Edited by
Sola Adesola · Surja Datta

Entrepreneurial Universities

Creating Institutional Innovation in Times of Turbulence

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Stanley Ibeku	Pan Atlantic University, Nigeria
Peter Bamkole	Pan Atlantic University, Nigeria

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Entrepreneurial Universities: Creating Institutional Innovation in Times of Turbulence

Sola Adesola and Surja Datta

Universities are at the heart of knowledge production, dissemination, and exploitation processes within the society. Acknowledging conceptual frameworks such as the Diamond Model (Porter 1991), National Innovation System (Freeman 1995; Nelson 1993; Chaminade et al. 2018), and Triple Helix (Etzkowitz and Leydesdorff 2000; Leydesdorff and Van den Besselaar 1994; cited in Leydesdorff and Meyer 2006), Datta and Adesola (2018) pointed out that the importance of universities has increased, and not lessened, with the lowering of barriers of international business. At the same time, recent events like Brexit and the COVID-19 pandemic have shaken the accepted view that globalisation is a linear trend of ever-increasing connectedness between nations; if nothing else, these global challenges have made the macro-environment much more uncertain and unpredictable.

Policymakers often exhort universities to be more entrepreneurial, but considerable ambiguity exists in the literature about what it means to be

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an "Entrepreneurial University". A very narrow conceptualisation of "Entrepreneurial University" equates entrepreneurial activities with commercialisation of university research (Shane 2004; Alexander et al. 2015). A very broad interpretation can incorporate any initiative for change undertaken by the university to respond to market conditions (Alexander et al. 2015; Sperrer et al. 2016). We suggest that as universities are primarily in the business of knowledge production, dissemination, and exploitation, its entrepreneurial behaviour needs to be conceptualised within this particular context. The institutional perspective is useful here. Institutions are "rules of the game" which simultaneously constrain and facilitate interactions of the key players.

The idea of the "Innovation Triad" focuses our attention on the institutional environment that governs knowledge production, dissemination, and exploitation and identifies the key actors: rule makers (RMs), knowledge entrepreneurs (KEs), and knowledge incubators (KIs) (Datta and Adesola 2018).

Policymakers (**R**ule **M**akers) take a leading role in setting up the "rules of the game" (North 1991). Typically, but not always, they are government bodies that set out policies which act as constraints and enablers for the players. The players themselves can be classified into two broad groups: Knowledge Entrepreneurs and Knowledge Incubators.

Knowledge **E**ntrepreneurs convert ideas/concepts into products, and services that are put into societal use. Typically, but not always, they are private, for-profit enterprises. Knowledge entrepreneurs specialise in exploitation of knowledge for financial and/or social rewards.

Knowledge **I**ncubators deal with knowledge. They create new knowledge, act as repositories of existing knowledge, and disseminate knowledge. Typically, but not always, they are universities, research institutes, think tanks, and learned societies.

The way RMs, KEs, and KIs interact with each other is mainly determined by formal institutions and informal norms (North 1991), and both together constitute the "rules of the game". The formal institutions are the written rules, while informal norms constitute the unwritten code of conduct, which influences the behaviour of key players. The nation is still the natural boundary for the Innovation Triad as laws, regulations, directives, and informal norms continue to differ significantly across

national boundaries. However, conceptually there is no reason for the Innovation Triad to transcend national boundaries. Indeed in Europe, one can already see the contours of an emergent EU-wide Innovation Triad, facilitated by a genuine supranational entity (the EU), and shared cultural norms.

The institutional perspective on innovation shifts the focus from the "heroic inventor" to the interactions of different constituent elements of the environment. Moreover, the constituent elements are more diverse than those specified in conventional system theories of innovation. Innovation is after all a key marker of all human societies, even those that do not have well-defined actors such as "government", "industry", and "academia". Knowledge Entrepreneurs, for example, can be individuals or teams or organisations (a collection of teams).

The institutional or "rules of the game" approach to understanding the innovation ecosystem has several benefits. First, it allows identification of different classes of players and explication of their roles in the "innovation game". Second, it alerts us to the fact that players' behaviour is guided both by constraints and incentives that pervade the system, and this knowledge facilitates our search for these variables. Third, an understanding of the rules, players, constraints, and incentives that are prevalent within the system allows for informed policymaking. The institutional perspective is useful for policymaking that seeks to change the behaviour of actors, as it focuses on rules, incentives, and constraints.

The chapters in this book either illustrate the institutional environment of knowledge production, dissemination, and exploitation, and/or explicate the roles of key players (RMs, KIs, and KEs) within it.

The Structure of the Book

Proceeding from this introductory chapter, the book follows a **three-part structure**, starting at a macro level (institutional environment) and then progressively focusing on meso- (inter-organisational) and micro- (intra-organisational) level aspects of the Entrepreneurial University. Chapters included in **Part I** explore the institutional environment, whilst in **Part II** the interrelationships between Knowledge Entrepreneurs and

Knowledge Incubators are investigated. Chapters in **Part III** are focused on one specific aspect of the entrepreneurial university (entrepreneurial education), demonstrating how it manifests itself in practice.

The chapters in this book volume illustrate the complex interplay between **R**ule-**M**akers, **K**nowledge **I**ncubators, and **K**nowledge **E**ntrepreneurs which fosters innovation and entrepreneurship within the society. These contributions also help to generate a richer and more nuanced perspective of entrepreneurial university. This book makes both theoretical and empirical contributions to the body of knowledge that focuses on university–industry–government interactions.

Part I: Macro Level—Institutional Environment

In **Part I,** we look at the institutional environment that concerns itself with knowledge production, dissemination, and exploitation.

In Chap. 2, titled "The Status of Innovation in Africa's Development Strategy: Where Should Science and Technology Fit In?", Clark et al. provide an overview of the evolution of the idea of a National Innovation System in the African context. The chapter explicates the reason behind the shifting of emphasis from "science and technology" to "science, technology, and innovation (STI)". The critical perspective that the authors adopt in evaluating STI programmes in Africa is useful as the key learnings are relevant to the policymakers in many developing countries across the globe.

In Chap. 3, the history of British universities and commercialisation of science is comprehensively captured by Chris Harlow in "Commercialisation of Science at British Universities". The chapter points to a paradox: ancient universities in the UK (Oxford and Cambridge) were slow to adopt science and technology in their curricula, yet they ended up being the leaders in commercialisation of research from the middle of the twentieth century onwards. Moreover, this success cannot be attributed to conscious policymaking by university administrators. The chapter highlights the importance of the institutional environment in the generation of the Entrepreneurial University.

Part II: Meso Level—Dynamics of Interactions Between Knowledge Incubators and Knowledge Entrepreneurs

In **Part II**, we explore interactions between Knowledge Incubators and Knowledge Entrepreneurs. We are reminded here that a university can act as both KI and KE; however, these distinct roles require different sets of competencies and resources.

In Chap. 4, titled "Research, Policy, and Practice in Knowledge Transfer: Towards an All-Inclusive Approach", Nicolette Michels critiques the current UK policy approach towards knowledge transfer partnerships which tends to be narrowly scoped. The chapter advocates support for heterogeneity of approaches between policymakers, universities, and companies engaged in knowledge transfer activities. Using the partnership metaphor, it is suggested that key stakeholders (RMs, KIs, and KEs) should strive to develop better understanding of each other's distinct perspectives to foster innovation in knowledge exchange partnerships.

Spinouts represent the most concrete form of the Entrepreneurial University. Chapter 5, titled "Spin-Off Strategy and Technology Transfer Office: Cases in Sweden" explicates the key success factors for university spinout based on Uppsala University in Sweden. The chapter provides a rich empirical longitudinal analysis that adds to our understanding of strategy. The main learning here is that incentives matter. Right policy environment both inside the university and within the broader institutional environment is critical to the success of the Entrepreneurial University.

Part III: Micro Level—Manifestation of the Entrepreneurial University: Case Studies

Part III presents three, primarily empirical chapters that illustrate the Entrepreneurial University in practice. All three chapters reflect on the varied experiences of universities delivering entrepreneurship education

and link these initiatives with the broader policy agenda of developing entrepreneurial-minded universities.

In Chap. 6, Bamkole and Ibeku make the argument that university administrators need to develop an entrepreneurial mindset to deliver effective entrepreneurship education to students. Their chapter titled "Entrepreneurial Universities: A Case Study of the Pan Atlantic University, Lagos, Nigeria" demonstrates that university is a natural Knowledge Incubator, and this makes it a key actor within the innovation ecosystem, even without the university taking on the role of a Knowledge Entrepreneur. The chapter suggests that fostering future Knowledge Entrepreneurs is an important role of universities.

Gray et al. in their chapter "Revisiting the New Entrepreneurial University in Times of Uncertainty" (Chap. 7) attempt to understand the meaning of the term "Entrepreneurial University" in the context of a Business School based in the UK. Interestingly, the chapter suggests that increased marketisation of Higher Education may act as a barrier to the entrepreneurial behaviour of students rather than being a facilitator as it is commonly assumed.

In Chap. 8, the notion of "Entrepreneurial University" is explored from the perspective of student orientation. This chapter by Madichie et al., titled "Entrepreneurial intentions Amongst African Students: A Case Study of the University of Education, Winneba, Ghana", examines the determinants of entrepreneurial intentions of university students in an African University setting in Ghana based on a quantitative survey. The findings from this study have implications for the development of entrepreneurship education in Ghana and African universities more generally.

Further Research on Entrepreneurial University

Overall, the chapters in this book illustrate the diverse roles that universities play in the innovation ecosystem in both developed and developing countries. While we have done our best to put together an insightful collection of research contributions on innovation and entrepreneurial university, we believe that this can only be a starting point and the field clearly deserves more scholarly attention in the future. The idea of

'Entrepreneurial University', with its dual roles as Knowledge Incubator and Knowledge Entrepreneur and its interactions with other key actors within the institutional environment, holds immense potential for future research. We hope that this book volume will encourage other scholars to take up this exciting research agenda.

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Part I

Macro Level: Institutional Environment

2

The Status of Innovation in Africa's Development Strategy: Where Should Science and Technology Fit In?

Norman Clark, Sola Adesola, and Usman Alkali

Introduction and Origin of Innovation Policy in an African Context

This chapter sets out the importance of knowledge systems in promoting economic development in African countries. Such relationships vary widely across countries given their unique histories and interrelationships. One especially important problem concerns the pattern of institutional development through which knowledge is produced, validated, and used, and how this pattern has evolved in recent years in many economically poor countries. National policies have tended to focus on established bodies such as those concerned with publicly financed

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education and research, but have paid little attention to the use of the resultant knowledge. This is especially so in Africa where the comparison with many South Asian countries shows poor effective knowledge-based development. A significant amount of recent research has begun to show that this happens because of excessive orientation to formal science in comparison to the kinds of knowledge related to investment, production, civil society goals, incomes, and employment possibilities for the bulk of populations.

The origin of the chapter goes back to early 2015, speaking to a group of donors on the topic of Africa's long-term strategy organised by the African Centre for Technology Studies (ACTS) in Nairobi, Kenya. The presentation was entitled *"The African Development Agenda and Strategic Priorities for Foreign Aid Post 2015: The Case for Aid for Science, Technology, Innovation and Sustainable Development"*. In preparation for the talk, we came across the official documents produced by the African Ministerial Council on Science and Technology (AMCOST). Their policy statements discussed innovation and innovation policy in a manner that hardly made any reference to economic production and employment. Instead, the discourse by AMCOST was dominated by reference to scientific research conducted in scientific institutions. The message clearly resonated with the 1970s view that innovation is really all about formal R&D conducted in universities and such like bodies.

The arguments were presented in a way that focused on what to policymakers appeared to be a new concept in the policy literature of relevance to African economic development, namely the conflation of Science, Technology and Innovation (STI) as the focus of national and international interventions designed to boost African growth. We say "new concept" advisedly because most of the documents consulted mentioned just Science and Technology. The insertion of "Innovation" after "Science & Technology" seems to have occurred in an African context around 2006. Prior to that, "Innovation" was hidden in most of the official texts read. The presentation then was mainly about a Department for International Development (DFID) programme the first author had been closely involved with, called the *Research into Use* (RIU). In an

earlier paper by Clark and Frost (2015), the authors had expressed the view that by using the term "STI", policymakers were consciously, or unconsciously, focusing on strategies for innovation policy that have little to do with nuts and bolts of what is really needed in an African context: namely, how to raise the productive capacity of African economies and, by extension, provide jobs and incomes for their citizens.

Revisiting Africa's Innovation in Development Strategy

Two reasons contributed to revisiting innovation in development strategy in Africa. First, on reflection we have realised that this focus on STI as the centre of gravity for innovation policy in Africa shows every sign of permanence and could actually be quite harmful. For policy is all about actions for social and economic change. To commit scarce resources in wrong directions in conditions of underdevelopment is something that Africa cannot afford. Moreover, the danger is that this could well take place if powerful scientific lobbies award themselves little gifts that are not justified. A second reason for revisiting the topic is that it raises an issue of the importance of links between higher education (HE) and economic production. For in a sense the relative inability of the HE system in Africa to assist in securing jobs for its graduates is by now clearly a continental problem.

Based on this, the chapter covers four points for discussion in the following sections:

1. Theoretical overview of innovation development and their application in Sub-Saharan Africa (SSA)
2. Institutional developments of African STI initiatives
3. The DFID Research into Use (RIU) Programme
4. Relevance of DFID/RIU and innovation policy for African Higher Education

Theoretical Overview of Innovation Development and Their Application in SSA

In contrast to the supply-led approach of the 1970s and building on analysts such as Freeman (1987), Lundvall (1992), Nelson (1993), Edquist (1997) and others, most modern treatments of innovation now conduct analysis as a systemic activity. Due to the globalisation and intensification of knowledge in production systems, many countries including those in Africa now routinely use science, technology, and entrepreneurship policies to stimulate economic transitions through innovation and entrepreneurship (Robson et al. 2009). Such transitions have comprised multiple shifts in government policies and strategic plans (Amankwah-Amoah 2016). In this way, a substantial body of work has been dedicated to understanding the circumstances under which an innovation can help countries to develop faster (Verspagen 2005; Hasan and Tucci 2010). However, many developing countries, especially in Africa, have not fully benefited from the positive externalities of STI. This has been ascribed to the failure of some states to direct their innovation policies to the most vital areas of necessity and address the critical needs of its people, particularly employment generation for youth.

Two recent approaches to the study of innovation have been those of Innovation Systems and Triple Helix. The central theme of innovation systems thinking highlights how private firms, government organisations, and institutions of higher education collaborate, create, diffuse, and apply knowledge for commercial benefit. This knowledge can be new or an enhancement of an existing product or process or a combination of both. Innovation System approaches have been adopted by many developed countries to promote competitiveness and economic growth. However, implementations of such policies in developing countries, especially those in SSA, have been insufficiently analysed (Lall and Pietrobelli 2003; Jauhiainen and Hooli 2017).

Representing a departure from the System of Innovation approach, the Triple Helix Model stresses interaction among university, industry, and government institutions. These emphasise distinct but complementary intersection and overlapping of roles between the three institutional

spheres (Etzkowitz and Dzisah 2007). With the emergence of a knowledge-based economy, the adoption and application of Triple Helix in the knowledge production and application both in developed and developing countries have become widespread. It emphasises the easy flow of actors across organisational borders, which can smooth knowledge flow and stimulate regional development (Liu and Huang 2018). The model considers the university as a key player that leads in the transition to knowledge-based economy by combining teaching, research, and commercialisation of research through academic spin-off facilitated by Technology Transfer Offices (TTOs).

However, according to Etzkowitz and Dzisah (2007), the higher education system in many developing countries (especially those in Africa) inherited colonial education arrangements, which have tended to weaken institutional capacities of universities in performing this role effectively. They argue that colonial education was not intended to prepare individuals for the service of the country. It was rather inspired by the need to instil the values and standards of the colonial society, and to train individuals for the service of the colonial state. The study by Saad and Zawdie (2011) in developing countries to explore the theory and application of the Triple Helix in innovation strategy found a challenge in operationalising the Triple Helix due to the low volume of institutional interactions.

Additionally, Africa has generally shown poor industrial performance because the majority of industrial sectors are state-owned and oriented towards local markets (Lall and Pietrobelli 2005). The region also remains technically backward and has failed to build competitive advantage in many export markets. It has attracted very little of the types of export-oriented foreign direct investment that has driven the growth of many East Asian economies (Lall and Pietrobelli 2005). It is this broad issue that has led to the Agenda 2063 to fast-track Africa's transition to an innovation-led, knowledge-driven economy (AU 2014b). This first agenda intends to accelerate the development of human capital, entrepreneurship, innovation, and industrialisation that will lead to social transformation and competitiveness of the continent (AU 2014a).

There is evidence to suggest that this ten-year STI strategy may have contributed to some limited innovation improvements. According to the Global Innovation Index 2019, the top three innovation economies in

Table 2.1 Top 20 SSA Innovation Performance (GII 2019)

Country/Economy	Rank	Region SSA Rank
South Africa	63	1
Kenya	77	2
Mauritius	82	3
Botswana	93	4
Rwanda	94	5
Senegal	96	6
Tanzania	97	7
Namibia	101	8
Uganda	102	9
Côte d'Ivoire	103	10
Ghana	106	11
Ethiopia	111	12
Mali	112	13
Nigeria	114	14
Cameroon	115	15
Burkina Faso	117	16
Malawi	118	17
Mozambique	119	18
Madagascar	121	19
Zimbabwe	122	20

SSA, shown in Table 2.1, are South Africa (63rd), Kenya (77th), and Mauritius (82nd) (GII 2019). In addition, the innovation landscape in Africa is changing. Out of the 18 innovation achievers identified, five SSA countries—Kenya, Rwanda, Mozambique, Malawi, and Madagascar—stand out as being innovation achievers relative to levels of development in the previous eight consecutive years (GII 2019).

According to Vallejo et al. (2019), over two-thirds of SSA countries have implemented STI policies at different levels though most countries still lack the requisite capacity to improve the potential of STI to develop structural transformations of their economies. In addition, most states in the region have immature and underdeveloped STI institutions, and have failed to produce and deploy knowledge effectively. According to ACBF (2017), for example, major barriers preventing SSA countries to promote growth and competitiveness include lack of relevant critical skills and weak higher education systems.

Institutional Developments in African STI

There was very little focus on S&T and African development before 1980. What generally happened was that countries tried to copy the West and build OECD-like bodies. The beginnings of change occurred in 1979 as a result of a high-level meeting of countries leading to the Lagos Plan of Action (LPA) for the Economic Development of Africa (1980–2000). The LPA was essentially a blueprint of how to foster collective self-reliance and sustainable development of the continent. It led to a number of subsequent regional conferences (such as CASTAFRICA II) organised by UNESCO/OAU/ECA which brought together 26 African ministers and experts of science and technology, for the purpose of developing strategies for the economic recovery of Africa.[1]

This was followed ultimately by the formation of the Africa Union (AU) and the *New Partnership for Africa's Development (NEPAD)* established in 2001. The AU subsequently adopted NEPAD in 2002 as a set of development programmes whose aims were to eradicate poverty, promote sustainable growth and development, integrate Africa in the world economy, and accelerate the empowerment of women. One of these programmes was about S&T whose implementation was passed to a Council of Ministers in charge of Science and Technology (AMCOST). This body met in 2003 and agreed to produce a consolidation plan of action (CPA) designed to embed S&T within the African region. The CPA was finally published in 2006. It is in this document that "innovation" (I) really appears for the first time and it does so as an add-on to science (S) and technology (T), becoming of course STI. As such, it now appears routinely in all texts and conversations relevant to economic development.

[1] Others include OAU: Africa's Priority Programme for Economic Recovery (1986–1990), The African Alternative Framework to Structural Adjustment Programme for Socio-economic Transformation (AAF-SAP)–1989, The African Charter for Popular Participation in Development and Transformation (ECOWAS 1990), The OAU Re-launching of Africa's Economic and Social Development: The Cairo Agenda for Action (1995) and the New Partnership for African Development (NEPAD), IISD (2006) 'AMCOST Bulletin – EXTRAORDINARY CONFERENCE OF THE AFRICAN MINISTERIAL COUNCIL ON SCIENCE AND TECHNOLOGY – 20–24 NOVEMBER 2006'. Available at: https://enb.iisd.org/africa/vol03/arc0301e.html, AU (2015) 'Agenda 2063: the Africa we want', *African Union Commission*, Ayittey, G. (2016) *Africa unchained: The blueprint for Africa's future.* Springer.

