural refraction and cross-cultural reflection can be examined. Accordingly, for instance, a Knowledge Amphora Modeling for cross-cultural informative—communicative interactions can be suggested (Fig. 9.8) to complement other models for cross-cultural collaborations for knowledge generation and innovation.

The knowledge-creating spiral in this model emphasizes the cross-cultural interactions and created different knowledge(s). The amphora (or Nautilus shell) expands compartment by compartment, each of which represents a cultural unity in the model. The passage from one compartment to another, then, represents a cultural change resulting in a new culture (as a new compartment of the shell). Thus these passages between compartments also underlie cross-cultural interactions. Here it is assumed that each culture has one particular type of knowledge. When there is a cultural change, knowledge type also changes. The cross-cultural knowledge-spiral then expands through reflective and refractive interactions. Within the cultural unity of each compartment, reflective *interactions* within ba settings for learning and knowledge management, which could be better expressed as *intra-actions*, are dominant. During the passages between different culture compartments, however, refractive interactions at ma interfaces dominate the nature of such interactions.

It can also be suggested that reflection can improve knowledge but does not change its type, while refraction can change the type of knowledge(s). The interactions among different cultural entities for (organizational) learning and knowledge creation, and the different knowledge types from these different cultural entities as a result from the cross-cultural interactions can be generalized such as K1, K2, K3, Kn... (Ki, $i = \{1 \ldots n\}$), where each "n" represents a different culture, thus "Kn" the knowledge of a different culture, as the cultural hybrid that cross-cultural interaction generate. Both reflection and refraction contributes to body of knowledge that can be represented by increases in fonts of Ks (Medeni et al. 2009).

Such modeling of reflective intra-actions and refractive interactions can also comply with complex systems. For instance, it fulfills the self-referentiality principle. In fact Plato argued that all physical reality experienced by human beings in the material world are actually only imperfect and refracted reflections of a perfect world (that exists elsewhere in the universe) (Willner et al. 2006). Benefiting from Plato and Hegel, and Heidegger' ideas, Eldred (2007) discusses how (it can be seen that) singular self is refracted on the other and thus 'broken in' on the world through the dialectic between singularity and universality. Authors like Geyer (2002) also brings the related discussions on self-reference into systems science. The model also satisfies not only self-organization but also emergence principles of complex systems.

Tihon (2006) also asserts that knowledge emerges from the information system whose attractor is the ba, the shared place, context, or basin. This assertion is supported by Tihon's findings from the case of an international non-governmental organization that the implicit and explicit domains of the organization's information system generally echo each other. Using Tihon's (ibid.) approach and analysis of information and knowledge management, it can also be suggested that beside the attractor of sharing, to a certain extent, the attractors of tension and rupture are also needed for knowledge creation. As the implicit and explicit domains' echoing each other is not a one-to-one but refracted reflection due to tensions as well as contextual difficulties, Tihon's approach highlights domains reflecting not only each other and sharing a common basin, but also refracting each other and differentiating an in-between-ness bound. In addition to ba, such an approach would incorporate ma, which supports the context for dealing with tensions, refractions and ruptures occuring in the progress of time, besides the relations and reflections cultivated by the shared space. Working together, and managed thoughtfully, the attractors of sharing, as well as tension and rupture, can turn the negative elements into positive aspects so that useful knowledge can emerge from the information system (Medeni 2008).

The model can provide a refreshing perspective of interface interactions among culturally-different entities for knowledge-creation. Rather than considering them as just industry or academic entities, among others, it provides a more comprehensive and useful framework by underlying the cultural difference of these entities, as well as explaining how these differences or similarities can affect the flow for knowledge generation and how interfaces/seams/time-space boundaries play a significant role in this cross-cultural knowledge flow. Considering all these features of the model, it could be suggested as an alternative for existing Helix Models with an explanatory power for how interfaces can operate effectively for cross-cultural collaboration.

Finally, the spiral structure of the model also resembles with the logo of E-Government Gateway (as in Fig. 9.1), which may inspiringly point out a collaborative interlink between theory and practice. In support of this interlink, the following part of the paper provides insights from practice.

## 9.6 Learning from Practice

Certain special factors can contribute to enabling cross-cultural interface interactions for industry-university collaboration. In these TÜRKSAT-University cases, some of these factors that have paved the way for achievement of these good results are listed below:

- *Continuous support of upper management*: Firstly, in recognition of the prestigious characteristics of these projects for an institution like TÜRKSAT prioritizing long term public value rather than short term profit, continuous support of upper management, despite all ongoing organizational challenges and changes, has been crucial.
- *Suitable scope and life-span for projects*: In addition, although a continuous monitoring was required, scope and life-span of these projects have also enabled manageable resource reallocations from routine jobs and business processes to the unique project tasks, which might not be possible for more demanding projects with shorter life-spans.
- *A well-established advisory role for bridging in*-between: Furthermore, a well-established advisory role, which could be otherwise prone to exploitation as a common case in Turkey, has relatively-more-smoothly facilitated the transfer of practical experience to academic knowledge and vice verse, generating useful outcomes for each. All these factors have contributed to enabling a sustainable operational environment for fruitful industry-university collaboration until recent time.

While positive factors and points can be increased, there are certain challenges to be noted with respect to these example cases and suggestions can also be provided to improve them. For instance, despite all the attempts for institutionalization, all the related project works have remained to be mostly efforts of a few self-motivated individuals in both sides of the collaborating organizations. Furthermore these institutions could be too focused on and biased towards own strategic priorities and cultural characteristics of their institutions. Thus, for sustainability, it is very important to systematize and institutionalize these efforts for intra-institutional capacity building and inter-organizational collaboration. A well-established and utilized position or unit that can boundary-span and bridge all the related sides and potential

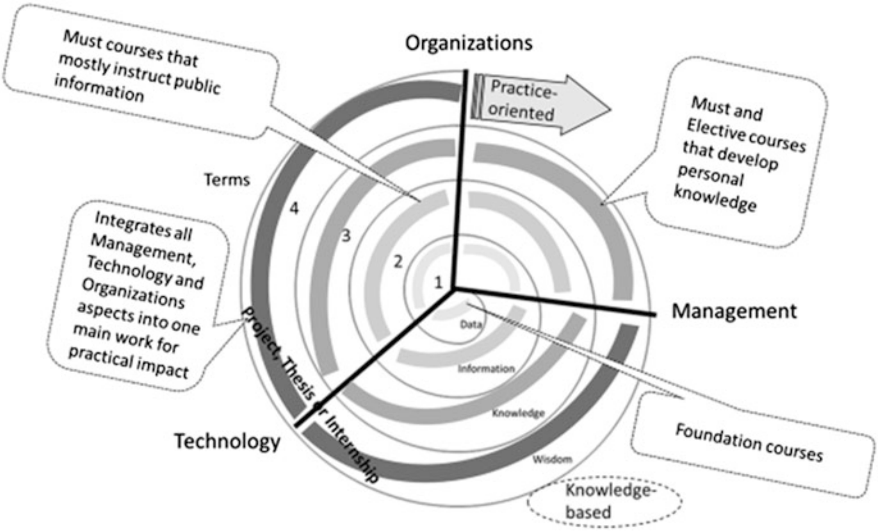


**Fig. 9.9** MIS knowledge-based society and practice-oriented programme, lolipop, model

stakeholders can also effectively contribute to these institutional efforts for sustainability. In that sense, recently TÜRKSAT's increasing the capacity of units located in university technopark (Ankara University) and considering the establishment of a R&D unit, and Yıldırım Beyazıt University's working on a R&D strategy can be seen as promising examples for future. Also a new relevant curriculum structure for the Management Information System (MIS) Department of Business Administration Faculty, called **MIS** kn**o**w**l**edge-based soc**i**ety and **p**ractice-**o**riented **p**rogramme, or lolipop, model has recently been suggested (Fig. 9.9).

The suggested structure adapts the trivet domains of Management, Technology and Organizations of MIS and allocates courses for each based upon different levels of knowledge typology, where data stands for foundation common or preparation courses, information stands for faculty instructed common, public and explicit information built on this foundation, knowledge stands for personally learned private, tacit knowledge based on interest and expertise build on the informative courses, and wisdom stands for experience on top of all.

This structure is adaptable to undergraduate and graduate programmes in general; the only difference can be the interpretation of the academic term related to the grades, i.e. in undergraduate programme, the terms can be either freshman, junior, sophomore or senior year, whereas in the graduate programme, it can be either spring or autumn period, which may not make much difference in Turkish universities, as in undergraduate programmes in Business Administration, most of the courses are allocated to the last 2 years. While the initial period is dedicated to foundation courses, the second term focuses on must courses mostly instructing public information and the third term on must and elective courses developing personal knowledge. The final and the fourth term is then dedicated to project, thesis or internship that integrates all Management, Technology and Organizations aspects into one main knowledge-based work for practical impact. A key aspect of the suggested structure is its practice-orientation that is crucial for improving learning outcomes and transferring them into workplace and real practice (Medeni and Medeni 2016).

All these actions and suggestions at institutional level can also match well with the recent policy development and implementation at national level. For instance, Turkey has recently announced its new Information/Knowledge Society Strategy, which has specific actions for improving ICT education, research and entrepreneurial programmes in universities (Ministry of Development 2014):

- 22. Updating ICT Curriculum in universities action will develop undergraduate and graduate programs in ICT related fields.
- 24. Developing ICT education/training collaboration programme among private sector and education institutions action will encourage university students' working part-time in private sector, adjusting the legislation to enforce graduation projects to be completed by students' working in companies. It also will support research and establish research centers as a collaboration between universities and private sector.
- 27. Improving capacity of ICT departments in higher education action will provide additional academic cadre in the required areas and develop educational models in order to ensure all undergraduate educators to have sufficient competency levels to follow-up technological developments.
- 28. Improving English proficiency in ICT education action will improve the English language proficiency required by ICT sector.
- 57. Establishing accelerator centers for Internet enterprises in universities action will support 20 universities to establish these centers and match these with technology clusters such as technoparks and R&D centers. University students and academicians will also be encouraged to take action and work as entrepreneur or staff in these centers.
- 72. Developing Information Society Research Programme horizontal action will support related undergraduate, graduate and doctorate works, including international collaborations and capacity development for inter-disciplinary areas in natural and social sciences that set the foundation behind technological developments. A dynamic catalogue and library (physical, virtual and digital), as well as an academic journal in the related areas will also be generated and sustained.

New undergraduate and graduate programmes can also be suggested for positioning the university offerings with respect to the all Knowledge Society Strategy actions introduced above. For instance, an integrative work in the form of project, thesis or internship can specifically facilitate university students' working in private sector and enforcing graduation projects to be completed by students' working in companies. For graduate programme, these private sector companies can be the institutions that students are affiliated with. Even the academic master thesis or doctorate dissertation work should have this practice-orientation, applying proper research methodologies such as Action Research.

These collaborative interactions with private sector can also pave the way for more formal collaborations in the form of co-research centers or cluster-linked accelerator centers for Internet enterprises in YBU, as aimed by other actions (#24, 57) of the Strategy. University students and academicians can work as entrepreneurs or staff in these centers, providing new opportunities for all concerned. Meanwhile, the Faculty members will benefit from continuous interaction with industry, giving them the state-of-the-art to be kept updated with recent developments in reality, and engage in interdisciplinary leading-edge work (that can also result in a digital library and journal), contributing to the satisfaction of the objectives recommended in actions 27 and 72. Here, collaborative interactions among different faculties and departments such as Management Information Systems, Computer Engineering or Knowledge and Document Management can be also very important.

The continuous development of e-Government services and ICT-supported business processes, of which STORK e-Academia TADS presented here is just a small example, also paves the way for the digital transformation towards the Fourth Industrial Revolution, where real and virtual worlds are merging and interfaces among different organizations, as well as services, people, technologies and data sources are of key importance.

## 9.7 Conclusion and Future Work

This paper has presented the TÜRKSAT-University innovative case for e-government service development, providing insights on practical factors contributing to and challenging against cross-cultural interface interactions between the institutions. It has also proposed the Knowledge Amphora model for cross-cultural informative—communicative (reflective and refractive) interactions occurring at interfaces (ba and ma) in order to shed light on micro dynamics of industry-university collaborations (Fig. 9.10).

The Knowledge Amphora explains the reflective and refractive aspects as the interface of the industry-university relations and collaborations. This explanation can be particularly useful for the e-Government industry practice and the MIS academic area for Industry 4.0 in Knowledge Economy and Society, and the operational infrastructure of the interface in-between, which could even be called an *Industry-University Collaboration Gateway and Broadband*.

In this paper, however, the industrial characteristics of TÜRKSAT, exemplified with a specific case, has been the main perspective, which can be detailed in future studies by a more comprehensive university perspective, as well as the governmental characteristics of TÜRKSAT, a semi-private semi-public institution. Furthermore, perspectives of other stakeholders such as the other government agencies responsible for e-Government, other public institutions or projects in charge of other related

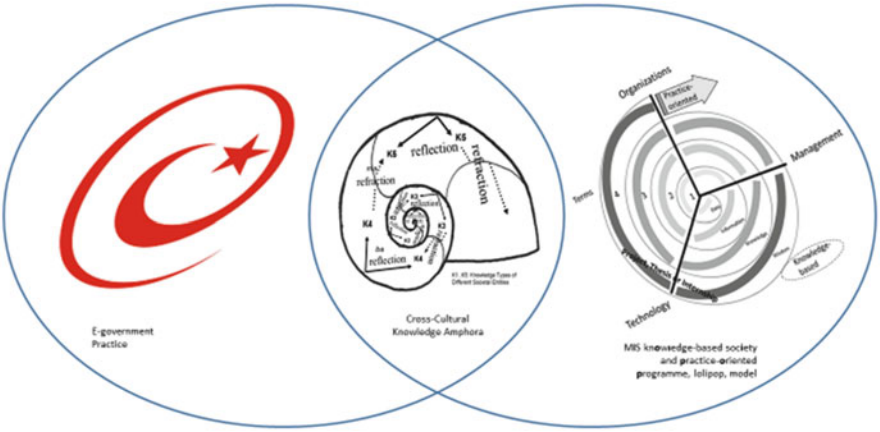


**Fig. 9.10** Cross-cultural knowledge Amphora as an interface between industry (E-Government practice) and university (ICT-related areas such as MIS)

projects, the civic society in the form of end users or related non-government agencies, and other private institutions operating in the e-Government and ICT sector can also be incorporated.

All these different perspectives of various stakeholders can actually provide the grounds for interlinking these mostly general and theoretical discussions with more specific and real-life cases, especially for those more refractive type of interactions among these different stakeholders with conflicting interests or issues. Some of these conflicting issues can be IPRs, fair competition, information security and privacy, among others. Here, another Japanese concept and practice, kintsugi, which means "to patch with gold" as the art of mending broken pottery with resin mixed with gold, can also contribute: Conflicts can be dealt with not by ignoring and hiding the fault lines, but by revering and illuminating them, which can consequently transform the relationships (Lenski 2015).

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# From a Nascent to a Mature Regional Innovation System: What Drives the Transition?

# 10

Marina Ranga and Serdal Temel

**Abstract**

While regional innovation systems (RIS) saw a relative development in many European countries in recent years due to decentralisation policies, they are at an early stage in Turkey, a unitary state with a strong centralised system rooted in the administrative structures of the Ottoman Empire. The Turkish region of Izmir was the first in the country to elaborate its own Regional Innovation Strategy in 2012 and achieved considerable improvements in its R&D and innovation capacity, based on the strategy's recommendations. What are the key factors driving the transition from a nascent to a mature RIS, and how can the transition be further enhanced? This paper aims to answer these questions by examining the Izmir RIS from the fine-grained perspective of the Triple Helix Systems concept, which sees regional innovation as the result of the interplay between a Knowledge Space, an Innovation Space and a Consensus Space. The spaces co-evolve in a multitude of ways and directions as a non-linear process and provide a detailed view of regional actors, knowledge flows and interactions between them, and the resources available, in view of identifying existing blockages or gaps and formulating policy recommendations. The picture provided by the Triple Helix Spaces is complemented, for a more comprehensive approach, with insights drawn from three other RIS typologies based on integration into internal and external environments, regional barriers to innovation, and regional development stage. We conclude that the key factor driving these improvements was the presence of high-impact national and

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regional R&D, innovation and entrepreneurship policies that have been implemented in a relatively well-defined Triple Helix System. Izmir's Triple Helix System features a more advanced Knowledge Space with a comprehensive, high-density institutional structure and a solid knowledge base, a younger but fast developing Innovation Space, with an increasing number of technology transfer offices, technoparks and innovation-support institutions, and a thinner, yet active Consensus Space promoting regional networking and collaborative leadership. For a successful transition to a mature RIS, policy and practice in the next stages need to focus on reducing fragmentation and strengthening the systemic linkages between the three Spaces.

**Keywords**

Regional entrepreneurial system · Triple helix · Regional innovation strategy · Emerging economy · Turkey

## 10.1 Introduction

Regional innovation systems (RIS) have been an important topic among academics, policy-makers and innovation practitioners for over three decades. The interest emerged from a shift from the national state-led regional policy of the 1980s towards a regional endogenous capacity-building policy based on local research and innovation, human capital, business culture and production capacity, education and learning (Moulaert and Sekia 2003). Globalisation of business and technology, the emergence of regional economic clusters and an increasing effort to build innovation capabilities and competitive advantage for regions through localised learning, knowledge creation and transfer also contributed to the process (Asheim and Isaksen 1997; Maskell and Malmberg 1999; Enright 2001; Cooke and Memedovic 2003; Asheim and Gertler 2004; Asheim and Coenen 2005). The European Commission further catalysed this process through specific plans to narrow development gaps within Europe and accelerate catching-up processes (e.g. the 1993 pilot project Regional Technology Plan and its successors Regional Innovation Strategies, Regional Innovation and Technology Transfer Infrastructures and Strategies and Regional Technology Transfer Projects).

While RIS saw a relative development in many European countries in recent years due to decentralisation policies, they are still at an early stage in Turkey, a unitary state with a strong centralised system rooted in the administrative structures of the Ottoman Empire. A regional focus has, nevertheless, been present in administration and development policies since the 1920s and was further developed in the 1950s, when the country was divided into seven geographical regions that were only territorial divisions with no regional governance responsibilities (Elci 2012). A regional focus also existed in the policies of the etatist period (1923–1959) that aimed to create a national economy and society through a dispersion of population and public investment to different country regions. However, as public investment was not sufficient to sustain this objective due to economic, social and political reasons, a reverse shift emerged in the late 1950s, from regions to urban nodes, and from inequalities between regions to inequalities between social groups (Eraydin 2001; Göymen 2008). Persisting regional disparities have been addressed in the country's 5-year national development plans that aimed to narrow them through various policies, ranging from the import-substitution of the 1960s to the neoliberal policies of the 1970s to early 1990s and the structural reforms for regional convergence started in the mid-1990s (Göymen 2008). In 2002, a new regional classification into 26 NUTS II regions, equal in terms of overall powers and responsibilities, was introduced in the context of Turkey's EU accession process.

The first formal references to a regional innovation policy in Turkey appear in the *2007 National Innovation Initiative (NII)* that introduces notions such as regionalisation of innovation governance and development of linkages with the regional development agencies (RDAs); development of regional support systems for the central administration and prioritisation of regional structures in national innovation governance; creation of 'Regional Innovation Alliances'; decentralisation of innovation support activities; start of two pilot RIS and dissemination of experience to other regions, etc. These NII provisions gave an impetus to the development of innovation policies at the regional level. A relevant example is the Turkish region of Izmir, which is the first in the country that elaborated its own *Regional Innovation Strategy* in 2012 (Izmir Development Agency 2012). The document builds on several local studies,[1] was financed by the local RDA and was coordinated by local actors. The strategy pursued two key objectives: (i) to establish strategic priorities for increasing the R&D and innovation potential of the region and bring it to an internationally competitive technological level; and (ii) to lay the foundation of the Izmir Innovation Ecosystem, by mapping the existing actors of the ecosystem, identifying those who should be established for an optimal functioning of the ecosystem, and creating synergies between them.

Izmir's Regional Innovation Strategy was the first document of its kind for the region and provided several recommendations aimed to make Izmir a better place for technology and innovation, e.g. strengthening local companies' focus on high value-added technological products, increasing regional awareness on R&D and innovation, building more technoparks and fostering university-industry collaboration. The strategy recommendations came at a time when the Turkish government enhanced its focus on R&D, innovation and entrepreneurship and adopted a large number of support schemes that have been further developed and broadened in scope in subsequent years. As a result of this combined national and regional support, Izmir RIS has seen considerable improvements in its R&D and innovation capacity. For example, prior to 2012, the region had eight company R&D centres created with the approval of the Ministry of Science, Industry and Technology, but at present their number amounts to 18. Similarly, from only one technopark in the region, Izmir is now home to four active technoparks, and the number of technology

[1] *Izmir Regional R&D and Innovation Capacity Analysis*; *Izmir Regional Innovation Strategy Field Survey,* and the *Situational Analysis on R&D and Innovation Ecosystem in İzmir*. These studies were conducted in 2010–2011 by Izmir Development Agency in collaboration with Ege University Science and Technology Centre (EBİLTEM) and the Turkish Statistical Institute (TURKSTAT).

companies in Izmir quadrupled from 67 to 263. In 2012, out of the nine universities in Izmir, only one had a technology transfer office, but the number of technology transfer offices has gone up to eight, and three of them currently receive financial support from the government.

All these achievements demonstrate a dynamic development of Izmir RIS, but the transition to a mature regional innovation system is still in the early stages. Therefore, two important questions arise in this context: **(i) What are the key factors that have driven the development of Izmir RIS so far? and (ii) How can the transition from a nascent to a mature RIS in Izmir be accelerated?** This paper aims to answer these questions by examining the Izmir RIS from the fine-grained perspective of the Triple Helix Systems concept (Ranga and Etzkowitz 2013). The concept sees regional innovation as the result of the interplay between a Knowledge Space, an Innovation Space and a Consensus Space, that can be created or organised in any physical space or time order and co-evolve in a multitude of ways and in different directions as a non-linear process. The Spaces incorporate the Triple Helix institutional spheres of university, industry and government into a higher-order picture that includes a broad range of actors, interactions among them, and resources available, in order to identify existing blockages or gaps and formulate adequate policy recommendations. In light of the general wisdom that there is no "one size fits all" approach to analysing RIS, the picture provided by the Triple Helix Spaces is complemented, for a more comprehensive approach, with insights drawn from three other RIS typologies, which are based on integration into internal and external environments (Asheim and Isaksen 2002), regional barriers to innovation (Tödtling and Trippl 2005) and regional development stage (Etzkowitz and Klofsten 2005). The multi-dimensional picture thus obtained provides a complex representation of the key factors that have driven the development of the Izmir RIS so far, but also identifies several ways to accelerate the transition to a mature RIS, which is defined for the purposes of this analysis, in light of six institutional foundations that support innovation-based economic growth (Dasher et al. 2015).

The remainder of the paper is organised as follows: Sect. 10.2 provides theoretical insights for our analysis drawn from the RIS literature. Section 10.3 analyses the current state of Izmir RIS by looking at the most important actors, activities and resources in each of the Knowledge, Innovation and Consensus Spaces. Section 10.4 provides a discussion of findings, and Sect. 10.5 concludes the paper.

## 10.2 Regional Innovation Systems: Theoretical Insights

The academic literature of the 1980s and 1990s presents a variety of models for regional innovation, from the 'milieu innovateur' (Aydalot 1986), industrial districts (Bagnasco 1977; Becattini 1987; Brusco 1986), localised production systems (Bouchrara 1987) and new industrial spaces (Storper and Scott 1988; Saxenian 1994), to clusters of innovation (Enright 1999), regional innovation systems (Edquist 1997; Lagendijk 1998) and learning regions (Cooke 1998). Among them, the regional innovation systems approach got higher visibility thanks to a large body of literature and wide acceptance among policy-makers. Although apparently similar semantically, on a closer analysis these models show many ambiguities in terms of innovation dynamics, role of institutions and organisations, view of regional development and culture, type of relations among agents and with the environment (Moulaert and Sekia 2003).

Ambiguities have also been reported in relation to the RIS model, particularly with regard to the nature of the system itself, its boundaries, role of cognitive frontiers, knowledge transfer and learning, and effect on the labour market (Asheim et al. 2011). This often generated confusion in the definition and validation of empirical representations of RIS (Doloreux and Parto 2004). For example, Cooke et al. (2004: 3) focus on the knowledge dimension of a RIS and see it as *"subsystems of generation and exploitation of knowledge that interact with other regional, national and global systems for the commercialisation of new knowledge"*. Asheim and Gertler (2005: 299) emphasise the technological development and productive structure of a RIS, defining it as the *"institutional infrastructure supporting innovation within the production structure of a region"*. Some consider that a collective identity generated from local competencies (Cooke et al. 1997) or a mechanism for knowledge integration (Vilanova and Leydesdorff 2001) are essential features that make a region a RIS, while others argue that some kind of regional innovation is present in all regions (Bunnell and Coe 2001).

Furthermore, while a vast body of research shows that research and innovation have a major positive impact on the techno-economic development of a regional economy (e.g. Storper 1995; Maskell and Malmberg 1999; Cooke 2001; Cooke and Leydesdorff 2006; Shapira and Youtie 2008, etc.), the actual ways in which these factors operate are complex and difficult to demonstrate. Several research streams aim at understanding RIS structure and dynamics through conceptualisation of a region's knowledge base (Autio 1998), the effects of geographically-bounded knowledge spillovers (Greunz 2003; Graf and Henning 2009), and the different scales of innovation (Cooke et al. 1997; Bunnell and Coe 2001; Cooke 2001, 2005; Parto 2003; Doloreux and Parto 2004).

Other research streams aim at understanding how a region's industrial specialisation depends on specific local economic structures and industrial legacies, and what is the role of the R&D intensity of local private and public research institutions in generating new knowledge (Martin and Sunley 2006; Fritsch and Slavtchev 2010). For example, Kauffeld-Monz and Fritsch (2013) show that in low innovative regions, public research organisations and universities can enhance innovation performance by taking over a 'gatekeeper function' that is usually performed by large firms in advanced regions. In some cases, spillovers from universities, public research organisations and private companies increase the efficiency of private companies' R&D (Fritsch and Slavtchev 2011), while in other cases, the diverging interests of regional actors may affect collaboration patterns and may result in unresolved local tensions (Fogelberg and Thorpenberg 2012). Regions specialised in high-technology services or located in the neighbourhood of such regions have a higher capacity to transform knowledge into innovation (Rodriguez 2014), while path-dependent regions are slower in building location-specific industrial specialisation and competitive advantages (David 1985).

Other factors influencing RIS performance refer to institutional arrangements and governance structures, corporate organisation of firms (Howells 1999) and financing for strategic investments in innovation infrastructures, as well as institutionalised learning and culture and trust, reliability, exchange and cooperative interaction (Cooke et al. 1997; Cooke 2005; Azoulay et al. 2009). All the factors above can generate important regional differences in the availability and quality of local inputs, and in the quality or efficiency of innovative outputs, even when inputs are similar quantitatively and qualitatively.

In order to advance analytical clarity on RIS functioning, but also for improving the regional policy design, several RIS taxonomies have been proposed. For example, Asheim and Isaksen (2002) focus on the integration of RIS into internal and external environments, and on that basis they differentiate between: (i) *territorially-embedded regional innovation networks,* characterised by localised learning processes stimulated by geographical, social and cultural proximity, and little interaction with knowledge organisations; (ii) *regional networked innovation systems,* characterised by localised, interactive learning and embeddedness of firms and organisations in a specific region with a local 'supporting' institutional infrastructure; and (iii) *regionalised national innovation systems*, that are more functionally integrated in national or international innovation systems, and carry out more cooperative innovative activities. Tödtling and Trippl (2005) differentiate between RIS taking into account regional barriers to innovation, such as: (i) *organisational thinness*, that occurs more frequently in peripheral regions which have no dynamic clusters or relevant organisations to support regional innovation, have few innovative firms, with low R&D levels and weak science-industry cooperation, and are typically focused on incremental and process innovations; (ii) *lock-in,* that occurs more frequently in old industrial regions with closed and rigid networks, strong clusters and over-specialised industrial systems, usually affected by path dependency and institutional, social and cultural "lock-in", typically conducting incremental and process innovations; and (iii) *fragmentation,* corresponding to metropolitan regions with weak relations between local actors, in spite of numerous educational and scientific organisations and technology firms, and weak industry-science relations.

Etzkowitz and Klofsten (2005) use the Triple Helix model to provide a RIS typology based on the development stage of a RIS. They distinguish between: (i) *the incipient stage*, where the idea of a new regional development model only emerges, for generating a new economic base for the region; (ii) *the implementation stage*, where new activities and infrastructure are developed for different types of entrepreneurs; (iii) *the consolidation and adjustment stage,* where integration of activities is performed to improve the efficiency of the infrastructure; and (iv) *the self-sustaining growth stage*, where the system can be renewed by identifying new areas of growth. All these stages can be strongly influenced by the presence of an entrepreneurial university and the relative dominance of the university, industry and government on regional dynamics.

A new framework for the analysis of regional innovation from a Triple Helix perspective was introduced by the Triple Helix Systems approach (Ranga and

Etzkowitz 2013), which conceptualizes innovation as a set of actors and activities in the Knowledge, Innovation and Consensus Spaces. The Triple Helix Systems framework provides a fine-grained view of innovation actors and relationships in each of these spaces. It explains variations in regional innovative performance by the structure of and articulation between the Spaces, and can help design regional innovation policies that are better tailored to the system's needs. On these grounds, the Triple Helix Spaces are used in our study as the main exploration tool of Izmir RIS. The findings resulted from this investigation are combined with insights from the other three RIS typologies, for a comprehensive view of the key factors that have driven the current development of Izmir RIS. The transition to maturity of Izmir RIS is examined taking as reference six institutional foundations that support innovation-based economic growth (Dasher et al. 2015): (i) a financial system that provides funding for risky ventures; (ii) a labour market that provides high-quality, diverse and mobile human resources; (iii) interactions between industry, universities, and government to generate a constant stream of innovative ideas, products, and businesses; (iv) industrial organisation where large established firms and small start-ups grow together; (v) a social system that encourage entrepreneurship; and (vi) professionals that assist the establishment and growth of start-ups.

## 10.3 Izmir's Regional Innovation System

This section provides an overview of Izmir's RIS from the perspective of the three Triple Helix spaces: Knowledge, Innovation Space and Consensus Spaces, that are briefly described below.

### 10.3.1 The Knowledge Space

The Knowledge Space was defined as an environment characterised by the presence of institutions, individuals and activities, policies and programmes that contribute to the generation and diffusion of knowledge, and develop knowledge resources, primarily research and development (R&D), to strengthen the local, regional and national knowledge base (Ranga and Etzkowitz 2013).

**The Policy Framework**

In terms of policies and programmes, the region implemented the priorities designed in the *National Science and Technology Policies Implementation Plan for 2005–2010,* which encouraged multidisciplinary R&D, sectoral and regional R&D and innovation, strengthened SMEs' role in the national innovation system and consolidated research infrastructures for the Turkish Research Area (TARAL). The successor *National Science, Technology and Innovation Strategy 2011–2016* increased the focus on human resources for science, technology and innovation, on interdisciplinary research and SMEs, R&D infrastructures and international cooperation, and also introduced two clear shifts relative to its predecessor: (i) a shift from a general to a sectoral focus in R&D and innovation policy, with several priority sectors, such as automotive, machinery and production technologies, ICT, energy, water, food, security and space, and the adoption of National R&D and Innovation Strategies in the sectors of energy, water and food; and (ii) a shift from research to innovation and more substantive efforts to turn research outputs into products and services.[2] The objectives of the 2011–2016 Strategy are pursued through six policy priorities and implementing programmes (Table 10.1).

**The Actors**

The most important actors in Izmir's Knowledge Space are: (i) universities, with their research centres, institutes, and R&D support institutions; (ii) public research organisations, and (iii) R&D-performing firms. The R&D personnel employed in these institutions is represented mainly by university researchers, who are concentrated especially in the engineering departments, while industry researchers are much fewer, because of unattractive salaries and a frequent mismatch between PhD researchers' qualifications and industry needs. It is noteworthy that only 4% of Izmir researchers are actively involved in research projects,[3] while the rest of 96% are primarily involved in education activities. These actors are briefly described below.

**(i) Universities**

At present, Izmir has nine universities, of which four are public and five are private (Table 10.2). This ranks Izmir third in the country in terms of number of universities after Istanbul (49) and Ankara (20), but Izmir universities count a larger number of employees (463,157) than Istanbul (299,131) and Ankara (263,529).[4] Public universities are older, having been established from the mid-1950s to the mid-1990s, while private universities emerged in Izmir after 2000.[5] Public universities typically have more education, research and innovation resources than private ones, especially in the engineering labs that are endowed with expensive equipment that may sometimes be unaffordable to private universities. Therefore, most private universities focus on social sciences, like business and economics, rather than on engineering and natural sciences. Only one public university in Izmir (Ege University) appears in a world university ranking (rank 546 in the 2015–2016 University Ranking by Academic Performance

[2]ERAWATCH Country Reports 2011: Turkey, pp. 16–17.

[3]This refers to the share of active researchers involved in projects funded by TUBITAK.

[4]TURKSTAT and YÖK, 2016 https://biruni.tuik.gov.tr/medas/?kn=95&locale=tr. Accessed on 10.02.2016.

[5]Among public universities, Ege University is the oldest (est. 1955), followed by Dokuz Eylul University (1982) and Izmir University of Technology (1994). Among private universities, Izmir University of Economics, the region's first private university, was established by Izmir Chamber of Commerce in 2001.

**Table 10.1** Policy priorities and implementing programmes to foster public and private R&D

| Policy priorities | Implementing programme/agency |
|---|---|
| 1. Establishment of new, indigenous, R&D-performing, technology-based firms | • *R&D, Innovation and Industrial Application Support Programme* (KOSGEB), with two sub-programmes:<br>– *R&D and Innovation Programme,*<br>– *Industrial Application Programme*<br>• *Technopreneurship Support Programme* (MoSIT)<br>• *Individual Young Entrepreneur Support Programme* (TUBITAK) |
| 2. Stimulating R&D investment in R&D-performing firms through subsidies (grants and soft loans) and fiscal incentives | • *Support Programme for Industrial R&D Projects* (TUBITAK)<br>• *Technology Development Project Support Programme* (TTGV)<br>• *Advanced Technology Projects Support Programme* (TTGV)<br>• *Law of Technology Development Zones* (tax exemption for R&D activities of technopark tenants)<br>• *Law on Supporting R&D Activities* (tax exemption for companies located outside technoparks and employing at least 30 researchers, if they are named "R&D Centre" by MoSIT) |
| 3. Stimulating firms that do not perform R&D yet | • *SME Funding Programme* (TUBITAK)—faster and easier access to funding for increasing the number of R&D projects<br>• *Mentoring Programme for Enhancing Innovation Management Capacity Of Companies* (TUBITAK) |
| 4. Attracting R&D-performing firms from abroad | • *Law on Supporting R&D Activities* (fiscal incentives for R&D activities of firms employing at least 30 researchers; aims to attract foreign firms outsourcing R&D subsidiaries)<br>• *Law of Technology Development Zones* (tax exemption for R&D-performing firms from abroad) |
| 5. Increasing extramural R&D carried out in cooperation with the public sector | • *Industrial Thesis (San-Tez) Support Programme* (MoSIT)<br>• *Technology Transfer Support Programme* 1513 (TUBITAK) |
| 6. Increasing R&D in the public sector | • *Support Programme for Research Projects of Public Institutions* allows public bodies to create consortia with the private sector, universities or public research institutes to conduct joint R&D activities |

Source: Selected from ERAWATCH Country Reports: Turkey, pp. 18–20
KOSGEB—Organization for the Development of Small- and Medium-sized Enterprises; MoSIT—Ministry of Science, Industry and Technology; TUBITAK—Scientific and Technological Research Council; TTGV—Technology Development Foundation of Turkey

**Table 10.2** Key figures for Izmir universities

| | Dokuz Eylül Uni (public) | Ege Uni (public) | Izmir Inst. of Tech. (public) | Izmir Uni of Econ. (private) | Yasar Uni (private) | Gediz Uni (private) | Izmir Uni (private) | Katip Çelebi Uni (public) | Total |
|---|---|---|---|---|---|---|---|---|---|
| No. of faculties | 14 | 14 | 3 | 7 | 7 | 5 | 7 | 12 | 69 |
| No. of institutes | 10 | 9 | 1 | 3 | 2 | 2 | 3 | 3 | 33 |
| No. of research centres | 11 | 11 | 5 | 5 | 3 | 1 | 1 | 3 | 40 |
| No. of high schools | 11 | 17 | 0 | 4 | 3 | 1 | 4 | 3 | 43 |
| No. of lecturers | 3365 | 3169 | 510 | 409 | 424 | 292 | 340 | 716 | 9225 |
| No. of students | 67,203 | 56,716 | 4081 | 7605 | 7525 | 6978 | 5061 | 4636 | 159,805 |
| Student/lecturer ratio | 20 | 18 | 8 | 19 | 18 | 24 | 15 | 7 | 16 |
| No. of researchers | 1640 | 1698 | 186 | 165 | 181 | 117 | 202 | 347 | 4436 |
| No. of papers URAB index point (2014–2015) | 285.47 | 314.72 | 255.27 | – | 72.60 | – | – | 63.59 | |
| No. of research projects registered at TUBITAK (2013–2014) (submitted/accepted and success rate) | 337/80 24% | 672/167 25% | 181/61 34% | 31/5 16% | 24/6 25% | 35/5 14% | 22/2 9% | 104/29 28% | 1386/355 26% |
| No. of engineering departments (2015) | 11 | 9 | 10 | 7 | 5 | 6 | 4 | 9 | 61 |
| Entrepreneurial activities (country ranking 2015) | 23th | 15th | 8th | 39th | – | – | – | – | |

Source: based on 2011 data (unless otherwise specified) provided by the Student Selection and Placement Centre (OSYM), the Council of Higher Education (YOK), the Scientific and Technological Research Council of Turkey (TUBITAK) and the Ministry of Science, Industry and Technology

URAP[6]). The higher quality of education and resources in public universities, together with the lower tuition fees, makes them the first choice for prospective students, and therefore, access to public universities is highly competitive.

The university R&D potential is concentrated mainly in the engineering departments and in university research centres and institutes:

- *Engineering departments* are more numerous in the public universities than in the private ones, as shown in Table 10.2. Most engineering departments are in computer sciences, electrical-electronics, mechanical, civil, industrial and software engineering. Biomedical and bioengineering departments are only emerging in Izmir, just like in the rest of the country. Izmir's bioengineering department was the first one of its kind in Turkey. Engineering departments concentrate the largest number of researchers (682), especially in the mechanical, computer, electrical-electronic and civil engineering departments, while software and bioengineering have much lower numbers (Izmir Development Agency and Ege University Science and Technology Centre 2010). The engineering departments have good research and technical infrastructure that provides technical support to industry, but they contribute little to the diversification and modernisation of science and technology-based industrial sectors in the region and in the country, because of weak links with industry, with other university departments and other universities, and a relatively low degree of research specialisation and diversification (*ibid.*). The technologies generated by these departments have been exploited in an increasing number of start-ups in the recent 6 years, due to the new R&D and innovation policies and new technoparks that facilitated this development.
- *University research centres (40)* are only present in three public universities, as shown above in Table 10.2. They provide services to industry partners in different sectors, and perform joint research or contract research. Each research centre has its own staff and budget, which is mostly public, with a very small share of own revenues. This makes most of them unable to be self-sustainable.
- *University institutes (33)* provide Master's and PhD education, conduct research and serve industry in the energy, informatics and healthcare sectors. Another eight institutes have been established in universities under different ministries, and provide tests and laboratory services.

R&D-support activities, such as training technicians for R&D and innovation projects, are provided by several vocational high schools (2-year education) and high schools (4-year education) that operate within Izmir's public and private universities. These schools provide relatively similar training programmes and have weak connections with business, which limits their effectiveness.

[6]URAP Research Laboratory of the Information Institute of Middle East Technical University has released yearly world rankings of 2000 higher education institutions since 2010 (http://www.urapcenter.org).

**(ii) Public Research Organisations**

Izmir has eight public research centres[7] that are affiliated to different ministries and are funded from the state budget, and eight other research centres that are established in universities (four at Ege University and four at Dokuz Eylul University) and are funded by the Ministry of Development under specific support programmes. These centres conduct basic research that is expected to provide input for applied research in the university, and they also cooperate with private companies. The centres are equipped with technological lab equipment that can provide services to industrial partners in Izmir and beyond, in the whole country. However, these centres have little visibility among industrial partners because of highly bureaucratic procedures and slow reaction to market requests, since they are not strongly motivated by profit-making.

**(iii) R&D-Performing Enterprises**

R&D-performing enterprises account for a low share of Izmir enterprises—only 15% have intra-mural R&D departments (Izmir Development Agency-Turkish Statistical Institute 2011). In 2010, eight enterprise R&D centres were established in Izmir under the *Law on Support to R&D Activities* (see Table 10.1, Priority 2), which gives a special regime to intra-mural R&D centres in enterprises,[8] but at present, the number of such R&D centres reached 18, thanks to the positive impact of the law on the host enterprises. They are active mainly in Chemicals, Machinery, Automotive and Automotive spare parts, and Textile, and employ a total of 688 R&D staff, placing Izmir fifth after Istanbul, Bursa, Kocaeli and Ankara.

R&D expenditure and R&D personnel have grown continuously in recent years, determining a constant increase of output indicators such as new goods and services, and patents (Izmir Development Agency 2012, p. 62). At sectoral level, however, there are some significant variations among R&D and innovation indicators (Table 10.3), which are determined by specificities of the R&D and innovation market in Izmir and more broadly, in Turkey. For example, Chemicals emerged as one of the most innovative sectors in 2007–2010, with the highest numbers of R&D departments and patent applications, and second highest in terms of PhD personnel and capacity to produce new goods and services, but was very low in R&D expenditure. This is due to the presence of large enterprises that are leading this sector (four of them are among the first big 20 companies in Turkey). They have high total expenditures, but their R&D expenditures remain low as a result of economies of scale and market bargaining power that keep the costs of R&D and innovation projects low. Such enterprises generally produce incremental

[7]Bornova Veterinary Control and Research Institute, Bornova Pesticide Control Research Institute, Aegean Forestry Research Directorate, ETAE—Aegean Agricultural Research Institute, İzmir Provincial Directorate of Control Laboratory, İzmir Agricultural Quarantine Directorate, UTAEM—Agricultural Research and Education Centre, and Olive Cultivation Research Station Directorate.

[8]They are government-subsidised, tax-exempted, need to employ minimum 50 FTE as R&D staff graduated from a 4-year university.

**Table 10.3** Sectoral R&D and innovation indicators (2007–2010)[9]

| | R&D departments (% of enterprises) | R&D expenditure (% of average turnover) | PhD personnel | Provision of new or significantly developed goods and services (% of enterprises) | Patent applications |
|---|---|---|---|---|---|
| Chemicals | **25** | 1.7 | 14 | 29 | **90** |
| Industrial HVAC (heating, ventilation and air conditioning) | 19 | 0.8 | 1 | **31** | 47 |
| Biomedical | 13 | 4.6 | 3 | 29 | 62 |
| Informatics | 12 | **10** | **19** | 26 | 65 |
| Renewable energy | 8 | 2.2 | 0 | 13 | 0 |
| Processed fruits and vegetables | 7 | 0.6 | 3 | 10 | 22 |
| Textile | 2 | 3.1 | 5 | 16 | 21 |

Source: Izmir Development Agency-Turkish Statistical Institute (2011)
Highest values for each indicator highlighted in bold

innovation, responding to specific customer needs. In contrast, the Informatics sector has the highest R&D expenditure and employs the largest numbers of R&D personnel, far ahead other sectors, but scores lower in terms of new goods and services. This is an effect of their location in technoparks, which require resident enterprises to allocate high R&D resources and attract higher numbers of R&D personnel in order to be eligible for this location and maintain it. The Industrial HVAC (heating, ventilation and air conditioning) sector has one of the lowest R&D expenditure shares, but ranks 2nd in terms of number of R&D units and 1st in the provision of new goods and services. This is due to the presence of some large enterprises with low R&D expenditure, similarly to the Chemicals sector, and also to a merger of the R&D and manufacturing departments, which allows a shared use of R&D and manufacturing staff and shared costs of some R&D and production operations, thus reducing R&D expenditure. The Biomedical sector, a very R&D-intensive sector, scores high in R&D expenditure and patent applications, but very low on PhD personnel, because they run most of their R&D projects in universities, together with university researchers, which reduces the pressure to hire own PhD researchers. The Renewable energy sector has no PhD

[9]Latest data is available for Izmir.

personnel and no patents, which is related to the nature of enterprises in this sector: some are large international companies which run their R&D and innovation projects abroad and only do manufacturing and assembly in Izmir, while others are small and act as service providers or subcontractors to the large enterprises, without being involved in innovation projects.

### 10.3.2 The Innovation Space

The Innovation Space is characterised by the presence of institutions and individuals that transform R&D results into innovative products, processes and services, develop local innovative firms and entrepreneurs, and create competitive advantage for the region and the country. The Innovation Space is shaped by policies and programmes that provide regulations, incentives and funding for innovation, innovation infrastructure and services (e.g. for marketing intellectual property, support for spin-off firms, for identifying market opportunities and partners), and bring together local and regional governments (Ranga and Etzkowitz 2013).

**The Policy Framework**

The Innovation Space in Izmir's RIS system has been shaped largely by the same policies described for the Knowledge Space (see Table 10.1). Specific programmes of relevance for the Innovation Space are: the *R&D, Innovation and Industrial Application Support Programme* that helps technology start-ups hosted in technology incubators established in cooperation with universities and local chambers, the *Technopreneurship Support Programme*, the *Industrial Thesis (San-Tez) Project Support Programme* that assists students developing Master's and PhD theses that address industry needs, *the Individual Young Entrepreneurial Support Programme* and the *Technology Transfer Support Programme (1513)*. The *Law of Technology Development Zones* (TDZ) is also important, as it provides tax exemption for R&D activities of technopark tenants. The establishment of technoparks in universities and/or research centres, and the provision of incentives to researchers to work with on-park private companies is at the core of the TDZ.[10]

Specific programmes for entrepreneurship and start-up creation include the *Support Programme for Technology-and Innovation-focused Entrepreneurship* and three KOSGEB programmes: (1) *Education of Applied Entrepreneurship,* (2) *Support for New Entrepreneurs* and (3) *Support for Business Development Centres and Other Supports*. Academic researchers are eligible for these programmes, but only few of them are actually involved, because of high teaching engagement. Entrepreneurial students and newly-graduated students can also

[10]Academic researchers can start a company only in a technopark/TDZ, upon permission from the University Executive Board, for the purposes of commercialising research results, become a partner in an established company, and/or take positions in the management of such companies. If the company is set up outside of a technopark/TDZ, the researcher is penalised with a 50% salary reduction.

benefit of the first and second programme. Other nation-wide schemes that encourage the creation of start-ups by undergraduate/graduate students and young graduates are the *Technopreneurship Capital Support Programme* and the *Individual Young Entrepreneurship Support Programme (BIGG)*. All of these programmes are available in big universities in Izmir, such as Ege, Dokuz Eylül and Izmir High Technology Institute. Apart from these national programmes, there is also a notable local initiative—Ege University's new Department of Innovation and Entrepreneurship that was established to improve engineering students' skills in these areas and prepare them for company creation after graduation. This department is the first of its kind in Turkey and is expected to increase the entrepreneurial level of the university. It provides four elective courses to students in the faculties of Engineering, Agriculture, Medicine and Pharmacy.

Notable transformations have also taken place in university technology transfer. This is a relatively new area in Turkey that started to receive significant government support after 2011, when the Scientific and Technological Research Council (TUBITAK) adopted new policies for national R&D and innovation. Before that, technology transfer was relatively unknown in Turkey, where the usual term was 'university-industry collaboration'. That was typically ensured by university-industry cooperation centres, generically named "interface organisations" that were all serving basically the same main purpose of encouraging contract research and contacts with industry. Such centres came to existence in the 1980s, but gained in importance after the 1996 launch of TUBITAK's *University-Industry Joint Research Centres Programme (USAMP)*. In 2012 TUBITAK introduced a major *Support programme for university technology transfer offices* (TTOs), where the best university TTOs are selected annually based on specific criteria and are granted TL 1m (approx. €312.000) per year for 10 years. This amount covers 80% of the TTO's budget, and the remaining 20% is covered by the TTO. TTOs are run by universities and aim to stimulate contract research, patenting and spin-off creation. In addition, TTOs also provide entrepreneurial training for researchers and students, organise information and awareness activities, assist entrepreneurial researchers and manage partnering events and the IPR portfolio of universities. In 2014, a *TTO Mentorship Programme* was introduced for 'candidate' TTOs,[11] as well as a *Patent Grant Programme,* covering application and report search fees, and a compensation upon patent granting. In Izmir, there are three university TTOs which received support from TUBITAK: the first was Ege University's TTO (EBİLTEM-TTO) in 2013, followed by Dokuz Eylül TTO (DETTO) and Izmir High Technology Institute's TTO (Atmosphere TTO) in 2014.

Technology transfer activities have become core events of universities since 2012, after the introduction by the Ministry of Science, Industry and Technology of the *Entrepreneurial and Innovation Index of Universities*. The index provides an annual ranking of 126 universities on the basis of 23 indicators spread over

[11]These two TUBITAK programmes currently support 34 TTOs, of which 24 belong to public universities and 10 to private ones.

five dimensions, one of them being economic contribution and commercialisation.[12] The index is very important because only the TTOs of the top 50 universities ranked by this index are eligible for TUBITAK funding. In Izmir, only four universities have managed to get into the top 50 universities (three public universities and one private).

**The Actors**

In Izmir, the most important actors of the Innovation Space are: (i) innovative enterprises; (ii) university TTOs; (iii) technoparks; and (iv) other innovation support institutions, such as chambers of commerce, professional associations, unions and federations, and Organized Industrial Zones (OIZ).

**(i) Innovative Enterprises**

The relatively low R&D potential in Izmir enterprises that was mentioned earlier in the Knowledge Space translates into low levels of innovation: only 25% of Izmir enterprises perform innovation activities and a very small share (5%) do radical innovation. Innovative products new to the company account for 26%, those new to the market for 13%, and those new to both for 19%. Enterprises operating in an open innovation model represent only 7% of the total enterprise population. Product innovation is the predominant form of innovation, with 14% of enterprises conducting R&D and innovation for producing and developing new goods, and only 5% are producing and developing new services. As a result, the services sector in Izmir is also underdeveloped (Izmir Development Agency-Turkish Statistical Institute 2011). In-company innovation training for employees is a rare occurrence, as companies do not usually do such programmes unless they are compulsory or linked to production. In some cases, employees attend various training programmes, seminars, etc. held by universities, chambers of commerce and other organisations.

**(ii) University TTOs**

The most developed TTOs are located in the public universities of Izmir, which are included in the country's top 50 entrepreneurial universities (Ministry of Science, Industry and Technology 2012):

- *EBILTEM Science and Technology Centre—the TTO of Ege University* (est. 1994) is the most developed in terms of activities, staff (43) and international presence. The centre assists university researchers and local companies, and also helps students start companies and gain company experience through the *Industrial Experience Certificate Programme* and the *Industrial PhD Programme in Biomedical Technologies* that it coordinates. EBILTEM-TTO has been

[12] Competence in scientific and technological research (20%), pool of IPR (15%), collaboration and interaction (25%), entrepreneurial and innovative culture (15%), and economic contribution and commercialisation (25%).

regionally and nationally recognised as a unique University-Industry interface organisation in Turkey and received 10-year funding from TUBİTAK's *Support Programme for Technology Transfer Offices* to develop its technology transfer activities.[13]

- *Atmosphere—the TTO of Izmir High Technology Institute* (est. 2013) operates under the institute's technopark and provides technology transfer services to the institute's incubated companies and researchers with the help of eight full-time staff.[14] Atmosphere TTO also assists researchers and companies in accessing national and international research projects and R&D grants. As the focus of the institute's technopark is on ICT and most companies are active in the ICT sector, Atmosphere TTO is also trying to specialise more in ICT and related sectors.
- *DETTO—the Technology Transfer Office of Dokuz Eylül University* (est. 2013) operates under the university technopark's DEPARK and serves researchers and the park's incubated companies. DETTO started to receive funds from TUBITAK's TTO Support Programme in 2014 and currently provides all the services defined by TUBITAK to researchers and companies mainly in DEPARK. It has 12 full time staff.[15]

Besides these three TTOs that receive support from TUBITAK, there are other TTOs in four private universities (Izmir Katip Celebi University, Izmir University of Economics, Yasar University, University of Izmir and Gediz University) that were established in the last 2 years. Their main mission is to increase tech transfer awareness among university researchers and include their universities in top 50, as ranked by the Entrepreneurial and Innovative University Index of Turkey, in order to become eligible for TUBITAK's TTO support programme. Currently, they employ very low numbers of full-time staff.

**(iii) Technoparks**

- *Izmir Teknopark* (est. 2002) is located in the Izmir Technology Development Zone (TDZ) on the campus of Izmir Institute of Technology. It became fully operational in 2004 and has as shareholders all universities of Izmir. It is the fourth largest technopark in Turkey and hosts 145 domestic and foreign R&D companies with 900 employees and an estimated value of TL 266 million turnover and $20 million export.[16] The technopark companies are active in a broad range of sectors: software development, biotechnology, electronics, machinery manufacturing, defence, energy, healthcare, design, chemistry, telecommunications, advanced materials, food, mining, nanomaterials, automotive, robotic systems, tourism, and environment. Thanks to their technopark location, these companies have important facilities and tax incentives. In 2013,

[13] http://ebiltem.ege.edu.tr/ENG/

[14] http://www.atmosfertto.com/en/

[15] http://detto.depark.com/

[16] http://teknoparkizmir.com.tr/about-us

Izmir Technopark was distinguished with the 2nd Award of the Ministry of Science, Industry, and Technology.