Close inspection of the CPA document shows that its analysis and recommendation followed precisely this template. Its recommended programmes were set in terms of five S&T "clusters" as follows:[2]

Cluster 1: Biodiversity, Biotechnology, and Indigenous Knowledge: (a) Conservation and Sustainable Use of Biodiversity; (b) Safe Development and Application of Biotechnology; and (c) Securing and Using Africa's Indigenous Knowledge Base

Cluster 2: Energy, Water, and Desertification: (a) Building a Sustainable Energy Base; (b) Securing and Sustaining Water; and (c) Combating Drought and Desertification

Cluster 3: Material Sciences, Manufacturing, Laser and Post-Harvest Technologies: (a) Building Africa's Capacity for Material Sciences; (b) Building Engineering Capacity for Manufacturing; (c) Strengthening the African Laser Centre; and (d) Technologies to Reduce Post-Harvest Food Loss

Cluster 4: Information and Communication Technologies: (a) Information and Communication Technologies and (b) Establishing the African Institute of Space Science

Cluster 5: Mathematical Sciences: including the next Einstein Initiative.

Each cluster would be managed by and through centres of excellence whose projects would be developed and implemented over the (coming) five years. Their "flagship" programmes would be research-organised on their "relationships and potential of establishing inter-related networks of implementing institutions". Advisory services would be orchestrated by high-level scientific committees who would ensure adequate "peer review" status to all programmes. Coordination would be effected by an AMCOST steering committee at overall level and by the NEPAD office in South Africa at the "technical" level. S&T then metamorphs into STI as the document proceeds. Thus, little mention of innovation can be seen in the first 50 pages or so of the text. The section on clusters is effectively on science policy strategy. For example, Cluster 2 on Energy, Water, and

[2] See Mugabe and Ambali (2006) Section 3, pp. 14–50.

Desertification is partly a wish list of things that need to be done to ease climate change problems, research on fact-finding about clean energy sources, making scientific assessments on subjects related to water quality and access, and improving "scientific understanding of causes of drought and desertification" (pp. 24–32). These initiatives are worthy as far as they go, but they are portrayed as a series of projects to be carried out and validated mainly by research bodies.

It is when we get to Sect. 4 entitled *Improving Policy Conditions and Building Innovation Mechanisms* that the CPA gets into discussing innovation as such. This primarily took the form of a programme designed to develop STI indicators. These were held to be "crucial for monitoring Africa's scientific and technological development. They are useful for formulating, adjusting and implementing STI policies. Indicators can be used to monitor global technological trends, conduct foresight exercises, and determine specific areas of investment" (p. 51). They were to be used to enable data to be gathered that would allow statistics to be calculated on regional activities connected to topics such as R&D and capacity-building that would provide an international platform for planning and dialogue.

It is noteworthy that even here very little is said about "innovation" as such, or about what practical measures could be taken to improve it. The remainder of the CPA is concerned with the creation of institutional mechanisms in matters such as regional contacts, science policy formulation at government level, and other matters. The nearest we get to innovation on a practical level is an abbreviated discussion on S&T parks at the end of the 75 pages or so. What started from the CPA was then continued with detailed survey work funded largely by international aid agencies at country level up until 2014 when the NEPAD produced a series of reports on indicators of innovation and related aspects of STI. The main published result of this work is *On Wings of Innovation* published in April 2014. Effectively, this document summarises what the AMCOST had done in response to the dictates of the CPA.

It may help to look at some of this indicators work using Nigeria and Ethiopia as exemplars. Ministries in 15 countries carried out detailed

survey work on indicators, which the NEPAD had determined as relevant measures of innovation in their economic systems. Not surprisingly these measures centred on R&D, much of which turned out to be conducted in universities and national R&D institutes. In the Nigerian document (2012), the report begins by talking only in terms of STI. For example, on page 15 it is stated that "*the transformation of the Nigerian economy based on science and technology is therefore the transformation of the Nigerian people, organizations and institutions into science and technology thinking entities*". Little attempt is made to specify how this relates to innovation potential and the document devotes most of its recommendations to (a long list of) measures to expand R&D and related public sector institutions. There are some general statements about the need to involve firms but little offered on how exactly this will be done.

Similarly, the 2006 Ethiopian document treats innovation much as a science-led activity. The 2012 document spends more time on issues of technology development (including foreign technology) but concentrates mainly on broad strategic objectives. The part on policy instruments appears in four pages at the end (out of 24 in all) and is unspecific about how in practice goals are to be achieved. Thus what we are seeing is arguably a resurrection of the old (1970s) view of innovation, one sometimes labelled the "pipeline model"; in this view, all (or most) innovation starts with formal science where new knowledge is formally produced through rigorous research in R&D departments (mainly in the public sector). This is then published in academic papers or related grey literature taken up by entrepreneurs, possibly privatised under forms of IPR (e.g. patents) and then used to produce new products and processes. In this new form, the pipeline has been subsumed under the moniker STI but it is still fundamentally a supply-led phenomenon. By extension in the Africa case, associated policies are essentially science policy ones. There is a nod in the direction of the twenty-first century but by and large this amounts to a series of projects designed to mobilise and update knowledge that already exists (perhaps in accessible forms).

The DFID Research into Use (RIU) Programme

This programme, worth some £40 million, concerned the natural resources (NR) sector (RNRRS);[3] it was established in 2006 to improve the roll-out of big sums of money spent by DFID in the previous ten years or so. Between 1995 and 2004 some £220 million had been invested in research designed to further economic development, the bulk of which went to UK public sector bodies (sometimes in collaboration with overseas partners in recipient countries). There was little evidence of this research being used, so the DFID approach was to invest a further £40 million to make the use of the research forthcoming. Clearly, pipeline thinking predominated since the underlying hypothesis was that relevant innovation in the natural resources sector needed a little more effort to get the productive show on the road. In other words, the DFID view had clearly been the traditional one to start with R&D projects.

When resultant production impacts did not materialise, the next step was to work out what had been missing and to fill the gap with more resources; but to be fair there was also a science policy agenda, to explore what else might be missing from the underlying technology transfer process and structure. It would take too long to describe in detail the RIU programme. Those interested are invited to consult other texts referenced here, in particular Clark et al. (2011 and 2013), Frost (2013), and Gildemacher and Mur (2012). In outline, the RIU identified a series of NR sectors in African and South Asian countries where resources could be allocated. A range of techniques was deployed to achieve this. For example, attempts were made in selected countries to identify "innovation coalitions" of relevant bodies; these would work together to propose relevant investments in sectors that were deemed to be key for development. The Tanzania case focused on poultry management while the Nigeria case covered cowpea. In every case a proposal was made to the RIU and, after modifications, resources were provided.

Another technique was the "Best Bets" programme in six African countries designed to fund a range of technology development projects to the tune of £5 million. The fund was a venture capital resource to be

[3] RNRRS stands for Renewable Natural Resources Research Strategy.

accessed competitively by consortia that would include partners who could be from publicly funded bodies. All were required to include private sector inputs and all were asked to provide an exit strategy on project conclusion. The call generated some 125 proposals which were vetted by a panel of senior African personnel that included venture capitalists, financial experts, and others involved in technology development. The resulting 15 or so projects produced some interesting outcomes.

In the "Best Bets" programme the funding call was set up as a competition that mirrored the British TV show "Dragons Den". Each applicant was given a short time to sell their venture followed by an interrogation from the panel of around 20 minutes or so. The successful shortlisted ones were then asked to prepare a formal business proposal that was subsequently vetted by other professional bodies before RIU management released the funds. In the event, some seemed to be successful and others not. By the end of 2013, the results were mixed with some failures, some successes, and some showing positive elements.

The main conclusion drawn from the RIU programme as a whole was that innovation has had very little to do with its portrayal in the AMCOST/NEPAD strategy documents. All the RIU projects were highly innovative but took the form of systemic interventions in which formal science played only a small part among many other knowledge agents. Where it helped was as a secondary input into a much more complex set of operations as outlined in Fig. 2.1. This illustrates the finding that each "innovation" has many components, ranging from acquiring pre-investment financial resources, managing risk and uncertainty, mobilising disparate knowledge elements, applications engineering, negotiations with government regulatory bodies, accessing products through imports (in the absence of local production capacity), and dealing with the many problems that always plague new innovative ventures.

There were also significant network links across different types of organisations such that, for an innovation to be successful, relevant flows of knowledge and resources needed to be coordinated and facilitated. It also showed ways in which the private sector can make a major contribution to international technology development for the rural poor. It became clear therefore that the idea of innovation should not be summarised under the generalised concept of "STI". Doing so is not only

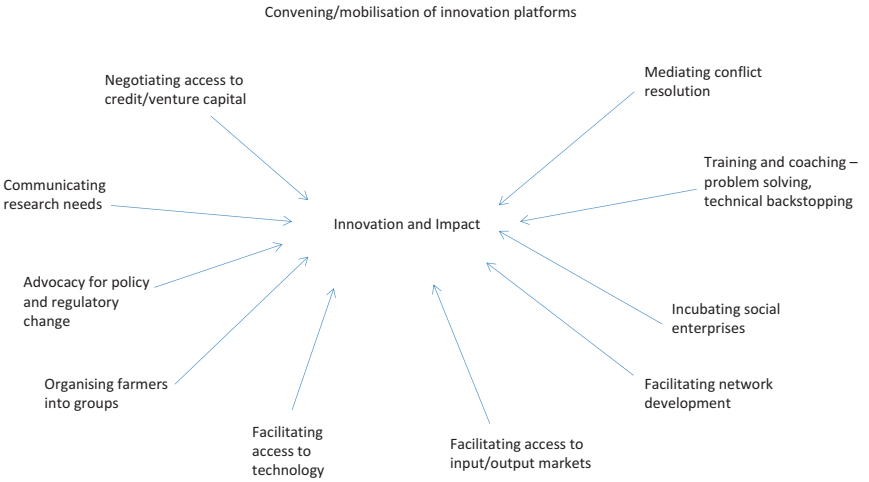

Fig. 2.1 Innovation Management/Brokerage Tasks Undertaken by RIU. (Authors' compilation)

misleading, it also distracts from what we need to understand about necessary policy and practice in low-income countries. For example, it allows policymakers to park complex policy issues in bureaucratic terms as a "science funding" problem that can be subcontracted to specialised institutions and "measured" using R&D statistics.

Relevance of DFID/RIU and Innovation Policy for the Africa Higher Education (HE)

What the DFIF/RIU case means for SSA can be summarised more generally as follows. The effectiveness of a viable knowledge system is to do with the ease with which relevant information can be organised and introduced into economic production, distribution, and associated activities, so as to improve performance. It has important institutional and policy dimensions (both at national and international levels) since such information is usually held in proprietary form by organisations that have interests in using it to achieve their own objectives. This means that issues of competition and co-operation may intrude into the effectiveness of

national policies of relevance. Much of the recent research on "innovation systems" has been oriented to manage such systems in more effective and efficient ways. What this implies for innovation policy can already be seen from Fig. 2.1. It comprises policies for everything from national fiscal and investment, foreign trade, international markets and technology transfer, finance and higher education and training to employment, international aid, and much else besides. Science and technology have of course a contribution to make, but there is very much more.

As already pointed out earlier, it is useful to highlight the HE sector not only because it is central to the theme of this book, but also because it is clear from the DFID experience that HE institutions have the capacity to play a central role and indeed did so in the RIU programme. For it is here that young people obtain the practical skills needed if they are to play useful roles in African development. There is a history here but it has never really taken root in developing countries. The EARTH University in Costa Rica was an early example. All students were required to establish their own business as part of a degree programme that concentrated on agricultural science. Failure to do so adequately would compromise the final quality of the degree awarded.

A more recent example was a major EU project on SSA regional fish trade carried out by World Fish, a CGIAR centre.[4] The project financed Master's degree students to work on cognate dissertations designed as part of the overall set of innovative activities designed to boost regional trade. Although academic supervision was standard, the students would also be supervised by a government official in a relevant ministry. A more recent innovation is the creation of a pan-African Master's degree programme by COMESA and currently managed by Kenyatta University in Kenya. This programme admitted its first cohort in September 2017 and has been designed to build capacity in managing trade policy across SSA. It is an online programme, but students are required to research their dissertation projects based on live work by their governments to promote continental trade.[5]

[4] Consultative Group for International Agricultural Research.

[5] For information, see http://www.ku.ac.ke/schools/economics/

A good example of one of the RIU projects was the approach taken by the Faculty of Veterinary Medicine at Makerere University in the Sleeping Sickness project.[6] It created a new *Institute for Strategic Animal Resource Services (AFRISA)* linked to (but financially independent of) the University of Makerere. Part of this new institute programme was designed for in-training community service delivery. The University saw this as a generic mechanism for equipping graduates for a labour market that is no longer satisfied by the supply of traditional university degree-holders. Instead the demand is for graduates who not only possess saleable business skills but are also capable of actually generating their own jobs virtually from scratch. Under this programme, veterinary students spent the final year of an undergraduate degree entirely in economic production activity producing at the end a project report that was assessed as a key component of the final degree.

In this case and in co-operation with a private veterinary company, final-year undergraduates participated in block treatment of cattle and ancillary spraying activities. In addition, a small number of these undergraduates were encouraged to set up small "agro vet" businesses (3 V Vets) under the supervision of a local private veterinary company. Undergraduate vets were trained in community animal health services and gained a three-month "short course" practical experience. Three years into the project, seven businesses had been established with 100 additional employment opportunities created—each vet had a shop assistant and between 90–100 spray persons were employed by these seven vets. On top of this, farmers began buying drugs for helminths, *trypanosomiasis*, and tick-borne diseases from the 3 V network of vets and a PPP vet service was now available in all districts. Twenty-seven BVM students were trained in Phase 2 in Soroti. Initially there were governance problems that related to perceived conflicts between academic and commercial roles. But these were quickly ironed out. By the end of the project, the RIU team had evidence that the AFRISA approach had started to be examined by other African universities and cognate work had begun in Nigeria.

[6] See Clark et al. (2013) chapter 6, pp. 108–114.

Conclusions and Policy Implications

We began this chapter with an emphasis on the use of the term STI as a focal point for Africa's development policies. It has struck us for many years now that more needs to be done to link education with economic production. Juxtaposing the empirical data to the theoretical lenses of the Triple Helix theory of innovation, it is clear that programmes like the DFID/RIU are beginning to fill the funding gap. They are doing this by promoting an entrepreneurial spirit and influencing innovation through innovation brokering, which promotes investments and institutional change. However, in many of the developing countries, especially in SSA, weak institutions of higher education and low investment in human capital present a chronic challenge to the full implementation of a Triple Helix network.

Indeed, in our experience of high-level senior management, academic, and researcher on Africa university interactions, one of the conclusions reached very quickly has been how little interaction exists between academic study and the world of work. This was the case in most higher education institutions that the authors experienced and observed. In science and engineering faculties, relevant equipment and materials were often absent (or at best inadequate) and very little seemed done to train students for the working world.

In contrast, many universities have become degree machines, churning out young people with paper qualifications but little else. The inevitable results follow. In the first author's own university in Africa,[7] very few graduates were successful in local job markets; most went on if they could to study for a higher degree at "Master's" level; even then, direct future employment was uncommon. Instead, what we have seen portrays a knowledge market, which in many parts of Africa appears to be getting out of control, turning out increasing numbers of graduates who have little hope of gaining useful work.

An important part of the problem lies in our view, in treating innovation policy as fundamentally science-related when in most cases the role of formal science is much more nuanced. What the RIU programme

[7] He spent a short period as Vice Chancellor in a Kenyan private university.

pioneered by DFID appears to have shown empirically (and really for the first time) is that effective technology development (and related innovation), at least in the natural resources sector, depends upon science being drawn into a complex systemic context as and when needed, not "pushed out" by R&D bodies in the hopes of finding a market. This systemic context is directly concerned with production, investment, and the creation of jobs and incomes for disenfranchised young graduates. In our view, if Africa's decision-makers do not get a grip on this, it will come back to haunt them as patterns of inequality harden into severe forms of political backlash across the region.

As pointed out in the DFID RIU programme, we are beginning to see some realisation of this on the part of relevant international agencies, especially in relation to Africa. For example, a relatively recent study of the medical sector in a range of countries has explored prospects for innovation-led pharmaceuticals production within the country.[8] Using a series of detailed national case studies, it sets out a series of policy programmes that governments are advised to adopt to ensure the growth of a sustainable medical sector in the region. Another recent project (again promoted by DFID) has been set up to identify practical areas for change to enhance the impact of government and external investments in science, technology, and innovation.[9]

This study is part of a wider partnership programme which includes the Science Granting Councils Initiative, a partnership between Canada's IDRC, South Africa's National Research Fund, and 15 Science Granting Councils across Africa. It also includes Accelerating Excellence in Science in Africa (AESA), a collaboration between the Africa Academy of Sciences and NEPAD, funded by the Wellcome Trust, Bill and Melinda Gates Foundation, and DFID.

The purpose of this research is to propose practical actions and recommendations for effective investments in science, technology, and innovation by these countries. Examples like these indicate strongly that policy changes are needed to shift the centre of gravity back towards those that link science and engineering training directly to economic production as

[8] See Mackintosh et al. [eds], (2016).

[9] See Atela et al. (2019).

an intrinsic part of higher education curricula. This is not easy to accomplish as it threatens power structures within academia. Nevertheless, there are now inspirational examples of institutional change that can act as templates for the future. These changes place the centre of policy gravity on the acquisition, deployment, and adoption of knowledge that is useful in a directly productive sense. It is probably now too late to get rid of the "STI" label but at least its flaws can be made clearer to those who have the responsibility of promoting balanced economic development in SSA.

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3

Commercialisation of Science at British Universities

Chris Harlow

Introduction

This chapter traces the history of the commercialisation of scientific knowledge alongside the parallel development of the British university sector, specifically to show how the two themes are connected. "Commercialisation", or the activity of applying scientific knowledge to commercial use, and the expansion of the higher education system have advanced in parallel, towards adopting a mutual objective of supporting the economic growth of the state. Because science studies have increasingly become centred at the universities, in the twenty-first century those institutions have become charged by the educational authorities with leading the "knowledge economy" and with becoming more entrepreneurial, through the process of finding commercial uses for the scientific knowledge which comes within their remit. Correspondingly, as over recent times the British university sector has come increasingly under the

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control of government, science policies, university expansion, and the entrepreneurial university have become intimately connected.

In a comprehensive work, The Gifts of Athena, Mokyr (2002) talks about the path from the discoveries of natural philosophy, or science, to widespread improvement in the useful arts or technology as being "commercialisation". He is referring there to early efforts by the scientists of the Royal Society to turn knowledge into technology, and it is this meaning of commercialisation which is the focus of the chapter. Thus commercialisation here stands for the flows of knowledge which take place in the transition from scientific discovery, yielding a method of achieving some purpose, then becoming an accepted technical advance, as discussed by Alexander et al. (2015).

Just as the practical uses of scientific knowledge have multiplied since the time of the Scientific Revolution, so has the British university structure. The six institutions which were established before 1800 have subsequently been expanded to become more than 160 universities, with the central government having a dominant influence in the expansion, as well as being the major source of financial support for science work in higher education.

Studying Commercialisation of Science at Universities

This chapter is based on a historical study of the way in which Britain's university sector has grown, with a similar historical study, at the same level, of how scientific discovery work and science studies have become largely centred on that British university structure. Primarily using published accounts of the two themes, the chapter also draws on direct accounts of commercialisation programmes as they have been carried out at some universities. Four centuries are covered here, from the seventeenth century, looking at the effects of the scientific revolution, through to the start of the twenty-first century, when British universities are being instructed to apply science discovery as part of the need to become more entrepreneurial.

Commercialisation occurs as inventors, scientists, technicians, engineers, entrepreneurs, and others contribute discoveries and these discoveries then become transformed into changes in technical methods and new products. The aim of this piece is to place those actors against the evolving background of the educational environment, the industrial environment, and the government policy environment, showing how the interactions between the three environments have brought about the thrust for commercialisation of university science today.

University Development

Five "cohorts" of universities are covered. The oldest English universities, formed originally as collections of teachers and students, date back to the twelfth century and became the repository for the care and study of written classical texts, those surviving from Greek and Roman times. The four oldest Scottish universities also date back 600 years. Where perhaps the study of ancient knowledge was a principal function, after 300 or 400 years universities in Britain also came to be education centres where clergy, lawyers, and more lately medical practitioners would acquire their status as graduates.

London universities are nearly 200 years old, and now comprise multiple educational institutions, from time to time federated with each other and later breaking free as independents. Civic universities, the third group, came into existence from 1900 through provincial towns and cities wanting their own higher education as the industrial revolution spread across Britain. Fourthly, the 1960s saw the creation of a new group, variously called the Robbins universities or the Plate Glass universities, formed to expand the whole sector of university education. Finally, the numerous Polytechnics of the 1970s and 1980s, accompanied by similar colleges for teacher training, were promoted to become universities in the era from 1992 to the present. Table 3.1 provides a timeline summary of these foundations.