- *Dokuz Eylül Park DEPARK* (est. 2013) is located on the university's engineering and medical campuses. It is the second technopark in Izmir, and has 13 shareholders from university, industry and NGOs in Turkey. Currently it hosts 56 companies that are active mainly in ICT, electric-electronics, software and health. These companies also benefit from tax incentives. In 2014, DEPARK was distinguished with the 1st Award of the Ministry of Science, Industry, and Technology in the early-stage technoparks category.
- *Izmir Science Park* (est. 2013) is a part of Izmir University of Economics and the third technopark in Izmir. It is the only technopark with an off-campus location, i.e. in an Organized Industrial Zone which provides larger space for mass production to on-park companies. It has 16 shareholders such as universities, Chambers of Commerce, Chambers of Industry, Stock Exchange, etc. As the park is trying to enhance its infrastructure, it accepted only a limited number of companies—22 as of 2016—that are active in renewable energies (solar, geothermal and wind).
- *IdeEGE.TGB* (est. 2014) is located on the Ege University campus and was established by the Ege University, which holds 100% equity. This made the technopark the first one with single ownership in Turkey. It is managed by a 13 member-board, with 6 university representatives and 7 from the private sector. It currently hosts 40 companies that are active in life sciences and health (52%), ICT (28%), materials (10%), electric-electronics (7%) and others (3%).

The technoparks are expected to strengthen university-industry links, which are quite weak at present. 81% of Izmir enterprises are not engaged in cooperation with universities and research centres, and only 5% of enterprises originate ideas for their innovation projects in university (Izmir Development Agency-Turkish Statistical Institute 2011). By sector, the highest level of university-industry cooperation was identified in the Biomedical sector (27% of enterprises), followed by Renewable Energy (21%), Chemicals (19%), Processed Fruits and Vegetables and Industrial HVAC (18%), Informatics (17%) and Textile (8%) *(ibid.)*. Of the 263 companies hosted by Izmir's four technoparks, only 62 are academic startups. The total number of university patents increased after the establishment of TTOs. Only Ege University has over 130 patent applications and 64 of them were recorded after 2013. Despite good numbers of patent applications, only 1% of them are triadic patents and the numbers of patents licensed by the local TTOs is very limited. The underdeveloped state of university-industry cooperation is largely caused by the early development stage of the local entrepreneurial environment, lack of VC and angel investments, shortage of qualified TTO managers and difficulty to recruit them from outside the university because of low and fixed salaries.

The weak culture of collaboration is determined by multiple reasons. *On the university side*, the lack of mechanisms and incentives to support university-industry cooperation was reported as the most significant obstacle by 63% of

Izmir universities, followed by high engagement of academics in teaching activities, leaving little time for entrepreneurial projects, and a weak motivation for engaging into such projects, as they are not considered in academic promotion (Izmir Development Agency-Ege University Science and Technology Centre 2011). *On the industry side*, the weak links with universities are caused by incremental innovation and limited cooperation that are predominant in Izmir enterprises. Only 19% of enterprises reported collaborative links with universities and indicated that cooperation was primarily driven by the need to increase the quality of existing products, get access to test and analysis services provided by universities, and to students and graduates. Cooperation aimed to develop new products with universities was ranked only 4th (*ibid.*).

**(iv) Other Innovation Support Institutions**

The most important innovation support institutions in Izmir include: chambers (e.g. Izmir Chamber of Agriculture and the Chamber of Industry of the Aegean Region), professional associations, unions and federations, a European Business Development Centre (ABIGEM), and six Organised Industrial Zones (OIZ). The first OIZ in Izmir (Atatürk OIZ) was established in 1990 and has grown into one of the largest and most modern production, employment and export centres in Turkey. The innovation support provided by these institutions to their members is limited, as only 30% of them have innovation policies and 90% lack a system for monitoring the innovation activities of their members (Izmir Development Agency and Ege University Science and Technology Centre 2011). In addition, they have insufficient technical infrastructure and human resources, so that most of the services offered consist of training courses and information on risk capital, EU grants, public funding for innovation, etc. About a third of the innovation support institutions are able to assist with the preparation of joint R&D and innovation projects between members, and provide support for IPR, project management, technology transfer and licensing. Many of these institutions have a better communication with universities (60%) than with own member enterprises (35%), but the communication seems to be unilaterally directed to members, which weakens considerably the effectiveness of the support services provided *(ibid.)*.

### 10.3.3 The Consensus Space

The Consensus Space was defined as the set of actors and activities that bring together innovation stakeholders to initiate and evaluate proposals, find resources and negotiate shared objectives for the advancement of a knowledge-based regime. The Consensus Space relies on networking, collaborative leadership and conflict moderation, generation of ideas and cross-fertilisation of diverse perspectives, all aiming to improve innovation governance in a broader sense (formal and informal governance) and shift the state boundaries towards more transparent delineations between public, private and voluntary sectors (Ranga and Etzkowitz 2013).

***Networking*** in formal and informal structures at national, regional and international level is an important form of achieving a Consensus Space. In Izmir, organisations use their networks mostly for marketing or for enhancing own members' activities, and only rarely for collaboration with other networks. Networks are most often built horizontally, among institutions of the same type (e.g. universities with other universities), regionally, nationally and internationally, and rarely expand to include institutions of other types (e.g. chambers of commerce). The TTO of Ege University—EBILTEM Science and Technology Centre—has been at the forefront of networking activities at regional, national and international levels, having promoted links with several international networks, forged international consortia in several EU projects and programmes, and concluded MoUs with a large number of leading international organisations.

***Collaborative leadership*** is illustrated by the activities of three local actors. *Izmir Universities Platform* was established in 2008 to strengthen Izmir's position as a 'city of universities' through collaboration and dialogue. The platform brings together the nine local universities under the leadership of Ege University. Key activities include joint projects, promotion of solidarity between the universities in academic, social, and cultural fields, the 'Izmir Universities Festival' and the 'Agora Cup', faculty exchange programmes and joint student research, collaboration with the community, the local and central government, the chambers, civil society, etc. Izmir Universities Platform also oversees the 'Study in Izmir' group, led by the International Offices of the member universities, which promotes the city as a destination for local and international staff and students.[17]

*Izmir Council of Executives* was established in 1995 by 22 heads of organisations (chambers, exporter associations, businessmen associations etc.) to stimulate the city's growth and find solutions for its problems and needs. To date, the Council actively promoted some major events in Izmir (e.g. Izmir UNIVERSIADE 2005, the establishment of Izmir Development Agency and Izmir Derivatives Exchange) and brought the city's problems to the attention of public authorities. The Council also plays a role in moderating some institutional conflicts arising in a large metropolitan city like Izmir, by meeting people, visiting organisations and using their authority for conflict resolution.

*The Supreme Board for University-Industry Collaboration and Coordination (USKK)* was established in 2000 under the leadership of the Aegean Regions' Chambers of Industry, and currently has 11 members from six universities in the Aegean Region.[18] The board aims to accelerate university-industry collaboration in Izmir, identify and report obstacles to policy-makers, provide feedback to national organisations and find new tools for successful collaboration.

[17]Selected from http://studyinizmir.com/about-the-university-platform/

[18]http://www.ebso.org.tr/kurumsal/media/uskk.pdf

## 10.4 Discussion

Our examination of the rapidly developing Izmir RIS was guided by two main questions: *(i) What are the key factors that have driven the development of Izmir's RIS so far? and (ii) How can the transition from a nascent to a mature RIS be accelerated?* These questions are addressed below.

**(i) What Are the Key Factors that Have Driven the Development of Izmir RIS so Far?**

To answer this question, Izmir RIS was examined from the fine-grained perspective of the three Spaces of a Triple Helix System, i.e. the Knowledge Space, the Innovation Space and the Consensus Space. For a complex representation, the picture was then complemented by insights derived from three other RIS typologies provided by the literature, which are based on: integration into internal and external environments (Asheim and Isaksen 2002), regional barriers to innovation (Tödtling and Trippl 2005) and regional development stage (Etzkowitz and Klofsten 2005). Below is a discussion of findings resulted from each of these approaches.

a. The examination of the three Spaces led to the following main findings:
   - *There are important differences in development stage of the three Spaces, coming especially from their different age and degree of institutional building*. The Knowledge Space is relatively compact, with older and well-established institutions (e.g. public universities were created from the mid-1950s to the mid-1990s, private universities since the early 2000s) and employ large numbers of permanent staff. The Innovation Space is comparatively more heterogeneous. It has, on the one hand, a relatively limited share of innovative enterprises (25%) and enterprises with intra-mural R&D departments (15%) that score low on R&D and innovation indicators (see Izmir Development Agency-Turkish Statistical Institute 2011). On the other hand, there is a growing number of interface organisations, which, with minor exceptions, have been created in the last 2–3 years (e.g. most university TTOs and most technoparks set up from 2013 onwards, mainly as a result of top-down policy drivers), employ relatively low numbers of permanent staff, and are only now building their capacities in technology transfer, innovation and entrepreneurship. Consensus Space institutions have been created over a larger period, starting from the mid-1990s to late 2000s, but have a weak and unspecific focus on innovation and promote collaboration mainly among institutions of the same type and in the same sector (e.g. universities, chambers, professional associations, etc.) with narrow involvement of industry. There is, thus, a notable advance of the Knowledge Space, with a fast catch-up of interface organisations in the Innovation Space in recent years, and a weak and unspecific innovation focus of the Consensus Space.

- *There is a comprehensive, high-density institutional structure in the Knowledge Space; a less dense but rapidly growing one in the Innovation Spaces; and a comparatively thinner one in the Consensus Space:* for example, in the Knowledge Space there are nine (public and private) universities with 40 research centres, 33 institutes and several R&D support institutions, 16 public research organisations, several R&D-performing firms and 18 enterprise R&D centres. The Innovation Space counts seven TTOs, four technoparks a large number of innovation support institutions, six Organised Industrial Zones (most of them very recent) and several large companies that are leading actors in the local industries (four of them are also among the first big 20 companies in Turkey). The Consensus Space has relatively few representative structures.
- *Greater institutional capacity does not necessarily mean improved performance*. For example, in the Innovation space, although regional R&D and innovation performance indicators are quite few and most of them are not up-to-date to allow a detailed assessment, on the basis of existing information one could identify a slow, but positive trend in performance. For example, a continuous growth in R&D expenditure and R&D personnel was reported in recent years, that determined a constant increase of output indicators such as new goods and services, and patents (Izmir Development Agency 2012: 62). The relatively low levels of performance indicators are caused by a variety of institutional, management and regulatory obstacles and limitations, low general awareness and culture of innovation and entrepreneurship, and a narrow range of services and innovation policies in the support institutions. Gradual improvements in performance indicators can be expected once with corrections or removal of these obstacles.
- *There is an uneven distribution of resources (human, financial, infrastructure, etc.) between the Knowledge and the Innovation Spaces*. This is to a large extent an effect of the older age and more established status of the Knowledge Space, as shown above, but is also a consequence of the different importance attached to R&D and innovation in university and in industry. For example, in terms of R&D personnel, universities concentrate the largest numbers of researchers, especially in the engineering labs, while industry researchers are much fewer, because of the low R&D orientation of enterprises, unattractive salaries and frequent mismatch between PhD researchers' qualifications and industry needs. Across industry sectors, the number of researchers also varies, as explained in Sect. 10.3.1. One can also add here the fact that innovation has been formally recognised as a policy priority in recent years, and that made possible the allocation of considerable funding for innovation objectives (see e.g. TUBITAK's support programme for university TTOs, which provides grants of TL 1 million/approx. 312.000€ per year for 10 years to the best university TTOs), but it is still too early to see significant accumulations in infrastructure, personnel, etc.
- *There are relatively low levels of diversification and specialisation* in the activities and/or services provided by the actors of all three Spaces.

- *There are weak university-industry links and institutional communication, in general, among actors both within and among Spaces*. On the university side, this is a consequence of weak motivations for cooperation and insufficient incentives to correct that, in addition to a high engagement of academics in teaching, that leaves little time for entrepreneurial projects. On the industry side, academic inputs to product and process development and staff recruitment are limited, and innovation is mainly based on customer feedback.
- *At the policy level, there is a comprehensive R&D and innovation policy framework*, with a strong top-down approach and very few bottom-up initiatives. The focus on innovation is much more recent than the focus on R&D, and has seen two significant shifts in the current National Science, Technology and Innovation Strategy 2011–2016: (i) a shift from a general to a sectoral focus in R&D and innovation policy, with several priority sectors and adoption of National R&D and Innovation Strategies in the sectors of energy, water and food; and (ii) a shift from research to innovation and more substantive efforts to turn research outputs into products and services.
- *The three Triple Helix Spaces co-evolve, shaping and influencing each other*. For example, universities, as the older and more established institutions of the Knowledge Space, provided the foundation on which most of the Innovation Space institutions (e.g. university TTOs and technoparks located on university campuses) have been built in recent years. They also provide a large part of the Consensus Space leadership, as exemplified by the Supreme Board for University Industry Collaboration and Coordination (USKK), which was established under the leadership of the Aegean Regions' Chambers of Industry and includes six regional universities. This suggests an evolution sequence of the type Knowledge → Innovation → Consensus Space, with various transitions among the spaces that occur as a non-linear process and at different speeds, specific to the reaction time of each individual space.

b. The above picture of Izmir RIS can be complemented by insights from other theoretical angles:
   - From the perspective of Asheim and Isaksen's (2002) typology based on the integration of RIS into internal and external environments, Izmir RIS can be considered a *regional networked innovation system* that is characterised by localised, interactive learning and embeddedness of firms and organisations in a region with specific characteristics and with a local 'supporting' institutional infrastructure. This categorisation is justified by the presence of a large number of firms, universities, and support institutions particularly in the Knowledge and Innovation Spaces, as discussed above, which have seen considerable improvements in recent years thanks to R&D and innovation policy drivers at national and regional level. While our study did not find evidence for emerging local clusters, it was, however, evident, that relations between (innovative) firms, universities, public research institutes, TTOs, technoparks, etc. did increase, albeit slowly, in recent years and may lead in a not so distant future to an aggregation of local clusters. The regional networked innovation system represents an endogenous development model

that can indeed prove successful in increasing Izmir's innovation capacity and collaboration through policy instruments, but also points out to some weaknesses that need to be addressed. We refer in particular, to the need to complement the localised learning with a more open and internationalised learning process, based on enhanced links with national and international partners, and grounded on enhanced R&D and innovation competences.

- From the perspective of Tödtling and Trippl's typology (2005) based on regional barriers to innovation, Izmir's RIS could be considered as a *fragmented RIS*. That corresponds to metropolitan regions with relatively little interaction between local actors and weak industry-science relations, in spite of numerous educational and scientific organisations and technology firms. Indeed, we retrieve in Izmir's RIS virtually all the characteristics of a fragmented RIS as described by Tödtling and Trippl (2005): in spite of a large number of local industries/services, there is no solid evidence of knowledge-based clusters in the region; in spite of some local concentrations of R&D capacities in local enterprises (e.g. 18 enterprises R&D centres established under the Law on Support to R&D activities, intra-mural R&D departments in 15% of R&D-performing enterprises), product and process innovations are still low, incremental innovation is prevalent, and new firm formation is limited. In spite of a large number of universities, university centres, public research institutions, R&D-support institutions, the degree of research specialisation and the diversity of services offered to industry and university-industry links are limited. Networks are used mainly for marketing or promoting individual interests of the members, and only rarely for collaboration with other networks, and rarely move from a horizontal, mono-institutional type to a multi-institutional type.
- From the perspective of Etzkowitz and Klofsten's (2005) typology based on the development stage, Izmir RIS can be considered to be in *the implementation stage*, where new activities and infrastructure are developed for different types of entrepreneurs, but can also be in a gradual transition to the next development stage, that of *consolidation and adjustment,* characterised by enhanced cooperation between actors and integration of activities to improve the infrastructure efficiency. The implementation stage is demonstrated by the various forms of innovation and business support that are currently added to the basic institutional infrastructure, especially in the Innovation Spaces (e.g. TTOs and technoparks, a new Department for Innovation and Entrepreneurship recently established in a local public university—the first of its kind, a wide range of government support programmes for entrepreneurship, etc.). Through their activities, these institutions operate as key "agents of change" on the local scale, and ensure the gradual transition to the consolidation and adjustment stage, characterised by stronger cooperation between local actors, closer links with firms, enhanced firm formation, improved networking, and more meetings at the level of formal and informal governance to pool resources, redefine roles and ensure consensus. This confirms the role of the Innovation Space in consolidating the Consensus Space that emerged from the analysis of Izmir RIS from the Triple Helix Spaces perspective.

Corroborating the evidence presented above, one can conclude that the key factors that have driven the current development of Izmir RIS are the structure and co-evolution of actors, institutions, activities and resources (human, financial, infrastructure, etc.) in the three Spaces of Izmir's Triple Helix system, each with its own peculiarities and dynamics, as described above. The structure of the Spaces and their co-evolution represented a fertile terrain for the implementation of a comprehensive set of national R&D and innovation policies since 2011, and for pursuing the recommendations of the Regional Innovation Strategy produced in 2012 by the local RDA. One can speak thus of a combined effect of national and regional policies that amplified each other, with positive effects on the region.

**(ii) How Can the Transition from a Nascent to a Mature RIS Be Accelerated?** In order to provide a clearer picture of what a mature RIS encompasses, our analysis took as reference six institutional foundations that support innovation-based economic growth (Dasher et al. 2015): (i) a financial system that provides funding for risky ventures; (ii) a labour market that provides high-quality, diverse and mobile human resources; (iii) interactions between industry, universities, and government to generate a constant stream of innovative ideas, products, and businesses; (iv) industrial organisation where large established firms and small start-ups grow together; (v) a social system that encourage entrepreneurship; and (vi) professionals that assist the establishment and growth of start-ups.

On a general level, advancements in these six institutional foundations arise from advancements in all three Spaces, in a synergic effect. On a more fine-grained analysis, though, it becomes apparent that some institutional foundations are more closely related to the Knowledge Space (e.g. ii and iii), while others pertain more to the Innovation Space (all the remaining four). Similarly, some foundations are more relevant to the Consensus Space than others (e.g. iv and v).

For example, *in the Knowledge Space*, it is of utmost importance to improve the connection between education, research and the labour market, as well as the quality and mobility of university graduates and R&D and innovation personnel. To that end, it is necessary to increase the quality of education and research, the attractiveness of research careers, the degree of research specialisation and interdisciplinarity of academic research, the number and salaries of industry researchers and the overall number of active researchers. It is also necessary to increase the diversification of services to industry offered by the engineering departments and their capacity to generate technologies that could be exploited commercially through university spin-offs. Public research organisations need higher visibility, more dynamism and less bureaucracy in the interaction with industrial partners. University-industry links also need a significant boost. A good example of incentives in this sense is the new *R&D Reform Package* that was recently approved by the Parliament, that is expected to stimulate university-industry collaboration. One of the provisions of the package allows academics involved in any type of R&D collaboration with industry to receive 85% of total payment made by industry (up from 55% previously). Also, the income tax was reduced from 45 to 15% in order to increase researchers' income from the collaboration with industry.[19] It is also necessary to reduce fragmentation and complement localised learning with a more open and internationalised learning process, based on enhanced links with national and international partners, and enhanced R&D and innovation competences.

*In the Innovation Space,* continued efforts are needed to increase the innovation capacity of local firms, by stimulating product and process innovation, in-company innovation training for employees and the development of the services sector. Also, the links between large established firms and small start-ups need to be strengthened, e.g. by stimulating joint participation in programmes funded by the national government of by the regional authorities. Furthermore, innovation support institutions need a boost, by introducing adequate monitoring of the innovation activities of their members, and a higher degree of diversification and specialisation in their services. In order to create a social system that encourages entrepreneurship, is necessary to foster an innovation and entrepreneurship culture, ensure professional training of technology transfer managers and facilitate their recruitment from outside the university by providing attractive salaries and recognition of their work, attract professionals who can assist the establishment and growth of start-ups, and introduce alternative sources of funding for risky ventures (e.g. venture capital, business angels). Some improvements to the current IPR regime is expected to come from an amendment to the Turkish Patent Law, aimed to make it similar to the US Bayh-Dole Act. The amended Patent Law will give universities ownership of the IPR resulting from government-supported research, and the academic inventions will automatically be categorised as service inventions. Universities will cover the patenting costs and, in case of licensing, a certain percentage will go to the inventor. The new law is expected to increase IPR awareness and support to academics, as well as the number of university patents and patenting costs, but is unlikely to bring immediate revenues from patenting.

*In the Consensus Space*, action is needed to ensure a more specific focus on research and innovation in the organisations involved in formal and informal governance of local activities, stimulate networking and collaborative leadership among large established firms, small start-ups, universities and public research organisations, professional associations, civil society representatives, etc., and encourage bottom-up initiatives.

## 10.5 Conclusions

Izmir RIS has seen fast improvements in its regional R&D and innovation capacity in recent years that have been triggered by high-impact national and regional R&D, innovation and entrepreneurship policies that have been implemented in a relatively

[19] http://www.dailysabah.com/money/2016/01/15/new-reform-package-lowers-cost-in-rd-for-turkish-companies; http://www.invest.gov.tr/en-US/infocenter/news/Pages/220216-turkey-new-r-d-reform-package-launched.aspx

well-defined Triple Helix System. If the main policy orientation so far has been on strengthening R&D and innovation potential and institutional capacity-building in industry and academia, technology transfer and entrepreneurship, university-industry links, human resources for research and innovation, etc., more targeted approaches become necessary in the next steps for a successful transition to a mature RIS. Particular attention needs to be given to strengthening the *systemic linkages* between sources of knowledge production (universities, research organisations), intermediaries (innovation support institutions) and firms, both large and small. In order to enhance these systemic linkages, a stronger articulation between the Knowledge, Innovation and Consensus Spaces is of the essence. That can be achieved through a better understanding of roles, capacities, needs and interactions of actors in all the three Spaces, of the knowledge flows between them and obstacles to these flows. That will allow the adoption of adequate measures to correct existing deficits, taking advantage of local strengths and correcting local weaknesses. Concerted actions of R&D and innovation actors in all the three Spaces can turn Izmir into a regional innovation leader in Turkey, and also into a good practice example for other emerging economies that invest in innovation-driven development.

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# Scientific Cooperation in a German Polish Border Region in the Light of EU Enlargement

11

Jutta Günther, Gresa Latifi, Judyta Lubacha-Sember, and Daniel Töbelmann

**Abstract**

Starting point of this paper is the Eastern enlargement of the EU and the economic advantages and disadvantages for the old and the new EU member states. It focuses on the impact of the enlargement on border regions, especially between Germany and Poland, and introduces into the EU support programs which aim to integrate regions on both sides of the border. The scientific cooperation is picked as an example of cross-border activities which had to be (re-)established after the system break. An empirical study on the example of Europa University Viadrina—a newly founded university in the German-Polish border region—shows the extent of German-Polish cooperation based on co-publication activity.

**Keywords**

Cross-border cooperation · Scientific cooperation · EU enlargement · Bibliometrics

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## 11.1 Introduction

After the system break in East Germany and Poland, an enormous transition process took place in the society and economy of both countries or regions. East Germany quickly became part of the reunified Germany and thus of the EU in the year 1990. It was integrated in an already established system with all its formal institutions and benefitted from financial transfers within Germany and the EU. Poland on the other hand had to establish a market-based economic system from scratch, and the accession to the EU took place only 14 years after the beginning of transition towards a market economy. The predictions about the effects of the EU enlargement on the old and new member states were manifold with positive and more sceptical expectations alike.

In 2004, the European Commission expected, that the eastern enlargement—also referred to as the fifth enlargement—would bring the following benefits (European Commission 2003, p. 5):

- “The extension of the zone of peace, stability and prosperity in Europe will enhance the security of all its peoples.
- The addition of more than 100 million people, in rapidly growing economies, to the EU’s market of 370 million will boost economic growth and create jobs, both in old and in new member states.
- There will be a better quality of life for citizens throughout Europe as the new members adopt EU policies for protection of the environment and the fight against crime, drugs and illegal immigration.
- Enlargement will strengthen the Union’s role in world affairs—in foreign and security policy, trade policy, and the other fields of global governance.”

Nevertheless, there were also more sceptical voices about the enlargement process (Verdun 2005, p. 14):

- “enlargement might jeopardise the process of ‘deepening’;
- Sharing the budgetary means with the applicant states;
- Being sceptical about the applicant states ability to implement the EU acquis communautaire;
- Fear of mass migration from the accession countries to the old member states;
- Concern that the EU will no longer be governable with so many member states and without clear institutional and policy-making reforms.”

For applicant countries both political and economic reasons played a role. They could benefit from being a part of a larger community sharing similar norms and practices, and from gaining access to the common European market (Verdun 2005). Moravcsik and Vachudova (2005) pointed out, that Central and Eastern European Countries (CEECs) faced a choice of taking part in the accession process, due to the economic, institutional and geopolitical benefits of EU membership, or of staying behind while others move forward.

There tends to be agreement as to the notion that EU integration and enlargement is an important process that leads to growth and economic development. However, such implications are not the same across countries. In this line of argumentation Lejour et al. (2001) claims that this process leads only to small welfare increases in most old EU members whereas new members are advantaged from the process. Epstein (2014) argues that this process will benefit the new countries that join the enlargement in particular.

The border between the Eastern and Western parts of the European Union is a border between countries that belonged to fundamentally different economic systems until 1990. It is not surprising that there are lasting differences between the "two parts" of Europe, but the question remains for how long the former separation will be visible and, even more, how the East-West divergence can be overcome.[1] One obvious perspective in this context is to look at the border regions between East and West European countries and their cooperation activities. This will be attempted in this paper, with a focus on the German-Polish border and the potential for scientific cooperation.

In the following, we will set the scene through a brief introduction into the enlargement process including a discussion of the pros and cons and the effects of enlargement in border regions. In this paper we will focus on the Eastern enlargement. We will proceed with an elaboration of the EU specific programmes that support cross border regional activities and economic development. After this, we will exemplarily provide a small empirical analysis of the scientific cooperation induced by a newly founded university in the border region between Germany and Poland. Finally, we will draw conclusions and discuss further research topics.

## 11.2 Enlargement of the European Union

The enlargement of the EU is a widely discussed topic and relevant to several disciplines, such as economics, political science, sociology and law. In this study we focus on the economic aspects only. Indeed, this aspect was the initial reason why the EU was originally established.

The history of the European Union starts in the years of 1951–1952, when the European Coal and Steel Community (ECSC) was founded in order to regulate the market for coal and steel in an attempt to solve economic problems in those sectors (Elvert 2004). In the years 1957–1958 the European Economic Community (EEC) was founded with the aim "to create a new politically stable and economically prosperous European order, which was supposed to be able to overcome the traditional tensions and conflicts between nation-states" (Elvert 2004, p. 201).

[1]There is a large literature on the convergence process between East and West Germany (e.g. Ludwig 2015; Heimpold and Titze 2014; Aumann and Scheufele 2011). The convergence process between the Eastern and Western part of Germany slowed down in the second half of the 1990s and has nearly come to an end now. It would be far beyond the scope of this article to go into this literature and analyses on East and West Germany.

Economic integration was seen as a way to secure peace. Since the Maastricht Treaty, which introduced three pillars of the European Union (Economic and Monetary Union, Common Foreign and Security Policy, Justice and Home Affairs) the European Union has started to be seen not only as an international economic organization, but also as an organization that supports democracy and the rule of law (Curzon Price and Landau 1999).

Over time, the alliance grew strongly from originally six to now 28 member states as a result of continued negotiations and enlargement agreements.[2] Tebbe (1994) defines the process of enlargement as a joint endeavour in which potential candidate states are obliged to attain the EU's state of economic and political integration—the so called "acquis communautaire". And vice versa, the EU is responsible for providing the relevant support for reaching the standard. From an institutional point of view, the enlargement of an organization is, according to Schimmelfennig and Sedelmeier (2002), a process of gradual formal horizontal institutionalization of the organizational rules and norms.

Due to the success of the former European Community (EC), the first enlargement took place in the year 1973 when Denmark, the United Kingdom, and Ireland joined the European community. This was followed up by Greece, which became a member in 1981, and Spain and Portugal who joined the European community in 1986 (Preston 1997). The achieved depth of cooperation, particularly after the decision to sign the Maastricht Treaty in the year 1991 which aimed to create a single political union, motivated another round of enlargement in 1995 when Austria, Sweden, and Finland joined the European Union leading to 15 member countries.

Though the beginning was tough, the EU became the most important means for providing prosperity on the continent, especially after the fifth and the greatest enlargement during which many Eastern European countries joined the agreement some 15 years after the collapse of communism. This unification is therefore called the most radical break that ever occurred in the history of the EU (Moravcsik and Vachudova 2002). In 2004, the EU welcomed 10 new countries, most of them from Central and Eastern Europe to join the EU (Cyprus, Malta, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia) (Zeff and Pirro 2006).

The next enlargement of the EU led to two new member states: Romania and Bulgaria. These countries became the newest members of EU in 2007, followed by Croatia, which joined in 2008.

This "great European event" was included in scientific debates over the years (e.g. Baldwin 1995; Sjursen 2002; Diez et al. 2006) especially when concerning the reasons why the EU intended to enlarge in Central and Eastern Europe. Baldwin (1995) argues that this decision was undertaken to achieve stronger political

[2] When writing this article, the referendum over the membership of the country in the EU took place in Great Britain. The majority voted for an exit of the EU, and negotiations are going on right now.

stability and long run economic prosperity. He furthermore overestimates the political reasons as compared to the economic interests of EU incumbents on newcomers. According to him, when an economically small region integrates with an economically large region, both gain but the small region gains much more,[3] implying that the EU intended to integrate East European countries to create more stability on the whole European Continent.

Somewhat surprisingly, Epstein and Jacoby (2014) find that the enlargement of the EU has had more direct and far-reaching effects on CEECs economies than on their democracies. For this reason, we will analyse the economic effects of the EU's eastern enlargement.

## 11.3 Economic Effects of EU Enlargement and Border Regions

EU eastern enlargement left in its wake many discussions, expectations as well as concerns. The changing of the borders from the EU15 to the EU28 raised the attention of economists as to the effects of such an enlargement, since the new members were anticipated to play a crucial role within these new spatial dynamics (Niebuhr 2008). This becomes even more important when one realizes that 11 out of the 13 new member countries are post-communist economies which gained their independence from the Soviet bloc between 1989 and 1991. Nevertheless, the main concern after the formalization process of enlargement was the economic and structural divergence between the old and new member states.

Early contributions in economic literature relating to the enlargement process of the EU focus on the possible growth effects within the member countries (e.g., Bröcker and Jäger-Roschko 1996; Bröcker 1998). In a quantitative analysis, Bröcker and Jäger-Roschko (1996) estimate the regional effects expected to be caused by the integration of CEECs. In particular, they focused on the effects of the enlargement on the lagging regions of the EU. They found that the trade of lagging regions would not be harmed because of the enlargement, and that there are no grounds for concern. In contrast, due to the geographic proximity of Greece,[4] they stand to benefit from Eastern reforms by having the opportunity to increase their new commercial links with new members from the East. Baldwin et al. (1997) in their analysis of the costs and benefits of the eastern enlargement estimated that the real income in the CEECs would increase by 18.8% in the long-run. Lejour et al. (2001) made an attempt to estimate the economic consequences of the enlargement of the European Union, taking into consideration three dimensions of enlargement: a customs union, an internal market, and the free movement of labour. It was found

[3]He was based on Francois and Shiells (1994) who described the impact of NAFTA on Mexico and US, so he made some tentative analysis-by-analogy assuming that a kind of same situation occurs in EU as well.

[4]Proximity to Bulgaria in this situation and with forthcoming potential candidates (Macedonia, Bosnia and Herzegovina, Kosovo, Albania, Serbia etc.).

that the east European countries' accession to the EU would be of significant importance, and that GDP per capita would increase by more than 8% in the long-run.[5] For the EU15 countries there was no significant influence, however for Germany it was found that GDP per capita could slightly decrease due to migration.

Later on, Brülhart et al. (2004) also investigated the economic effects of the enlargement at regional level and the consequences of changes in market access. Relating to the impact of the enlargement on the border regions, Niebuhr and Stiller (2002) discuss the effects of the enlargement on the regions which were located on borders of new member states. They argue that border regions might have an advantage in attracting resources—hence the above average benefits; but still there is no clear conclusion either from theory or from empirical findings about the spatial effects of the integration, since in some specific circumstances border regions might lose, and sometimes national borders are important barriers for economic relationships.

Consequences of eastern enlargement on the EU and on the CEECs are visible in various areas. In economic research the two most relevant topics are economic convergence on the national and regional level, and migration movements after the EU's eastern enlargement.

Oblath et al. (2015) analysing beta[6] and sigma[7] convergence showed in their preliminary results that both types of convergence have been visible within the EU26 since 2000.[8] Forgo and Jevcak (2015) confirmed that the CEECs (10 new member states) achieved real and nominal convergence vis-à-vis euro area countries.[9] Also, Kohl (2015) found that economic convergence takes place in new member states as compared to old member states.[10] A quite different picture can be found on a regional level. Mikulić et al. (2013), in analysing regional beta convergence in new member states, confirmed that beta convergence can be found at the national level but that on the regional level the convergence speed is lower. Similar results were obtained by Pukeliene and Butkus (2012) for NUTS-3 level analysis. Also Monastiriotis (2011, p. 23) confirmed that "regional evolutions continue to be on the whole divergent, with a pattern of convergence at the middle-

[5]Henrekson et al. (1997) analysing effects of European integration on economic growth of UE-15 found, that European Community membership may increase growth rate (about 0.6–0.8 percentage points), and that technology transfer is the main mechanism through which membership can affect growth.

[6]Beta convergence refers to "a statistically significant negative relationship exists between the "initial" per capita GDP of individual countries on the one hand, and their per capita growth rates on the other" (Oblath et al. 2015, p. 26).

[7]Sigma convergence refers to "the cross-section dispersion in levels of income declines over time" (Oblath et al. 2015, p. 26).

[8]However, some methodological issues regarding to measures of comparative growth performance (which can influence interpretation of results) are discussed in the paper.

[9]Authors probably analysed beta-convergence process, but the type of convergence was not directly mentioned in the text.

[10]Kohl (2015) in his text analysed also the social cohesion processes in new member states.

and lower-ends of the distribution and a slower tendency for club formation at the higher end, and thus overall an increasing trend of polarization."

Considering the great importance of migration on the macroeconomic stability of a country, we should briefly shed some light on the effects of the enlargement on the propensity of migration. Generally it is found that the enlargement of the EU in May 2004 was followed by an increase of migration from the poorest Central and Eastern European regions to richer regions in the EU15 (Barrell et al. 2010), but there was no evidence for a negative effect of migration on wages or employment in the old member countries (Kahanec and Zimmermann 2009). The macroeconomic impact of migration is expected to be stronger visible in English-speaking countries of the EU15 rather than, for example, in Germany or Austria, which were regarded as attractive destinations for a large migration flow (Boeri and Brücker 2001). The United Kingdom, which is expected to be more affected by migration, experienced a period of slow productivity growth. Generally, the high outflow migration from new member states predicted by Boeri (2002) did not take place. Around 2.2 million residents from the CEECs migrated to Western European countries between 1988 and 2012 (Balazs et al. 2014), which equals 2% of total CEECs-10 population in the year 2012.[11]

Concerned about the impact of the EU enlargement on border regions, Niebuhr (2008) measures the enlargement effects, this time with a special focus on the border regions in the EU27. Firstly, he concedes that the great benefit of EU enlargement is seen in the new member states rather than in the EU15 (important signal toward cohesion). This finding is categorically opposed by Ellison (2006) who sates that the benefits of West European states are clearly underestimated.[12] Secondly, Niebuhr (2008) argues that border regions indeed realize higher integration benefits than non-border regions demonstrating that there are certainly above average benefits (Niebuhr and Stiller 2002; Niebuhr 2006).

Overall, from the literature and EU reports, it can be concluded that the enlargement positively affected the economies of the EU in general and especially the new member states. Furthermore, border regions of the EU15 are considered the most beneficiaries from this process.

## 11.4 EU Financial Support Programmes for Border Regions

The cross-border cooperation between countries of the EU has always been one of the prioritized goals of the EU. According to Perkmann (2003), a trans-frontier region is a region inherent in geography, history, ecology, ethnic groups, and

[11]Total CEECs-10 population calculated based on Eurostat database (demo_pjan).

[12]The author found irrational also the overestimation of the benefits of new EU members and underestimation of their costs. For more information see Ellison (2006) Divide and Conquer: The European Union Enlargement's Successful Conclusion? *International Studies Review*, Vol. 8, No. 1, pp. 150–65.

economic possibilities, but disrupted by sovereignty of the governments ruling on each side of the frontier.

Through various programmes, the EU tries to intensify the cooperation within border regions of the EU. In the following, we would like to introduce the specific EU support programmes for border regions and their relevance for a successful cooperation on the EU East-West border.

Cross-border co-operation programmes have the objective to develop a shared space in cooperation. These programmes are aimed at sharing, integration and improving the quality of life. Knowledge, infrastructure, and other assets can be shared by using cross-border programmes. The improvement of the quality of life includes programmes aimed at environmental protection, health care services or access to a labour market. Within the programmes, all types of partners are welcome: ministers, small municipalities, universities, NGOs, SMEs. The European Territorial Cooperation has been established as a part of a policy of cohesion. The first INTERREG programme started in 1990. INTERREG II and III were undertaken in the years 1994–1999 and 2000–2006 (European Commission 2011). INTEREG IV covered the years 2007–2013. This policy is set up by the European Commission and it aims to foster the cooperation between EU regions, with a particular focus on border zones. (O'Dowd 2002). For the years 2014–2020 INTERREG EUROPE is launched as complement with the Europe 2020 strategy. It is used as an instrument for the implementation of a policy of cohesion. The following objectives are addressed by INTERREG EUROPE programme:

1. Strengthening research, technological development and innovation
2. Enhancing the competitiveness of SMEs
3. Supporting the shift towards a low-carbon economy in all sectors
4. Protecting the environment and promoting resource efficiency (INTERREG EUROPE 2015).

Another category of programmes effective during the period of 1997–2003 and established by the European Commission for an inter-regional cooperation between the EU and CEECs is that of OUVERTURE/ECOS. It focused on the local economic development in the sense of administrative and regional urban planning (Gruchman and Walk 1997). Countries within the EU that had at least two territorial units were eligible for this programme.

The additional possibility of benefiting from another Action Programme supporting the cooperation between local and regional territorial units of at least three EU countries in the field of exchange of experience is called PEE. It's main focus is in the field of know-how exchange in the implementation of EU policies towards public administration, transport, applied research, universities and enterprises, local resources, energy and the environment (Gruchman and Walk 1997).

There were also specific programmes in support of tourism and cross-border environmental policies such as LIFE (Gruchman and Walk 1997) which started in the year 1992. In 2007, according to the new Regulation (Regulation (EC) No 614/2007), the LIFE+ programme became a successor of the LIFE programme. It is divided into three components: Nature and biodiversity; Environmental Policy and Governance; Information and Communication. For the years 2014–2020 the Programme for the Environment and Climate Action (LIFE Programme) was established (Regulation (EU) No 1293/2013). Besides the aforementioned programmes, a particularly important programme for the Polish-German border regions is RETEX, which is aimed at the textile and clothing industry. Finally, the original programme, PHARE, and its two subprogrammes TEMPUS and STRUDER were specifically designed for the assistance of Eastern European countries in their transformations toward market economies (Cunderlikova 2007).

For the years 2007–2013, the Cross-border Cooperation Operational Programme between Poland (Lubuskie) and Germany (Brandenburg) was approved by the European Commission. The main objective of the programme was the reduction of the inconvenience caused by the location of the regions' borders and the joint development of the regions.

Operational objectives of the programme were the following:

1. Improvement of infrastructure and environmental protection.
2. Development of economic relations and cooperation of science and economic sectors.
3. Support of development of human capital and cross-border cooperation (Program Operacyjny Współpracy Transgranicznej Polska 2008; Operationelles Programm zur grenzübergreifenden Zusammenarbeit 2008).

## 11.5 Economic and Scientific Effects on Polish-German Border Regions

The enlargement of the EU and integration of Poland had economic implications in both countries, especially in the regions along the border. Reflecting the historical tensions between the two countries, we explore the changes of cooperation activities over the years. After 1945, as a consequence of the Second World War, the two rivers Oder/Odra and Neissemwas/Nysa became heavily guarded dividing lines between the German Democratic Republic (GDR) and Poland. As a consequence, there was little opportunity for direct contacts or local cooperations between communities and regions (Gruchman and Walk 1997).

Over time, the GDR, due to the shortage of manpower, encouraged people from Poland to work in the large industrial plants close to the border. The effect of commuting to work became particularly significant in cities like Guben/Gubin or Görlitz/Zgorzelec, both located close to the river Neissemwas/Nysa. In the 1970s, there was a short period of freedom of mobility between both countries—crossing the border without a passport and visa. However, until 1989, when socialism in the GDR and Poland collapsed, cooperation between the two countries faced many obstacles and not very many possibilities of trans-frontier synergy effects and development (Gruchman and Walk 1997).

Only after the changes in 1989 did administrative entities, economic and social institutions, enterprises and local governments emerge on both sides of the border to institutionalize mutual economic and social cooperation. Starting, for example, from the launch of *Neisse-Nysa Euroregion* in 1992 followed by *Pomerania Euroregion, Spree-Neisse-Bober* in 1993*, Pro-Euorpa Viadrina Euroregion* in 1993. These initiatives aimed to establish and intensify cooperation in many fields, especially industry, innovation, agriculture, tourism, science, culture, and sports (Gruchman and Walk 1997).

Later, after the efforts undertaken to meet the Copenhagen criteria, the accession process, and more than 10 years of being part of the EU, things have changed substantially, especially for Poland. In being a neighbour of Germany, one of the founding countries of the EU, Poland is the neighbour of an economically strong and relatively large country. This has its advantages and disadvantages. We have found little evidence and very few robust figures related to the effects and consequences of Poland's integration into the EU, specifically along the border regions of both countries. However, on the Polish side, it is recognized that the Polish regions along the border with Germany are rendered particularly attractive for foreign and local investments due to the historical development of this part of Poland and due also to the accession of Poland to the EU. The importance of border regions for the economic development of Poland remains a challenge for the eastern part of the country, where the lack of investors is easily recognized (Cieślik 2005).

On the other hand, there is little evidence regarding workers' mobility, which started to be a challenge for Poland after the accession to the EU. Generally, the population of Poland is declining. After 3 years of membership of EU, the number of Polish workers (especially qualified workers) looking for employment in the EU15 countries rose from 1 million to 2.3 million (WPBS Report 2012). "Before Poland's accession to the EU, Germany (37% of all emigrants) and the United States (20%) were the most common destinations chosen by Polish emigrants. After 2004, Poles most willingly went to EU member states: the UK (30%), Germany (23.5%), Ireland (5.5%), Italy (4.5%) and the Netherlands (4.5%) (CSO 2012). At the same time, the rate of emigration to the US dropped to 12%" (Kałużyńska et al. 2014, p. 197). It has been observed in the past,[13] that Polish migration to Germany was characterized by short-term, and back-and-forth mobility, without the will to settle down in Germany (Anacka and Fihel 2012). "Poles make up 6.4% (468,481 people) of all foreigners in Germany.[14] Their median age is 37.3 years and they stay for an average of 9.7 years. Nowadays, the number of Poles with a migration background is about 1.3 million people and they mostly work in construction, manufacturing, health care, restaurants and trade" (Iglicka 2010, cited in Eichhorst and Wozny 2012, p. 4).

[13]Migration until the year 2006 was analysed by Anacka and Fihel (2012).

[14]Authors based on data from: Bundesamt, Bevölkerung und Erwerbstätigkeit Fachserie 1 Reihe 2, 2011.

In the field of scientific collaboration between Germany and Poland, an important initial step likely to impact collaboration both in science and economy, was the foundation of the European University Viadrina (EUV) in Frankfurt in the year 1992 with a student body composed at least to one-third of Polish students. On the other side of the border in Słubice the Collegium Polonicum was established as a part of EUV (Gruchman and Walk 1997).

The founding of the EUV and Collegium Polonicaum, however, is not the starting point of German-Polish scientific collaboration. Glänzel and Winterhager (1992) have found results of the collaboration in the realm of science between eastern European countries (Hungary, Poland and Czechoslovakia), Germany and other members of the EC during 1980–1989. German scientists (compared to other scientists of EC member states) played an important role as co-authors with the three eastern countries, particularly with Poland.[15] Nevertheless, they did not deal with the question whether this relatively strong link between the two countries was because of being in the same border area.

Later on, Braun and Glänzel (1996) also identified an increasing cooperation between Germany and Poland during the period of 1984–1993. In comparison with other EC members, Germany remains the main collaboration partner of Poland and other Eastern European countries, such as Hungary and Romania. Generally, they did not find a clear justification for the German-Polish scientific cooperation being due in large part to the spatial proximity of these two countries. On the contrary, they state that the two countries substantially increased the international scientific cooperation as a result of the contraction of basic research in the course of the transition during the nineties. Due to the economic problems that Poland was going through, international cooperation in science during the 1990s was mainly viewed as a channel through which academia could get financial support from outside the country (Stefaniak 1998).

In the following, we will present the results of an explorative empirical study into the cross-border scientific relationships of scientists from the European University Viadrina with scientists from Poland. Our focus is the intensity of relations expressed in scientific co-publications.

## 11.6 Scientific Cooperation in a Polish-German Border Region: The Example of Viadrina

The persistence in increasing the depth of cooperation between Poland and Germany, especially after the foundation of the European University Viadrina (EUV), shapes our paper's focus. Since it is difficult to find scientific evidence whether or not the impact of the foundation of the university is positive or negative, we carry out a small primary data collection and analysis.

[15]Glänzel and Winterhager (1992) have also measured the rate of citations impact of the three.

Our interest was to identify the cooperation between Polish and German scientists on the example of the discipline of economics. Henceforth, we run an analysis based upon the available information on the university homepage (European University Viadrina 2015) of the four departments of the Faculty of Business Administration and Economics: Finance, Accounting, Controlling & Taxation (FACT), Finance & International Economics (FINE), Information & Operations Management (IOM) and Management & Marketing (M & M). Each department consists of at least two professorships (chairs) with a team of scientific assistants. We investigated the scientific work of each professorship, i.e. the scientific work of each chair of the Faculty of Business Administration and Economics. From the full list of publications, co-publications were identified, and from them co-publications with Polish co-authors.[16] The purpose of this is to identify the intensity in cooperation with different Polish co-authors, especially after Poland's accession to the EU.

Firstly, we identified the existing overall number of Polish and international academic employees in each chair in order to see the relationship of each chair with Polish scientists. Secondly co-publications with Polish co-authors were counted. Polish co-authors were defined in three groups: (1) Polish co-authors employed at EUV, (2) Polish co-authors employed at research entities or at the business sector in Poland, and (3) Polish co-authors employed at other than EUV German research entities. In case of co-publications with 2–3 co-authors from different groups, they were assigned to each type of group. Therefore the sum of co-publications with co-authors from the three groups mentioned above are not equal to the number of "All Polish co-publications". Polish co-authors and employees were identified based on the following scheme: Firstly, all Polish-written surnames were selected, then curriculum vitae on Universities' website were analysed. If a person was born or educated (in the early stage) in Poland he or she was counted as Polish employee or co-author. The research entity to which the co-author is affiliated was identified using Scopus, Web of Science, or the text of publications when information about authors are provided. In case of co-authors employed at the business sector, internet based sources, such as LinkedIn were used.

Based on this analysis, it can be stated, that every department employs international employees, foremost the department of "Finance, Accounting, Controlling and Taxation" (FACT) with the highest number in comparison to the other departments (Fig. 11.1). Out of four, two departments employ Polish employees. Here the department FACT can be named again, with three Polish employees out of 59 employees in total (i.e. 5%), and the department FINE with eight Polish employees out of 27 in total (i.e. 30%). The high share in the case of FINE is due

[16]Authors focus in the text on Polish-German cross-border cooperation, therefore other co-publications were not detailed investigated, although data about them were also collected.

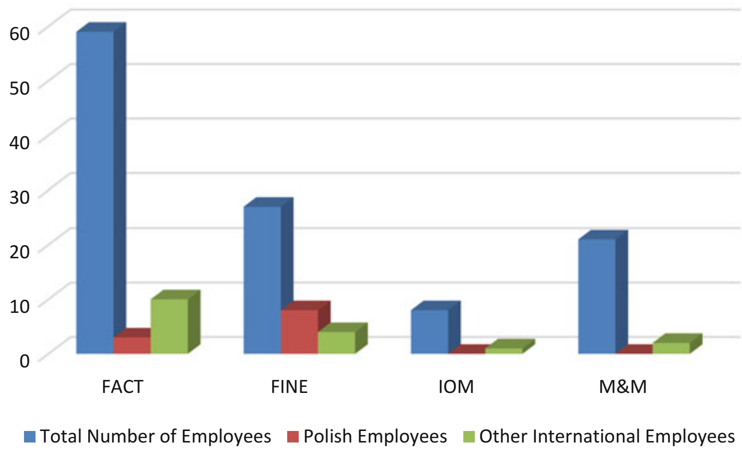


**Fig. 11.1** Number of Polish and other international employees by departments of the Faculty of Business Administration and Economics, EUV. Source: own data collection and calculations based on https://www.wiwi.europa-uni.de/en/lehrstuhl/index.html (last visited 05.07.2016)

to the "Professorship for Interdisciplinary Polish Studies", which employs seven Polish scientists, which is half of its team.[17]

Referring to publications with Polish co-authorships, we found, that two departments cooperate with Polish authors. Similar to the results of the employee analysis above, for the departments of FACT and FINE it is possible to determine publications in cooperation with Polish co-authors as shown in Fig. 11.2. With 128 co-publications with Polish co-authors, which is around 16.5% out of the entire number of the department's documented publications, FACT can be described as the most active department in cooperating with Polish authors. The largest number derives from the "Professorship in Taxation and Auditing", with 120 Polish cooperations. For FINE, eight Polish co-publications out of 228 co-publications in total, can be determined. Here again the largest part of cooperative activity is due to the chair of "Professorship for Interdisciplinary Polish Studies", to which are attributable six Polish co-publications.

In Fig. 11.3 it can be seen, that in the departments FACT and FINE a large part of the entire Polish co-publications are in collaboration with EUV affiliated Polish authors. However, the number of co-authors affiliated in Poland is even larger in both departments. The smallest number are publications with Polish co-authors affiliated with other than EUV research entities in Germany. For the departments "Information & Operations Management" (IOM) and "Management & Marketing" (M & M) neither Polish employees nor Polish co-publications were reported.

To further analyse the Polish co-publications (as many as 136 in total), we run a network analysis to show the intensity of cooperation between EUV (represented by

[17]The "Professorship for Interdisciplinary Polish Studies" is closely connected to the centre for Interdisciplinary Studies on Poland (ZIP). The chair holder is the head of ZIP.

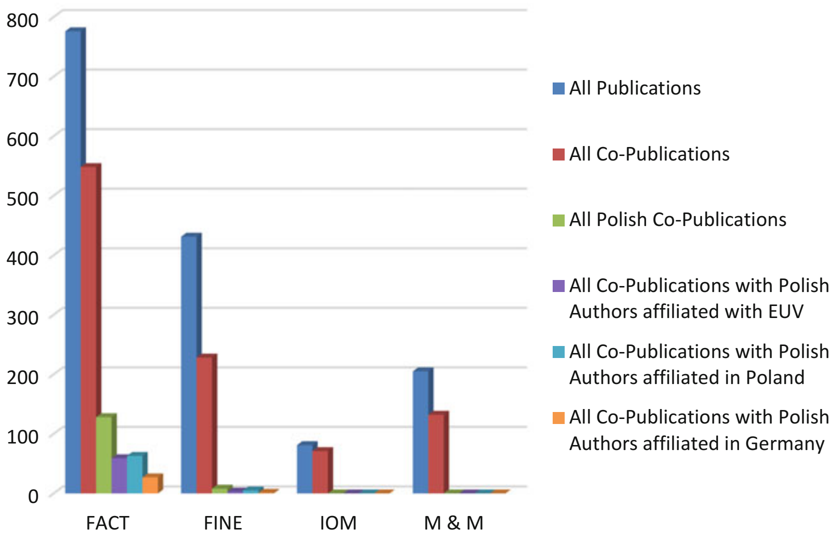


**Fig. 11.2** Number of co-publications and co-publications with Polish authors by departments of the Faculty of Business Administration and Economics, EUV. Source: own data collection and calculations based on https://www.wiwi.europa-uni.de/en/lehrstuhl/index.html (last visited 05.07.2016)

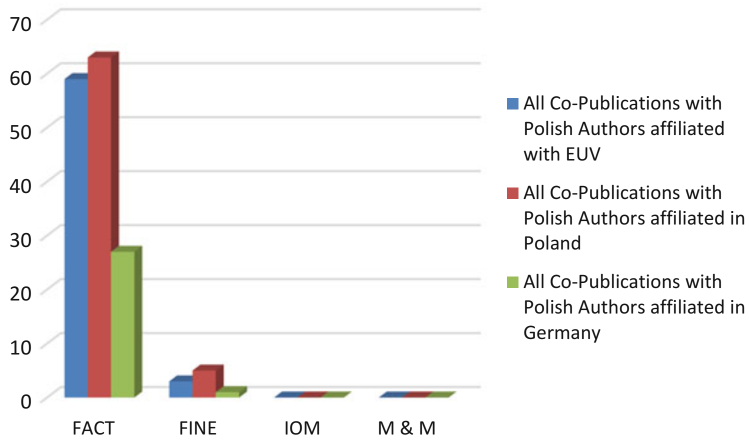


**Fig. 11.3** Number of co-publications with Polish authors by departments of the Faculty of Business Administration and Economics, EUV. Source: own data collection and calculations based on https://www.wiwi.europa-uni.de/en/lehrstuhl/index.html (last visited 05.07.2016)

the Faculty of Business Administration and Economics) and other selected institutions. In Fig. 11.4, the number of co-authors affiliated with a given research entity is represented by the size of the node, and the number of co-publications with

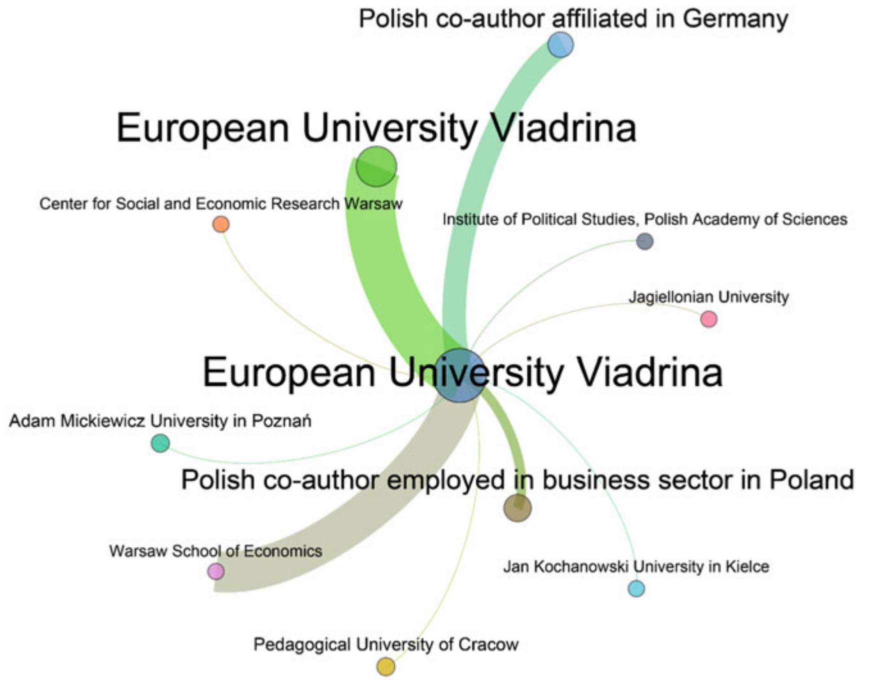


**Fig. 11.4** Network analysis of cooperation of the Faculty of Business Administration and Economics, EUV with Polish co-authors. Source: own calculations based on https://www.wiwi.europa-uni.de/en/lehrstuhl/index.html (last visited 05.07.2016), prepared in Gephi

the given institution is represented by the width of the links. For example, EUV has 51 co-publications with the Warsaw School of Economics (the width of the link), and one co-author affiliated with the Warsaw School of Economics cooperate with EUV (the size of the node).