Studying the development of universities is worthwhile, both because they are long-lived institutions and because they stand as national assets which have significance for the intellectual life of the country where they

Table 3.1 Timeline of the foundation dates of British Universities (Author's Compilation)

1180 to 1600	**Ancient Universities**	
Late twelfth century	Oxford	
Early thirteenth	Cambridge	
1413	St Andrews	
1451	Glasgow	
1495	Aberdeen	Marischal later merged with Aberdeen
1593	Marischal	
1583	Edinburgh	
1600–1900.	**London University**	
1600s to 1900s,	London	18 colleges, intermittently federated, later independent Colleges & hospitals: Gresham 1597, Heythrop 1614, St George's 1733 Veterinary 1791, Music 1822, Birkbeck 1823 University 1826, King's 1829, Holloway 1886 Q Mary 1887, Goldsmiths 1891, LSE 1895, LSHTM 1899 etc.
1836	London	(Formal designation of the University of London) Created as an academic "over-reach" to administer degree-giving exams for London Colleges and for provincial University Colleges
1600–1900	**Durham, to balance against the secularism of London**	
1830s	Durham	
1600–1900	**The first tentative move to give provincial University Colleges some status**	
1880–1903	Victoria University	University Colleges: one each from Manchester, Leeds, Liverpool
1870s to 2000s	Wales	Eight colleges: initially federated, later became independent

(*continued*)

Table 3.1 (continued)

First Phase Expansion by Government	**Civic Universities (12)**	
1900–1909	Civic Group (1)	Birmingham, Manchester, Liverpool,
1926	Civic Group (2)	Leeds, Sheffield, Bristol
1948–57		Reading
		Nottingham, Southampton, Hull, Exeter, Leicester
Second Phase Expansion by Government	**Robbins Group (24 Universities) sometimes called Plate Glass Universities**	
1960–1970	Robbins Group	Twenty-four universities, mainly as "green field" institutions
		Sussex, Keele, East Anglia, York, Newcastle, Kent, Lancaster
		Strathclyde, Essex, Warwick, Loughborough, Aston, Brunel, Surrey
		Bath, Bradford, City, Heriot-Watt, Salford, Dundee, Stirling, RC Art
		Ulster, Open University
(Off Track:	**One Private University)**	
(1980s	Buckingham	Private foundation as a company)
Third Phase Expansion by Government	**Polytechnic Universities (40 + in the first 1992 swathe)**	
1992–1994	Polytechnic	Anglia Ruskin, B'ham City, Brighton, Central Lancs, De Montfort,
		Coventry, Derby, E London, Greenwich, Herts, Huddersfield
		Kingston, Leeds Beckett, Lincoln, L'pool Moores, S Bank,
		Mch'ster Metro, Middlesex, Napier, Northumbria, Trent, Brookes
		W Scotland, Portsmouth, Robt Gordon, Sheffield Hallam, Staffs,
		Sunderland, Teesside, W London, Westminster, UWE, Wolverhampton
		Glasgow Caledonian, Cranfield, Abertay, UMIST plus some additions
		made up by giving independence to formerly federated London & Wales
		University Colleges

(*continued*)

Table 3.1 (continued)

Third Phase Expansion by Government	Polytechnics, Arts Colleges, & Teacher Training (45)	
2000–2015	Poly, Arts & TT	Gloucester, London Metro, Bolton, Roehampton, etc. Many of the 45 formed in the twenty-first century were based on former teacher training, technical colleges, or colleges of arts from the nineteenth century. Most had become Colleges of Further Education during the twentieth century. In addition, more members of the London or the Welsh groups, previously federated, became independent.

have grown up. As national assets the universities can be regarded as having alternative uses. A second reason for studying the phenomenon is that the transition affecting the universities is ongoing (Salter and Tapper 1994). In the next decade or two the trend towards converting the university sector into one that is more closely affected by market forces is likely to continue. In these circumstances understanding how the sector has been transformed in the past can give guidance to the formation of policy in the future, as the new ideas about the purpose of universities take hold (Maskell and Robinson 2001).

Teaching from Classical Sources at Oxford and Cambridge

At the start of the seventeenth century there were two English universities: Oxford founded in 1180 and Cambridge in 1209. In Scotland there were four: St Andrews 1413, Glasgow 1451, Aberdeen 1495, and Edinburgh founded in 1583. For the previous 400 years, Oxford and Cambridge had sustained their students and their dons well, in the study of classical knowledge. Their reputations for learning and scholarship did

not, however, do as much to assist them in the years of the scientific revolution.

Oxbridge was the home of the Scholastic tradition, characterised as relying on sources such as Ptolemy, Aristotle, and Plato for its authority. The two universities excluded Dissenters as students, not being part of the Church of England, and were relatively elite, being patronised largely by the sons of the wealthy. Their academic system was to require students to study the Greek and Roman classical scripts, conducting examinations for the degree on the *trivium*, grammar, rhetoric, and logic, followed by the *quadrivium*, geometry, arithmetic, astronomy, and music according to ancient and medieval practice. Rich students could bypass the second requirement by paying a fee (Roberts 1947).

By the seventeenth century the dominating Oxbridge power had become the individual college, not the central authority of the university. While university professorships in several subjects including "natural philosophy" and science were endowed and the posts representing the sciences were usually filled, few of the title holders undertook lecturing as part of a regular student course to be examined and students needed no knowledge of modern science to earn their awards (Ellis 2014). Within the colleges themselves the fellow-commoners (students) who came from good families would socialise and dine with their tutors in a self-reinforcing system; those same tutors would then conduct the oral recitation required for the student's award; poorer students were given space and some support, but needed to be self-sufficient materially. As well as being strongly influenced by classical learning, for some considerable time before the 1600s the teaching at Oxbridge had been slanted to reflect religious views in accordance with the Church of England (Britain 1999).

One historian of the universities' image at that time wrote of Oxford in the eighteenth century as providing full material for the satirist (Gibbon 1752) and Cambridge fared little better (Roberts op cit). The student life was portrayed as one where idleness was permitted. Oxford was lampooned by contemporaries as a place from which the hunting could be passable in good weather.

As an example of the approach to the study of science, when the bequest of antiquities from the Tradescant family was applied at Oxford

to establish a centre for the study of chemistry in a laboratory, activity in the latter facility soon ceased, with the scientific study sections of the building being turned into display areas. At Cambridge, in spite of the contribution made to the revival of maths as a study by Newton, the numbers of students proceeding to a degree dropped during the seventeenth and eighteenth centuries. Examination of the student continued to be via oral disputation.

The Scientific Revolution, Experimentalism and the Royal Society

The scientific revolution after the Renaissance was a force which upset the academic apple cart. Where the claim by the universities to represent knowledge rested on their focus on classical authorities, study of the natural world after 1500 took the form of more realistic investigation, or Experimentalism, in which knowledge could be supported by demonstration of cause and effect. Gilbert, a scientist practising at London's Gresham House in 1600, made startling strides towards understanding the earth's structure by showing the phenomena attached to its magnetism (Shapin 1998). Experimentalism threatened to devalue the claims of the English universities to represent the standard in learning and knowledge. No matter whether the new science really contradicted their authorities, the old institutions holding strong reputations for being major sources of learning were not ready to give up reliance on their traditions. In addition, the practitioners of new scientific routes to understanding the natural world were claiming a significance for it which further disturbed the academic peace. In his years as Chancellor, Francis Bacon wrote in the 1620s that all scientific knowledge should be put to the use of society and of industry and trades in general, to relieve working people of their burden of toil (Rees 2003).

Leading scientists who followed Bacon began to meet at Gresham's in the years after the Civil War, and then at the newly founded Wadham College, Oxford. Known at first as the *invisible college*, the growing clique founded the Royal Society in 1662, receiving Charles II's patronage.

From that point and a little way into the eighteenth century, the claims of the Royal Society's scientists seemed to demand from the Oxbridge scholastic world strongly worded defences of the venerable *trivium* and *quadrivium*. Disputes about the true nature of knowledge featured regularly in books and pamphlets (Musson and Robinson 1969). Far from joining in the enthusiasm shown by the experimentalist scientists for the application of science to assist commerce and advance the nation's industry, the old English universities maintained the traditional curriculum, teaching system, and examining method for undergraduate students. They thus acquired a reputation as practically serviceable only as the entry method for succeeding to a prosperous living in the established Church, or as a passport to the legal profession or into London politics.

In pursuit of the Baconian mission to render science commercially useful, the newly formed Royal Society set up a research study, their History of Trades project, which was intended to analyse all the artisanal skills and processes of the main seventeenth-century industries, and in doing so to subject them to scientific scrutiny and improvement, setting the labouring classes free of the most arduous labour and "improving" society. Perhaps not surprisingly, artisans and tradespeople, who had taken pains to gain their skills and who valued them, did not willingly give up the secrets from which they were able to earn a living (Ochs 1985).

As a beginning to the commercialisation of science knowledge, the History of Trades must be judged to have failed, but its consequences were far-reaching in the eighteenth and nineteenth centuries. Not daunted by the setback, the Royal Society continued to meet, to correspond with scientists in other countries, and to report on the latest news of discoveries about the natural world in its published transactions. Popular magazines such as *Weekly Memorials for the Ingenious* and the *Athenian Mercury* pirated the Royal Society's information to send it out to a wider audience (Hunter 1981 Chapter 2).

Industrialists in the Eighteenth Century Create a "Shadow" System of Higher Education

Scientific knowledge useful for industry, commercialised knowledge, was not being studied or passed on by the Ancient Universities at the time of Britain's developing industrial lead. While the well-to-do sons of the socialite and Anglican gentry could enter higher education at Oxbridge, there was no established system through which the industrialists, the eager young men and women of the new business classes, being Dissenters and of limited means, could learn new scientific and technological skills which would advance their ambitions or forward their desire for commercial success. Business people of the industrialist class were emerging in increasing numbers amongst artisans and small firm owners. By the end of the seventeenth century they constituted a significant section of technicians, people who could best use new knowledge where it was available to improve their industries. Excitement for knowledge and the search for education amongst these strata in the industrial centres nurtured national interest in the commercial value of scientific and technical understanding (Hunter op cit Chapter 3).

Interested groups of the new business class were growing in the towns and cities where the British industrial revolution was located. Rather than being the "unlettered" and humble sons of toil according to some traditions, intuitively inventing and innovating, the new class arose more from those families which already owned and managed grain mills, cotton mills, textile businesses, quarries, foundries, metal hand crafts in engineering, local building firms, food supply enterprises, and farms, all looking for better methods and greater productivity. Analysis of the genealogy of the early industrialists in Britain shows them to be of breeding amply suited to higher education in the new branches of knowledge, had it been offered by the universities (Crouzet 1985).

This unsatisfied demand for education, and the interest in knowledge which it represented, can be argued to have been met by a range of mechanisms which, taken together, amounted to an alternative informal higher education system, parallel to the universities but randomly assembled and serving a much wider customer group. Although the phenomenon

was uncoordinated and poorly resourced, it presaged a strong desire amongst the industrial towns, as they grew into manufacturing centres, for higher education institutions of their own. As this demand became expressed more forcibly in the nineteenth century, it supplied the pressure for the foundation of new colleges in London and the provinces. The colleges then became the Civic Universities of the twentieth century (Sanderson 1972).

The popularity with which new science knowledge was consumed represented a trend in demand, to which supply resources addressed themselves. Aspiring students of the sciences, serious about academia as an occupation, were able to put together enough lecture material from ready sources to enable them to address the ready consumers in the provincial towns. Some of the itinerant lecturers spreading news of scientific knowledge to industrial centres carried their own demonstration equipment with them.

Itinerant Lecturers

One typical itinerant lecturer was Samuel Kaye, available for lecturing to self-appointed groups in the north during the 1740s. Records of his delivery in Manchester show 22 topics being covered, from Gilbertian magnetism to Isaac Newton's theories of colour in light, all illustrated to the wondering public (Turner 1927). Other famous itinerants were Theophilus Desaguliers, Benjamin Martin, and John Banks (Soares 2012). As the lecturing fraternity became known, provincial society would push up its own gatherings of the citizens who wished for the advancement of their district and their trades. By the middle of the eighteenth century some of the better-established groups were calling themselves Literary and Philosophical Societies (Lit & Phils). Leeds, Liverpool, Manchester, Newcastle, Hull, and Halifax were the kind of towns where Lit & Phils were set up. Their purpose perhaps not so much to the literary study of great fictional works, as to the news of "natural philosophy", which was being broadly reported throughout the country, but they provide evidence of the interest in matters technical and industrial.

Itinerant lecturers may have looked not unlike travelling tinkers, but their pretensions were higher and made more substantial by the availability of knowledge being published. Neither did they lack audiences. The burghers of the growing towns would often start a small lending library, composed from members' own modest book collections and current magazines like the *Athenian Mercury* for its versions of the Royal Society's Transactions. Just by showing their thirst for learning and by associating with their peers in this pursuit, the potential audiences gained an identity.

An Informal Higher Education Cohort of Science and Technology

Famous groups like the Lunar Society of Birmingham had their modest equivalents in Leeds, Newcastle, Halifax, Liverpool, and in smaller centres like Macclesfield, Stoke, and Wolverhampton. Their composition was eclectic. The less privileged were to be found in self-made experts like Brindley, who became a confidant of the Duke of Bridgewater. The rich were to be seen in personages such as Sir Roger Newdigate, a landowner with coal on his estates near Nuneaton. An MP and a founder of the Oxford University Newdigate poetry prize, Sir Roger attended Parliament and intellectual London lectures; he "milked" social groups in London to learn of business opportunities; he travelled back several times a year to his estates to implement his plans. Between 1765 and 1769 he recruited a group of investors, mainly living between Northampton and Oxford, to finance the Oxford canal, to be built during the next two decades (Gibson 2015). Shareholders included landowners, trades people and many Oxford academics. Shares in the canal continued to pay good dividends to their owners for a hundred years.

As a Means of Commercialisation, the Informal System Supplanted the Old Universities

Where the Experimentalist approach to science, and the Baconian mission to make it useful to society had not been taken up in changes to the universities' regime for undergraduate students, the underlying agenda for commercialisation of university-type scientific knowledge was being carried out by individuals educating themselves. Some were the self-taught of Brindley's nature; some had inherited engineering traits, like Matthew Boulton. Wedgwood came from a potters' family; the derivation of Worcester porcelain was from an individual scientist's work. James Watt was lucky enough to fall in with the Scottish universities during the Enlightenment and to get his science of the improved steam engine directly from the chemistry professor. Many of the social networks were composed of scientifically oriented individuals, using their natural intelligence to further their knowledge into scientific discovery.

Thus was the commercialisation of scientific knowledge in the eighteenth century a vernacular movement. It was the publication of Royal Society knowledge and the growth of informal personal connections, not university instruction, which brought together the science of atmospheric pressure, the notional engine designs of Savery and Papin, and the technology of Thomas Newcomen. These were the inputs that created the first industrial power, the atmospheric steam engine, changing the power available to drain mines, to run spindles, and to process wool. The growth of the peripatetic contracting gangs, building engines for mines or canals was the means to establish the industrial revolution on a firm footing (Rolt 1963).

Provincial Citizens and Industrialists' Appetites for Higher Education

As a collection of routes to greater depths of learning, this structure appealed to the variegated cohorts of the young, aspiring to widen their knowledge but finding this was not available at university. Equally, this

happenstance construction of higher education appealed to the burghers and solid citizens of the northern industrial towns. Their expressions of support for learning proclaimed their self-image of being enlightened members of society. Their readiness to join with other people of substance exhibited their desire for industry and for the district to flourish. A quasi-tradition began to be visible of philanthropic funding being used to set up institutions where ordinary people could acquire the forms of education which would help them to better themselves.

From this analysis it can be argued that the direction which grew from the internal pressures amounted to nothing less than the building up, over two or three generations from the eighteenth century onwards, of an alternative, a shadow structure of higher education. Lecturers of the itinerant persuasion were apt to set up also as tutors to the aspiring young student. Groups like the Lunar Society offered a beacon for learned self-help in the manufacturing towns. Settled collections of lecturers could promote themselves into regular institutions which would feed into the Lit & Phil Societies. More regular employment for otherwise casually occupied lecturers could be found by working at the Dissenting Colleges. Some of the would-be scientists and lecturers were ready to set up their own colleges, rivalling Oxbridge (Stephens and Roderick 1977).

From 1800, Commercialisation and University Expansion Moved Towards Common Ends

During the period 1800–2020 utilisation of scientific knowledge to bolster the national economy and the expansion of the British higher education sector moved increasingly closer to each other. Their conjunction in the twenty-first century is illustrated by central government's mantra that the universities are to exploit scientific advances, to become more entrepreneurial, and thus to lead the "knowledge economy".

Before 1800, there were separate worlds for science discovery, for industrial progress, and for the established university education. Great advances were made in knowledge of the natural environment, through physics, chemistry, biology, and other sciences but these had only

marginal impact on the degree regimes. Many scientists of the post-Renaissance scientific revolution were university-educated or had strong connections with universities but their advances in knowledge were scarcely represented in the teaching or the degree requirements of universities. Implementation of new scientific ideas and of technical advances in the industrial life of Britain took place through the informal, or "shadow", system of higher education. New industrialists and business people gained access to knowledge in an ad hoc fashion. Up to the end of the eighteenth century the universities, especially in England, remained much as they had been for several hundred years.

After 1800 education in the sciences began to change as part of a widening of general access to higher education. This was brought about by provincial pressures at the local level for education to be more universally available, but also in the middle of the century, by central government initiatives and by political pressure for scientific expertise to be applied to national economic priorities. As central government began to take more responsibility for financing and directing the higher education sector, university-type skills and knowledge in scientific topics became recruited into the service of the national economy.

Changes in the Structure of the British Universities

After 1800, better conditions for the commercialisation of science at British universities were created by changes in the structure of higher education. These can be seen to be generated first in Edinburgh and Glasgow, then transmitted to London, spreading out into the larger English centres as the nineteenth century progressed. Scottish society and politics had been much changed by the transfer of monarchy to England, and the Act of Union in 1707 was a critical turning point in the way the nation saw its position and its prospects. The leading figures of Carstares as Edinburgh University's Principal and of Drummond as Edinburgh's Provost Principal during the early part of the eighteenth century laid the groundwork for the Scottish Enlightenment to take hold of the major

cities in the middle of the century. Edinburgh University set up its medical school in the 1740s. Glasgow shook off the Presbyterian yoke of seminary status and began to instruct students in the new scientific fields of chemistry and physics. Social and cultural groups proliferated in both urban centres, similar to the Lit & Phil Societies of contemporary English towns, but with greater aspirations, greater intensity, and wider inclusion of society's members (Herman 2001).

Enlightenment acted as a magnet for English industrialists and intellectuals, already bent on the "invention" of their own alternative higher education. Members of the Lunar Society were induced to visit Scotland because of the presence of James Watt in their midst and because their discussions and meetings were lit up by the type of liveliness that the Scottish clubs exuded (Uglow 2002). Birkbeck, one of the pioneers of the spread of education to a wider society, left his Yorkshire family home and the tuition he had received from amateur scientists in Kendal and Leeds, to enrol as a student at Edinburgh University. Joining groups of intellectuals in the city introduced him to important friends, such as Lord Brougham, for his later educational inspirations in London. Soon after attaining his degree in medicine from Edinburgh, Birkbeck was asked to lecture at the Glasgow Anderson Institute, intended by the bequest of John Anderson to be a university for working men and women.

After Anderson's death Birkbeck applied for the post of Professor of Natural Philosophy at Anderson's and during his five years' tenure evolved courses which were the model for later innovations in teaching science to "mechanics", the term employed to cover various categories of working people (Kelly 1957). Leaving Glasgow in 1804, Birkbeck spent more than ten years in London building up a medical practice, but began working with contacts from Scotland on the extension of higher education in the capital to working people, based on the lines used by Anderson's Institute some twenty years previously. Because of the amount of interest in scientific learning already evident from the presence of itinerant lecturers and Dissenting Colleges, the ideas behind the formation of the London Mechanics Institute by Birkbeck and his associates in 1823 were understood (Walker 2012). Because of the strong association between Birkbeck and Brougham and the groups which set up University College, London, three years later, Birkbeck's move can also be seen as

representing a part of the challenge to the old Universities of Oxford and Cambridge, still exclusive in their entry conditions and limited in their science.