It can also be shown in Fig. 11.4 that there is a strong co-authorship activity within the EUV shown by the width of the link which is attributable to the number of co-publications (62) with Polish EUV affiliated employees (14 co-authors). Scientists from EVU are also co-publishing with Polish authors from institutions in Poland, such as Warsaw School of Economics and others. Though the number of co-publications behind is often very small. Several Polish co-authors are affiliated with research entities in Germany other than EUV (6 co-authors) or with the business sector in Poland (7 co-authors).

## 11.7 Conclusion

The system break down in 1990 triggered a deep transition and restructuring process in East Germany and Poland. While in East Germany the EU accession took place automatically with the German re-unification, Poland became a member of the EU only much later in the year 2004. In the early stage of transition both countries (or region in case of East Germany) were strongly occupied with restructuring and reorientation in nearly every field of economic and scientific activity. However, the EU supported from the very beginning cross-border activities in order to integrate the regions and people working and living there. Cross-border activities related to a closer economic integration appear in many areas and forms, among them scientific cooperation. We focused in this article on the scientific cooperation in a German-Polish border region in which a new university was founded after the changes of the year 1990, not least with the objective to strengthen regional and overall scientific integration between Germany and Poland. The Europa Universität Viadrina (EUV), located on the German side of the border in Frankfurt/Oder, is thus a unique case together with the Collegium Polonicum, located on the Polish side of the border in Słubice. As many as one third of the student at EUV are from Poland, which means a large share and expresses the success of the cross-border oriented university. In this paper we also shed some light on the question of scientific cooperation which needed to be established with the foundation of the university and the overall re-orientation process in the early 1990s. Scientific cooperation can take place in many different forms, reaching from very informal and implicit activities to formally institutionalised projects. To get a first impression whether joint German-Polish activities have been established at all and to which extend, we looked at co-publications. Co-publications express an already advanced stage of scientific cooperation since they go beyond just informal contacts and document a clear scientific product. In our small-scale empirical investigation for the Faculty of Business Administration and Economics of the EUV, we identified quite a number of co-publications between EUV staff and Polish colleagues. Most of them take place within the EUV, and many relate to cooperative work with scientific entities in Poland. A network of scientific contacts has been created since the early 1990s. The entire intensity and frequency of cooperative scientific activities is, however, much broader than the publication analysis shows and offers scope for further integration with possible positive spillovers for the economic development as well.

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# Part IV

# Evolving University/Industry Collabrations in Response to New Modes of Knowledge Production

# How Will Open Science Impact on University/Industry Collaborations?

# 12

Joanna Chataway, Sarah Parks, and Elta Smith

**Abstract**

Open science represents a challenge to traditional modes of scientific practice and collaboration. Knowledge exchange is still heavily influenced by researchers ambition to publish in highly cited journals and within 'closed partnerships' (Holmes, Nature 533: 54, 2016) where interactions are based on patenting based on IPR. However, perceived inefficiencies, a desire to make publically funded research available to all and a crisis of confidence in the quality of research published in top journals all serve to fuel demands for more openness in the conduct of science and the exchange of scientific knowledge. Whilst there is a strong logic behind the contention that increased openness will promote efficiencies, quality and fairness, there is still considerable uncertainty about the impact on university/industry collaboration and the balance that needs to be struck between open and closed approaches. Policy obstacles are also likely to impede the pace of change.

**Keywords**

Open science · IPR · University-industry collaboration · Science · Technology and innovation policy

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## 12.1 Introduction

Calls for research to be made 'open' are gaining momentum. Funders have been particularly active in demanding change. Although they vary in the degree of openness required and in their interpretation of what a more open approach actually constitutes, there is now a near consensus that at the very least open access must apply to published research results and some funders increasingly require access to research data as well. In addition to funder requirements, other drivers of increasing openness include calls from a variety of stakeholders including researchers themselves for more transparency and less duplication in research.

It is too early to give a definitive answer to the question posed in the title to this chapter. But asking the question at this time is a useful exercise as it encourages us to reflect on the current situation and to begin to analyze current trends, drivers and enablers related to open science based collaboration as well as obstacles and tensions associated with open and global access to science. This chapter endeavours to begin that work and to identify some of the policy challenges associated with moves towards more open science. The chapter is structured around a number of sub-questions to the title's overall question and concludes with some reflections on the implications for policy-making.

## 12.2 Are We Moving Away from Traditional Models of S&T Based University/Industry Collaboration?

Over the past century, a professionalization of science has seen been associated with the emergence of specific organisational and institutional centres of scientific activity. Scientific activity has overwhelmingly taken place in universities or other research organisations, government laboratories or in research and scientific facilities supported by private companies. Norms have emerged that provide the basis of career development and incentives and that have come to define 'excellent' science. An infrastructure of knowledge generating and diffusing institutions have provided powerful embodiment of Western science's ambition to produce more of this type of knowledge. The world's best universities and leading scientific journals have reflected a deeply engrained understanding of how excellence is produced and how it is shared (Chataway and Smith 2007).

Patterns of interaction and knowledge exchange between organisations and institutions have also been underpinned by well-established norms and increasingly in R&D intensive sectors, by intellectual property rights. There have been periods and specific instances of data sharing and collaborative approaches which run counter to the usual restrictions on ownership and governance structures but these have usually associated with security issues and national emergencies. Outside of this particular circumstances and periods of time, for the most part the extent to which data have been generated or shared has been regulated by professional norms and by various forms of copyright and intellectual property protection. Collaboration between companies and universities has increasingly been built on IP agreements and other mechanisms to facilitate partnership to protect investment in early stage research (Arora and Athreye 2012).

The premise of these arrangements is that universities produce science that, once patented and perhaps published in leading journals, can be transferred and commercially exploited by new or existing companies. A recent article described this era of knowledge translation and exchange as 'closed partnerships' (Holmes 2016) and argued that this arrangement was typical in the 1980s. However, in recent decades this formula has been modified, added to with other forms of partnerships and in some cases replaced with more open arrangements (Holmes 2016). It is no longer assumed to be the most efficient way of sharing results and the debate about the impact that more open science might have on university and industry relations points to several areas where the evidence is ambiguous and uncertain.

First, a number of academics and analysts have pointed out that the majority of innovation does not depend on outputs from R&D (NESTA 2007). Most changes in patent restrictions and open access approaches which reveal early research findings in an accessible way would not have a negative impact on relationships between universities and industry, in the sense of a decrease in the quantity or quality of transactions, because tacit knowledge is and always has been at the heart of successful relationships (Nelson 2004). In addition to this, there is a mounting of body of evidence that questions whether the traditional model is actually the most efficient way of organising the production of science and whether it is effective in underpinning product development and innovation. We will look briefly at two areas where there has been critique of restricted access to knowledge. The first area relates to intellectual property rights (IPR) and the second is access to publications.

### 12.2.1 Questioning the Impact of IPR on Innovation: Do the Tragedy of the Anti-Commons and Perceived Inefficiencies Outweigh the Benefits?

Use of IPR has been an important component of innovation policy for many years and the history of IPR and innovation policy is long and complex. It is not our intent to review or summarise that history here. Our aim is limited to highlighting the increasingly contentious notion that patenting, especially as it applies to early research results and tools, fosters innovation. Most of our examples are from the life sciences. This is the sector where the debate about patenting has been most intense and a sector where experimentation in open science and open innovation is particularly evident.

In recent decades the rate of patenting has increased significantly across a range of sectors and particularly in the life sciences (Owen-Smith and Powell 2003; Bubela et al. 2013). The causes of this increase are complex and differ somewhat across sectors. One of the drivers behind a move to early patenting in both public and private sectors is increasing financial pressures (Morgan Jones et al. 2014). In areas such as biotechnology, innovation is largely rooted in industrial structures that depend on patent backed finance and this has fuelled what some analysts consider an unproductive tendency to hype patented research results and tools which subsequently led to investors becoming disillusioned with the sector (Hopkins et al. 2007; Owen and Hopkins 2016).

A number of authors have questioned the effectiveness of patenting at an early stage more generally (Marshall 2012; Eisenberg 2012) noting that patenting may reduce incentives and capacities to share knowledge. Michael Heller deploys the term 'the tragedy of the anti-commons' to refute a longstanding contention that common property will be neglected and will not generate expected returns to a community over the long run (Heller 1998).

In more recent years, modelling of anti-commons behaviour has been used to dispute the efficiacy of patenting across a range of sectors including biotechnology (Burk and Lemley 2009; Heller 2016). Nelson (2004) argues that technological advance is an evolutionary process, and as such, benefits from the development of knowledge via multiple pathways by a number of different actors. It is also cumulative, as bodies of knowledge build on previous understanding. The scientific community, Nelson claims, should not be hindered in working freely with and from new scientific findings because of the long term and public goods benefits that come to a society from investment in basic research.

Patents on early stage research in particular can prove costly and bureaucratic and this has obvious and less obvious impacts on the rate and direction of research. One of the less obvious consequences is that researchers may need to weigh up the costs of accessing tools and techniques to enable them to undertake research and this make them more risk-adverse. This is a problem for public and private sector scientists.

Although IP provides a route for start-up companies to raise financing and is therefore seen by many as enabling innovation, the impact of reliance on IP for financing also constrains what companies are able to do (Tait and Chataway 2007) and has led proponents of open science approaches to question the degree of risky innovation which organisations that are highly dependent on patenting can undertake. Aled Edwards from the Structural Genomics Consortium says:

> Industry scientists do not have the opportunity to focus their efforts on discovering new validated targets and mechanisms. More often, they develop innovative ways to tackle established ("validated") drug discovery mechanisms. This situation arises because there is a disconnect between drug discovery timelines (5–10 years) and the need for biotech investors to recoup their investment (2–5 years) (Edwards 2013).

Edwards concludes that because biotech firms are dependent on IP related finance they can never be the source of more radical and risky innovation.

## 12.3 Should We Be Concerned About the Efficiency and Quality of Mainstream Science?

A paper appearing in Nature in 2012 (Begley and Ellis 2012) by researchers from the pharmaceutical company, Amgen, raised a set of worries about the quality of science being produced in top journals and the extent to which that 'excellent' science could actually be used in innovation and product development. The article reported that a large percentage of cancer related studies that Amgen researchers tried to replicate were not reproducible. Begley and Ellis (2012) question the incentive frameworks that academics work within and question whether peer review is an effective mechanism for assessing the quality of scientific output and evaluating grant applications. The authors suggest bad practice is not checked and maybe is actually encouraged under the current system. "...the academic system and peer-review process tolerates and perhaps even inadvertently encourages such conduct. To obtain funding, a job, promotion or tenure, researchers need a strong publication record, often including a first authored high impact publication. Journal editors, reviewers and grant giving-review committees often look for a scientific finding that is simple, clear and complete—a "perfect" story. It is therefore tempting for investigators to submit selected data sets for publication, or even to massage data to fit the underlying hypothesis" (Begley and Ellis 2012). Even diligent peer review commissioned by the best journals will not be able to detect problems which arise from this behaviour.

In an introduction to a recent series of papers on increasing value and reducing waste in health research, the editors of The Lancet, a leading health research journal, reflected on Randy Schekman's critique of standards in 'luxury' journals such as Nature, Science and Cell. When Schekman won a Nobel Prize for his work in medicine, he used his acceptance speech to launch an attack on these journals whose reputations rest on an unwarranted notion that they publish uniformly excellent research and his observation that they are not the only outlets for outstanding research. The Lancet editors produced a special issue that tried to look more broadly at the following question "how should the entire scientific enterprise change to produce reliable and accessible evidence that addresses the challenges faced by society and the individuals who make up those societies?" (Kleiner and Horton 2014).

One of the articles in the special issue analyses the cost of R&D and the amount of waste associated with conventional methods of producing knowledge. Costs associated with R&D rise annually and current expenditure on a global basis was estimated at US$240 billion annually in 2010 (Chalmers et al. 2014). Basic research is the principle beneficiary of this investment. More than half of £1.6 billion of public and charitable investment in research in the UK in 2009/2010 was spent on basic research and this pattern is also seen in the US. While researchers often want to work on basic research and 'luxury journals' want to publish breakthrough findings, there appears to be strong evidence emerging that basic research is not responsible for major success in medical innovation in the way that earlier analysts assumed that it was (Chalmers et al. 2014). In 2009 Chalmers and Glasziou estimated that the cumulative effect of avoidable waste in biomedical research means that about 85% of research investment—equating to $200 billion of the investment in 2010—is wasted. Using a narrower measure of waste, Freedman et al. estimate that the cost of lack of reproducibility in life sciences is $28 billion—(Macleod et al. 2014; Freedman et al. 2015). The complex set of factors that produce this situation is related to a lack of transparency and an incentive structure that promotes secrecy, a lack of openness and a fixation with publishing in high impact journals.

## 12.4 What Is Open Science and Might It Help Produce Science More Efficiently and Effectively?

There are changes taking place that may be helping to counteract some of the problems associated with our current 'conventional' modes of doing and rewarding research. These changes are happening across the research process, from the way public research agendas are set to the way researchers and the public engage with research results. They are neither uniform across the research process nor equally shared amongst disciplines, but collectively they appear to be having fundamental effects on the research system. Together, these changes are often referred to as 'open science' and they represent what might be best described as a movement of researchers and others involved in scientific research that in some respects runs counter to but is also effectively evolving from the traditional model of scientific research.

Open science is most frequently and closely associated with *how* research is conducted and the results disseminated. Open access to scientific publications is the most well-known characteristic of the open science movement, whereby research outputs—typically journal articles—are made freely available, without access fees and increasingly with fewer copyright and licensing restrictions. As an example, Randy Scheckman, the noble prize winner mentioned earlier, has since established an on-line open access journal that defines itself as existing outside of the framework assessing impact factor. Worldwide the proportion of papers published open access in 2011 was about 44%, up from 38% in 2004, taking this practice well into the mainstream of research (Archambault et al. 2013). Many researchers and increasingly policymakers aspire to open access becoming a standard feature of the research process (The Netherlands EU Presidency 2016). The EU Competitiveness Council has already concluded that all scientific articles should be open access by 2020 (Council of the European Union 2016).

Open science also refers to an increase in researchers making the data underpinning research results freely available online. Some of the most prominent examples have emerged from large-scale public health crises. For example, data sharing of genome analyses to tackle the Ebola epidemic was widely seen to have enabled geneticists and evolutionary virologists to work together to confirm the origin and transmission mode of the virus as well as estimated routes of infection and predicted rates of mutation. This information supported crisis management efforts by local and international public health organisations by showing them where to focus their relief efforts and enabling them to develop practical advice to limit the spread of infections. Data sharing was also considered to be helpful for both the public and private sectors to more quickly design new therapies, diagnostics kits and vaccines (Yozwiak et al. 2015).[1] Similar efforts have been undertaken to support the Zika virus outbreak and to combat malaria.[2] Indeed, there is emerging evidence that where data sharing fails to occur, progress in addressing the problem is slowed or hindered, such as during the outbreak of Middle East respiratory syndrome (MERS) in Saudi Arabia where disputes over intellectual property rights created barriers to access to samples (Yozwiak et al. 2015).

Online repositories have emerged in recent years to collect and make available researchers' data. Zenodo is an example at the other end of the spectrum from the international efforts to address major diseases cited previously, focusing instead on the 'long tail' of smaller research results that are not otherwise part of existing institutional or other repositories. Zenodo invites submissions from any discipline and particularly encourages multidisciplinary contributions.

Researchers have also begun to share their code, software, and lab books. For example, GitHub has become an important source of open code and the development of open software, citing 15 million users across 38 million repositories on the site.[3] The overall effect of this 'opening up' in the research process means that researchers are communicating more freely and transparently, and at earlier stages in the research process to generate new ideas, find collaborators, build research tools and analyse their results. This should lead to greater use and reuse of data, earlier identification of problems, and better and faster development of research tools, which may mean that 'open science' can address some of the challenges with research efficiency which are embedded in 'traditional' research.

Open science can also offer correctives for the problems associated with low reproducibility and poor quality that can occur through more traditional scientific research approaches. Open peer review can include attribution of the peer reviewer (as opposed to anonymization) and publishing the contents of the review. It can also refer to a process of allowing unsolicited peer review. Alongside more freely available data and access to research results, being able to assess the contents of a peer review could help others to identify the bad practices and too perfect stories that can be told when this information is not available. Scientists have used online forums and social media to quickly uncover high-profile studies with major underlying flaws including the 'discovery' of arsenic-based life (Hayden 2012).

Other initiatives aim squarely at the problems associated with the lack of reproducibility identified in many disciplines. A leading example from psychology,

[1]Ebola (www.eboladata.org).

[2]For example, an open science initiative for Malaria: www.opensourcemalaria.org

[3]https://github.com/

the Reproducibility Project, involved 270 scientists in trying to reproduce the key findings from 100 articles published in three leading psychology journals, which found that only one-third to one-half could be replicated (Aarts et al. 2015). From the perspective of opening up the scientific process, this project not only prioritised correspondence and collaboration with the original authors, but the authors also published the results in an open access format and made the underlying datasets available for others to use in the future. A similar effort is being undertaken in other disciplines, such as cancer biology, with the effect of highlighting the importance of replication in the advancement of science. Innovation is important, but without replication we cannot verify new findings, and therefore can never be certain whether we actually 'know what we think we know' (*Ibid.*).

A final potential corrective to the traditional model of scientific research enabled through 'open science' is the increasing support in the research process by non-professionals and multi-disciplinary researchers. Crowdsourcing is the archetypal example whereby an often undefined set of people—the 'crowd'—is called upon to help solve problems or contribute to other aspects of the research process including correcting mistakes and raising money. This may range from generating research ideas to data gathering, problem-solving and decision-making either in a collaborative way or through independent contributions. Foldit is one example, involving an online game about protein folding; the highest scoring submissions are analysed by researchers to determine whether the configuration is applicable to proteins found in nature. A study of the outcomes of the Foldit approach, published in 2010, found that the solutions identified by gamers were better than those generated by a computer algorithm. The solutions could be used to develop new biological innovations or target diseases.

In many cases, the people who participate in these projects would not traditionally be considered 'experts' in the field to which they are contributing, while in others, crowdsourcing enables the engagement of researchers who may not otherwise have had the opportunity to participate. The Reproducibility Project is one such example of the latter. In most cases, participants are recruited online through an open call. This reduces the logistical problems associated with having participants travel to a centralized location and enables the call to generate a wider reaching set of potential participants.

Proponents of Open Science argue that these activities can increase transparency, collaboration, communication and participation in scientific practices. They could help remove disciplinary barriers and encourage greater interaction between 'science' and 'society'. They could also speed up the scientific process by tapping into the critical mass necessary to generate ideas and facilitate falsification of theories enabling greater efficiency as well.

Digital technology enables many of the developments that are considered to be part of Open Science, but technology alone is not responsible for the size and scale of activities in this area. Open Science is also strongly underpinned by those who hold strong beliefs about the value of freely circulating knowledge and critiques of that knowledge, and interest in the role, value and function of data in the research enterprise.

## 12.5 Are We Moving Towards a New Era?

The history of drug development is full of examples of progress that has its roots in the advocacy of patients and patient organisations (Chataway et al. 2010; Marjanovic et al. 2015). Pressure for resources to be allocated in certain directions and for organisations to begin to work together resulted in significant investment in treatments of HIV/AIDS and in treatments for certain kinds of cancer (Taylor et al. 2015). The power of advocacy and social movements in health innovation is acknowledged as an important factor in innovation. As the previous section suggests, the dynamics between advocacy, technological progress and institutional change are also interesting to consider in the progress of open science. Whilst the momentum behind open science grows, the evidence about the costs and benefits lags behind. The extent to which open science will transform relations is likely to depend both on the strength of advocacy and evidence in a number of areas.

### 12.5.1 What Is the Right Balance Between Openness and Ownership?

The issue of whether various forms of open science contribute to more efficient science (improving the rate of output) or more effective science (improving the rate of outcome or in other words the degree to which that science is made use of by target audiences) will be important in determining the degree to which it takes root institutionally.

Some benefits of open science are easier to calculate than others. The value of data repositories has been examined and studies suggest that economic value is clear (Lateral Economics 2016). This still leaves ambiguity however with regard to the extent that open science and open innovation more generally are associated with economic efficiency and value creation. The evidence base on that remains unclear. It is true, however, that there is a clear logic that argues for more efficiency on a number of grounds. In drug development, where patenting is still the norm and where the costs of research are so high, the argument that open science could reduce duplication is particularly strong. A more open approach would reduce the extent to which companies conduct identical or similar research behind closed doors. This is particularly important because companies tend not to publish failed studies. This means that other groups are likely to follow the same routes of enquiry without knowledge of previous unsuccessful attempts. On this point, Pierre Meulien, head of the Innovative Medicines Initiative (IMI) is quoted in *Nature* as saying “If ten companies are working on Alzheimer’s disease on exactly the same target and it’s failed, that’s ten times the investment that is down the tubes” (Savage 2016). This duplication and unproductive replication of research may well underlie much of the waste identified by Glasziou and Chalmers in the study referred to earlier in this chapter.

Many proponents of more open approaches feel that the more significant contributions of open science will come from knowledge gains. Sharing the investments and opening up knowledge exchange will lead to greater understanding and generation of research results in areas that were previously deemed too risky and expensive (Morgan Jones et al. 2014; Savage 2016). Moreover, open partnerships facilitate greater knowledge exchange between public and private sector based researchers, each of whom bring different focus and orientation to the science and development of research (Morgan Jones et al. 2014).

If the logic behind arguments that more open approaches will generate benefits overall and particularly in early stages of research seem strong, an important issue still remains about how economic benefits from research will be shared. This issue becomes more acute at later stages of applied research when in drug development for instance research costs rise dramatically. Members of the SGC team have tried to develop more downstream approaches and have had much more difficulty in making openness work in this context (Savage 2016).

While an evidence base is emerging to help us determine the benefits of more open approaches, there remains a great deal of uncertainty about the nature of benefits. If this is the case in basic science, it is amplified in more applied research where there is a very high degree of uncertainty about the balance that should be struck between open science and patenting which would help to ensure return on investment. The move to more openness is hampered by this lack of evidence.

### 12.5.2 Academic Career Structures: Will Open Science Work for University Scientists?

Current career structures, and researcher evaluation methods, do not necessarily encourage open science. Academics often need to point to high impact publications in journals that are not open access. There is mixed evidence about how university scientists are experiencing a push towards open science. This is potentially an important issue of course in thinking about how university/industry collaborations might evolve.

Some evidence suggests that open science activities tend to be seen as time-consuming, and not necessarily as rewarding career-wise as traditional research. In a 2014 public consultation on Science 2.0 (now known as "Open Science") 88% of respondents listed a perceived lack of credit for researchers involved in Open Science activities as a barrier to Open Science.[4] This was the second largest barrier at the level of individual scientists. Other barriers included uncertain benefits for researchers and a lack of financial support for Open Science activities.

Concerns about the effects of Open Science activities on careers vary depending on career stage. A 2014 knowledge exchange report on data sharing found that early career researchers feared both getting scooped, and the potential embarrassment of showing immature, or potentially inaccurate data. Mid-career researchers did not

[4]Validation of the results of the public consultation on Science 2.0: Science in Transition http://ec.europa.eu/research/consultations/science-2.0/science_2_0_final_report.pdf

fear embarrassment but did worry about getting scooped, and wanted to maximise the number of publications they can use a data source for and hence may not want to share it (Van den Eynden and Bishop 2014).

Despite these concerns, evidence is building up that embracing Open Science practices can enhance careers. A recent review highlighted a number of small but potentially important effects on researchers' careers (McKiernan et al. 2016). These included the facts that open access publications receive more citations and more media attention then non-Open Access papers. The paper also lists examples of ways open research practices can enable researchers to find collaborators, and open up possible job and funding opportunities.

Some Open Science developments are also specifically designed to help careers. For example, Publons, a website where researchers can register their peer-reviews, including whether or not they were open, produces a report researchers can put on their CV to show their activity in general, and their level of open-ness.[5] This idea of having something that proves activity is also being experimented with by the journal *Psychological Science*, which has introduced badges attached to papers if the paper provides links to open data or open materials. Early evidence suggests these badges encourage openness (Kidwell et al. 2016).

### 12.5.3 Is the Increasing Fragmentation of Initiatives a Problem?

Policies encouraging Open Science, and in particular Open Access, have taken off and multiplied in the last 10 years. As of July 2016 ROARMAP,[6] which records Open Access policies and mandates worldwide, contains 779 policies; 133 of these are funder policies (54 of these funders also carry out their own research), and the other 636 are held by research organisations, or sub-units of research organisations. European institutions hold 463 of the 779 policies.

These policies vary greatly between and within research organisations and funders, with differences including:

- Whether open access is mandatory or encouraged,
- Preference between green and gold publishing (where gold refers to an article being published open access in a journal, and green refers to the article being deposited in an Open Access repository after publishing in a subscription journal), and
- Whether embargos are permitted.

The Pasteur4OA report on Open Access policies (Swan et al. 2015) highlights the need for aligned policies, noting that researchers may receive funding from more than one funder, and if there is significant difference between the policies they

[5] https://publons.com/

[6] https://roarmap.eprints.org/

may be less likely to comply. Due to the large variation, and the lack of evidence about what makes a good open access policy, there are ongoing efforts to compare policies and develop a measure of the "strength" of a policy (Vincent-Lamarre et al. 2016). This could then help funders develop effective policies, and may reduce the variation between policies.