University College London must certainly be seen as a challenge to the established structure of higher education. Promoted as being a secular institution, and opposed with serious intent by the church, the foundation of University College in 1826 set in train the very wide expansion of universities which then took place for the 200 years that followed. Provincial pressures in favour of local colleges which could serve the educational needs of the working people led to charitable foundations, to initiatives by local authorities, and to a steady growth of the Mechanics Institutes movement, all three sources of development producing a range of more local colleges and institutions to enhance the status of the working population (Cardwell 1963).

Kings College in London was founded three years after University College, as a counter on the church's side to its secular predecessor, but neither entrant could claim to be the University of London. This title was bestowed on the institution formed in 1836 to conduct examinations and to award London degrees. Since the newly formed University was also authorised to award degrees to colleges outside London, the so-called University Colleges in provincial towns and cities set up during the rest of the century affiliated themselves to the London examining body, and were able to enter their students for London University degrees.

Civic Universities

Entitlement to put forward students for such a degree encouraged more than a dozen towns and cities to respond by setting up University Colleges, aided by local pressure and frequently by local fundraising. Manchester University started life with a bequest from the local businessman, John Owens, in his will of 1846; Birmingham, similarly, from the generosity of Josiah Mason; Sheffield from Mark Firth's and the steel firms' support. These new Civic Universities could often trace their origins to patrons in the middle of the nineteenth century, but it was not until the first years of the twentieth century that they became established

as universities in their own right, substituting their own degree for London's.

In the first wave of the Civics, between 1900 and 1909, Birmingham, Manchester, Leeds, Liverpool, Sheffield, and Bristol were granted university status. Reading, based on funds granted by Huntley & Palmers, biscuit makers, was at first an outpost for agricultural studies from Oxford, but had to wait until 1926 to achieve university status, while Nottingham, Hull, Southampton, Exeter, and Leicester were constrained to wait to become Civic Universities until after WW2 (Sanderson op cit).

The New Universities Founded to Serve Government's Objective for Science Students

Where central government had found it simple enough to be supremely oblivious to the failures of Oxbridge to adapt teaching to the arrival of new scientific discoveries, the nineteenth century saw commercialisation of science and scientific discoveries become contrarily as consciously a priority to the political intelligentsia as its absence had been for a hundred years before. Government policies for the improvement of science and technology in the national interest can be dated from the middle of the century.

Lyon Playfair, of distinguished Scottish family background, had trained himself as an industrial chemist through university in the Netherlands and time spent in German industry. When asked by the Great Exhibition committee to help recruit business support for this grand enterprise, he obliged effectively. Much was the concern at government levels, however, when Playfair had to report that the pre-eminent position occupied by Britain in 1851 had been supplanted by failure in the industrial categories at the Paris Exhibition 16 years later in 1867. Germany was demonstrably overtaking the lead which Britain had held in industrial products and trade for the previous 150 years (Norrish 1951).

At some great remove in time from when Oxbridge had ignored the scientific revolution, government attention was now focused on Germany's universities and on the German system for training and using

scientists and engineers in industry. Even before unification in the 1870s, Friedrich List had prepared for the nascent empire of the German states a system of education and economic resources development which was felt to have given that country an enviable advantage in matters of trade and industry (Freeman 1995). The Paris Exhibition seemed to confirm it. Government commissions of inquiry and committees of Parliament were organised to question how science, maths, and the industrial arts were being taught, both at schools and at the traditional Oxford and Cambridge universities.

When the House of Commons report on scientific instruction (House of Commons 1868) and the Duke of Devonshire's Royal Commission on the same subject both confirmed that there was little competent teaching of science subjects, and that science was scarcely represented at university level, the government department set up to oversee Education in the Sciences & Arts asked Parliament for subventions from the public purse to reward schools and colleges which were able to show student achievements. Parliament grudgingly voted small amounts in the last two decades of the nineteenth century but these were enough for the Department of the Sciences & Arts and the Treasury, at least from 1900, to offer limited financial support to the new Civic Universities. The principal expectation from the subsidies was that the universities would produce a new supply of science graduates, whose remit could be to bring commercialisation of science to British industry by applying scientific knowledge, in emulation of the German practices.

Financing Universities and Science at Universities

Oxford and Cambridge had attracted gifts and endowment funds, building up substantial assets for buildings and running costs. When the Treasury and the Education Department began to encourage science studies and to authorise the Civic Universities, in the hope of producing more science graduates, it was expected that industrial companies, charities, and the local authorities would grant endowments for the capital

costs and that fees or charges on the localities would cover most running costs. As the twentieth century's first decade turned into the second, it was becoming apparent that these hopes would not be realised.

The new foundations were in danger of failing for simple financial reasons (Sanderson op cit Table 6). Year after year the new universities, and colleges which had been hopefully founded in their train, were coming back, cap in hand, to seek subventions from Parliament. At first, the government agencies found it simpler to accept this inconvenience but in the first year of WW1 it became more difficult to countenance continued intermittent subsidy (Vernon 2008).

Then the true knowledge of Britain's disastrous supply position vis-à-vis Germany changed the perspective of the War Office and the central departments of government. Essentials for the war effort and for the economic function of the country were either not available from British industry or, worse still, had been supplied up to the start of hostilities by the country that was now Britain's enemy.

In order to make good technically based items and to commission research for advanced ones, the War Office had to turn to the universities as one of the sources of support, combined with the appropriate indigenous industries. Commercialisation of science had become essential searches for the types of new knowledge which would help to defeat Germany. In the years 1915 and 1916, the Treasury authorised through Parliamentary Acts the formation of the University Grants Commission (UGC Shattock 1994) and the Department of Scientific & Industrial Research (DSIR Melville 1962). Initially as temporary measures to meet the emergencies, these agencies became permanently responsible for much of the running costs, and for research science, in the 50 years from when the war ceased. By 1920 public funds were meeting about 40% of universities' costs and before the 1960s public funds accounted for approximately 80% of those costs (Berdahl 1959); the DSIR was becoming a principal resource for university science programmes.

Science, Technology, and Commercialisation from WW1 to the 1980s

While the new Civic Universities were able, after some time bedding in, to expand the supply of science-qualified students and to brew up their own expertise in potentially useful branches of the main disciplines, the grant regime which was wished on the higher education sector in WW1, and the science and technology policies which filled the years around the two world wars came very little closer to the vision of commercialisation of university research which had been raised first by the Royal Society.

One of the contributing factors for this omission was that the science resources which were available in the stringent times of economic depression and recovery from wars tended to remain in the hands of government agencies. Secondly, the models held by government departments and by many academics of how economic growth occurred were loaded towards neoclassical theories in which technology and the application of scientific knowledge played a fairly small part.

Leading technological projects and advances in technical methods during much of the century involved universities only in a marginal way. Building up very strong departments in some of the most demanding areas of discovery was not encouraged by the parsimonious eking out of UGC and DSIR funds (Shattock op cit). Wartime experience of being able to command industrial resources successfully against the enemy gave the authorities an overblown idea of the effectiveness of centralised action. Aircraft and jet technology were left to the industry and the RAE at Farnborough, rather than being scientifically investigated. The government's efforts to build a viable aircraft-manufacturing industry after the war failed (Miller and Sawers 1968). Groundbreaking work in computing, carried out in Bletchley Park, was thrown away in peacetime by the lack of commitment to a national effort (Lavington 1980). Nuclear generating designs and the engineering development of electronic phone exchanges were similarly abortive (Harlow 1977).

Questions about the allocation of science and technology resources were being asked in public debate during the 20 years after WW2 casting doubt about whether the structures set up in WW1 were pragmatic in an

age of rapidly developing technological change. At the same time the Education Ministry, the Minister for Science, and the Cabinet Office were raising questions about the adequacy of the British higher education system in producing sufficiently aware and educated scientists and engineers (qualified scientists and engineers [QSEs]). In the 1960s, the machinery for allocating research funds to the universities and other contractors for science work was revised after reports from Parliament and a government commission under Burke Trend (Wilkie 1991).

Responding to concerns about the numbers of QSEs, Robbins recommended the creation of more than 20 new universities (Cmnd 2154 1963). In Table 3.1 these new 1960s universities are listed as the Robbins or Plate Glass Universities; they include new green field site universities like Sussex, York, Kent, and Lancaster, plus some of earlier origin: Strathclyde, formerly the Anderson Institute; Loughborough, formerly one of the CATs or Colleges of Advanced Technology; Surrey, formerly the Battersea Polytechnic Institute; and Bradford, which had been founded in 1832 as an early Mechanics Institute (Walker op cit).

Criticism of the way that science and technology research work was distributed by public agencies produced a long-term shake-up of the structure between the 1960s and the 1980s. To begin with, Sir Burke Trend's report to the House of Commons, combined with extensive consultation in academic and industry centres, resulted in the creation of the Science Research Council (SRC) quickly adapted as the Science & Engineering Research Council (Wilkie op cit). Continuous elaboration of the research allocation structure into the twenty-first century produced more research councils, indeed Council after Council, until an Act in 2017 returned the system to coordination of scientific and technological research resources under a single body, the UK's Research and Innovation organisation (UKRI).

Raising the Output of Professionally Qualified Personnel for British Industry's Needs

Having passed through the phase before 1900 when there were scarcely any science graduates coming from the universities into industry, and having made some moves to rectify this by the creation of the Civic Universities, then starting to reform the system for raising research and technical development capabilities, following Trend, policymakers began to turn to the question not just of the supply of graduates but of the more generally demanded technically qualified engineers of professional standing.

Robbins had proposed that doubling the number of universities from about 20 to more than 40 would be advisable to bring the supplies of university graduates up to scratch. Alongside his report, policy analysts identified a shortage of professional technically qualified personnel. From the 20 plus universities in the late 1950s, hosting 80,000 students, only about 20,000 graduates emerged each year. Many of those with science or technical degrees went into teaching at the schools or universities, and many into professional, administrative, and civil service roles. Few graduates were reaching the realms of industry.

During the years leading up to the 1960s and 1970s, the principal route for technically qualified staff to reach professional status and senior positions in industry was through study for the exams of the professional institutes, the Institutes for Electrical or Mechanical or Civil Engineers and their like. Study was often part-time alongside an apprenticeship; education in evening or day-release classes was typically at one of the local technical colleges, or colleges of further education, which had progressed up from the workers' colleges, founded typically during the mid-nineteenth century as local authority Colleges for the Arts & Sciences. A few of the latter colleges had been raised to the status of polytechnics, on the model of the Regent Street Polytechnic (Royal Polytechnic Institution) founded in the 1830s and qualifying its students via the London University exam system. As a new version, one or two local colleges in the 1950s were designated as Colleges of Advanced Technology (CATs). Nevertheless, the numbers of personnel emerging annually with

technical or quasi-scientific qualifications which could be regarded as comparable to a university degree was small compared to the equivalent numbers available to the economies of the US, Germany, and some of Britain's industrial competitors.

The Polytechnic "Experiment" Replaced by the 1992 Universities

Following Robbins' proposals for greater general further education and for higher numbers of university students, two government policy papers were published in the mid-1960s. Taken together, they proposed that selected existing local authority colleges of further education, the "technical colleges" of vernacular reference, should be raised to polytechnic status and that the exiting qualification earned by students should be regarded as of degree standard (Pratt 1997). Some 35 plus polytechnic colleges were so designated before 1980. The effect was expected to increase the output of quasi-degree-level QSEs from non-university sources from a few thousand per year in the early 1960s to tens of thousands per year by the 1980s. Although targeted at filling the identified gap in the training of personnel for industry, this "binary" higher education structure suffered from much criticism. During the years between Robbins in 1963 and the education Acts of the 1980s and 1990s, opinion swung in favour of having a single-status higher education structure in which all institutions would be designated as universities, with their own degree-awarding powers.

In the interests of providing adequately for the needs of industry, a wide range of the former polytechnics, plus many teacher training colleges and other further educational institutions were raised to university status by education acts from 1988 to 1992. By 2018, the actual number of universities in the UK was given by Universities UK, the representative body for the sector, as exceeding 160. In 1957 it had been as low as 23, depending on how the London and the Welsh institutions were counted; even after the Robbins' expansion was in place the numbers could be reckoned in the 1980s as only about 45 universities in Britain, hosting

about 300,000 students. Today, Universities UK gives the number of British students at the universities as in the region of 1.7 million.

Commercialisation, the 1992 University Expansion, and the Entrepreneurial University

University expansion on the scale mentioned had implications for the balancing of public finance budgets; the Thatcher promises of the 1979 to 1980s administrations were to reduce taxes by keeping the public expenditure percentage of GDP down; raising the number of universities by nearly four times and the number of students, still in the 1980s receiving substantial grants, by nearly six times did not make a consistent election message. Although the university expansion could be attributed to educational policies implemented under the Conservatives, the message for the public purse could also be read by Labour. The Treasury thus initiated measures in the 1993 White Paper "Realising Our Potential" (Cm 2250 1993) to make the higher education sector explicitly responsible for providing a financial return to the economy, in essence repaying the research expenditures on science and technology.

Once these demands had been made, they became reiterated and reinforced over the following 25 years by a series of government policy papers. They came under various authors, first Lambert, then the DTI, followed by reiteration of the principal message from Dowling and Wilson. Putting the universities in charge of bringing in the knowledge economy was the message contained in them. An additional message was spelt out that universities could not count on the substantial funds being granted by Parliament. Student fees were introduced when the Labour government took over in 1997, and were escalated to more than £9000 per year in 2012. Commercialisation of university science discovery and the expansion of university education for the majority of the school-leaving population had become consolidated into a unified policy mantra: universities were to become part of a market in education and knowledge.

Within the policy initiatives there also came the expectation that universities should act in an entrepreneurial fashion, perhaps by taking

founder share ownership in the spin-out companies which would result from commercialisation. Inducement programmes under the title of Higher Education Investment Funds (HEIF) were offered before the end of the twentieth century and an agency for measuring progress in commercialisation was set up as the Higher Education Statistics Agency (HESA).

Consonant with the edict that universities should become more entrepreneurial was the expectation in government policies that each university should establish an office which would become responsible for commercialisation, developing the support for launching spin-out companies and setting up communications with industry for joint ventures using science and technology expertise from the academic environment. The Technology Transfer Office (TTO) model owed something to the success which Oxford and Cambridge had shown, even before the 1993 White Paper, in launching spin-out companies and in securing research contracts with industry (Cook et al. 2008, Wicksteed 1985). By the end of the first decade of the new century HESA's figures showed that from the greatly expanded university structure there had been more than a thousand new firms launched (HESA 2012 & 2014).

Oxford, Cambridge, the older Scottish universities, and some London institutions have been shown to head the list of successful spin-out firms. Reporting of statistics by HESA up to the second decade of the twenty-first century suggests that the more recently established universities were achieving few spin-out companies. If the rate of formation of new enterprises was the criterion of success in the search for science commercialisation, then the recorded results would suggest that launching the commercialisation campaign on the basis of the Oxbridge model made the mistake of expecting that all universities were of the same nature in experience and structure.

Conclusion: Commercialisation, University Expansion, and the Entrepreneurial University

Reviewing the commercialisation policies of the last 25 years and the emergence of the entrepreneurial university against the seventeenth-century aspirations of the Experimental Scientists of the Royal Society allows one to make a more favourable judgement. These scientists were partly faithful to Francis Bacon's injunction, when writing in the 1620s, to examine how knowledge was to be gained and how it should be used to make working lives easier (Rees op cit) and to Robert Hooke, a member of the Society himself, who wished for a disciplined and regulated army (of experimentalists it can be assumed) which would overcome the difficulties of natural knowledge "to produce somewhat of use to themselves or mankind" (Hooke quoted by Mokyr op cit).

The question must arise, however, whether those seventeenth-century personages wished for universities to be focused on commercialisation as fully as might now be the case. Credit can be given for the dogged sense of pursuit which has led from the long ago rejections of science by the older universities, compared to quite different records of attainment by the older universities today.

This favourable judgement, however, is not without its ironies. The first must be that Oxford and Cambridge, determined to have little to do with revolutions in the seventeenth century, scientific or industrial, should now be found heading the lists of business enterprise spin-outs. Neither came into the commercialisation "game" through any policy directive forged by the university authorities, but instead by movements, from the bottom of their respective university structures, then working towards the top. In Oxford the architects of the climb were independent spirits, such as Martin and Audrey Wood, founding Oxford Instruments, and Tim Cook, nurturing the university's business support unit (Wood 2001, Cook et al. op cit). In Cambridge there are many possible individuals to praise but the ideas which Maurice Wilkes, an ex-Bletchley Park scientist, pursued in obtaining an early model computer for his department might have ignited his university's start into computer technology and electronics research (Lavington op cit).

Secondly, there is the irony that, just as the Royal Society's History of Trades ran into its great difficulties when trades people were reluctant to have their secrets learned and their working methods "improved" by eager experimentalist scientists (Ochs op cit), so have the entrepreneurial university projects demanding collaboration with industry been slower to be realised than those where new entrepreneurial university ventures are launched. Oxbridge's spin-out companies were a phenomenon 20 years before the Treasury's 1993 White Paper.

It is also ironic that science commercialisation policies should only blossom most fruitfully when the Polytechnic University cohort of new arrivals was formed, considering that the new universities of this cohort were the least well-endowed with previous access to research funds and the least experienced in building their own areas of science expertise, ready to be exploited as spin-out companies. A project involving 11 English universities which received £5 million under the HEIF 3 grant programme and hoped for a score of businesses to be launched from its work was in the end able to record next to nothing in the form of viable new business launches (Wright 2011). Looking at the detail, this HEIF expenditure was poured into a group of universities mainly from the ranks of former Polytechnics, plus a sprinkling of Robbins types and one Civic. These institutions from the university expansion programme have been the ones least able, by their history and experience, to cut their science research teeth on publicly funded work. The older universities founded at much earlier times had had time to practise, but the polytechnic portfolios of projects ready to convert were empty.

What the experience of the unfortunate multi-English-university project might tell us is that any extrapolation of the commercialisation successes earned by Oxbridge or by the older Scottish universities, to propose a single model of commercialisation, based principally on new ventures, would not conform to experience about whether organisations can turn themselves around, intrapreneurially, and become more entrepreneurial to order. Examination of the HESA data suggests that, as time has gone by since the Treasury exhortations to the universities, so different sections of the "becoming more entrepreneurial" menu have been attacked by different universities (Datta et al. 2019). In introducing the origins of the entrepreneurial university it is hoped that this chapter can assist the

reader in viewing the whole subject of the entrepreneurial university with a wider perspective.

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Part II

Meso Level: Dynamics of Interactions Between Knowledge Incubators and Knowledge Entrepreneurs

4

Research, Policy, and Practice in Knowledge Transfer: Towards an All-inclusive Approach

Nicolette Michels

Introduction

The agenda of university knowledge transfer is problematically characterised by heterogeneity. With apparent ongoing issues of inconsistent engagement in this agenda, uncertain impact, and continued development of various government departments, policy mechanisms, white papers, and research aiming to support, understand, measure, or even just define the nature of impact of this agenda, a "one-size-fits-all" approach seems problematic. This chapter questions the effectiveness of UK policy and research approaches to date, and aims to inform the role of research in supporting the policy agenda that must achieve the difficult balance of providing something implementable but meaningful, inclusive, and accommodating the heterogeneity of activities, stakeholders, and outputs.

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Heterogeneity even in the terms given to describe this domain is illustrative, with commonplace interchangeable terminology: "third stream", "third mission", "knowledge transfer", "knowledge exchange", and "partnership" to name a few. Uncertainty over terms to adopt and awareness of possible (mis)interpretation by the reader are indicative. A short explanation of definitions is important for contextualising the ensuing discussion.

The "third mission" of universities, which is understood to have emerged following the "first" and "second" missions of teaching and research, dates back to the agreement of the European Councils of Lisbon and Barcelona in 2000 and 2002. A seemingly much-used definition from that era by the Science Policy Research Unit considered something called the "third stream" to be "concerned with the generation, application and exploitation of knowledge and other university capabilities outside academic environments" (Watson and Hall 2015). More recent definitions suggest that a broader scope has developed. The Head of Knowledge Exchange policy for the Higher Education Funding Council for England (HEFCE), has described "the third stream (knowledge exchange) as the trend among many universities toward a third function, which has been described using a range of terms such as knowledge transfer, community service, community engagement and the third stream" (Frost 2016). Essentially, university knowledge transfer, or the third stream, is now arguably a catch-all to describe the activity of universities engaging or even partnering with external stakeholders, for various reasons other than teaching and academic research, and which may be commercial or social in nature.

The scope of the third stream may have appeared to broaden over time but this agenda continues to be associated with innovation or at least positive outcomes of economic and social benefits, and hence stimulating academic research and governmental policy interventions which aim to support. Exactly what such innovation or positive benefits look like is also, however, debated—and certainly heterogeneous.

There is need in both policy and research for an overarching approach but one that effectively incorporates the inherent heterogeneity of the

domain: accommodating newer areas involved in innovation without excluding older ones; supporting innovative small and medium enterprises (SMEs) but also corporates; catering for innovation imperatives of the new economy and of "society".

The critical review of policy and research provided in this chapter firstly aims to evidence that the domain of the third stream is problematically heterogeneous: it offers an array of definitions, typologies, approaches, and conclusions. More significantly, it is critiqued for appearing to offer no coherent, overarching view of the third stream, nor any associated inclusive, implementable framework of action for policy and practice. Given the heterogeneous nature of this agenda, which in turn involves the agenda of multiple different stakeholders (universities and others) working together, the core concepts of "partnership working" are, however, identifiable as relevant and useful. It is argued that commonality, difference, and intersubjectivity, which are understood as inherent in and between universities and other stakeholders working in such a partnership activity, are thus fundamentally important and valuable for policymakers, practitioners, and researchers to incorporate in their approach to this domain. If research aims to help inform policy and practice, it is suggested that an approach is needed that goes beyond simply acknowledging heterogeneity: indeed, one should incorporate understanding of intersubjectivity and "variation" in the very design of the approach. The phenomenographic research method, which is based on the assumption that variation exists, but is thus far not adopted in the field of university knowledge transfer, may consequently offer a valuable new "all-inclusive" framework for providing relevant insights into innovation, hidden innovation, or potential innovation in the domain of the third stream. Examples of what this might look like in practice are provided.

The following critical review of research and policy, and subsequent conclusions offering a new approach are focused on the UK, but are expected to resonate with other national contexts and thereby contribute to developing ongoing better understanding and hence research, policy, and practice for all of us involved in this important area.

Issues in UK Knowledge Transfer Policy

An All-Inclusive Agenda?

Whilst the university knowledge transfer agenda arguably originated as commercialisation of Science, Technology, Engineering, and Maths (STEM) areas, UK policy statements some ten years ago showed an ambition to provide a "framework for innovation" (DIUS 2008) for all types of Higher Education Institution (HEI), and all types of knowledge: research- and non-research-intensive, and "the full range of subjects" (HEFCE 2008, p. 31). Evident in more recent policy papers is an assumption of the universal relevance of such business–university collaborations with recommendations that "all domains must attain excellence" (Wilson 2012). Conclusions of the latest Higher Education Business and Community Interaction (HE-BCI) survey, which noted the need for example to capture more insight into "no or low income driven outcomes and impact" (HEFCE 2017), show that UK policy continues to regard this agenda as broadly relevant for all. The positive ideology of the third stream and the role of policy has persisted in subsequent White Papers and policies (e.g. Witty 2013; Dowling 2015; Industrial Strategy 2017).

Some would argue that this broadening, all-inclusive but "wide variation" of the agenda represents a "Changing University Paradigm" (Gibb et al. 2009), an evolution of the original third mission university–industry innovation concept (Nelles and Vorley 2010), or even in fact a return to academia's roots of playing a social/community role. Some embrace the breadth whilst others regard the "wide-ranging moniker" (Urwin 2003) as problematic. Whilst UK policy contextualises the review conducted here, the debate about the aims and achievements of the third mission are observable across the global academic sector (Gibb et al. 2009; Krucken et al. 2007; Nelles and Vorley 2010; Lockett et al. 2012). The current all-encompassing nature of the third stream with pressures for academics increasingly to perform across multiple agendas (first, second, and third stream) leads arguably to "strategic overload" for academia (Sanchez-Barrioluengo and Benneworth 2019).

Issues of Engagement and Impact

In spite of all the positive ideology and rhetoric about university knowledge transfer, problems identified ten years ago of "inconsistent stakeholder engagement" in the third stream, of "hidden innovation", and of the need for "better insight" (DIUS 2008) signalled issues which various policy initiatives appear to continue to seek to address today. Inconsistent engagement by academic and industry stakeholders' "supply and demand-side" (HEFCE 2008), and no clear pattern of engagement by discipline or type of HEI (Pilbeam 2006) led to suggestions that policy was not all-inclusive but biased towards STEM subjects, alienating Humanities, Arts, and Social Science (HASS) disciplines (Smith and Taylor 2009). Policymakers acknowledged the need to embrace innovation in "newer areas" such as charities (PACEC 2010). In order to "understand better", the UK has thus introduced data-gathering and benchmarking mechanisms like the annual HE-BCI survey and Knowledge Exchange Framework (KEF), alongside established knowledge transfer funding mechanisms such as the Higher Education Innovation Fund (HEIF) and Knowledge Transfer Partnerships (KTPs). Most recent data from some of these suggest overall enhanced improvement in "performance" in the third stream (HEFCE 2017). However, within top-line good news it may be noted that engagement by stakeholders continues to be inconsistent with "institutional differences" (Fuller et al. 2017; Salomaa 2019); lower levels of achievement from certain types of third stream activity such as consultancy and low-income activities (HEFCE 2017); and regional and sectoral disparities (Sanchez-Barcaluengo and Benneworth 2019; PACEC 2017). Recognition that funding criteria and performance measures which are "formulaic" and "monetised" may be "imperfect" and not capturing and facilitating all types of innovation (HEFCE 2011; Rossi and Rosli 2015) continues to seem relevant. Investigation of barriers to engagement is not just a UK issue—see, for example, Nielsen and Cappelen's (2014) research in Denmark and Norway.

Some have argued not so much that policy is biased but rather that policy discourse is ambiguous (Smith and Taylor 2009; Michels 2010). Whitchurch (2010) and Wersun (2010) point to problems of policy "lost

in translation" and "triple translation" due to the ambiguity regarding the "more publicly-orientated strands" or "service-orientated approach" of knowledge transfer versus more "privately-orientated strands" or "commercially-orientated approach". Difference between "normative policy discourse" and HEI implementation has been noted. Apparent aims to be all-inclusive seem problematic.

Knowledge transfer policy in the UK has previously presented itself as a framework for innovation (DIUS 2008). Validity of this stance could be challenged by the issues of engagement cited earlier and these apparently persist—as shown by the recommendations from the later Wilson review that "all domains must attain excellence" (Wilson 2012). Even in the context of the most recent HE-BCI survey policymakers have continued to note the need for better understanding, and the role of academic research for informing or impacting policy is increasingly under scrutiny. However, current research as reviewed in the following section is not offering an all-inclusive, fit-for-purpose approach for better understanding.

Current Understandings About the Nature of University Knowledge Transfer

The review presented here questions the ability of current research into university knowledge transfer to inform policy aimed at supporting innovation through knowledge transfer. Research into the nature of knowledge, university knowledge transfer, and how to manage it is mature but highly dispersed across disciplines spanning STEM and HASS, including management, enterprise, education, learning, policy, geography, and technology. The cross-disciplinary nature of this body of research is appropriate but also illustrative of heterogeneity and hence has potential for diverse interpretations.

Heterogeneous Domain of Definitions and Activities

The recognition of wide-ranging, complex features, opportunities, and barriers to achieving a fully-fledged university third stream focuses some attention on the nature of the "ecosystem" for this important agenda, including the wide range of definitions, narratives, approaches, partners, strategies, policies, impacts, overall trends, enablers, and blockers. The ecosystem or environment for the third stream continues to be regarded as important: HEFCE as recently as 2017 commissioned a report on "The state of the English University knowledge exchange landscape" (PACEC 2017), which looked into the ranges of approaches and features within the UK context. Heterogeneity has been observed as defining the global as much as the UK third stream environment (Krucken et al. 2007; Nelles and Vorley 2010; Lockett et al. 2012). The "tremendous variation across the HE sector" (Nelles and Vorley 2010, p. 345) is specifically for some the result of diversification of the third steam over time, and illustrated by the range of definitions and activities, diversity of scope, and impact.

An overview of the types of activity that have been the subject of research in this area since the turn of the century reveals that university knowledge transfer might include patented research, university spin-outs, consultancy, corporate education, student placements, advisory board membership, amongst others. Individual studies demonstrate the continuum: Pilbeam (2006) adopts an economic definition looking at research income from government, charity, and business, whilst Streir and Shechter (2016) look at community engagement.

Even the focus of individual research studies makes their findings difficult to contextualise. Single studies include a range of activities both explicitly (e.g. Krucken et al. 2007; Nelles and Vorley 2010; Wersun 2010; Whitchurch 2010; Ramos-Vielba and Fernandez-Esquinas 2012) and apparently inadvertently (e.g. Ozga and Jones 2006; Sharifi et al. 2014). Several studies draw conclusions based on multiple types of third stream work: for example, Ozga and Jones (2006) look at different non-comparable types of activity within various Scottish HEIs and Sharifi

et al. (2014) interview people involved in very diverse third stream activities.

Overall, the body of existing research provides little insight into relative importance or predominance of the different definitions but only shows diversity of interpretations of what university knowledge transfer might be about. How one measures success and the level or type of innovation achieved is at best defined as probably "different", and identifying links to innovation is confounded by such diversity (Perkmann and Walsh 2007).

Heterogeneity of Implications and Conclusions

An overview of findings from this body of research provides a long list and range of policy implications and recommendations, including amongst others the importance of

- Language and communication
- Relationships/familiarity (including institutional)
- Degree of formality
- Trust; time for relationship-building
- Number of interactions/cross-boundary networks/networking
- Cross/beyond-boundary perspective/attitude
- Motivation/incentive/reward (intrinsic/extrinsic)
- Individual expectations/aims
- Strategic (institutional/sector) objectives/valorisation/clarity
- Individual skill, motivation
- Effort/negotiation/politics
- Skills (such as project management)
- Restrictive contracts/ownership issues/bureaucracy
- Space
- Difficulty in finding partners/accessibility
- Flexibility
- Leadership, management
- Planning and reflexivity

Although summarised here as a list, there is no clear hierarchy of importance identified. Further, although some issues may be interrelated in some way (for example, "trust" with "time for relationship-building", and "motivation" with "expectations" and "reward mechanisms"), it is not identified how these are related or how dealing with all of these should be translated into national or institutional strategy. Some of the findings provide implications for policymakers in terms of engagement, measurement, or resource allocation. For example, findings about the length of time required for relationship-building leads to suggestions of the importance of (developing) soft (interpersonal) skills, and longer-term, non-commercial measures of, for example, the number of cross-boundary interactions. Findings urging "flexibility" (e.g. Sharifi et al. 2014) or respecting academic identity (e.g. Boyd and Smith 2016) offer no tangible, overarching policy strategy for addressing heterogeneity of types of activity.

Heterogeneity of Typologies and Frameworks

Attempts to address heterogeneity of the knowledge transfer domain have resulted in various analytical frameworks or typologies mapping different types of knowledge and processes. Arguably founded on Biglan's (1973) typology of academic knowledge and associated activity as hard/soft/pure/applied, later typologies recognised knowledge creation as open-sourced and problem-orientated, leading to bipolar categorisations of mode 1/mode 2 knowledge (Gibbons et al. 1994) and explicit/tacit. Postmodern and social constructivist contexts saw greater fragmentation such as in organisational literature into five types of knowledge as embedded, encultured, embrained, encoded, and embodied (Blackler 1995), and in education into Godemann's (2008) four types of trans-disciplinary knowledge involving a journey of integration, problem orientation, reorganisation, and universal vantage point.

Some suggest the third mission as a continuum of activity: "formal–informal" (Perkmann and Walsh 2007; Amara et al. 2013); from "outcome to outreach" (e.g. Wersun 2010); paid and unpaid activities (Amara et al. 2013); open versus closed process (Sharifi et al. 2014);

encompassing three "functions of the third mission" (Laredo 2007); four categories of "community-based", "commercialisation", "problem-solving", and "public space/people-based" (PACEC 2009). Perkmann and Walsh (2007) identify 16 categories of knowledge transfer. All these typologies represent attempts to provide a framework for heterogeneous understandings of knowledge, but do not identify any hierarchy for policy.

Distinctions between the nature of knowledge and the process of knowledge working (Ozga and Jones 2006) are also evident. Blackler (1995) charts a shift of emphasis in contemporary capitalism from understanding "knowledge" as a product to focus on processes of "knowing" and "doing". Some typologies focus on contexts/boundaries to explain different knowledge processes: Carlile's (2004) three-part continuum envisaged increasingly complex boundaries of syntactic, semantic, and pragmatic knowledge collaboration. Krucken et al.'s (2007) typology comparing Germany and the US focuses on differing levels of knowledge integration. Laredo's typology (2007) articulates "education products" of transfer: mass; professional; doctoral. The 5 Cs Model of Good Practice Knowledge Transfer developed by the UK's Council for Industry and Higher Education (CIHE 2012) sees a staged journey and iterative action-learning process. A review of this heterogeneous domain (Michels 2010) led to suggestions for an overarching conceptual framework based on popular metaphors such as transfer, exchange, and partnership. The Metaphor Framework highlighted different discursive domains as explaining different conceptions of valid knowledge and knowledge transfer (and associated policy issues), surfacing the significance of a non-homogeneous view of knowledge "as portrayed by the knower"(s). Each metaphor represented conceptions held by some stakeholders but therefore might exclude, even alienate, the perspectives of others and hence possibly explain issues of policy (dis-)engagement and inflection. However, that framework did not pursue the nature of the interrelationships between metaphors or policy implications.

Current research provides a range of typologies but in spite, or because, of these provides an unwieldy body of understanding, offering no overarching insight for policymakers about innovation through knowledge transfer or how best to measure and support it.

Implications for Better Understanding

The different understandings about what is regarded as valid knowledge, how it is created, and to what end arguably reflect different stakeholder interpretation, possibly evolving understandings about knowledge, and the context about and for academia generally: from concern with national competitiveness and the link to innovation and university knowledge, and subsequently a broadening (or re-emerging) concern with a social agenda and the associated role of (academic) knowledge. Gibb et al.'s (2009) "Changing University Paradigm" acknowledged the increasingly complex, uncertain university task environment which persists (Lockett et al. 2012).

Providing a coherent inclusive framework is thus complex. The need continues for more fine-grained policy (Lockett et al. 2012) and hence research agenda/approach. Identifying, understanding, and defining the interpretations of different contexts and stakeholders is important for those informing, designing, implementing, and participating in university knowledge transfer. This arguably underpins different approaches adopted to date to investigate this domain and these are reviewed in the following section.

Current Approaches to Understanding Issues in University Knowledge Transfer

Third stream research has understood context and stakeholder interpretations to be valuable (Benneworth and Jongbloed 2010; Streir 2011; Sharifi et al. 2014) and particularly for insights into issues of policy (dis-) engagement, inflection, and hidden innovation. Whilst knowledge may be regarded as valuable capital, what is valuable seems contested (typified by the so-called great divide of the sciences versus humanities). There may be no absolute truth: what counts as "within the true" is subject to different discursive domains and "participants'" interpretations of an experience are "a form of knowledge" (Fowler and Lee 2007). Calls for more insight lead to suggestions for investigation into different

interpretive domains: individual; discipline; department; organisation; sector; region; policy instrument (Urwin 2003; Pilbeam 2006; Geunia and Muscio 2009; Arzensek et al. 2014; Boyd and Smith 2016).

A review of approaches adopted to date identifies research falling largely into three broad categories:

- Individual and disciplinary-based approaches
- Organisation-based approaches
- Case study approaches

However, implications drawn from this research were already critiqued earlier in this chapter for lack of an overarching action framework for supporting innovation. Ramos-Vielba and Fernandez-Esquinas (2012) identified "methodological difficulties" with heterogeneous knowledge transfer. The review here indeed challenges the extent to which current approaches provide a meaningful, coherent view of heterogeneous knowledge transfer and associated issues.

The Individual and Disciplinary-Based Approaches

Individual identity as key for understanding varying participation in knowledge transfer has been suggested (Gibb et al. 2009) and pursued (e.g. Sharifi et al. 2014). Academics' identity in knowledge transfer may be a complex mix of factors including discipline (Boyd and Smith 2016). A focus on the individual and their identity assumes linkages between knowledge owned and valued by the academic and their engagement in knowledge transfer.

The merits of disciplinary-based approaches to understanding and capturing hidden innovation and issues of policy effectiveness are not clear. The seminal work of Biglan (1973) laid foundations for subsequent assumptions about the significance of disciplinary difference, leading to epistemic approaches to understanding the heterogeneous nature of academic behaviour in first and second academic activities: the different approaches to research and teaching suggested as related to discipline, for

example didactic/interactive and positivist/phenomenologically inflected (e.g. Fowler and Lee 2007). Disciplinary-based approaches to understanding the third activity of knowledge transfer have been pursued overtly and indirectly.

Links between discipline and approach to knowledge transfer have been noted. Firstly as evidenced by discontented voices from the HASS community (Fowler and Lee 2007; Smith and Taylor 2009) responding to a perceived mismatch of third stream policy for their discipline, and their inflection of policy (valuing softer, intangible skills and knowledge). Recent acknowledgement of the need for measurement of "no or low income driven outcomes or impact" suggests this sort of issue may still exist (HEFCE 2017). A disciplinary perspective exists also in the "hard" disciplines. HEFCE's (2011) call for research in newer areas (namely non-technological) also assumes merits of disciplinary-based approaches. Studies which investigate knowledge transfer activities within a specific discipline or sector (e.g. Benneworth and Jongbloed 2010; Amara et al. 2013; Boyd and Smith 2016; Thatcher et al. 2016) by implication suggest there is significance in relation to discipline. But their conclusions then remain only discipline-relevant.

Further, investigations into the significance of discipline for varying engagement in the third stream have been inconclusive. Pilbeam's (2006) quantitative study found no correlation between academic discipline and varying degrees of engagement in third stream activity. Perkmann and Walsh's (2007) review is inconclusive regarding disciplinary linkages. HEFCE's research likewise suggests little difference in disciplinary engagement (PACEC 2009).

Understanding heterogeneity in knowledge transfer framed by disciplinary conceptions seems questionable. Disciplinary differences may be one element in a more complex situated context. Whitchurch (2010), identifying academics as "blended professionals", implies disciplinary distinctions as less relevant. Categorising stakeholders as "academic", "not academic", or "hybrid academics" in itself provided no meaningful framework for policymakers trying to support the cross-boundary innovation work of this non-homogeneous group.

Organisation-Based Approaches

The organisation or institution as a meaningful unit of analysis is strong in policy and research. Two key UK policy mechanisms—the Higher Education Innovation Fund and the Knowledge Transfer Partnership scheme—are based on *institutional* resource allocation: high-performing HEIs and certain types/sizes of business. The assumption is that meaningful knowledge transfer and policy focus on the organisation. Lockett et al. (2012) identify the HEI rather than individual academics as their "micro" level of analysis.

An organisational focus underpins the seminal work of Clark (1998) linking the third stream to notions of "the entrepreneurial university". Nelles and Vorley (2010) specifically valorise the HEI/institution with assertions about the importance of developing HEI-tailored missions. Gibb et al. (2009), Sharifi et al. (2014), and Lockett et al. (2012) focus on organisational structure and leadership in the higher education sector as significant. Typologies of UK pre/post-1992 universities or research-/non-research-intensive HEIs (Van Vught 2009; Gibb et al. 2009) assume institutional difference to be significant.

However, such studies are not instructive for action. Indicative of this is the work of Nelles and Vorley urging HEIs to develop institutional third stream missions—anyone working on such a mission will testify that this is complicated largely because of the diverse multidisciplinary domains within most HEIs. Suggestions for flexibility in mechanisms supporting institutional knowledge transfer (e.g. Whitchurch 2010; Sharifi et al. 2014) do not define what such institutional policy looks like in practice.

In spite of HEI-funding structures and assertions of the role of HEIs in third stream success (Van Vught 2009; Nelles and Vorley 2010), and of SMEs in national innovation (e.g. Wynn et al. 2008), organisational factors are not unequivocally significant. Pilbeam's (2006) quantitative study found no correlation between type of institution and engagement in knowledge transfer. Gibb et al. (2009) suggest that physical and administrative structures are not as significant as other factors. Usefulness of institution-/organisation-based research is debatable.