While other aspects of Open Science policy are currently less developed, such as policies on data sharing, these also suffer from fragmentation, with a high degree of variation in the much smaller number of data sharing policies that do exist. Funder policies are also not the only policies researchers are subject to. Institutions and publishers also have policies on open access and data sharing. This means that when a researcher wishes to publish they have to understand the policies of their funder(s), institutions and chosen publishing location, and work out how to satisfy all of these at the same time.

### 12.5.4 Do We Need New Policy Tools Including Indicators and Monitoring Tools?

Open science initiatives are aligned with many researchers' own beliefs in the importance of knowledge exchange and collaboration. They are being pursued in earnest by researchers themselves through grassroots-style efforts to build online communities to share information and ideas. At the same time, funders, publishers, industry and citizens are closely engaged with open science activities, driving their development at multiple levels. And the movement has more lately received serious attention from governments and other institutions worldwide. In the U.S., the White House Office of Science and Technology Policy developed policies to increase public access to federally-funded research results.[7]

The EU has gone even further, making it one of three main priority areas for the European Commission's science, research and innovation policy (Moedas 2015). The EU and its Member States have acted to facilitate Open Science in some areas, such as open access to research publications, which is a requirement under EU policy. Open data policies and infrastructure development are under discussion, for example a pilot initiative on Open Research Data was launched under Horizon 2020. Some of the most relevant issues underpinning Open Science have been addressed by the European Research Area Communication and the Commission Recommendation on access to and preservation of scientific information (European Commission 2012a, b), which contain measures designed to improve access to scientific information produced in Europe.

The movement is still in its infancy, however, despite the momentum building around it. Acknowledging this, the European Commission set up an Open Science Platform in 2016 composed of nominated individuals representing organisations

[7]U.S. OSTP (ND) 'OSTP Public Access Policy Forum', https://www.whitehouse.gov/administration/eop/ostp/library/publicaccesspolicy

across Europe engaged in open science initiatives (European Commission 2015). The Platform is designed to provide expert advice to the Commission on how to develop and implement open science policy with a view to ensuring that any policy initiatives are based on an informed view of the benefits and drawbacks of open science and the potential for approaches identified to incentivise these activities or reduce their costs.

There is a real need to understand better where open science activities are concentrated: in countries, amongst disciplines and at different stages of the research process. And it is still too early to really begin to measure the impacts of efforts in this area. As such, there is potential to develop monitoring tools that can help to track trends in open science as an initial step towards informing policy-making in this area. Over time, as impacts begin to be realised, monitoring activity can feed into assessments of open science achievements.

In order to meet this challenge, the EU has begun to build an open science monitor, piloting an approach that focuses on core characteristics of open science such as open access to research publications and open research data, and developing indicators that can illuminate trends occurring from idea generation and funding through to data collection, analysis and communication of research findings. Such a monitor can help the Commission and their advisors to better understand how open science is evolving in Europe and in other parts of the world and therefore focus on areas where the most impact can be achieved through policy initiatives.

## 12.6 Policy Challenges

Growing support from research funders and policy makers suggest that the momentum behind open science is likely to continue building. This chapter has outlined mounting evidence that open science presents a set of convincing alternatives to traditional models of scientific activity and conventional metrics used to define academic success and career progression. We have also tried to set out some of the key questions and issues underlying the rate and direction of change in open science. In conclusion, we argue that the impact on industry/university collaboration will rest on several key assessments made by stakeholders and policymakers.

First, to date there has been relatively little assessment of the costs and benefits of open access approaches to publications and data. There have been some assessments of individual schemes such as the Structural Genomics Consortium (SGC) such as the evaluation carried out by RAND Europe (Morgan Jones et al. 2014) but decision making would be facilitated by studies that span initiatives and develop broader frameworks and criteria for evaluation. Many in both private and public sectors naturally view the move to open data sharing in particular as extremely risky and the extent of benefits gained will depend on particular contexts (Morgan Jones et al. 2014). The rate and direction of moves towards more openness, and the success or failure of the movement behind it, are likely to be impacted on the nature of evidence produced over the coming years. The support that policymakers and funders of research provide in generating this evidence and implementing recommendations on the basis of that evidence. Steps taken by the EU to build a monitoring mechanism are extremely helpful in this respect.

Second, researcher attitudes to open access publishing will to some extent depend on the way that they assessed. In the UK and other countries, assessment of the performance of university based researchers has begun to change (Manville et al. 2015). The Research Excellence Framework which for the first time assessed research and allocated funds on the basis of academic and non-academic research could potentially break open the nexus of factors underpinning academics' overwhelming concern with publishing in high impact journals. If university researchers can point to a variety of indicators to support claims to excellence and impact, the incentive to publish in those journals is undermined to some extent and these may make publishing in open access journals more appealing. There is also some evidence that open access journals are proving to have a larger number of citations than their traditional counterparts and this may impact university researcher's choices.

The REF is beginning to change the way in which UK universities reward and promote academics (Stern 2016) but the weight of long traditions of a culture which viewed academic research activity according to quite a narrow set of academic achievements is unlikely to change smoothly and rapidly.

With regard to impact on university/industry collaboration, many questions also remain. While the logic behind the potential benefits of open access publishing are clear, there is limited empirical evidence about the way it influences the take up of research by industry. Monitoring and evaluation tools and analysis are needed both to clarify the situation as it exists and to provide evidence for better decision making, If this is true for open access, it is even more relevant for open data approaches which may well have greater implications for the ability to patent. The extent to which universities engage with supporting more open approaches will depend in part on how open access and open data are valued by the broader community and so the pace and direction may well be impacted by the availability of data and evidence which can be used to support moves in the direction of openness. Steps are being taken to gather evidence about the impact of open access and data repositories but there are numerous difficulties associated with the exercise and endeavours are still at a relatively early stage (Keserű 2015).

We should also note uncertainty about the future of non-academic metrics and the role that they will have in policy. The UK is committed to continued use of non-academic metrics and policy is based on encouraging the development of a broader range of assessment metrics (Stern 2016). Other European countries and US institutions are interested in similar policy pathways (Guthrie et al. 2013). However, the UK appears to be the front runner in introducing a national scheme which bases funding allocations on broader impact metrics and the extent to which other countries will follow remains unclear.

One of the unintended consequences of the growing enthusiasm for open science is the plethora of initiatives that are being undertaken to promote and support related activities. As we have pointed out, initiatives and policies are issued not only by a wide range of different funding bodies but also by some universities and publishers. Whilst this good news for those supporting open science in some respects, it could be that fragmentation and confusion undermine longer term development in the area. If the complexity adds to transaction costs it may even inhibit the growth of open science based partnerships and collaborations. This danger applies particularly to university/industry partnerships. Work on the Structural Genomics Consortium indicates (Morgan Jones et al. 2014) that it is precisely the absence of complex agreements that is one of the draws for companies to engage with the collaboration. If different organisations and institutions begin to impose a wide variety of different standards, one of the main attractions for partners to engage in collaborations may be removed.

The ability of funders and policy makers to define a coherent and shared agenda is likely to be an increasingly important factor in the way in which open science evolves. Of course this agenda will ideally be based on evaluation of different approaches and evidenced based development of more standardised approaches. However, political and interest based considerations may be very likely to play some role in determining the future shape of open science policies. It will be vital for those interested in using open science to structure university/industry collaborations to monitor the developments and support approaches that serve the interests of sustainable and useful collaborations that serve a broad array of interests.

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# 13 Value Generation from Industry-Science Linkages in Light of Targeted Open Innovation

Dirk Meissner and Elias Carayannis

**Abstract**

The chapter provides a substantial overview of features and channels of knowledge and technology transfer in light of achieving impact from science and research. A taxonomy of transfer channels is proved and levels of impact from science and technology on innovation is proposed. It's found that there are different levels of value generated from STI, each featuring different stakeholders with different agendas and expectations. The authors argue that to make knowledge and technology transfer impactful and sustainable a long term and holistic view and approach is required. Against most literature about technology and knowledge transfer this work presents an overarching overview of objects, channels and features of partners involved in transfer. It features technology and knowledge transfer from a holistic perspective and provides useful background for future empiric studies and impact assessments.

**Keywords**

Open innovation · Technology transfer · Knowledge transfer · Public research

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## 13.1 Introduction

For the last decade innovation has received increasing attention in the academic community, among policy makers and also in the industrial establishments. Whereas for long time innovation was commonly considered a normal precondition for successful business it's now been increasingly challenged to provide more visible and countable contribution to industry successes and to the economic and social development of nations. Accordingly more and more approaches towards defining, measuring and accounting innovation and its' resulting impact were developed and described and thoughts given to increasing the speed and impact of innovation activities and results. In doing so two major schools emerged which share the same aim but view the challenge from different angles:

1. The innovation management school looked at the innovation activities of companies and postulated the open innovation paradigm at the beginning of the twenty-first century by the meanwhile most prominent scholar Henry Chesbrough.
2. The second stream was looking from the macro perspective by means of linking the national science & technology base (S&T) with the innovation actors (companies) which has frequently been called 'industry-science linkages', 'university-industry relationships' or 'technology transfer', 'knowledge transfer' and similar.

In the end both schools of thoughts aim at explaining and modeling the same phenomenon: the emergence of innovation and approaches to accelerate innovation generation combined with the quest to measure the outputs from investments into S&T regardless the source of origin, e.g. public or private investments (Abbate et al. 2013; Perkmann et al. 2013; Plewa et al. 2013).

Eventually the argumentation about Open Innovation as well as about Industry-Science relationships (ISR)—sometimes also called University—Industry Linkages (UI linkages), technology transfer (TT) or knowledge and technology transfer (KTT)—aims at generating value from science and technology (S&T) or in a broader understanding value from STI (science, technology and innovation), the latter extending S&T with innovation (I). Initially it's assumed that STI generates economic value resulting from innovation which in turn is depending on the inputs from S&T (Kindras et al. 2014). However a more profound consideration of the application of STI discloses more levels at which value is generated including the broad national level and the societal level. Obviously the potential value differs at each level with diverging assessment and measurability features which is looked at in the following sections. Further to the STI value generation levels STI generated UI linkages come in different shapes, in other words value is generated by using different channels for transferring knowledge and technology and also the object which is being transferred determines the effectiveness, efficiency and eventual impact of ISR. These features are discussed in the third and fourth section of the article. Finally the term ISR refers to Higher education institutes (HEI), among them universities, and public research institutes (PRI) equally.

## 13.2 Value Generation from STI

### 13.2.1 Levels of Value Generation from STI

There's broad consensus that investment in different forms and fields of STI is expected to deliver value to stakeholders and demonstrate impact. Still stakeholder expectations are varied and STI impacts come in different forms and shape (Sarpong et al. 2015). It's not the objective of this chapter to discuss the forms of impact which arise or arise potentially from ISR but to provide a general overview of the different levels ISR show impact. Overall four main levels of value creation from STI can be featured (Fig. 13.1):

- National level
- Research institution (HEI/PRI) level
- Company level
- Societal level

For achieving impact from STI measures are taken at the different levels (OECD 2002, 2003; Meissner and Zaichenko 2012). *National approaches* include but are not limited to widespread investment initiatives in the STI infrastructure and equally widespread the development and implementation of numerous diverse policy measures aimed at connecting STI to industrial innovation for a sustainable economic growth (Carayannis and Grigoroudis 2016; Cervantes and Meissner 2014; Gnidchenko et al. 2016). Among these often measures for developing or maintaining centers of excellence and defining and supporting priority field funding

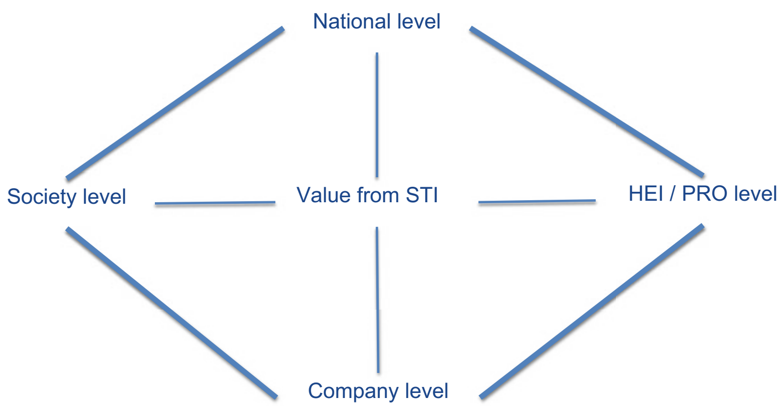


**Fig. 13.1** Levels of value creation from STI

are the most common (Gibson and Butler 2013). In a broader STI sense there is an increasing awareness and willingness to increase spending on education and HEI as well as raising the public awareness for STI (Schartinger et al. 2001).

*Universities and Public Research Institutes* are meeting these challenges by increasingly applying industrial research and innovation strategies and management concepts, often in form of developing and implementing dedicated strategies aiming at value creation. There is consensus that these institutions carefully balance their activities towards meeting the different stakeholders' interests in value creation. In general terms value these institutions generate value by education (graduates), scientific reputation, networks and cooperation with different partners.

Obviously *companies* follow more short term and dedicated approaches to STI based value generation which is rooted in their longer and deeper experience with innovation. Whereas these experiences were mainly found in company internal innovation activities and the sole focus on one dedicated application and exploitation field for a technology the companies' horizon has expanded towards openness of innovation activities involving multiple partners and the multiple use of technologies and innovations. This goes in line with the nowadays widespread use of brands and trademarks as innovation synonym aiming at building innovation driven brands and the respective customer perception of companies' offerings. Another recent approach is mergers and acquisitions which are similarly often understood to improve at least one partners' innovation performance overall among other related ambitions. It's not surprising that in light of these developments a service industry for innovation with dedicated specialized service to companies has emerged and continues to grow.

Obviously the individual levels can't be understood and analyzed separated from each other but the impacts on each other need to be identified and understood. This then also requires profound understanding of the causality of impacts at different levels, in most cases the 'chicken and egg' challenge appears on the screen.

### 13.2.2 Determinants of STI Value Generation

Technology and knowledge transfer has become a common task for HEIs and PRIs. There is substantial literature about the outcome and results of these activities but little has been written so far about the underlying determinants of successful technology and knowledge transfer, however these determinants shall be considered in order to develop activities and procedures within an organization to foster such transfer (Alfaki 2016; D'Este and Patel 2007). Figure 13.2 shows five major transfer project determinants which are:

– Transfer object
– Transfer instrument
– Time
– Information flow
– Partner characteristics.

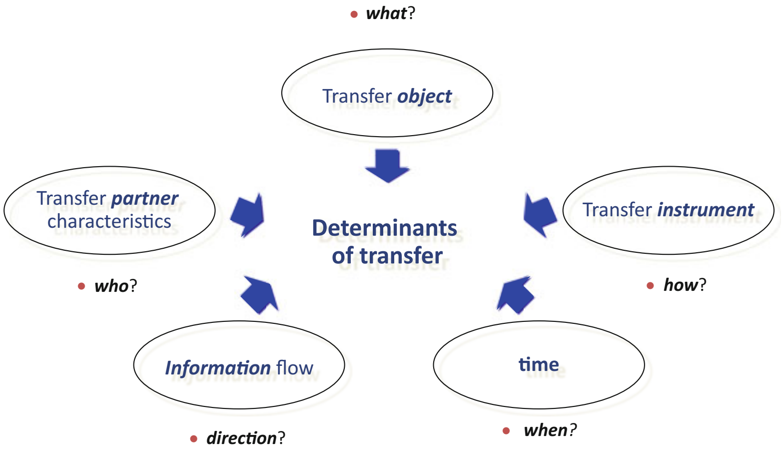


**Fig. 13.2** Technology and knowledge transfer determinants

These determinants are rather general and should be considered equally important. Furthermore the success of transfer activities doesn't depend on one or several selected features only but strongly depends on the full spectrum of features, e.g. there's a strong interrelationship between individual features (Del Giudice et al. 2013).

In the first instance the issue arises about *WHAT* to transfer, e.g. what the *object of transfer* is and which related characteristics are involved. There's a strong difference between the possible transfer objects in discussion, e.g. this might include prototypes, formulas, recipes, experiment protocols, patents, licenses, training and education programs among many other (Meissner and Sultanian 2007). Applicable features to describe the transfer objects are:

– specialization
– complexity
– compatibility
– maturity
– demonstrability
– divisibility
– newness
– technical advantage
– economic advantage
– centrality (Meissner 2001).

*Specialization* of the transfer object is a two-sided issue. On the one hand one might argue that the more specialized and complex a technology is the more attractive it is for transfer. However this thinking implies that the specialization and *complexity* of technology and knowledge also brings a unique element for the transfer partner which pays of in terms of competitive advantage. Also a highly specialized and complex transfer object is likely to require supporting activities such as complementary training. Furthermore these transfer objects typically impose additional administrative burden, namely legal issues on the parties involved. It's been found that concluding agreements which describe the transfer do require very special legal and administrative competencies and people to assure that the transfer object and all the potential resulting impacts from its use are included in the respective agreements accordingly.

Other features which are frequently reported are *compatibility* but also *maturity* and *demonstrability* of the transfer object. Compatibility here mainly refers to the potential to integrate the knowledge and technology into the existing technology and knowledge infrastructure and base of the transfer recipient, e.g. referring to the absorptive capacity. Also with increasing maturity it's expected that both technology and knowledge show higher potential and possibility of demonstration which is in many cases essential for transferring and bringing to application. Demonstrability of namely technologies developed at HEIs is usually less problematic in the engineering disciplines but more complicated in natural science and medicine as well as in the social sciences and humanities. Other related features include *divisibility* and *newness* which both are thought of being potential drivers of *technical* and *economic advantage*. Theoretically technologies and knowledge are easily divisible but practical experiences shows the contrary because it usually forms one solution which consists of several systems which can't be exchanged and diverted in plug and play modus. The reason is often found in the challenges imposed on the interfaces between the different systems. These interfaces are typically challenging to define and document due to the nature of premature, e.g. early in the life cycle, technologies but also in the documentation of selected pieces and features of knowledge which appears difficult to understand and process if not treated in context. Lastly transfer objects centrality to the recipients but also sender own competencies base is worth mentioning.

In conclusion potential transfer objects' features can be summed up to codification and availability (Table 13.1).

Obviously there is a clear dominance of codified transfer objects or at least there is a strong possibility to codify these, the more tacit dimension though is equally important as the codified part. There's a slight difference to the availability of the possible transfer objects, a significant share of objects is typically kept secret for different reasons among which the resistance of researchers towards making datasets and databases public domain is one major (Geuna and Nesta 2006). This is because researchers are less reluctant to disclose and publicize the results of research but the underlying raw dataset are typically less subject of disclosure. Instead researchers often have a tendency to keep the dataset in their ownership, not or maximum partial sharing is common practice as long as possession of these dataset is considered the competitive advantage of researchers who use them multiple times for different purposes. Also datasets underlying the factual research results are the major asset researchers possess, some even argue that original dataset

**Table 13.1** Availability and publicity of transfer objects

| Object | | Codified | Publicly available |
|---|---|---|---|
| Materialized technology | Products | T | S |
| | Machines, equipment | T | S |
| | Software | C | P |
| | Parts, materials | T | S |
| Documented subject knowledge | Handbooks | C | P |
| | Training programs | C | P |
| | Data bases | C | P/S |
| Documented know-how | Property rights/patents | C | P |
| | Published research reports | C | P |
| | Construction plans/ blueprints | C | S |
| | Recipes | C | S |
| | Algorithms | C | S |
| | Protocols | C | S |
| | Experiments results | C | P/S |
| | Scientific effects | C | P |

*C* Codified, *T* tacit, *S* secret, *P* public
Source: Meissner (2001)

are the currency of science. Similar holds true for algorithms and selected blueprints. In such cases institutional approaches towards increasing the transfer performance of HEI and PRI might be misleading if targeted at this transfer objects.

Another challenge is *HOW* to transfer the object, e.g. which channel to use to generate significant value (Ramos-Vielba and Fernández-Esquinas 2012). Broadly spoken there is a range of channels available (Table 13.2) with each showing its own unique characteristics.

*Educational transfer channels* are meant to include standard teaching programs but also involving exchange of staff which mainly includes a learning component (in this sense understood and defined as teaching) but also a research. Frequently *scientific communication* is an efficient channel to inform about state of the art of science and technology, less about innovation related achievements. Furthermore these channels usually fulfill an orientation function providing an initial overview as to where to find expertise in specified domains but also inspiration. Among the channels with broadest outreach are *information and communication channels* which involve networks and associations as well as electronic libraries and repositories. *Service offerings* usually refer to the role and meaning of intermediaries who aim at matching demand and supply for technology and knowledge to the largest possible extend but also include services such as consulting on selected themes, reviewing and the like. *Project related instruments* are characterized by clearly defined aims and scope of collaborative often including project management or parts and elements of project management. *Joint research undertakings* come in similar shape but are typically more long term focused. Many

**Table 13.2** Transfer channels

| | | | |
|---|---|---|---|
| Education/further education | Tertiary education | Information and communication technology related channels | General communities |
| | Staff exchange | | Online publications |
| | Further education | | Scientific databases |
| Scientific communication | Scientific publications | | Technical databases |
| | Conferences | | Social networks |
| | Libraries | | Technical networks |
| | Doctoral studies | Project related | Contract research |
| | Other publications | | R&D co-operations |
| | Sponsored professorships | Research joint ventures | Physical public private partnerships |
| Services | Services | | Networks |
| | Transfer intermediaries | | |
| Spin offs | | Intellectual Property Rights | Trademarks |
| Mobility of individuals | | | Licenses |
| Trade of goods | | | Patents |

Source: Meissner (2001)

debates around technology and knowledge transfer are considering the exploitation and commercialization of *Intellectual Property* (IP). Revenues and impact from these activities however often remains at modest level because IP underlying technologies are often too far from actual application and require substantial financial investment to build and maintain. Furthermore IP isn't an opportunity only but also brings considerable risk in form of liabilities if products or processes affiliated with the respective IP have negative impacts even though these were not known by the time of IP filing and granting.

In sum it can be concluded that there's a much broader range of transfer channels than the often quoted research co-operations and IP related ones. On the contrary it should be noted that in most cases the channels will be bundled and a mix of channels used depending on the transfer object and partners.

Besides the two main transfer features, namely object and channel used, the *timing of transfer* is important. It makes a huge difference if technology is thought to be transferred in the early phases of technology life cycle, e.g. as pacing technology delivering considerable technical and economic value or in the more mature life cycle when the initial technical and also economic value is rather marginal instead of large. In this respect the life cycle phase, e.g. time, directly impacts the risk and uncertainty attitudes of partners involved in transfer and also the choice of transfer channels.

Finally the *direction of information flows* and actual *transfer partner characteristics* are important to consider for impactful and sustainable transfer relationships. The first is an important feature for research cooperation based transfer which requires continuous mutual information exchange whereas in case of communication and information exchange channels a tendency towards one-sided dominated information flows is predominant. Similar issues hold true for the partner features which are centered around the location of partners, e.g. in close or remote proximity, the size of partners, e.g. small or large entities and the spectrum of technology domains served among others. These features overall make up the climate and trust between the partners to some extend thus showing a clear influence on the cooperative behavior during the transfer itself.

## 13.3 Approaches to STI Value Generation

In light of the complexity of technology and knowledge transfer outlined in the earlier sections it becomes obvious that there is a quest for coordinated actions of all stakeholders in the process and at the different level. There is a general perception especially within the policy community that linking HEI/PRI and industry leads to short term economic impact and strengthens both sides including the existing willingness of both sides to engage in these undertakings (Barge-Gil and Modrego-Rico 2013). But this expectations rest on many assumptions, most of them aren't fulfilled in reality. In order to accelerate the impact from these linkages measures are required by governments, HEI/PRI and also industry.

**Governments Approaches—Framework Conditions**

It's an essential request towards governments to design framework conditions ensuring clarity of aims in the first instance. Not only during the last years policies and respective framework conditions were changed many times leading to confusion among the research but also the industry community. Government initiatives are needed which set out the objectives of innovation policy clearly and define the HEI and PRI main objectives and missions. Since these two institutions are mainly publicly funded and steered by governments in one way or the other it's governments responsibility to support HEI and PRI in providing access to resources and building capabilities for innovation. A framework considering this needs to be rather flexible to account for different possible constellations which occur in the transfer process, accommodate different roles of HEI and PRI as well as the broad range of shapes these institutions take and also allow institutions flexibility in Human Resources matters. To achieving this it requires an intelligent interface between government and HEI/PRI which includes that governments develop and apply metrics that reflect the individual HEI/PRI missions and objectives but also appoint staff within the government who understand R&D and can engage with HEI/PRO staff over an extended time.

Networking and people transfer is frequently quoted an efficient enabler for transfer but it requires that HEI and PRI as well as individuals are provided reasonable incentives to network externally (Mora Valentin 2002). This goes in line with governments taking an encouraging and missionary role towards HEI and PRO to consider and use funding and employment conditions to encourage people transfer especially. Thus the framework conditions need to be adjusted accordingly with respect to employment conditions to remove barriers of movement between industry and HEI/PRIs and rig the risk-reward balance involved.

**HEI/PRO Approaches**

There is an urgent need for HEI/PRI to develop and implement more sophisticated management tools to ensure flexibility and foster collaboration with industry partners. This includes especially flexibility concluding industrial collaborative arrangements with regard to IPR ownership and respective management procedures as well as internal rewards and incentives and staff career patterns. In addition the institutions need to develop and maintain more expertise in selecting ventures and transfer partners by means of building and maintaining substantial entry barriers, that ventures being supported enjoy a better long-term success rate. This is also closely affiliated with the more general quest for research portfolio management approaches meaning to apply portfolio management tools to run a mix, appropriate to the institute's mission, of basic, strategic & applied research and to accommodate a range of risks, timescale and size of research projects (Kauppila et al. 2015).

In addition to the research management instruments proactive industry linkages facilitation seems plausible to establish (Lind et al. 2013). This includes following the "Get close to your partner" paradigm which implies an explicit focus on the 'Under one roof works' whereas the adjacent sites approach is less promising. Furthermore people transfer and exchange needs to be enhanced as a precondition to build close sustainable co-operation. Other related mobility promotion measures include the revision of rigid hiring conditions which often appear in fixed term short, e.g. with a minimum duration of 1 year and respective extension options and second support to industry staff career development by allowing researchers, doctoral students and others to have access to the equipment, skills and networks of HEI/PRIs (Gokhberg et al. 2016). Collaborative work might also be seen as a scientific training ground and a route to qualification also including to enable industry researchers to submit work for higher qualifications accredited by a university.

**Industry Partners Approaches—"Appreciating the Other's Thinking"**

Equally to HEI/PRI industry partners' attitudes and thinking requires more flexibility in collaboration arrangements and negotiation of contractual terms and a fair share of rewards with the originators of the technology or intellectual property. Often industry is driven by short wins-thinking but in order to build lasting advantages relations a strong and clearly expressed commitment (financial and human resources) over the life of a project even though this may be longer than the normal horizon of industrial R&D and beyond is essential (Koch 2011; Krylova et al. 2016). This goes hand in hand with ensuring mutual recognition by recognizing and appreciating the scientific at arms-length with the business motivation and acknowledging and valuing scientific excellence of researchers (Kodama 2008).