Further, Agrawal (2001) exposed a tendency for research to focus on one organisational party: firm/university, recipient/creator. An acknowledged policy focus on the "supply side" of "academia", specifically HEIs (HEFCE 2008), exposed the need for more insight into the "demand-side". Research into industry perspectives does exist (e.g. Wynn et al. 2008); however, even the latest HEFCE review of the state of the UK Knowledge exchange landscape (PACEC 2017) focused entirely on HEIs and other supply side rather than demand side stakeholders. The most recent HE-BCI survey (HEFCE 2017) acknowledging the need for more insight into "collaborators" exposes the lack of a real understanding of demand-side (industry) focus. Problematically, conclusions about one stakeholder category may not apply to another. "Firm–firm interactions" are not necessarily relevant for "university–firm" interactions (Agrawal 2001). Insights from industry may not help support academia and vice versa.

Some research incorporates all organisational parties in the knowledge equation, but fails to conclude meaningfully for all. Whitchurch (2010) and Wersun (2010), interested in "publically orientated" and "community-based" academics engaged in "triple translation" of policy, focus conclusions on academic "institutional management" but not on managers in the "public/private space" (community/industry), potentially missing "quadruple" translation (hidden innovation?).

Studies drawing conclusions that focus empirically and conceptually on one organisational stakeholder are less helpful for policy needing to accommodate the heterogeneity of issues stemming from other/all parties involved. Research is necessarily bounded, but the question is what is meaningful for the heterogeneous area of knowledge transfer. Case studies have appeared to offer an approach to gain meaningful insight into multiple viewpoints inherently involved.

Case Study Approaches

Case studies arguably take a cross-stakeholder and/or cross-case perspective and thereby opportunities for overarching insights and frameworks for analysis and action. Using data from academics, associates, managers,

and industry partners in single or multiple projects could provide insight into all/multiple different perspectives in a knowledge case. Case studies have become popular (e.g. Edwards 2006; Wynn et al. 2008; Smith and Taylor 2009; Benneworth and Jongbloed 2010; Wersun 2010). UK policymakers use case studies to illustrate impact of funding and best practice (e.g. CIHE 2012).

Interrelated, individual, departmental, institutional, and regional factors may be significant in knowledge transfer (Urwin 2003; Ozga and Jones 2006; Pilbeam 2006; Fowler and Lee 2007; Geunia and Muscio 2009), and arguably justify case methodology. Case studies can focus on situated dimensions. Situation-specific factors arguably explain regional and cluster-based research (HEFCE 2017) and policy such as UK funding of Knowledge Transfer Networks (ktn-uk.co.uk) and EU funding of regional innovation hubs (Gibb et al. 2009).

Data from all parties in single or multiple knowledge transfer projects arguably encompass all perspectives of a knowledge partnership group. However, whether conclusions integrate all heterogeneity is questionable. Wynn et al. (2008) focuses findings and recommendations only on the issues for the SMEs (excluding those for the academic). Nelles and Vorley (2010) incorporate "students on placement" in their "inclusive" concept of HEI third stream missions, but ignore other stakeholders (e.g. the companies employing these placement students).

Some studies interview academic and industry partners (e.g. Edwards 2006; CIHE 2012), but take an overly integrative approach, failing to capture the heterogeneity within and across stakeholders. Here, methodology, analysis, presentation of findings, and conclusions avoid looking at differences between parties and variation in the partnership group. Rather, themes of commonality are presented. Perhaps heterogeneity problematizes attempts at synthesis and thus difference is ignored/considered not valuable—but thereby hidden innovation may not be captured. Assuming or focusing only on shared, integrated, and common perspectives of knowledge partners does not help develop policy that needs to accommodate heterogeneity.

Some case study research does capture diversity, commenting on common perspectives and "contradictions" or "tensions" between university and company partners (Streir and Shechter 2016). Wynn et al. (2008)

acknowledge issues of mismatching expectations between knowledge transfer partners and highlight issues of communication requiring management. But frameworks and conclusions presented underplay the problems by failing to explore deeply the different conceptions of stakeholders which may be valuable and meaningful.

No overarching framework of understanding or action for those trying to support innovation through knowledge transfer has yet resulted from case study research. Research at levels of the individual, discipline, organisation, or case study offers a range of insights into different issues and implications for different stakeholders but no overarching conclusions. Whilst heterogeneity has been confirmed, what is missing is an overarching action framework for those supporting innovation that incorporates heterogeneity in a coherent way.

From a Missing Approach to a New Approach

Beyond Heterogeneity

Many critics of third stream policy decry the one-size-fits-all approach—this arguably explains the adoption of disciplinary, organisation, or case study-based methodologies. There is need in policy and in research for an overarching approach that incorporates heterogeneity: accommodating newer areas involved in innovation without excluding older ones; supporting innovative SMEs but also corporates; catering for innovation imperatives of the new economy and of "society". In activities supported by policy, different stakeholders have to operate under the same framework; this in spite of, or more importantly in theory, incorporating differences between parties.

Discomfort with one-size-fits-all policy approaches resonates with those arguing for consideration of complexity in knowledge creation. Blackler (1995) noted the multidimensional nature of knowing, and argued for a more multilayered approach. Spender (2008) suggested developing typologies based on "action opportunities open to us" and managers' "morally burdened" experiences. This might validate approaches investigating the lived experience at the level of the

individual, organisation, and case. However, Spender argued further for recognition of knowledge as "held intersubjectively" by groups of people and hence acknowledging the interrelatedness of knowledge(s).

Some frameworks attempt to incorporate the realities of a complex interpretive landscape: Laredo (2007) suggested that each HEI may hold a "unique mix" of his "three functions"; Krucken et al. (2007) suggested their "ideal models" were able to be held "simultaneously". Systematic, multilevel stakeholder analysis (Benneworth and Jongbloed 2010) suggests perceived merit in a pluralist, multidisciplinary perspective.

However, research to date offers only an understanding that there is heterogeneity in conceptualisations (regarding types of activity, implications, typologies, and approaches), but does not show whether/how these may be understood as a web of connected, evolving, simultaneous, or hierarchical conceptualisations—and what this means for policy. We continue to be left with questions: how to define university knowledge transfer? which issues/opportunities are most significant? where to focus resource (individuals, organisations, clusters)? There is no overarching holistic framework of understanding for policy or for action incorporating this variation.

Previous work (Michels 2018) noted the value for the third stream agenda of notions from the partnership concept that acknowledges both common ground and difference, consensus and dissensus between stakeholders, and integration but also non-integration of knowledge. Further, attention was drawn to the value placed in management and enterprise disciplines specifically of difference—of creative abrasion for innovation—and in partnership working the resultant innovation as inherently and positively including both collaborative diversity and conflict (Carlile 2004). Variations of perspective integrating commonality and difference in a knowledge transfer relationship are inherent but also valuable for identifying hidden innovation (Michels 2018).

A New Approach: Variation as Inherent

Many studies of knowledge transfer have mirrored Godemann's (2008) conceptual assumption and focus on common, shared, and integrated

perspectives of knowledge partners and have dismissed the equal value of interpretive differences of the working group for insights into innovation. Edwards (2006) identifies the political nature of knowledge partnership working and partnership working as by necessity a single unit of analysis: "knowledge-sharing is expected to be achieved through a strategy that is based on mutual dependence where participants are effectively held hostage in a set of relations that rely on close co-operation" (p. 70). Rejecting "an essentialist view of partnership" Streir (2011) recognises "multiple tensions". But neither offers an all-inclusive framework for such "politically aware" practice or management.

Policymakers want to "understand better" hidden innovation, provide a framework for innovation, and need to strike a meaningful balance between something inclusive and easy-to-implement, accommodating the heterogeneity of stakeholders. Research has yet to adopt fully or to address the issue of variation, and leverage the web of commonality and difference as providing valuable insights for innovation, hidden innovation, or potential innovation in multiparty, cross-boundary university knowledge transfer. Research could better inform when framed conceptually by variation.

The approach needed here conceptualises participants as a collective group, with variation as assumed and inherent, and knowledge partners understood as likely to hold different and similar views—indeed irrespective of their identity/role as "industry" or "academic" or from a certain "sector" or "discipline" or size of "organisation" or type of "institution". An academic partner engaged in knowledge transfer may or may not share an appreciation of the value of commercial "outputs" as well as social or academic ones; an industry partner may or may not consider academic publications or social benefits as indicators of success as much as "commercialisation". Diversity can exist within one stakeholder group: for example institutional leaders, HEI tech transfer managers, or young research scientists may interpret the agenda of knowledge transfer differently from their peers holding shared but also distinct conceptions (Sharifi et al. 2014; Arzensek et al. 2014). Such variation is inherent in knowledge transfer—understanding and integrating this into research and policy is important.

The non-dualist approach suggested here allows for conceptualisation of more than simply two sides involved in the knowledge activity. A research approach which investigates how knowledge is understood differently (and similarly) by knowledge transfer participants—analysing the variation of all these knowledge parties as a group, a single unit of analysis has yet to be considered in knowledge transfer research.

Table 4.1 offers examples (both generic and UK-specific) to illustrate the focus of the approach suggested and to contextualise potential insights and implications. The point is that the unit of analysis is all participants in the mechanism: their collective interpretation and variation. So, for example, in contract research projects the unit of analysis is the collective group of industry clients, academics, research assistants, and so on and

Table 4.1 All-inclusive research incorporating variation: examples from UK HEI policy context

Knowledge transfer activity	Included in "partnership" unit of analysis	Focus of analysis
Industry-funded contract research	Industry client; academic; research assistant	Variation of perceptions of the partnership group: commonality and difference leading to all-inclusive framework of understanding and action
Bespoke executive education/CPD	Commissioning industry client; academic delivery team; recipients/ delegates	
University spin-outs	University tech transfer office; academics; spin-out team; investors; legal team	
Higher education innovation fund (HEIF) SME engagement vouchers	SME owner; academic; institutional KT manager; HEIF manager	
Knowledge transfer partnership scheme (KTPs)	Company partner; academic partner; associate; HEI manager; KTP regional adviser	
Industry-funded student work placement scheme	Employer; student; academic supervisor; university placement scheme manager	

their shared common ground and different perspectives about what is valuable and hence useful for identifying (hidden) innovation.

Conclusion and Way Forward: An All-Inclusive Approach

This review has identified "wide variation" in university knowledge transfer in terms of types of activity and stakeholder that challenges the ability of policy mechanisms and associated measurements to be universally effective. Knowledge transfer brings together academics, associates, and industry partners from arts through to science, from private through to not-for-profit sectors. There are by definition diverse knowledge partners who may hold both common and different conceptions, attitudes, expectations, and value judgements in relation to knowledge transfer, valid knowledge, and innovation. This may lead to different interpretation, implementation, translation, and inflection of policy. It points specifically towards an interpretive methodology that acknowledges variation of interpretation as appropriate.

Implications offered by current research have been critiqued for not providing an overarching, coherent, prioritised view of implementable implications for policy. Current research approaches do not inherently incorporate heterogeneity, intersubjectivity between partners, and variation in the knowledge transfer partnership group.

Studies to date note to a greater or lesser extent commonality and difference but what has not been investigated is what value might be discovered by understanding the shared difference, the variation of perspectives of the knowledge partners involved in a knowledge transfer activity. Existing research has yet to be framed methodologically by an understanding of diverse stakeholders working in a given knowledge transfer activity, as a heterogeneous group with commonality and difference as inherent.

A potentially relevant research methodology for enhancing understanding and new theoretical and practical insights in this domain is phenomenography and embodies a "broad speculation that variation of

perception is likely to exist" (Cousin 2009, p. 191). Limited thus far to research in education, phenomenography "assumes variation". Phenomenography goes beyond heterogeneity and adopts an understanding of the inherent value of non-dualism, of "a range of experience", and that respondents "who experience a situation in different ways may have different outcomes" (Micari et al. 2007, p. 461). As such it is conceptually appropriate for research aiming to be informative for those in knowledge transfer trying explicitly to understand and support heterogeneous engagement (including "local inflection") and innovation (including "hidden").

Phenomenography's second-order perspective reports practice and identifies what is experienced and valued by participants, but further attributes values to the "collective experience of variation in experience", with the unit of analysis being the "group". This directly aligns with research aiming to inform the understanding and practice of those who acknowledge the challenge of an all-inclusive policy mechanism (here knowledge transfer) aimed at a heterogeneous group (here knowledge transfer partners). The underlying assumption in phenomenography of not just a set of different meanings but "a logically inclusive structure relating the different meanings" (Åkerlind 2005, p. 323) offers possibilities for deeper understanding for those trying to engage in and support knowledge transfer through an "all-inclusive" policy.

Understanding the variation in perspectives of knowledge partners trying to operate within a given knowledge transfer activity offers potential to understand better (dis-)engagement, innovation, and hidden innovation, and hence provides important insights for research and policy. Further consideration should be given to the merits of phenomenography as a methodological framework for providing an all-inclusive approach in the heterogeneous domain of university knowledge transfer. The review of research and policy here focused on the UK context is expected to resonate and trigger reflection and research in other national contexts and thereby contribute to developing ongoing "better understanding" for all of us involved in this challenging, stimulating, and important area.

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5

Spin-Off Strategy and Technology Transfer Office: Cases in Sweden

Lars O. Jonsson

Introduction

An entrepreneurial university has to embrace many different activities at the interface between the traditional university and its surrounding society. In this chapter we will focus on spin-off strategies and technology transfer offices which are the instruments used when commercialization is believed to be the best way to utilize research results. We will use a previously published analysis of spin-off companies from Uppsala University in Sweden as an example (Jonsson et al. 2018). The example study shows that an active venture creation strategy can be a successful way for a university to contribute to the regional economy. However, it is important to bear in mind that these strategies are resource dependent and can also be risky. To become successful the university needs a strong base of research results of business relevance, funding to protect them, resources for business development as well as early seed investment

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money. Furthermore, the surrounding ecosystem such as small businesses and entrepreneurial culture should preferably have a high absorptive capacity for new high-tech products.

The example study identified a number of key success factors for any new university spin-out company: the recruitment of an experienced, external entrepreneur to the management team, the use of support offered by an independent business incubator and the entrepreneurial commitment of the founding researcher(s). We recommend that an innovation support organization should have a holistic approach assessing the driving forces and network capabilities of the inventor(s) as an important part of the invention as well as be able to support academic engagement in technology transfer through other channels such as collaborative projects.

The chapter is organized in the following way: first we start with a general description of commercialization of university research results and the establishment of technology transfer offices (TTOs). Thereafter, a short theoretical section describes two established models for the commercialization process followed by a short literature review and a description of Uppsala University and its regional prerequisites which forms the context of our example study. Following this, a short description of the methodology used in the example study will be presented and the findings of the analysis presented and discussed. In the final section some conclusions and recommendations are given together with some general considerations.

Commercialization of University Research Results

Currently, many policy makers focus on innovation and knowledge as driving forces for the so-called knowledge economy. This view puts a much higher demand on universities' role in boosting economic growth in both a national and a global context (Etzkowitz and Leydesdorff 2000; Bercovitz and Feldmann 2006) by being actively involved in the commercialization of new inventions which arise from different research

activities. The underlying belief is that since university research is often financed through governmental bodies, it should provide a payback in figures like patent applications, the creation of new start-ups, employment numbers and other indicators for economic growth (Balconi et al. 2010).

This aspiration became a trend in Western Europe at the end of the twentieth century very much using the US as an example. In 1980 the so-called Bayh-Dole Act, which gave the universities ownership of all research results funded with federal funds, became law. An effect of this legislation was that it gave universities a responsibility to work more actively with technology transfer (Mowery and Sampat 2005). Today, almost all universities in the US and Europe have a Technology Transfer Office (TTO) with the aim of supporting commercialization of codified research results. This can be done through licensing deals with existing companies, but it has also become popular to create new ventures through collaboration between the university and the inventing researcher(s), and in which both parts have a stake. These new ventures are generally defined as university spin-off companies (USOs).

The TTOs constitute an organization positioned at the border between the traditional university and non-faculty professionals like patent lawyers and business developers employed within the university (Clark 2003). TTOs can be either non-profit or for-profit oriented (Markman et al. 2005b). Whilst most TTOs focus upon supporting codified research results, these represent only a minority of the knowledge transferred to society from an entrepreneurial university (Cohen et al. 1998; Agrawal and Henderson 2002). Furthermore, the commercialization journey is not an easy one and only a minority of the inventions become successful. Studies from Ontario, Canada and the US have found that only 0.5 per cent to 0.6 per cent of the inventions not linked to an existing company became commercial successes and that only 16 per cent of the US TTOs were financially self-sustainable from income generated by the TTO (Åstebro 2003; McDevitt et al. 2014; Abrams et al. 2009).

It has been argued that a more holistic approach for TTOs would be a better way to create mutual benefits for all involved parties including the university itself and the researchers (Kelli et al. 2013; Jonsson et al. 2015a). This means that the TTO should not only focus upon patents

and codified results but also support the broader interaction channels of academic engagement (collaborative research, contract research, consulting, informal and formal meetings, etc.; see Perkmann et al. 2013). In order for this type of support to result in mutual benefits, four key elements seem to be important: (1) the alignment with selected goals and activities of the university; (2) the recruitment strategy with innovation support officers possessing both academic and business development knowledge and experience; (3) building trust among all stakeholders and (4) the introduction of specific tools to enhance the effects of academia-industry interactive activities (Jonsson et al. 2015a, 2015b).

The underlying reasons for a university to be involved in technology transfer should not be purely economic. One reason for this is the difficulty for university TTOs to generate enough income to be self-sustainable as has already been discussed. Another reason is that focusing too much on profitability may lead to many new ideas in fields with less commercial activity being ignored, even if they may result in high value for society. The TTOs may then become bottlenecks instead of facilitators (Litan et al. 2007). At Uppsala University, the reason to be involved in industrial collaboration and commercialization has been based upon the belief that this interchange of ideas and experiences will be of mutual interest and generate value not only to society but also to the university and to the researchers involved. These values might be new knowledge or new insights that can be used in both educational and research situations as well as an increased prestige that adds to the attractiveness of the university in the eyes of research funders, academic partners as well as potential students and future employees. According to an analysis made, many of these beliefs also seems to have been fulfilled (Jonsson et al. 2015a).

Theoretical Framework

The linear process of taking an invention from idea to innovation has been described by Clarysse et al. (2005) as the commercialization funnel, where a new idea enters the funnel at one end and is scrutinized in a development and verification process as it moves forward. Most of the new ideas drop out in the process and only a few emerge as a commercial

success at the other end of the funnel. In reality, though, the commercialization process is not linear, but goes through iterative loops, interacting between academia, established companies, producers and customers before becoming a valuable innovation (Jonsson et al. 2015b).

In an analysis of the creation and development of USOs from British universities, Vohora et al. (2004) developed a generic model of five distinct phases for USOs. These phases start from research, opportunity framing, preorganization, reorganization and end with the final phase of sustainable returns. To move from the first to the second phase, the venture has to pass the critical junction of opportunity recognition. Transition from phase 2 to 3 demands passing the junction of entrepreneurial commitment, and to proceed from phase 3 to phase 4, the threshold of credibility must be passed. To reach the final development stage of sustainable returns, the new venture has to pass the threshold of sustainability. Compared to the commercialization funnel model (Clarysse et al. 2005), the generic model of Vohora et al. (2004) captures extended interactions within each of the phases, illustrating that new research results can reveal new opportunities to frame, and that new information often leads to several loops of re-orientation before final commercialization.

Literature Review

A review of the existing literature reveals some factors that have been found to affect the outcome of a commercialization journey such as the experiences of the entrepreneurs, the role of the university and the importance of network capabilities. According to Clarysse et al. (2011), the individual-level attributes and experiences are the most important predictors of academic entrepreneurship. Erikson (2002) argues that the entrepreneurial capital, defined as a multiplicative function of entrepreneurial competence and commitment, is the new venture's most important asset. Colombo and Piva (2012) argue that academic high-tech start-ups exhibit peculiar 'genetic characteristics' that leave an enduring imprint on the company's development in such a way that the business strategy chosen often prioritizes further improvement of technological and scientific competencies instead of being more business-oriented.

Olofsson et al. (2008) found three separate types of behaviour among academics involved in commercialization. One group continued to focus on their academic research without any, or only little, interaction with the spun-out venture which had resulted from their research. Another group left the university and focused full-time on the new venture created while a third group applied a hybrid model where they combined academic research with a high degree of involvement in the spun-out venture. This is in line with the findings by Nicolaou and Birley (2003) and the study of Jain et al. (2009) who found that US researchers took active steps to preserve their academic identity even when participating in technology transfer activities either by a delegating or by a buffering behaviour. While delegating means that the researcher establishes interfaces with external actors who themselves take on many of the business activities, buffering behaviour means that the researcher always prioritizes academic research activities and will take care of the commercialization issues when, and if, time permits. Walter et al. (2006) and Mosey and Wright (2007) found entrepreneurial commitment of the academic inventor/founder and his or her active engagement in the commercialization process to be important. Furthermore, Radosevich (1995) found the role of an external entrepreneur with business experience who collaborates with the academic inventor(s) and becomes the principal driver of the new venture beneficial. He termed this person 'surrogate entrepreneur'. Later publications have confirmed these findings (Franklin et al. 2001; Lockett et al. 2003; Lundqvist 2014).

Many studies have emphasized the goals and function of university TTOs and incentive policies as important factors to stimulate academic entrepreneurship (see, for example, Markman et al. 2005a; Litan et al. 2007; Powell et al. 2007; Abrams et al. 2009; Fini et al. 2011; Meissner and Shmatko 2017). Rasmussen and Borch (2010) argue that a university's capability to support the formation and development of USOs is based on many levels, both within and outside the university organization, and find in their study that the TTOs played a modest role compared to the researcher's own network. Sternberg (2014) states that the regional context in which an individual starts a new venture has an impact on the start-up's success, which is also in line with the findings of Fini et al. (2011). Gilsing et al. (2010) argue that university polices regarding

commercialization can serve either the creation of USOs, as in the Eindhoven region, or the future success of the created USOs, as in the Leuven region. On the other hand, Berbegal-Mirabent et al. (2015), in a study of 63 Spanish universities, did not find a unique combination of antecedent conditions that yielded university spin-offs.

Soetanto and Jack (2016) argue that business incubation in the form of networking and entrepreneurial support has a positive effect on the performance of spin-offs. Mosey and Wright (2007) find that experienced academic entrepreneurs have a broader and more active network compared to the novices and that they were more effective in developing new contacts. They also conclude that business ownership experience appears essential to learn to build relationships with experienced managers and potential equity investors. The importance of the capabilities of the inventor(s) to use and develop a suitable network to find complementary skills and competences needed to overcome hindrances in the development of the USO has also been highlighted by many others (see, for instance, Vohora et al. 2004; Murray 2004; Clarysse and Moray 2004; Walter et al. 2006; Lockett et al. 2003; O'Gorman et al. 2008; Baraldi et al. 2018). The ability to utilize the network in which the new venture is created was also found to be a determinant for the venture's survival in a recently published statistical analysis of 870 UK spin-off companies (Prokop et al. 2019). This study found that the investors, the external entrepreneurs and the TTOs were the three core university network players on which the USOs' survival was dependent.

Uppsala University and Its Context

Uppsala University is situated in the city of Uppsala, 60 km north of Stockholm, in Sweden. It is an old, comprehensive university founded in 1477 and like the vast majority of the Swedish universities it is organized as a state agency. Today, the university has more than 40,000 students, a turnover of more than 7 billion SEK (equal to about 750 million U$) of which 70 per cent is used for research and the education of PhD students. It has a long tradition of utilization of knowledge and research results done very much on an ad hoc basis dependent on the driving forces of

the individual researcher(s) with only a passive support from the university's management. Since Sweden has had, and still has, a professor's privilege as part of its legislation, all research results belong to the researcher(s) and it is always up to him or her to decide if and how they should be commercialized. The university, being a state agency, is even forbidden by law to incur a business risk without the specific approval by the Swedish parliament for each individual case.

In the 1990s, the Swedish economy went through a serious crisis. One of the government's actions to solve the situation was to enforce a more structured commercialization support at the Swedish universities and to circumvent the legal hindrances for the universities to be actively involved. As a result, holding companies, one of them being Uppsala University Holding (UUH), were linked to each of the research-intensive universities with the mission to invest in patent applications and venture creations based upon the university's activities. The control of UUH was handed over from the government to the University in 1998 and the company has since been acting as an entrepreneurial tool for the university management whilst remaining formally at an arm's length distance and with a separate economy.

The primary role of UUH is to make very early seed investments ranging from 10,000 U$ up to 50,000 U$ at the start of new USOs. Because of the author's privilege, this is done through legal agreements with the inventor(s) whereby UUH receives a 5–15 per cent stake in the new venture in return for its investment. Normally, UUH also takes part in the first and maybe second round of investment in the new venture and the total amount invested over time normally ends up between 100,000 U$ and 300,000 U$ before an exit is possible. The aim is to make profitable exits as soon as possible without speculating in a possible future share value increase. Any profit yielded is used to cover the running costs of UUH (about 700,000 U$ per year) and for investments in new ventures. No dividends are to be given to the University or the government.

In total, UUH has, or has had, stakes in 94 ventures from its start in 1995 to the end of 2018 of which more than 70 per cent have been USOs. The remaining 30 per cent were stakes in different support companies linked to the innovation support system of the University together

with some shares in established companies given as currency in mergers and acquisitions for some USOs.

According to the official annual reports from all the companies created with the assistance of UUH, together they employed more than 450 employees (see Fig. 5.1) and had a total turnover of about 75 million U$ by December 2017. The total value of the created companies was more than 1.5 billion U$ in June 2018 based upon the latest available share prices (own elaboration based upon downloads of the company's audited annual records from the Swedish Companies Registration Office). The start-ups from Uppsala University thus contributed substantially to the regional economy. At the same time, the equity of UUH has increased from the approximately 1 million U$ given at the start by the government, to more than 10 million U$ at the end of year 2018. This increase was primarily driven by seven very successful exits together with a number of smaller but profitable exits. During the same time period, UUH invested almost 12 million U$ as seed capital in new ventures or about 600,000 U$ per year. These investments act as a 'start-engine' and a

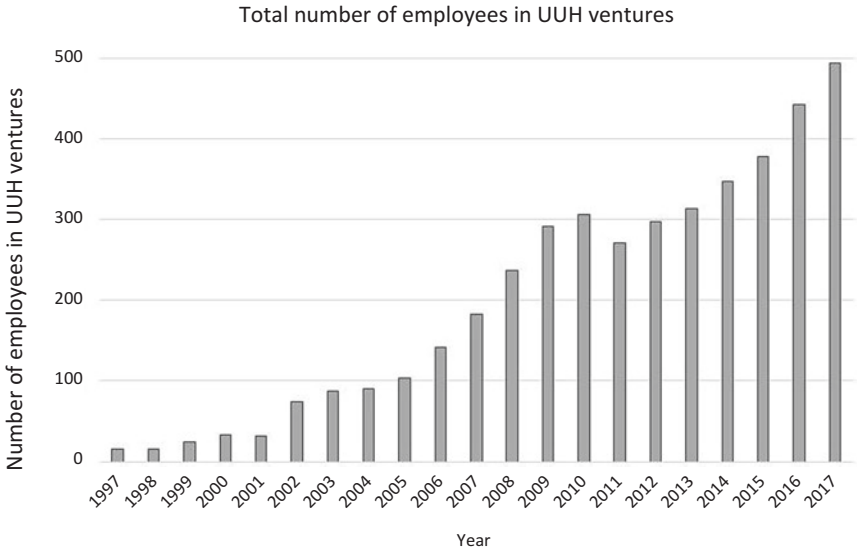

Fig. 5.1 The total number of employees at the end of December each year in those companies where UUH have or have had a stake (author's compilation)

leverage for the new companies which attracted more than 100 million U$ in external private investments during the financial year 2017 (UU Holding 2018).

Today, there are 17 university holding companies in Sweden but so far only the holding companies which are linked to the two major research universities in Lund and Uppsala together with the holding company at Chalmers University of Technology have reached substantial and sustainable returns from their investment activities. This is in line with the US experiences (Abrams et al. 2009). The majority of the Swedish university holding companies serve mainly as executors of different university services such as running the university's innovation offices financed by earmarked annual contributions from the government and have the seed investment strategy more or less as a subordinate task due to the lack of available capital. The university innovation offices financed by the government can support the researchers with patent and business advice. They also provide a conduit through which some 'soft' project money from the innovation support agency Vinnova (up to about 25,000 U$ per case) is channelled and which can be used to verify specific aspects of the business idea prior to eventually forming a USO.

At Uppsala University, the innovation office was initiated based on the needs seen by UUH, but has been run as an entity within the university from its start in 2007 reporting directly to the vice-chancellor. In addition to business support for researchers, its resources are also used to initiate and manage collaborative national and international research programmes with existing companies. Today the innovation office at Uppsala University has about 30 employees, of which 7 are patent lawyers. The office is financed roughly in three equal parts by the governmental earmarked money, by the budgets of the university and its faculties and by external financing obtained for specific projects. UUH, being a separate organization, employs only a CEO, an investment manager and a CFO (50%), all financed by the accumulated profit from operations of the company and a yearly governmental contribution of about 105,000 U$.

Today, there is a network of actors associated with the entrepreneurial activities at Uppsala University including organized and non-organized private investors. Because of the professor's privilege, UUH has no

monopoly and must compete with the private actors by showing the researchers an added value of having UUH as part of a venture creation. In most cases, UUH syndicates investments with at least one of the private actors to make up an owner team supporting the new venture and some of these private investors also act as a surrogate entrepreneur in the management team of the new company or as a very active board director from time to time. Since Uppsala is part of the Stockholm business area, which is ranked as a top innovative region in Europe, the innovation support system also has good connections to highly innovative companies with a substantial absorptive capacity for new ideas in fields like medicine, biotechnology, material technology and ICT.

Analysed Material and Research Methods in the Example Study

When defining a USO some researchers focus on the founders' connection to a university while others focus on whether any inventions or research results are transferred from a university to the new firm. The majority of the USOs in the example study transferred new codified research results such as patent(s), in combination with having an academic researcher and/or PhD students as part of the founding team. New ventures formed by students on the master's level were also assessed as USOs and included in the study as long as those companies were vehicles for codified results from the founders' university studies or acquired methodology from the University. Out of a total of 1188 disclosures during the period 1998–2016, 82 new ventures were created with the assistance of UUH and, of those, 50 companies were considered to be USOs and mature enough to be analysed. Out of the analysed USOs, 88 per cent transferred codified knowledge. The research method applied in the example study was a qualitative case study (Yin 2003) based on an 'action research' design (Levin and Greenwood 2001; Blake 2007). The authors had been involved in the creation of the USOs studied and had followed their operations closely on a regular schedule during their entire development.

Factors that might have contributed to a successful commercialization were assessed based upon the following criteria: (1) *entrepreneurial commitment* was defined to be fulfilled if at least one of the inventors was part-time or full-time employed by the USO or heavily engaged in the commercialization of the invention in a similar way; (2) the use of a *business incubator* was defined to be fulfilled if the USO had been included in the business acceleration programme of the university-linked business incubator and (3) the use of an external *surrogate entrepreneur* in the management team was defined to be fulfilled if a person not employed within academia but with business development experience was engaged by the inventor(s) at the foundation of the USO or soon after.

When the development of businesses is studied, the grade of success is often measured by calculating the growth rates in sales, the number of employees or the net profit during a specific time period. However, since most USOs will not have a product to launch from start and often have irregular and small sales during the first three to five or even ten years of operations, their development must be measured by other means. Some use only survival rate (Olofsson et al. 2008; van Geenhüizen and Soetanto 2009; Prokop et al. 2019), which has the disadvantage of making dormant companies or lifestyle and hobby companies look like commercial successes. In the example study, the perspective of a TTO was deliberately chosen whose aim is to support the growth of sustainable businesses and thus add value to the regional economy. Therefore, an assessment method based upon the companies' official annual reports was constructed. Five categories were chosen: (1) sales, (2) profitability, (3) number of full-time employees, (4) calculated valuation of the company as of 31 December 2016 and (5) financial attractiveness. In each category, the companies were graded on a six-point grade from 0 to 5 points.

All points from the five categories were added together to arrive at a total *Commercialization Assessment Points* (*CAP)*. Companies that reached at least 13 CAP out of the maximum 25 were regarded as a success. Also, companies not reaching this cut-off limit could be regarded as a success if they had been listed on an established stock market through a successful initial public offer (IPO) or had been acquired by an established company on a valuation which gave the initial founders a substantial profit. For obvious reasons, companies that had gone bankrupt during the

studied time period were considered failures as were companies which had been liquidated or were undergoing liquidation. Additionally, companies that had struggled for at least five years with little or no operating income and insufficient capital investments from existing and/or new owners were also considered to have failed. For more details regarding the assessment method, see Jonsson et al. (2018).

Findings and Discussion

The overall survival rate in the study of the Uppsala USOs was 80 per cent, which is comparable with a similar study of 870 USOs in the UK where the survival rate was found to be 83 per cent (Prokop et al. 2019). Out of the 50 companies analysed, 6 companies qualified to achieve the cut-off level of success in the CAP assessment of which 3 were considered to have reached the final development phase of sustainable returns in the model by Vohora et al. (2004). An additional five companies were considered successful since they had managed to have a successful IPO and another four because they were acquired by existing companies before their business had become profitable. Thus, in total 15 ventures or 30 per cent of the total number of USOs analysed were assessed to have been successfully commercialized while 14 were considered failures. The remaining 21 USOs were assessed as still struggling. The mean time for the successful USOs to reach their success was 8.5 years, thus stressing the importance of taking a 'long view' when dealing with commercialization of research results.

Three beneficial key factors for a successful commercialization were identified in the example study: (1) entrepreneurial commitment, (2) surrogate entrepreneur and (3) business incubation. Below, these key factors are elaborated in more detail.

Entrepreneurial Commitment Fourteen out of 15 companies grouped as successful cases or 93 per cent fulfilled the criteria of having a strong entrepreneurial commitment in the group of research founders compared to only 6 out of 15 or 43 per cent in the failing group. If none of the academic inventors have a real entrepreneurial commitment, the

commercialization process will be very difficult, regardless of how good the invention may be. One reason for this is that commercializing high-tech inventions requires both codified and tacit knowledge. The codified knowledge, for instance, a patent application, can be taken on by a surrogate entrepreneur or a TTO officer and marketed, but without the tacit knowledge resting in the inventor(s) it will be very difficult to create any substantial commercial value. A new USO based upon high-level research will also encounter many technological hurdles during its commercialization and must rely on good technical support from the originating institution and its facilities. Having a committed researcher on board will make the relationship to, and the knowledge of, the source of the technology strong and technical support easier to acquire.

Surrogate Entrepreneur The successful USOs had a surrogate entrepreneur on board almost six times more often than the failed USOs. This is very much in line with studies showing the benefits of engaging an experienced business person from outside academia to partner with the academic inventor(s) and become the primary driver of the commercialization process (Radosevich 1995; Franklin et al. 2001; Lockett et al. 2003; Lundqvist 2014). It is notable that in all six successful cases in the example study having a surrogate entrepreneur on board, there was also a high entrepreneurial commitment from at least one researcher inventor.

According to Radosevich (1995), there are nine key variables to be controlled in a new university spin-out. Four of them are technology and science related (technology know-how, technology commitment, relationship to the source of technology and reliance on technical assistance from the source of technology) and these are best captured by an entrepreneurial committed founder from the research team behind the USO. On the other hand, five of the nine key variables described by Radosevich are more business related (previous entrepreneurial experience, reliance on business infrastructure support, access to sophisticated venture capital, managerial functional focus and a low degree of entrepreneurial hurdles) and these are best covered by an experienced external entrepreneur. Generally, no single person will be able to manage all nine key variables needed, and thus the combination of an entrepreneur and a research inventor is normally required.

Business Incubation In the Uppsala study, the successful USOs were found to have fulfilled the criteria of business incubation 3.4 times more often than the USOs in the failing group. Being part of the business incubation programme given by the business incubator linked to Uppsala University means that the USO is given an experienced business coach with complementary skills and experiences who commits one day per week to support the development of the new company. This means that by entering the incubation programme the USO will get access not only to the founding team's network and the existing network of the surrogate entrepreneur, but also to the existing network of the incubator coach. Furthermore, mandatory seminars given by the incubator are designed to enlarge the network of the incubated ventures. According to the results in the study by Mosey and Wright (2007), both the surrogate entrepreneur and the incubator coach, having experiences in business exploration, will probably be more effective in developing and making use of the USOs' network compared to the founding researchers. As mentioned in the literature review section above, access to a relevant network and the ability to use this network have been found to be crucial for a USO (Lockett et al. 2003, Clarysse and Moray 2004; Vohora et al. 2004; Walter et al. 2006; Mosey and Wright 2007; O'Gorman et al. 2008; Soetanto and Jack 2016; Prokop et al. 2019).

In the Uppsala study, no significant beneficial effects of the engagement of the TTO office in the business development phase of the USOs were identified. This is in line with the findings by Bathelt et al. (2010) as well as the findings of Rasmussen and Borch (2010) that state that the impact of the university is crucial for the new venture to occur, but modest in the further entrepreneurial process. To some extent, these findings seem to be contradictory to the conclusion by Prokop et al. (2019) who state that the TTO is one of three core university network actors for a new USO. However, that study was a statistical study designed in a totally different way. Since UUH has been able to reach financial sustainability from profitable exits, it can be compared to the top 16 per cent of US TTOs. Furthermore, the survival rate of the USOs in the Uppsala study was well in line with that found in the study of Prokop et al. (2019).

An interesting finding in the study from Uppsala was that 23 of the 50 analysed USOs, or 46 per cent, were still navigating through, or had failed to manage, the critical junction between the development phase 3 and 4 in the model by Vohora et al. (2004), which is described as the threshold of credibility. This is in agreement with findings in previous studies showing that one of the most challenging phases in a new venture's development is the process of becoming embedded into an existing business network where they have to compete with already proven solutions and existing investments in infrastructure (Baraldi et al. 2018). Another side finding in the study from Uppsala was that 67 per cent of the USOs founded during the period 2011–2016 had at least one female founder compared to less than 7 per cent during the period 1998–2004. It has been noted that commercialization of university research and innovation businesses has a strong male dominance (Prokop et al. 2019; Sugimoto et al. 2015) but the figures found in the Uppsala study seem encouraging and may give some hope that new venture creation in academia might be shifting in the direction of more gender equality.

Conclusions, Recommendations and Considerations

Venture creation by spinning off new companies based upon research findings is a powerful instrument to boost the local economy. However, patenting and venture creation will always be quite a narrow channel of knowledge transfer from a university to society and will never engage the vast majority of academics even in research-intensive entrepreneurial universities. Furthermore, an active involvement in the creation of new ventures based upon research will always be risky. For the vast majority of universities, it will cost more money than can be realized from successful exits especially if the running cost of the TTO is included. At the same time, such a strategy may result in a considerable contribution to the regional economy in the long term, as seen from our example study, and will most probably also contribute to many benefits to the university as well. Even if the universities frequently do not get any direct monetary

payback from actively supporting spin-off ventures, the spin-offs most often remain connected to their originating institutions and may act as hosts and sources for master's and doctoral studies as well as contribute to the research and educational missions of the university. If the spin-out ventures become successful, they will be able to absorb many highly educated students who remain in close connection with the university after their exams. Successful spin-out companies will also positively impact the reputation of the university in the eyes of policy makers and research funders, which may result in improved funding opportunities.

The money spent by the university in supporting venture creation should thus be regarded as a long-term investment which helps to create mutual values for the university, its researchers and society. However, the university's financial risk must be controlled carefully, and the money invested should only be a small amount of the available resources and used in such a way that they create a leverage for the ventures created. If those activities are placed in a separate organization controlled by the university management and using a separate budget, as is the case at Uppsala University, this can be achieved. In Uppsala, the operations of UUH consume a little more than 1 million U$ annually including running costs and investment money in USOs, which should be compared to the total budget of the University of about 750 million U$ per year. If the university's own cost for its internal innovation office is included, the total annual TTO cost burden for Uppsala University increases to about 3 million U$, which is still only about 0.4 per cent of the total university budget (own elaboration).

Policy and Managerial Implications

Innovation support is a very context-dependent area both in society as such and in a specific university. However, some more general conclusions from the existing research literature and the results from our example study can be drawn. On a policy level, it seems wise to underline the importance to see the specific disclosure and the inventor as a package which need to be assessed as a whole to determine if further support is warranted. Our experience is that even highly potential disclosures will

probably fail in the commercialization process if the inventor(s) do not have enough entrepreneurial commitment and capability to make use of a supporting network. One of the most important missions of a TTO office or a business incubator in an academic environment should also be to make sure that a network of as many different resources as possible are linked to the support organizations and can be offered to the inventor. These networks are always living bodies and should be renewed and expanded whenever possible. There are assessment instruments regarding the business potential of a disclosure, such as, for instance, the Business Canvass method from the University of California at Berkeley and the NABC approach developed by SRI at Stanford. However, it is often more difficult to assess the driving forces and the capabilities of the inventor to cooperate and make use of a network. The working processes of the TTO and the business incubator should therefore be organized in ways such that the entrepreneurial commitment and the willingness and capability of the inventor(s) to make use of networks can be assessed in addition to the technical and business opportunities of the invention.