The so described approaches are theoretically not new but daily practice shows the contrary. In many cases industry partners don't appreciate the full competences and the initial mission and business model of the HEI/PRI at the fullest extent.

## 13.4 STI Value Creation Under the Open Innovation Paradigm

The open innovation paradigm is present to companies and researchers for a long time stressing the importance of companies cooperating along the innovation value chain with multiple partners and highlighting the meaning of joint innovation related efforts with external partners (Dahlandera and Gann 2010; Huizingh 2011; Chiaroni et al. 2011; Bianchi et al. 2011). In this respect it can be observed that new forms of complementarity between business and public research have emerged which correspond to the increasing desire by companies to take advantage of the growing technology and knowledge stock as a result of the ongoing increasing public expenditure in research and education (Carayannis et al. 2015). This increased knowledge and technology inventory brings more options and opportunities for generating innovation because in a more narrow understanding innovation is rooted in the combination/recombination/assembly of existing knowledge and technologies paired towards special purposes in course of which companies are increasingly engaging in alternative innovation practices (Doz et al. 2004). Looking at the innovation process from this perspective it's obvious that the main features of generating innovation remain similar (Huizingh 2011) whereas inbound innovation, so to say ideas for innovation and outbound innovation, e.g. exploitation paths have, became more divers (Dahlandera and Gann 2010). Another important challenge arises from the quest to integrating complementary knowledge and competences to leverage the innovation potential (Doz et al. 2004) because different knowledge and technology sources are not always complementary (Fallick et al. 2004). Knowledge and technology absorption from different sources is more challenging when it also requires integrating market, customer and competitive intelligence. Speed and intensity of incorporating external knowledge and technology is also at least partially determined by the geographical proximity of partners (Döring and Schnellenbach 2004; Fritsch and Franke 2004; Simmie 2003; Spithoven et al. 2010).

In order to accelerate partnering with HEI/PRI companies are frequently employing a clearly defined and structured approach assessing the respective institutions prior engagement towards a number of criteria among the most important are:

- research and scientific excellence
- degree of matching competences
- institutions networking capabilities

- interdisciplinary thinking and cross-disciplinary research agendas
- openness towards external PhD students are important factors
- availability of qualified staff is considered a precondition for cooperation
- innovation culture established and practiced in HEI and PRI
- awareness for innovation and openness towards risk
- acceptance of and openness to external sources for research proposals and research agendas
- fast responses and quick decisions preferably delivered via a one-stop shop solution
- institutions willingness to go new unusual ways and its' openness to experiment with models of cooperation

Aside from these institutions specific expectations and requirements general legal framework conditions are assessed among which are principle cooperation rules and modes, IP regulations, staff mobility regulations (including sabbaticals and part time employment possibilities), and the local and regional quality of life (Gulbrandsen and Smeby 2005).

Company R&D cooperation activities are embedded in their overall R&D portfolio which is characterized by a growing share of joint projects with customers and other external partners, which are now a key R&D performance indicator. Among the key success factors R&D related collaboration are the commonly known clear common technical objectives; complementary skills; joint investment to ensure critical mass and respective agreements on confidentiality and commercial targets and close monitoring exploitation. One of the cooperation forms are public-private partnerships which are used to promote collaborative high risk, pre-competitive research in specific areas with important potential social benefits that justify government support and where some competences of the public research sector are key for success (Gururajan and Fink 2010).

Having said this it becomes clear that companies are increasingly open towards ISR which even go beyond the common KTT channels. However companies are also becoming more selective in choosing partners and sources for their innovation activities which imposes now challenges on HEI and PRI to become partner of choice (Hutzschenreuter and Horstkotte 2010).

## 13.5 Discussion and Conclusion

Over the last decade much has changed in the innovation generation process and the respective strategic orientation of the actors. This includes the changed attitudes towards innovation by HEI and PRI as well as the open innovation paradigm which is common sense meanwhile among companies. Moreover company innovations are increasingly targeted at more integrated innovation models e.g. combined product/process and service innovation and also business model innovation. This implies that product and process innovations are now accompanied by services and modeled around the business itself and in turn opens new and broader opportunities for companies' collaborating with external partners in R&D undertakings.

In addition it needs to be noted that HEI/PRIs are not a homogeneous class but much of their value lies in their diversity. Therefore any collaborative relationship of a company and a HEI/PRI is unique in scope, shape and size which make it difficult to depict general best practices as often requested. However good practice doesn't necessarily need to be understood as copying these practices but more as observing, understanding, selecting, adapting and sharing & learning with and from others. This allows to looking at transfer relations between HEI/PRI and companies from a more objective perspective and enables both to detecting relevant features which support successful and impactful transfer relations.

This paper argued that HEI/PRI–company linkages continue to rise in light of the open innovation paradigm. In this regard HEI/PRI-company linkages take many different forms which require different administrative support functions. Moreover the awareness for innovation and the respective motivation of individuals to engaging in theses linkages turn out among the most crucial issues which need to be solved. In addition to accessing the HEI/PRI knowledge and technology base companies are engaging in such relationships with the aim of approaching talent which is educated in these institutions and which are considered becoming potential employees. This is a fully different motivation of companies for transfer relationships which hasn't been thought of previously. Also company human resource development, e.g. engineers and researcher professional training need to be seen in this context. Cooperation with the public research base researchers is considered one company approach to keep abreast with long-term science and technology development paths which aren't in the recent scope of companies. Namely cooperation channels with a personal note, e.g. requiring and supporting direct interaction of people, are seen efficient and effective for achieving this.

To take account of this special personnel related governments should support the creation of sustainable thematic clusters which act as open innovation hubs and attract talent to HEI/PRI and companies, for example through scientist hosting programs, simplifying and streamlining public funding programs, and combining R&D and innovation funding with tax benefits. Furthermore, governments should support mobility of skilled people internationally as this is crucial to business success.

Furthermore the public perception of start-ups originating from HEI/PRIs should be changed. Until recently start-ups are seen as one of the drivers for economic development of regions and countries by regional and national governments and governmental bodies. However, these start-ups often transport the "entrepreneurial spirit" to larger companies which invest in such companies with their own venture funds. Typically these investments are done from the perspective of company strategic development; hence they are considered strategic investments with a solid financial assessment. This attitude is different from the established Venture Capital companies, which are driven by investment from a financial perspective and so typically want a shorter return on investment. Hence governmental initiative should also target the promotion of company venture investment initiatives by different means, e.g. tax reliefs and direct support programs.

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# 14 The Latent Role of Universities in Boosting Innovations: An Informational Approach

Inga Ivanova, Mark Johnson, and Nikita Krupenskiy

**Abstract**

The chapter looks at universities in their relation to other entities in society. It proposes new metrics for gaining insight into these relationships. The possibilities for the reorganisation of the relationships between universities, industry and government so as to stimulate economic growth or innovation can themselves be classed as innovations. Whilst universities often are the locus of specific innovations, their broader discursive role provides a means of exploring contesting perspectives on innovation. In doing so, they can contribute to a broader public discourse where some innovations which were once seen to be controversial become normalised. The discourse dynamics illustrated by the Triple Helix allows for the description of this process as one where redundancies of expectation are produced not only within the transactional productions of the academy (i.e. academic papers) but also within the management of institutions surrounding education, including university management, academic quality agencies, institutional ranking organisations, academic journals, as well as other institutions which the university is associated with such as health or law.

**Keywords**

Entrepreneurship · Incubation · Success · Policy making

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The origin of the concept of national system of innovations, according Freeman and Soete (1997) can be traced down to the middle of nineteenth century when Friedrich List's book "The National System of Political Economy" (1841) first appeared. Since then a system's perspective to innovation studies was first introduced by Freeman (1987) with reference to the Japanese system of innovations, then generalized by Lundvall (1988, 1992) and Nelson (1993) to the theory of "national systems of innovation", and then conceptualized to the theory of Triple Helix (TH) model of university-industry-government relations (Etzkowitz and Leydesdorff 1995, 2000).

Knowledge generating institutions are reputedly considered to be principal drivers of innovations. Whilst what this means remains obscure, it is suggested that the appropriate institutions for generating new knowledge which may be turned in innovations are the universities. However, the nature and role of the universities has been contested: from the Newman's classic 'Idea of a University' (1953) and his appeal for Universities teaching 'universal knowledge', or the Humboldtian ideal of Bildung, to recent market-driven characterisations where universities become competing 'knowledge enterprises' there continues to be much debate—particularly as modern institutions are affected by pressures of an 'educational market' (Brown 2012; Barnett 2013). In presenting the Triple Helix, we frame our discussion around a generalized dynamics of communication which principally has focused on the discursive relations between universities, government and industry. Universities can be seen to contribute to a nonlinear dynamic of knowledge exchange within society, and that the study of this dynamic can bring deeper understanding of the relationship between universities, innovation and the economic growth that is produced. Drawing on this, in the second part of the paper, a more generalized view of this dynamic is taken in order to account for recent examples of innovation which appear to arise outside the traditional bounds of university, government or industry. Emphasizing a generalized discourse dynamic in three dimensions without reifying institutional entities allows for a deeper consideration of innovative processes within the context of the discourse dynamics described, and a deeper consideration of the discursive role played by Universities.

In the Triple Helix (TH) metaphor, innovation system comprises three key actors: University, Industry, and Government, responsible correspondingly for the functions of knowledge production, wealth generation, and normative control (Etzkowitz and Leydesdorff 1995, 2000). The model assumes that economic development increasingly relies on knowledge based development than simply on manufacturing. The most appropriate institution for generating new knowledge and new technologies which can further be transformed to innovations are universities. However, the role of universities in innovations seems to be more diversified, and the role of knowledge generating institutions in the network of relations among the key actors constantly grows. The spheres of actor's activities increasingly overlap and in the area of overlapping actors can partially substitute for one another. Overlapping spheres of activity can be schematically presented with the help of a Venn diagram (Fig. 14.1).

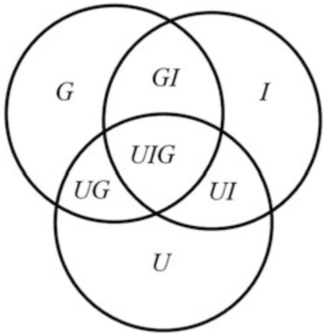


**Fig. 14.1** Graphical representation of the TH model: *U* university, *I* industry, *G* government

TH actors operate as selection environments for each other. The interactions among the selection mechanisms govern the system's evolution. Universities, primarily responsible for research and educational functions, tend to engage in business, in the form of small innovative companies. Corporations, making ties with universities, improve their own R&D and personal training activity. They may also be able to use the university's infrastructure in order to conduct their own R&D activities, and thus shift part of their costs to the state as the main source of funding for universities. Governments stimulate development and implementing of innovative technologies, and can support small innovative enterprises through priority financing of specific universities and legislative regulation. Universities and industry can partially substitute for the state in the creation of an innovation infrastructure. Inter-substitution of activities spheres can be graphically presented as a vector *V* rotating in a three-dimensional coordinate system formed by three institutional actors (Fig. 14.2). The values of the components of vector *V* along the axes define the relative importance of the corresponding institutional actor at the specific moment of innovation processes.

Etzkowitz and Ranga (2012) suggested describe the TH evolution via Knowledge, Consensus, and Innovations Spaces which are correspondingly related to functions of novelty production, normative control, and wealth generation. Each of the Spaces involves activity of all three actors, but the weight of the actors in each of the Spaces is unequal. The Knowledge Space, based on R&D activities, is primarily occupied by universities because universities perform the leading role in creating new knowledge. The Consensus Space is mostly controlled by government, and the Innovation Space, based on knowledge-based entrepreneurship, belongs to the Industry sphere.

Depending on specific initial conditions in various regions, the innovation process may comprise consecutive initiatives that lead to building the mentioned spaces in different time sequences. Etzkowitz and Ranga (2010) discuss the situation in two regions: Norrköping in Sweden and New England in the United States. While in the first region the sequence of space generation was Consensus → Innovation → Knowledge Space, in the second it was Knowledge → Consensus → Innovation Space. The creation of Spaces entails a change of the corresponding

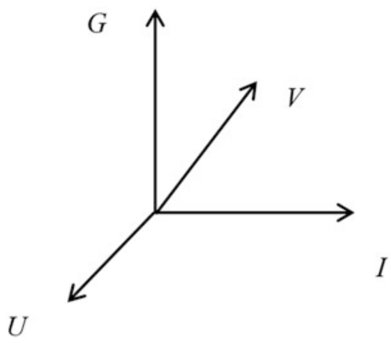


**Fig. 14.2** Cartesian coordinate representation of the TH model (from: Ivanova and Leydesdorff 2014a)

actors' relative roles. For example, the Consensus → Innovation → Knowledge Space sequence in Sweden reflects a shift of emphasis from Government to Industry, and then to Science. This process can schematically be depicted as a rotation of the vector *V* in Fig. 14.2 in the three-dimensional coordinate system. The rotation changes the relative value of the vector components, and accordingly the corresponding contributions of *U, I, G* institutional spheres.

Thus, the evolution of the TH system can be presented as rotations of the vector *V* in three-dimensional coordinate system. Rotations in three dimensions belong to the non-Abelian (i.e. non-commutative) symmetry group, as opposed to rotations in a two-dimensional coordinate system, which can be described by an Abelian (i.e. commutative) symmetry group. Whereas communication in system with two actors (for example, university-industry or industry-government relation) can be described by linear equations, the order of rotations in a three dimensional system cannot be interchanged without changing the final result. In other words, the pivotal role of universities comprised in changing the dynamics of the innovation system by shifting it into non-linear domain.

Constant variations and non-linearity characterize a TH system because of the non-linear dynamics. A nonlinear dynamical system can have the following features: first, the system contains feedback loops; second, areas are present where more than a single state of equilibrium is possible; third, the system can be considered as fractal; and fourth, there is a sensitive dependence of the systems dynamics on initial conditions (Peters 1996).

The Triple Helix model can be further generalized to a Quadruple (Baber 2001; Carayannis and Campbell 2009). Although these generalizations can be broader than that of TH, they do not bring any substantially new dynamics into the system (Ivanova 2014) when compared with a TH system because the same kind of non-commutative symmetry is responsible for the system's non-linear behavior.

Equations describing the communications among TH actors in a model approximation can be reduced to a modified form of generalized Lotka-Volterra equations (Ivanova and Leydesdorff 2014b) which can generally be used to describe the evolutionary dynamics of self-organizing eco-systems (Hofbauer and Sigmund 1998). A set of possible solutions of generalized Lotka-Volterra equations, depending of initial conditions and the values of the coefficients, comprises as well chaotic solutions, point attractors, limit cycles, etc. Initial conditions and coefficient values are implicitly defined by corresponding STI policy.

The non-linearity extremely increases the role of STI policy in providing an optimal environment for generating innovations. The mistake cost of the STI policies increases in the case of non-linear innovation environments, in comparison with linear ones, and wrongly applied policy can push the system into in an effective or alternatively a chaotic mode. For example, recent considerable expenditure on innovations in Russia did not result in any considerable shifts in the Russian economy.

## 14.1 Synergy and the Mathematical Theory of Communication

Another not commonly realized role of the universities refers to the synergy of communications among actors. Figure 14.1, illustrating the overlap among institutional spheres, allows for an explanation in terms of information theory. The overlapping parts can be considered as a reduction of uncertainty so that system entropy is decreased in comparison with non-overlapping (non-communicating) institutional spheres. Mutual information between two random variables minimizes maximum entropy and is formulated, according Shannon's mathematical theory of communication, as follows:

$$T_{12} = H_1 + H_2 - H_{12} \tag{14.1}$$

The mathematical theory of communications was developed by Shannon (1948) with reference to technical systems. However, communication in social systems is different from communication in technical systems, as was acknowledged by Weaver when he stated that "[t]he concept of information developed in this theory . . . has nothing to do with meaning . . ." (Shannon and Weaver 1949, p. 27). Information in social systems is defined with reference to a receiving system which supplies information with meaning. Weaver (1949) suggested complementing Shannon's original diagram representing communication process with the semantic box at the sender sides with which to code the information. A similar semantic box can also be added at the receiver side with which to decode and supply meaning to the received information.

Codes of communication are used at the symbolic level to supply communication with meaning. The codes operate as expectations entertained reflexively in the communications among human beings. They open horizons of meaning that offer options. Options add to the redundancy as the complement of the information; adding options thus changes the maximum entropy—that is, the definition—of the system. The interactions among codes of communication may generate redundancies (as feedback on the forward arrow of entropy production). Increases in redundancy can be measured as a net reduction of prevailing uncertainty (measurable in bits). This generation of redundancy (options) can be considered as a hallmark of a knowledge-based system: new knowledge provides more options than can be realized.

New options can be generated as mutual redundancy when two (or more) codes of communication are instantiated; for example, in the case of introducing a new technology in a market or when writing an evidence-based report for a government agency. In this latter case, one needs text that can be read using the various perspectives involved, and thus one generates redundancies deliberately (Fujigaki and Leydesdorff 2000). We propose to specify mutual redundancy between systems in analogy to the concept of mutual information as specified in Shannon's theory, but using whole sets. In addition to mutual information, the overlap can be considered as containing redundancy as a surplus of information. We can thus define an "excess" information value $Y_{12}$—equivalent to $H_{12}$ but with the plus sign, so that maximum entropy increases, since we do not correct for the duplication in the case of redundancies—as follows (Leydesdorff and Ivanova 2014):

$$Y_{12} = H_1 + H_2 + T_{12} = H_{12} + 2T_{12} \tag{14.2}$$

The corresponding value of $R_{12}$ can now be found by using $Y_{12}$ instead of $H_{12}$ in Eq. (14.2), as follows:

$$R_{12} = H_1 + H_2 - Y_{12} = H_1 + H_2 - (H_{12} + 2T_{12}) = -T_{12} \tag{14.3}$$

Since $T_{12}$ is necessarily positive (Theil 1972, 59 ff.), it follows from Eq. (14.3) that $R_{12}$ is negative and *therefore* cannot be anything other than the consequence of an increased redundancy. This redundancy—reduction of the uncertainty—can be measured in bits of information, but the sign is negative.

For the three-dimensional case, one obtains:

$$R_{123} = T_{123} \tag{14.4}$$

Introduction of mutual redundancy corrects for the alternating sign in mutual information with each additional dimension. In empirical configurations, the resulting value of $R$ is the result of generation of redundancy on the one side versus the historical process of relating and the generation of uncertainty, on the other. When the resulting $R$ is negative, (evolutionary) self-organization prevails over organization (at specific moments of time) in the configuration under study, whereas a positive $R$ indicates conversely a predominance of organization over self-organization as two different sub-dynamics. In the case when there are only two sub-dynamics presenting two selection mechanisms the interaction among codes can lead to mutual shaping and a "lock-in" to a stable regime (Leydesdorff and van den Besselaar 1998). In the TH model the selection mechanisms in addition to stable regime allows for a various kinds of dynamics where various regimes (e.g., meta-stable, hyper-stable, or global) become possible.

One can further ask whether there is a smooth transition between organization and self-organization? To answer this question, Eq. (14.1) can be written as follows:

$$H_{12} = H_1 + H_2 - \alpha T_{12} \tag{14.5}$$

Here: $\alpha = 1$ for organization and $\alpha = -1$ for self-organization. When communication code sets coincide and the message is uniquely interpreted one would have a net entropy decrease and $\alpha = -1$ in Eq. (14.5). The coefficient varies in the interval: $-1 \leq \alpha \leq 1$. The coefficient $\alpha$ can be considered as a correlation between two sets $\alpha = \alpha(r)$, where $r$ is a correlation and $(1 - r)$ a distance. The supply of meaning can be numerically modeled with help of multiple trace theory used for item recognition (Hintzman and Block 1971; Ivanova and Leydesdorff, in preparation).

In summary the model of communication can be considered as comprising three levels which change the linear model into an evolutionary one because feedback and feed-forward loops are possible among the levels. At level A, information is transmitted; at level B, information is organized and thus made meaningful in a vector-space. Reflexivity reveals that this vector space is constructed and therefore a potential subject of reconstruction: the possibility of reconstruction opens horizons of meaning (level C). This layer generates horizontal differentiation among the codes of communication as a top-down pressure.

Codes of communication are no longer actor-attributes, but operate as second-order variables on the communications. The codes emerge in a self-organizing mode, that is, insofar as constraints on the communication are removed. The system itself has to find these resonances by varying historically because the agents are first-order. The generation of redundancy can enter the historical instantiations reflexively under the condition of self-reinforcing loops tipping the balance towards the prevalence of evolutionary self-organization over historical organization.

Redundancy is a more crucial subject of study in the case of innovation than information. A system without sufficient options can be locked-in. However, redundancies are not generated on the side of the (first-order) variation, but by the codes of communication operating upon one another as selection mechanisms. When three or more selection mechanisms operate, auto-catalysis and self-organization is an option, and options can then be generated at an increasing pace. However, the warp and woof of meaning generation and self-organization are not harmoniously integrated as in textiles, but differentiated and disturbing one another since operating at the same time. These dynamics lead to a fractal manifold in different directions. Through breakages—interruptions—new options are generated (Ivanova and Leydesdorff 2015; Freeman and Perez 1988). This fractal structure is instantiated by the emergence of TH like patterns at different levels: first-order relations among agents, second order positions in systems, and next-order perspectives. Thus additional options generated through the interaction of communication codes can be expected to lead to the emergence of new organizational formats.

## 14.2 Universities and Innovation: Generalizing the Communication Dynamics

In the preceding section, we specified a generalized dynamic of meaning and communication. In investigating the role of Universities in the innovation processes, it is useful to inspect the mapping of the communication model onto the institutional entities of Universities, Industry and Government more closely. In much of the Triple Helix discourse, this mapping has followed Institutional theory with its concern for regarding institutions through the lens of the transactions they engage in. In this context, the academic discourse is an indicator of transactions within the University, the production of patents is an indication of transactions within innovative firms, and the production of policy documents is a transaction of government. There is however, a question about the claims of New Institutionalism, and the broader theory of the firm (Coarse 1937). Real Universities, Government departments or industrial firms are subject to social dynamic forces which extend beyond the production of visible documents. Willmott, for example, has recently criticized institutional theory arguing that:

> A constructionist ontology is domesticated by a neo-positivist epistemology that tends to treat is objects of investigation as givens, rather than as media of domination. Institutional theory thereby precludes consideration of how its objects of investigation can be adequately researched without reference to asymmetries of power in processes of institutionalization. (Willmott 2015)

The study of communicative transactions might indeed be considered a poor representation of institutional dynamics, and appears to ignore dynamics of power. In acknowledging the criticism above, we nevertheless draw attention to the emphasis within the Triple Helix communication dynamics on mutual redundancies. Power exerts itself within constraints which are indexed by measurement of mutual redundancy. With a more generalized dynamic of communication, Willmott's criticism can be addressed because constraints exercise themselves in many ways, including in the production of communication, presenting a possibility for a deeper analysis of institutional dynamics with a more generalized analysis of constraint.

Cases of real innovation present a backdrop against which to consider this, as an innovation which emerged outside the academy and on the fringes of society, but which has gradually infiltrated mainstream discourse. Like an innovation of cryptocurrency, and its underpinning technology of 'block chain' or 'distributed ledgers' has emerged outside the traditional bounds of the university, government or industry. The current prominence in the discourse within universities, government and industry of block chain, its potential applications and theoretical implications rests on an innovation which belonged initially to the counter-culture. Whilst using the labels of "university", "industry" and "government" for a countercultural movement is unhelpful, the Triple Helix discourse dynamics in three

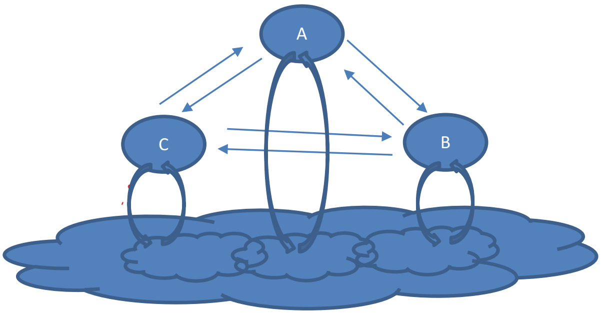


**Fig. 14.3** Relation between three entities and their environment

dimensions might be reframed in order to consider the deeper conditions that led to the emergence of block chain.

It is possible to consider emergent discourse from outside the traditional domains of University, Industry or Government, and regard each element of the discourse dynamics as a part of a system of inter-communicating entities engaging in transactions whose boundaries are specified and agreed by researchers (for example, researchers agree that academic papers in the Web of Science index are transactions of the university, or patents are transactions of industry). In other words, the association of transactions with particular institutions is an explicit selection, among many possibilities, made by researchers in an effort to uncover new knowledge through analysis. Researchers themselves are within one of the communicating entities, and their research produces transactions (i.e. publishing academic papers), which helps to define their own entity as a "university". Yet processes of intellectual inquiry exist in many communities outside universities, producing transactions which are not academic papers, but where those communities will similarly self-identify—recognizing activities which belong to their group and those which belong to different groups. The discourse dynamics described can be used to consider how BitCoin and Block Chain emerged from such a nonconformist community.

The behavior of intercommunicating entities—in producing communications of various sorts—is constrained by the dynamics of interaction between them as they define each other in contradistinction to their identification of themselves, and in their relationship with a continually transforming shared environment. This latter element may be seen to be characterized both by systems of expectation and by tangible changes to the lifeworld within which discourses emerge (for example, new technologies or practices). In Fig. 14.3, each entity, A–C, identifies itself in contradistinction to the others with which it interacts. Each is produced as a balance between the mutual information it shares with neighboring elements, and the dynamics between elements which generates new options for communication. Each element must survive within its environment, which it does by selecting specific aspects of information in the environment [what Beer refers to as 'attenuation' of the environment (Beer 1973)], whilst continually transforming the environment (through making communications, changing work environments, and technological innovation) and through doing so generating new options.

Innovations result in shifts in expectation: they are transformations in the ‘code of communication’ which translates into new practices, the reorganisation of institutions and sometimes the redrawing of boundaries between communicating entities. Changes in expectation produced by innovation can produce reactive results: radical shifts in expectation are often met with opposition since they represent environmental changes to which other actors have to adapt. Under these conditions, discourses may break apart as changes in expectations produce or reinforce the ‘otherness’ of discourses in other dimensions. In such conditions of break-up of discourses, Leydesdorff comments on the relation between communicating entities that:

> From the perspective of each binary interface, the third dimension remains then ‘latent’ as a structural given in the background. This third system entertains interfaces with each of the first two, but not directly (or less so) with their interaction. (Leydesdorff 2003)

This ‘otherness’ may then be considered as a constraint which shapes the discourse of the other two dimensions. Within the Triple Helix, this produces what Leydesdorff characterises as a ‘hypercycle’. He comments that “the hypercyclic integration can be identified as an overlay of negotiations and exchange relations among the institutional carriers of the Triple Helix dynamics”. It is within this domain of conflict and negotiation that critique and protest accompany innovation and development. Furthermore, it is within this process that the dynamics of power unfold. Indeed, as Sen and others have indicated, the democratic and inclusive social environment where the challenges of innovation can be explored plays a fundamental role in economic development (Sen 2000). In most developed societies, the University serves the role as a site of dispute where discursive boundaries can be explored and redrawn.

This discursive role of the University cannot be reduced to a description of it as a “locus of innovation”. Constrained descriptions of the University have emerged in recent years as education itself has become subject to market forces. Market innovations in academia, including metrics for journal and institutional ranking, teaching appraisals and student satisfactions, have also changed expectations about the nature of the university within the academy itself, and this in turn has changed the rhythms of academic life (Graeber 2015). The study of communication dynamics highlights the effects of these changes and their larger-scale economic impact.

## 14.3 University Participation in Innovation Dynamics: The Case of BitCoin

BitCoin is a relatively recent innovation in finance. The theoretical work behind the establishment of a virtual currency was first announced in a paper by Nakamoto (2008) sent not to an academic journal, but to an online cryptography mailing list.

The unorthodox nature of this communications was further amplified by the fact that Nakamoto's identity remained a mystery: there was some suggestion that 'he' was a nom-de-plume of a collective (Frisby 2014). The paper specified the creation of a "chain of digital signatures" which would act as an open and transparent ledger of transactions in the currency. The idea was that a scarce digital asset could be created where the exchange of which from one owner to another could be verified "by digitally signing a hash of the previous transaction and the public key of the next owner and adding these to the end of the coin". The technical language was understood within the cryptography community to whom it was directed. The initiative had support from various countercultural groups who had been exploring the possibility of a virtual currency for a number of years. Nakamoto's suggestion included some ingredients missing from earlier attempts to found a virtual currency: notably, that the money supply should be controlled through a process of verifying the transactions within a peer-to-peer "distributed ledger" of transactions which would be rewarded with the creation of new currency. The distributed ledger, or Block Chain, effectively fulfilled the purpose of a central bank in controlling the money supply, and in serving as an object of trust for users of the currency: indeed, Nakamoto saw the 'block chain' as a replacement for trust in third parties like banks: "an electronic payment system based on cryptographic proof instead of trust" (Vigna and Casey 2015). In being distributed, the ledger was copied in its entirety across the different users of the currency. Mass replication meant that there was no central authority which could make changes to it: change had to occur through a collaborative process of verification.

Fiat currency is, as Marx and many others have commented, a symbolic codification of exchange (Marx 1867). BitCoin represents a shift in the mechanisms whereby the symbolic codification is established. Without a central bank to uphold the value of the currency, trust falls on the veracity of the ledger and the transactions within it. In other words the operation of Block Chain is executed by a network of the nodes running BitCoin software. Other cryptocurrencies appeared after BitCoin operate the same way, but with its own software. Those institutions which were challenged by it saw BitCoin as both fascinating and disturbing. Attention was drawn to the fact that the currency was ideally suited to illicit transactions in drugs or weapons (Martin 2014). Due to various initiatives to regulate the currency, including the closing-down of one of the major BitCoin exchanges (Decker and Wattenhoffer 2014), the price of BitCoin fluctuated significantly, limiting the ability of BitCoin to be the reliable tool for value store. In 2013 and 2014 regulatory organizations like Financial Industry Regulatory Authority and European Banking Authority warned about the huge risks in investing in BitCoin. In 2014 Bloomberg called BitCoin as a worst way of money investment. However, despite this and worries about its technology and doubts about its viability, BitCoin survives with increasing acceptance for the payment of online services. In 2015 BitCoin was recognised as one of the best ways of investment. And despite the huge volatility that can be witnessed even today, the current (2017) price exceeds \$10,000 compared to under \$600 in 2014.

By 2015, the technology underpinning the BitCoin phenomenon gained mainstream attention. The idea of a distributed ledger of transactions as an object of trust became a focus of inquiry as to how other institutions might be transformed with a similar kind of innovation. The fundamental innovation was seen to be in database technology (the Block Chain is a replicating distributed database) alongside rethinking as to how the worldwide web currently operates through a process of centrally addressing specific servers rather than addressing distributed data (Benet 2014). These technological issues led to participation in Block Chain research by Microsoft and IBM alongside industrial participation ranging from banks and law firms to the media. The UK government released a report outlining the potential transformation of industry, government and public services (Walport 2016). 'Smart contracts', peer-to-peer networks, and a fundamental reorganisation of the worldwide web were all discussed within academia, industry and government as an important technology.

In terms of discourse dynamics, what has been witnessed is a very rapid transformation from where BitCoin was a 'niche' activity mostly discussed in the finance industry, to where it is an important topic in academic, government and industry literature. Very quickly, there has been a generation of both mutual information and mutual redundancy between many different communities—not least between universities, government and industry. These continue to generate many options for development. The speed with which this has occurred together with the unconventional roots of the innovation demands further explanation.

## 14.4 Institutional Isomorphism and the Block Chain Disruption to Institutions

The communicating entities that engage in transactions are not homogeneous. All organisations comprise many different kinds of activity—from management to production. Whilst the self-organisation of communication involves a process of defining boundaries where each boundary is determined by other discourses, this process can be seen to occur within institutions themselves. The discourse of management distinguishes itself from the discourse of the accounts department or the discourse of production. Whilst many innovations concern one particular aspect of an institution's activities (usually production), other discourses like management are relatively untouched and perform a function of managing new kinds of production produced through innovation. In the university, this might take the form of managing new courses, or programmes of research. Block Chain, however, may be seen not only as an innovation in production, but also in management, and in finance. It addresses the trust which underpins the existence of institutions and so its impact on discourse at many levels has been simultaneous.

DiMaggio and Powell's concept of 'institutional isomorphism' (1983), where there is an increasingly universal set of expectations which emerge around the activity of 'management' within institutions provides a framework for conceiving how mutual information amongst managers across sectors has a dynamic impact on institutional life. Whilst management is characterised by high mutual information, differentiation between codes of communication is upheld by the activities of institutional workers (academics, industrialists, politicians). Indeed, this differentiation is essential for managers to maintain—without it, the institution would have no identity and there would be nothing to manage. With the internal differentiation of expectations within each institution, there is a case to argue that an analysis of institutional communication dynamics needs to consider transactions at different levels within the institution, between different roles, as well as looking at the dynamics between institutions. Between different institutional roles there are mechanisms for maintaining trust in the institution. For example, within the university, managers coordinate educational activities whilst monitoring quality with various forms of audit. In academic publishing, this function is performed by editors. Since the technologies of Block Chain represent an alternative to organising processes of maintaining trust, the combination of institutional isomorphism alongside dissatisfaction with levels of bureaucracy arising from existing practices of audit creates the conditions where a viable alternative stimulates communication across different domains. From the perspective of Triple Helix theory, this activity would be indicative of a shift of expectations, and consequently, innovation. However, since the source of this innovation is not a University, and other stakeholders are equally interested in Block Chain (government and industry), a question remains about the role of University in this innovation process, and in innovation more broadly.

Block Chain and BitCoin are innovations which open up a contested space in the discourse. The ideas around the technologies have to struggle to establish legitimacy in different domains of practice. Walport's UK government report of 2016 was an intervention which signalled the legitimacy of the exploration of the potential of block chain across a number of different domains. The contest created by BitCoin and Block Chain between those who suggest the impact of the technology is overstated, and those who see it as a fundamentally new opportunity unfold within academic journals, curriculum review teams, IT firms, government and managers across many different sectors. The question is, How are such contests to be managed, and how might they resolve themselves?

Block Chain has implications which cut across the knowledge domain: there are technological implications to be explored, sociological, political and governmental issues, educational, legal and medical scenarios where the technology requires exploration. Within each domain of discourse, there are also critiques of existing institutional structures, as well as critiques based on historical examples. There are also conservative arguments which defend the status quo. The University as a site of engagement across disciplines and discourses offers the space within which the contested implications of a new technology—particularly a fundamental technology—may be explored. The conditions the university provides for this include the scope of its knowledge-base, the availability of its scholars and students, and a non-threatening environment for the exploration of new ideas. In other words, the role of the University in innovation is as a structurally-embedded social entity for managing the variety of communications produced within society.

This role for universities in the discursive environment of innovation is itself contested. Marketisation in education has been a management-driven initiative which places emphasis on the university as an innovation and education factory, where the status of each individual institution is prioritised above its structural role within society. Status and success is established through discursive productions in recognised journals and successful recruitment onto popular courses. These forces operate as constraints in the self-identification of the university as an institution distinct in its transactions from businesses or government, but similar in its transactions at the level of management. In other words, in terms of Eq. (14.5), $\alpha$ is negative for institutional management (thus communication codes coincide), and positive for the institution's discursive functions. The Block Chain innovation creates redundancies of expectation at the level of management as well as at the level of discourse thus making $\alpha$ positive for both management and the institution's discursive productions. Its fundamental effect is that questions about the development of technology become closely related to questions about the way the institutions which ask those questions operate and are managed.

## 14.5 Conclusion

The data analysis techniques described in this paper provide a lens through which to view the university in its relations to other entities in society. New metrics bring opportunities for gaining insight into these relationships. The possibilities for the reorganisation of the relationships between universities, industry and government so as to stimulate economic growth or innovation can themselves be classed as innovations. The effects of innovations are often contested. Competing views of innovation characterise the internal dynamics of power within institutions. In most institutions, including government, management processes will eventually select "winning" innovations, providing appropriate levels of resource to develop good ideas further. The making of good decisions relies on a process of exploring the boundaries of dispute created by different kinds of innovation.

Whilst universities can be the locus of specific innovations, their broader discursive role provides a means of exploring contesting perspectives on innovation. They can do this because they possess sufficient redundancy of ideas and knowledge to auto-catalyse discourse in new areas. In doing so, they can contribute to a broader public discourse where some innovations which were once seen to be controversial become normalised. Importantly, the universities capacity for doing this is dependent on it maintaining a sufficiently broad knowledge-base: this breadth of knowledge and experience can be threatened by excessive market forces which reject branches of knowledge from the academic on the grounds of them not being fashionable.

The BitCoin and Block Chain story illustrates the role of universities as the site of contest between discourses, and as an actor in the process of normalising technologies which in their inception were seen as challenging. The issues surrounding Block Chain particularly are not just issues about technical implementation or new kinds of software: they are issues about trust in institutions and their management processes, including universities. The discourse dynamics illustrated by the Triple Helix allows for the description of this process as one where redundancies of expectation are produced not only within the transactional productions of the academy (i.e. academic papers) but also within the management of institutions surrounding education, including university management, academic quality agencies, institutional ranking organisations, academic journals, as well as other institutions which the university is associated with such as health or law.

The way a society conceives of innovation and economic growth is itself an innovation: inevitably innovation theories are the "slaves of some defunct economist" (Keynes 1937). Whilst some innovation activity can be accommodated within an existing paradigm, other innovations—particularly those concerned with communication or trust—change expectations and demand new theories and new approaches to the institutions which are seen to be responsible for supporting innovation. Universities are faced with conflicting narratives about themselves. The Triple Helix presents a generalised dynamics of communication which can help clarify the nature of the relationship between universities and their society. Using the Triple Helix to view technical innovations which challenge the way institutions are organised, such as Block Chain, can help to make the case for a balance to be struck between the market forces which tend to constrain the university's activity, and the role of the university as a site of disputation. Into this higher level contest about the nature and role of universities in the relation to society, it might be hoped that the analytical techniques of the Triple Helix help government, industry and universities to head the plea of Pope Pius XII who argued for the acceptance of scientific discovery within the Catholic Church: "One Galileo in two thousand years is enough" (Beer 1975).

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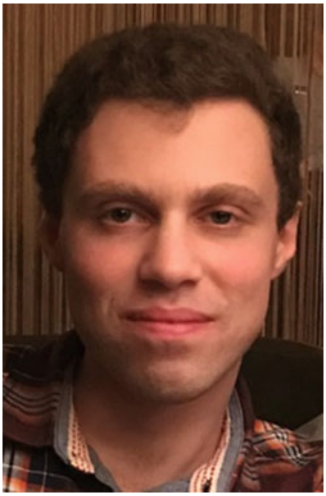

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# Part V

# Targeting on Innovation: Potentials and Limits of Entrepreneurial Universities

# Targeting on Innovation: Potentials and Limits of Entrepreneurial Universities

# 15

Dirk Meissner and Erkan Erdil

**Abstract**

Innovation has become a frequently quoted and lived central missions of universities. This book demonstrates however that the mission is not constant. New challenges and opportunities emerge at different moments in history and there are currently a number of important strategic orientations that universities need to consider and balance. Universities face the challenge to balance their different activities and missions in order to ensure sustainable impact on innovation ecosystems at different levels. The authors argue that entrepreneurial universities as we know them today will change their thinking and activities from being purely demonstrable impact driven towards an activity portfolio approach. The latter considers ongoing institutional and governance change paired with a selected number of activities which provide demonstrable and visible impact but also continuing to invest into the free mind blue sky driven work typical for such institutions. Even beyond this the entrepreneurial university features risk taking by means of a research and innovation friendly internal climate and organization which is driven by rigor but not administration and performance indicators.

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Entrepreneurial university · Government intervention · Innovation · Basic research · Academic freedom

The innovation mission has been described as one of the central missions of universities even since the emergence of the Humbold's ideal. This book demonstrates however that the mission is not constant. New challenges and opportunities emerge at different moments in history and there are currently a number of important strategic orientations that universities need to consider and balance.

The first challenge is to balance academic autonomy and non-academic relevance. There is a strong perception and self-understanding of scientists that universities are a place for free research which does not follow clear application thinking in the first instance. At the first sight this perception appears plausible and one might consider it easy changing scientist perception towards more application and use thinking. But it is not about implementing an awareness of possible applications for scientists' initial blue sky driven work. On the contrary this thinking also requires changes in the routines and procedures of academic research work including stronger controlling and monitoring or research projects. The challenge in monitoring research progress lies in the uncertainty of these works. It starts with a description of research themes and projects which are frequently to broad and vague in light of monitoring and controlling. The reason is found in the nature of blue sky research projects which can be split into separate work packages and steps but the outcome of these is not always clear because it is themes and works which were not done before at all. Therefore work packages results are very likely to deliver unexpected results which might cause delay or repetition of work steps or even whole work packages. More applied research projects on the contrary are more plannable and predictable because they frequently build upon existing previous basic works, e.g. compared to pure blue sky research works the results are more likely predictable when they are achieved. Against this background innovation driven entrepreneurial universities increasingly establish monitoring and controlling schemes aiming at assessing research works progress and predicting possible outcomes. Obviously such approaches are not fully compatible with scientist's attitudes because it is perceived an intervention in academic freedom and an attempt to 'make the unmeasurable measurable'. Similar phenomena are known from the industrial research community, e.g. researchers working in companies' research laboratories.

In this respect it becomes the meaning of the increasing pressure on universities to comply with multiple missions which can be challenging to reconcile. One important determinant of universities' orientation is connected to funding sources which in some cases appears that although formally granting independence to universities they might intervene in the strategic orientation of the university funded in one way or the other. Such interventions might be more are less obvious and direct instead funders are represented in respective governing bodies such as senate, academic council or the like. Frequently the influence comes from a high level of the institution which is in charge of setting the institutional framework including priorities for fund allocation but also implementing performance measurement schemes for the institution. The creation of an entrepreneurial system by government intervention is legitimized, especially in emerging economies, through the insufficiency of infrastructure and lack of systemic approach. Thus, this situation seems to necessitate the performance measurement through a top-down approach that acts sometimes as the sword of Damocles for the researchers who are generally taking the risk of, especially, cutting-edge research. Internal performance measurement schemes include the assessment of faculties, chairs, groups and other organizational units but also individual employees involving scientists, researchers and teaching staff but also support and administrative staff. Depending on the main duties different assessment schemes are applied including professors' teaching evaluation, academic impact evaluation by means of publications and conference contributions, reliability and punctuality of administrative staff work among others. The so named assessment schemes involve numerous indicators against which the performance of the respective unit or person is assessed. In order to empower the meaning of these assessments universities often award bonus payments for successful staff members but might also take other measures if poor work performance is achieved. At first sight these approaches seem plausible however it needs to noted that such top-down and one-size-fits all approaches of performance measurement in daily practice appear to become barriers for academic freedoms and creativity of researchers, in turn may have impact on entrepreneurial-creativity driven university especially in emerging economies. Yet these schemes are often systems established but seldom discussed in public and scholarly works.

Furthermore a frequently applied approach is the combination of funding and evaluation schemes, e.g. chairs, groups, faculties or other units depending on the institutional set up receive initial basic funding often designed for minimal operation of the unit which is accompanied by competitive university internal funding for dedicated research projects. Obtaining these additional complimentary budgets requires that the respective units develop plausible project applications including estimated outcomes and results. Among different applications throughout the university the most promising are chosen according to internal evaluation procedures. Although this procedure is well known and long established for third party funding, e.g. competitive funding by agencies, science & research councils among others it's a rather recent development only that universities begin introducing similar funding schemes internally.

Performance assessment of universities varies in different countries and regions. By such means universities are giving up their freedom to decide about promising science and research fields but are implementing management methods which ultimately aim at meeting stakeholders, in a more narrow sense financiers, expectations and requirements. This is in line with the increasing widespread recognition and acceptance of university rankings as a means to demonstrate the performance and impact of local activities in a broader comparison despite concerns about the comparability of indicators used and the underlying information and data. Apparently these efforts towards making universities comparable globally demonstrate already now significant impact on their activities. Forced by stakeholders universities increasingly invest reasonable resources towards meeting ranking criteria to their best. These ranking criteria however are designed to allow a global comparison but do not consider the actual mission and aim of an individual institution. The one and only meaning of rankings eventually is to identify the global leaders in predefined domains. This is certainly a positive development since it forces and inspires universities to develop further by different means. Yet this also puts additional administrative burden on the institutions which was not in place a decade ago. Despite the overhead burden for universities there appears additional administrative burden for research and teaching staff within the universities. Taking part in these rankings requires a dedicated reporting of indicators for which to build administration needs to collect the necessary information from the ground, e.g. research and teaching staff. Frequently this information collection is perceived as less productive and constructive use of resources by the respective staff due to the fact that there are many different initiatives in place at the institutions which require different information many times during the year. Although the main information required by stakeholders and ranking institutions does not eventually differ very much there is no harmonized information system which is capable of automatizing information disclosure. However this is only a minor challenge university management is confronted with. Even the term ‘university management’ is controversial because in the perception of university staff a management approach will inherently restrict the scientific freedom which is anchored in most countries constitutions or in respective high level laws. Many times university staff points to freedom of science and teaching—the latter also quotes the freedom of speech—when it comes to evaluations and/or performance assessment. Not surprisingly universities experience hidden revolutions against related management attempts. Further the scientific community has well understood the meaning of indicators and rankings over the last decade which enabled the community to establish practices across local scientific communities to responding to these managerial approaches. Among such responses is the publication behavior and routines of scientists for meeting the targets imposed on them by university management.

Publication counts and journal impact factor rankings are among the indicators used to assess the academic performance and impact achieved from the universities activities. Per se these indicators are potentially make the individuals and institutional standing in the community visible and transparent but over the years the targets connected with these indicators have been increased constantly. In a broader sense this development has led to pressurizing the academic body generating more and more publications. What is forgotten in this context is the human factor, e.g. there is a natural threshold up to which the individual can contribute respected and valuable publications, even in groups of researchers. The intellectual contribution comes from a smaller number of contributors; the majority of authors included in such publications might contribute rather technical work such as running experiments and analyzing data which is challenging itself yet not equivalent to the intellectual contribution affiliated with the initial design of experiments and model development. Further most publications are prepared in researcher groups originating in many cases from different institutions which brings the challenge with it which institution is designated the source for a publication. Until recently respective publications were indicated for each university assuming that each author had an equal share on the underlying work. Yet how to determine the shares of individuals if more than 5 authors are involved? Arguably in science there are a few mindsets with the idea what and how to investigate but there are many more individuals involved in the process of finding a solution. The border between the actual idea and solution concept and the implementation is diminishing even further which makes it more complicated to assign real contributions to the eventual work to individuals. Assigning the importance of individuals' contributions to a broader work eventually impacts the individuals' home institutions' scientific performance. Here we can clearly observe a change in scientific culture which drives the individuals towards protecting their assets (knowledge) but at the same time taking as much advantage from others as possible. This begins with the communication patterns of scientists who become more closed in their ambitions to discussing recent state of the art research and science both in terms of their own ongoing works and also their future oriented works. Instead of constructive forward looking exchange of views and fruitful debates the major emphasis meanwhile is on critical discussion of existing works while disclosing as little as possible of own works except the publicly available works. This tendency is also evident in the publication procedures and the related review practices, e.g. there is an ever increasing rate of rejected submission by the journals which is hardly explained by the limited space for article publication in the journals. On the contrary there is a reasonable share of journals which abolish printed editions and refrain to electronic versions only with all bibliographic information included. Therefore the space for publications is not as limited as often cited but there is a changing paradigm for scientific publications which manifests in reviewers being more critical and skeptical about breakthrough discoveries instead preferring more incremental publications. This, in turn, increases the threat on publications even further since common review practice also pays attention to a substantial review and synthesis of existing literature and knowledge even though the space limits for scientific publications (articles) remain in place. Accordingly if authors are following the standard scientific publication practice the reviews of previous works covers more space than before which allows less space for actual new research results and discoveries. Eventually scientists which are confronted with the challenge to deliver new knowledge while elaborating existing in depth tend to extend the discussion of existing works with the aim of justifying their works which are often targeted to small research and knowledge gaps. In a broader sense the publication routines are directing researchers and scientists to either limit the scope of their initial research or to break the research results into smaller bits and pieces in order to (1) be in line with publication standards and (2) to meet evaluation criteria which force them to publish more scientific articles constantly. In consequence researchers are challenged with devoting more time to studying published works than before. Also in this respect it needs to be noted that collaborative research is both cause and effect of change in the structure, shape and purpose of research institutions. It should be considered within a macro policy context rather than at micro and meso levels. In recent decades, the top-down approach also used as a tool for policy intervention especially by supranational funding bodies.

Further universities in the spotlight of the entrepreneurial university paradigm are tempted to direct their activities towards closer demonstration of applicability of research but also educational activities. Whereas application demonstrability of research results for long time forms an important element of the research process itself it is more difficult to demonstrate the applicability of educational measures. Over the last decades this was mainly understood as the development of executive education programs which complement the initial undergraduate and graduate programs. Yet during the last years even undergraduate and graduate programs are more and more targeted to the immediate applicability of competences taught to students. The reason for this gradual shift is doubtless found in the indirect impact of rankings at universities activities' and also in the emerging accreditation of study programs by several associations. Among the criteria for rankings and accreditations are assessments by human resource managers regarding the competences and capabilities of hires which graduated from a university. These assessments clearly take into account graduates training and the match of educational programs with potential employers' current needs and demands. In market economy terms there is hardly any argument against orientation of educational programs towards potential employers needs. However this argumentation neglects the pace of change of employer requirements and expectations towards graduates. This lead in some cases to the phenomena that educational programs are focusing increasingly on graduates soft skills—among them presentation skills—at the cost of the initial hard skills. Meanwhile employers are calling for stronger emphasis on hard skills which appears a vicious circle. An entrepreneurial university will master the challenge of maintaining leading edge hard skills focused training and education while considering soft skills as complementary assets which are integrated in the initial training. Thus designing future oriented educational programs isn't featured by replacing hard vs soft skills instead the challenge is to complement the hard skills education with soft skills training. So far there is no golden recipe available for keeping a balanced educational approach. Furthermore there is an obvious tendency towards industrial PhD students which come in different shapes in different countries and institutions. Typically industrial PhD students are industry sponsored (financed) PhD students who're expected to target their PhD thesis related research activities on pre-defined themes and topics with clear almost immediate outcomes. In fact, global university rankings somehow cause social exclusion. The ranking business combines social research, marketing and public relations and some extent ignores and redefines social purposes of higher education in pseudo-scientific manner based upon neoliberal global rationalities. These ranking itself cause a commercialization (or more truly commodification) of university research and education in an ill-defined manner. This makes university output a quasi-public or private good at the extreme. However, the role of universities can be enhanced through the regrounding of the public character of higher education institutions. Only then, the entrepreneurial universities can be successful especially in emerging economies.

Overall the markets for innovation are changing which opens new avenues for industry–research collaborations which take account of the speed of technological development and innovation in the end. This naturally raises the question which challenges universities face and how the current challenges differ from previously known ones.

In conclusion the innovation landscape is featured by changing paradigms which have the potential to become challenges to universities in general and entrepreneurial universities especially. The manifold changes can be summarized under three main headings which have clear direct impact on universities:

– First markets for innovation are changing in some sectors, e.g. the lifecycle of innovations changes, the ratio of radical vs incremental innovation favors incremental innovation, marketing and communication of innovation (and inventions) become more influential and decisive, user-innovation and co-generation phenomena exist among others. These developments do impact the established forms of innovation collaboration thus offering new potentials for universities.
– Second the progressing digital transformation continues to challenge the importance of the geographical dimension in industry–research collaborations which appear an important issue for multi-actor collaboration and share of work in research and innovation but also education. It follows that the role of regional institutions and universities' approaches to taking advantage of this developments change which potentially imposes new requirements to collaboration management on all partners.
– Third there are an increasing number of large research consortia emerging involving industry and universities but also other research intensive organizations. Against previous research consortia the recent generation of consortia employs more actors which bring the challenge of defining a common scope and share of results in the early consortia stages. Moreover there is no guarantee of the conduciveness of such consortia to innovation and job creation. Consequently there is a desire to align the respective ownership models in order to provide the best economic benefits to participants and the socioeconomic context at large.

All these changes come in different shape in different science and technology and also industry fields and sectors. Nonetheless interdisciplinary works provide additional challenges for institutions. In this light universities are challenged to adapt their institutional responses to the changing innovation landscape. The main driver of the need to respond is clearly tight with the changing university stakeholder expectations and requirements which place universities contribution to innovation more prominently on the agendas.

In conclusion we argue that the challenge remains for universities to measure and demonstrate their impact on innovation at any level. There are many measures and indicators which are frequently used for this purpose, including spin-offs from universities, patent and licensing activities and other related knowledge and technology transfer indicators but universities main contribution remains at the 'hidden level' which is in the education and training of people to detect and solve problems and challenges. This said means that it is not necessarily the numbers of university graduates from any study program but the competence to analyze and understand more or less complex phenomena and develop measures to meet them. Such 'soft skills' are included in almost any university educational program, the higher the program level (undergraduate, graduate, postgraduate) the more prominent these skills are. This contribution has been accepted and known since the establishment of universities and the like institutions however there is not any indicator available which allows universities to provide evidence of their contribution to innovation. This is even despite the fact that innovators often use these competences and appreciate them but the causality between related education and resulting innovation is unclear for several reasons. The main reason is that the human factor, e.g. people, are developing further with or without university education but also the fact that the basis for structured thinking and similar is laid at secondary and primary level education already. To overcome this problem universities recently attempt to direct their activities ever more towards demonstration of applicability and short term impact. The potentials for universities are huge in this respect although at the same time the institutions risk to hamper their long term development perspectives due to unexpected and unforeseeable developments in the technology and innovation landscape.

Eventually we postulate that entrepreneurial universities as we know them today will change their thinking and activities from being purely demonstrable impact driven towards an activity portfolio approach. The latter considers ongoing institutional and governance change paired with a selected number of activities which provide demonstrable and visible impact but also continuing to invest into the free mind blue sky driven work typical for such institutions. Even beyond this the entrepreneurial university features risk taking by means of a research and innovation friendly internal climate and organization which is driven by rigor but not administration and performance indicators.

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