Another policy recommendation is to support processes which will make the academics and master's students more aware of what is required to commercialize a high-level invention and run a business. This can be done through entrepreneurial courses offered on a voluntary basis or through mandatory programmes. At Uppsala University there is a one-year entrepreneurial school which is an option which can replace the final year studies in a master's programme. There are also shorter courses linked to different PhD programmes and open seminars to established researchers. A very successful initiative used in Uppsala is the Mentor for Research programme, originally initiated by the Royal Swedish Academy for Engineering Sciences. In this programme, researchers and PhD students can apply to get an experienced business mentor even without having a specific invention. Several of the more recent spin-out companies founded at the University have their origins from discussions in this programme and have both the 'adept' and the mentor among their founders.

It is also important that the university management identify and proudly promote role models within the university and use them as sources of inspiration both in research and in education. One of the success factors behind the results in the example study from Uppsala has

been continuous robust support from the different vice-chancellors that have been in charge of the University during the 19 years covered by the study. Based on the experiences from Uppsala University it is also recommended that the university managers have a holistic perspective when managing the technology transfer processes. At Uppsala University the broader interactive channels of academic engagement have been given professional support by the TTO during the last ten years, which has created mutual benefits for external organizations, society and the university itself as well as its faculties (Jonsson et al. 2015a). Benefits to the university include additional research funding awarded for collaborative research and educational projects with partners from industrial and business as well as other international universities. According to a recently published study by Datta and Souleh (2018), such a holistic approach seems especially important for universities in resource-constrained environments since they often lack the explicit knowledge which results from resource-intensive research and which can form the base of a successful spin-out company. Nevertheless, these universities can still play an important role in the economic development of the surrounding societies by leveraging their human capital and knowledge assimilation as well as their dissemination capabilities.

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Part III

Micro Level: Manifestation of the Entrepreneurial University—Case Studies

6

Entrepreneurial Universities: A Case Study of the Pan Atlantic University, Lagos, Nigeria

Peter Bamkole and Stanley Ibeku

Introduction

Entrepreneurship is considered as a strong factor for employment creation, economic growth and competitiveness in global economies (Dalmarco et al. 2018) and the trend has seen the implementation of a set of strategies which translates to a more fertile entrepreneurial environment (Bikse et al. 2013). A key aspect of this development is the changing roles of universities which have seen the emergence of a trend of universities adopting a robust and more direct role in stimulating entrepreneurship in countries (Guerrero et al. 2016). With the rise of emerging economies, it is also becoming extremely important that both the context and the condition of innovation development and the increasing role of universities as an agent of innovation development and entrepreneurship in those countries be taken into consideration (Klofsten et al. 2019; Williams and Kluev 2014).

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These developments have led to the concept of entrepreneurial universities to incorporate economic and other societal considerations into the conventional mandates of universities. Similarly, in developed economies, governments encourage universities to become more innovative in their approaches as well as become entrepreneurial (Williams and Kluev 2014), leading to the emergence of the entrepreneurial university where, among other things, multiple programmes and policies are put in place to ensure that the knowledge generated translates to tangible economic development (Jessop 2017). The role of the university is important to the growth of entrepreneurial intentions especially among staff and students, and an individual's decision in favour of or against becoming an entrepreneur depends on the context and practices obtainable and provided by the university (Hayter 2016).

The entrepreneurial university has been conceptualized to include among others, innovation, notions of enterprise, commercialization, employability and new venture creation (Bikse et al. 2013). It can also reflect governance structures, organizational leadership and an organizational response to external pressures and challenges (Hannon 2013). Over the last two decades a new type of entrepreneurial, innovative university has emerged in some countries (Brown 2016). These universities have included the third mission which entails playing a more active role in regional and national economic transformation and development by not only generating and transmitting new knowledge but also generating new innovative businesses ideas and solutions (Williams and Kluev 2014). According to the authors, these initiatives enhance university research and entrepreneurship capacity, making them centres for regional innovation development through more effective technology transfer and production of graduates for the knowledge economy.

The notion of an entrepreneurial university is a university that creates an enabling environment, within which the development of entrepreneurial behaviour and mindsets are encouraged, embedded, supported and subsequently become accepted in economies and institutions with different traditions (Hannon 2013; Brown 2016). The focus towards an entrepreneurial university is majorly in strategic thinking at the top level of university administration as entrepreneurship is embedded in the university mission as well as in the internal university practices (Guerrero

et al. 2016). The major considerations in incorporating entrepreneurship into the universities' development strategy are the mission; the degree of concern for the relevance of its research output; its recognition of its role in, and level of commitment to, addressing the problems of society; the strength of its associated commitment to knowledge transfer and exchange; the related commitment to business development and more .recently its focus upon graduate employability (Gibb 2012).

While entrepreneurial universities have a mandate to facilitate the commercialization of university research and generate new ventures and start-ups, the role of the university in the entrepreneurial society is considerably more fundamental and broader—to provide leadership, thinking and activity to improve entrepreneurship capital (Dalmarco et al. 2018). The goal of entrepreneurial universities goes beyond the promotion of technology transfer and increase in the number of new ventures or start-ups but to ensure that individuals thrive in the emerging entrepreneurial society (Audretsch 2012). The rationale for entrepreneurial universities' education is the provision of training and support for students and staff alike in their entrepreneurship careers, with a focus on managing independence and developing the capacity for expansion in high-impact business areas (Williams and Kluev 2014).

Also, an entrepreneurial university can provide new alternatives to the university community and the society, which basically identifies entrepreneurial choices and opportunities (Guerrero and Urbano 2012). Apart from entrepreneurial universities taking entrepreneurial responses towards addressing the challenges and pressures of society, they are also aligning with the environment, turning to institutions that inculcate entrepreneurial thinking through managerial policies, governance structures and practices (Hannon 2013). This is because a key assumption underlying most entrepreneurship and innovation policies especially for developing countries is that universities are important entrepreneurial actors (Audretsch 2012; Siegel and Wright 2015) which must be supported to spur entrepreneurship. During the last decade, some universities also began investing heavily in entrepreneurship training/programmes (Brown 2016), venture capital funds, entrepreneurship clubs and business angel syndicates (Klofsten et al. 2019).

Entrepreneurship education programmes are an important mechanism to promote the entrepreneurial mindset and culture in the university community since they help to improve skills, abilities, behaviour, attributes and knowledge relevant to innovation and entrepreneurship (Fayolle and Redford 2014). Extant literature recognizes universities' roles on innovation by important channels including the development of spin-off firms, patents and licences but also by the strong indirect relationship such as supplier of knowledge through trained graduates, consulting and publications (Salamzadeh 2015). Therefore, entrepreneurial universities usually facilitate entrepreneurial-driven economic growth through institutional contexts which are conducive to entrepreneurial activities (Guerrero et al. 2015). Entrepreneurship education in universities may provide relevant training and support as critical factors in developing positive perceptions and mindsets of competence for both staff and students. Brown (2016) suggests that entrepreneurship training should help improve students' perceptions of the feasibility of entrepreneurial activities by increasing their knowledge, building their confidence and promoting self-efficacy.

Extant literature on entrepreneurial universities provides insights on the entrepreneurial transformation process of universities especially in developed economies. This chapter aims at contributing to a better understanding of the entrepreneurial transformation process of Pan Atlantic University, Lagos, Nigeria. The university is an illustrative case of an entrepreneurial university especially from a developing country. Attempt is made at describing the factors and processes aiding the entrepreneurial journey. Adopting entrepreneurial universities' theoretical models including resource based view and institutional economics which emphasize the institutional factors and resources needed for entrepreneurial activities, the chapter also provides insights on the practices that can stimulate the entrepreneurial activity of universities in developing economies and thus foster innovation and competitiveness. It also examines the extent to which the university has adopted an entrepreneurial mission in its strategic development.

Literature Review

Entrepreneurial university has gained considerable attention from policymakers, academics and other stakeholders especially with the growing need for universities to accommodate emerging economic challenges in the society. Hence, extant literature and empirical studies on entrepreneurial universities provide an understanding on the transformation process, technology transfer as well as the outcomes of entrepreneurial universities especially in developed countries (Klofsten et al. 2019; Guerrero and Urbano 2012). The literature covers a range of areas relating to the model and configuration of a typical entrepreneurial university and this is from formulating or reformulating the mission and strategy of the university to realigning the university with challenges that might be external (Bikse et al. 2013). This also requires that entrepreneurship education be embedded in the university curricula and the required infrastructure to support both staff and student/graduate entrepreneurship be sustained.

Williams and Kluev (2014) remark that for a university to be considered entrepreneurial, the university must incorporate entrepreneurship in all aspects of its dealings, from its leadership/governance through to its teaching, learning and also student impact. By implication, the university would need to demonstrate excellence in strong leadership across the levels, innovative resource persons and a tangible, clear impact on staff, strong engagement with students in a variety of learning opportunities, business and local community. The university also needs to demonstrate a strong commitment of tertiary education institutions to engaging in entrepreneurship, which could lead to the development of the economy (Hannon 2013; Fayolle and Redford 2014). This discourse on entrepreneurial presents a practical challenge to university stakeholders in transforming their institutions to a more entrepreneurial one (Williams and Kluev 2014).

A typical entrepreneurial university functions as a knowledge producer and also as a disseminating organization to society and, by adopting a defined strategy across important activities (including teaching and research), tries to provide a conducive atmosphere which enables the

university community including academics, staff and students to explore, evaluate and also exploit ideas that could translate to social and economic entrepreneurial opportunities/initiatives (Fuller et al. 2019). Entrepreneurial universities usually engage in a range of relationships and networks, with both private and public organizations, and this serves as avenues for cooperation and collaboration (Inzelt 2004). According to Inzelt, the interactions are manifestations and also critical elements of the university's strategic responses to the entrepreneurial challenges (Guerrero et al. 2015). In addressing the challenges, universities incorporate continuing entrepreneurship training/education programmes, collaboration strategies and exchange programmes between university and the industry.

In recent times, the role of universities is facing changes especially in the expansion of their tasks, leading to the idea of entrepreneurial universities, creating business incubators for the academic community. The conventional university is involved in two major activities including teaching and research, but a new thinking to the role of universities envisages a major shift from their traditional approach to another task: the commercialization of new knowledge for economic development (Jessop 2017) in the form of entrepreneurship. Entrepreneurial universities have realized that a big challenge of the university system is to create favourable conditions that would enable young people to create jobs themselves, thus preparing them for the evolving business practices (Bikse et al. 2013). This also requires re-orienting the education process towards entrepreneurship education, involving students in new modules such as university-based business incubator activities and encouraging them to become entrepreneurs, thereby contributing to job creation, personal development and sustainable economic development (Bikse et al. 2013).

Similarly, economic and social realities have made some universities transform from the traditional teaching and research universities to entrepreneurial universities (Guerrero et al. 2016). Thus universities play critical roles in providing entrepreneurial education for future entrepreneurs with enhanced intuitive decision-making, the ability to make things happen. Other attributes entrepreneurial universities inculcate into potential entrepreneurs include innovative thinking, networking, creative

problem-solving, opportunity identification, strategic thinking and self-efficacy. Also, entrepreneurial universities instil in people the ability to cope with an unpredictable external environment and the associated entrepreneurial ways of doing, feeling, communicating, thinking, organizing and learning (Brown 2016). Entrepreneurial universities also provide students with skills, new ideas and the ability to think and respond entrepreneurially to societal issues, and to improving co-creation with external partners (Bikse et al. 2013).

Entrepreneurial universities provide the opportunities for staff and students to participate in entrepreneurial activities during the study process (Fuller et al. 2019); they also facilitate strong links with external stakeholders and entrepreneurs to serve as mentors, helping the university to identify and further discover commercialization opportunities and the associated initiatives (Klofsten et al. 2019). Entrepreneurial universities ensure the integrity of both theory and practice in entrepreneurial training enabling students to learn by doing and to also demonstrate their skills in specific activities with the aim of coming out with innovative approaches to economic problems.

Universities are increasingly being expected to operate more entrepreneurially, spinning out new, knowledge-based enterprises, commercializing their research and playing active roles in the knowledge economy (Williams and Klueyv 2014) and the innovation process. Similarly, universities become an important factor of economic development since not only do they fulfil their teaching and research mandate but they are also active participants in the innovation process (Ratten 2017). Extant literature on innovation systems has also placed universities at the heart of entrepreneurship and innovation (Stam 2015) even as scholars have accorded universities a key role in the innovation and entrepreneurial processes. This increased focus on entrepreneurial universities has ascribed them as key actors in entrepreneurial ecosystems (Fayolle and Redford 2014) and the actors in the ecosystems include entrepreneurs, business incubators and universities. The interrelationships in the ecosystem depict the links between entrepreneurs and venture capitalists, and university-industry linkages which could shape the type of regional entrepreneurship (Ratten 2017; Stam 2015).

Theoretical Foundations

A number of studies have drawn from the resource based view and institutional economics to explain entrepreneurial universities. These two approaches emphasize the availability and utilization of resources to cause social and economic changes in institutions. Brown (2016) notes that the conceptual model of an entrepreneurial university is aptly integrated by the internal and environmental factors associated with the creation and eventual development of entrepreneurial universities. The institutional economics framework is widely applied in the study of institutional factors affecting the transformations of a conventional university to an entrepreneurial university (Salamzadeh 2015). The framework recognizes the structure and processes in institutions that help transition from one form to the other. The perception about graduates as not only future job-seekers but also future job-creators fits into the description of entrepreneurial university. The governance and organization structure of the university refers to the internal management mechanism, leadership functions, decision-making mechanisms and contracts and so on (Guerrero et al. 2015). According to the authors, the informal components include values, codes of conduct, norms of behaviour, attitudes and so on.

The governance structure of a university becomes integral to the nature of its entrepreneurial mission (Mok 2013) and this influences the numerous support measures used in supporting new firm creation, including small businesses, research groups, research facilities, technology transfer offices, liaison offices and incubators (Stam 2015; Fayolle and Redford 2014). The support measures try to reduce the conflict that exists between the roles of an entrepreneur and an academic (Salamzadeh 2015), while at the same time allowing academic entrepreneurs to create linkages with markets and other external agents (Ratten 2017).

Most entrepreneurial universities' theoretical models adopt the Resource Based View to explain the internal factors including resources and capabilities of organizations which could lead to a competitive advantage; in other words, to understand the critical factors in the spin-off process within an entrepreneurial university (Budyldina 2018; Dalmarco

et al. 2018). The Resource Based View Approach recognizes the importance of human capital in creating an entrepreneurial university, and this is key to the functions served by both university faculty and university leadership (Guerrero et al. 2015). For instance, entrepreneurial universities need leaders with strong management abilities, as well as leadership attributes, serving in professionalized permanent posts to fulfil the universities' missions. This suggests that academic entrepreneurs are important human resources in entrepreneurial universities as they are also characterized by their capacity to create multifunctional teams (Hannon 2013).

The Resource Based View also presupposes that entrepreneurial university's technological capital, which includes both physical resources and the delimitation of the old boundaries between universities and the outside world through infrastructure expansion, is designed to meet relevant demands (Fuller et al. 2019). The major function of these infrastructures is to assist in developing the networks between investors and potential entrepreneurs, managers and advisers that provide the financial and human resources required to start a firm (Salamzadeh 2015). This means that the infrastructure enables potential entrepreneurs to have access to expertise in important areas including market evaluation, venture capital sourcing, business plan formulation and spin-off team assembly which underscores the success of any such business.

While the institutional economics approach emphasizes internal factors including leadership functions, decision-making mechanisms, values, codes of conduct, norms of behaviour and attitudes that enable institutions transition from one form to the other, the Resource Based View considers physical resources in terms of infrastructure needed to transform to an entrepreneurial university.

Methodology

Case study methodology has been employed as a suitable approach in examining under-explored and complex topics in entrepreneurship (Gartner and Birley 2002; Siegel and Wright 2015). Most authors have also adopted case studies to examine the entrepreneurial university

phenomenon using different viewpoints (Brown 2016; Klofsten and Jones-Evans 2000; Bernasconi 2005; Martinelli et al. 2008; O'Shea et al. 2007). This chapter presents a review of literature on the characteristics of entrepreneurial universities. Extensive explorations of reports pertaining to the practices that stimulate entrepreneurial activities in the university are used. Documented reports on the various interventions led by the Enterprise Development Centre provide insights into the activities, lessons learnt and recommendations for improvement.

Reports on the university-led entrepreneurial programmes and sessions also highlight the practices aimed at making entrepreneurship prominent in the university's journey. The authors' experiences are also accounted for in this chapter. The authors who are key actors in the entrepreneurial university' transformational process highlight critical issues both from the conceptualization and from the implementation of these activities/interventions.

Pan Atlantic University's Entrepreneurial Journey

Founded in 2002, the Pan Atlantic University is a non-profit, private institution of higher learning located in Lagos, Nigeria. The mission statement of the university is "to form competent and committed professionals and encourage them to serve with personal initiative and social responsibility the community in which they work, thereby helping to build a better society in Nigeria and Africa at large". In other words, the university aims at nurturing individuals who are professionally competent, enterprising and creative, zealous for the common good and able to make free and morally upright decisions and who thus act as positive agents of change in service to the society. The university which has about 430 staff, 3 schools, 1 centre and 1 institute also seeks to inculcate and groom the entrepreneurial spirit in the staff, students and participants. From the foregoing, the university clearly identified entrepreneurship in its mandate and is committed to becoming a full entrepreneurial university. The university is therefore deliberate in its approach to building an

entrepreneurship mindset across the university and in all aspects of university life including teaching and learning, research and service to the larger community.

Through Enterprise Development Centre (EDC), a unit of the university that has the responsibility of providing entrepreneurial training and practice, the university is striving towards becoming an entrepreneurial university in Nigeria. EDC was founded in 2003 and has about 30 staff excluding external faculty members and experts/consultants. In addition to supporting students and executive education participants across campus, EDC also provides a variety of capacity building programmes and value added services to the larger small and medium enterprises (SMEs) all over Nigeria. These include business advisory, networking meetings, mentoring, retreats, access to market and information (Fig. 6.1).

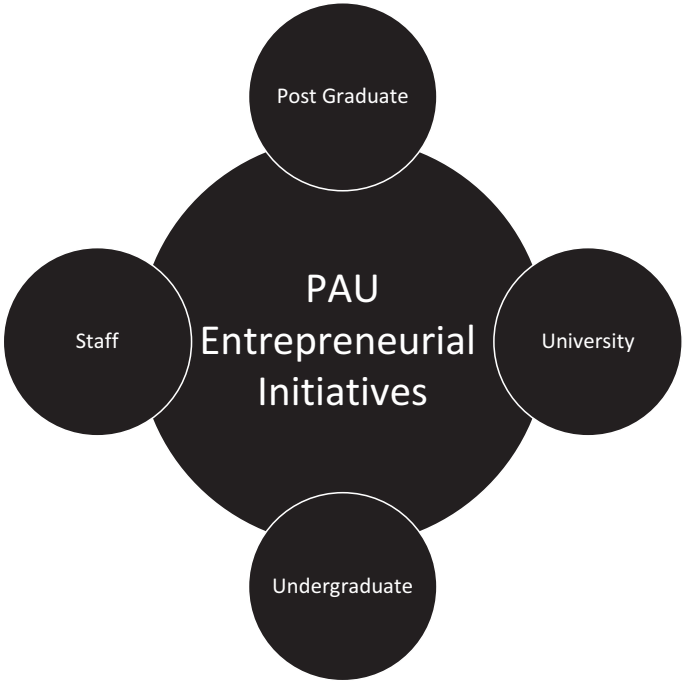

Fig. 6.1 Pan Atlantic University (PAU) Entrepreneurial initiatives

Staff Entrepreneurial Building

The university's approach to being an entrepreneurial university is multi-pronged. Typically, staff and students have access to entrepreneurial education/training in entrepreneurial universities and entrepreneurship courses are offered as an integrated approach that delivers the knowledge and skills needed at every phase of entrepreneurship (Williams and Kluev 2014). The university has a structured approach at building entrepreneurial capacity in staff. At EDC, for example, it is usual for a staff to be part of the "Certificate in Entrepreneurial Management" (CEM) cohort. This allows them to achieve three things. First, they get to learn and become certified on how to start and manage a business effectively. Second, they get to interact and understand the challenges entrepreneurs face and how they innovate and solve these problems. Third, they build their network within the entrepreneurial community.

The staff are also encouraged to serve the community by teaching and guiding aspiring entrepreneurs in the local communities. This is being done as "community service" on a quarterly basis. This allows the staff to deepen their knowledge, understanding and practice in the field. The approach also allows the staff to reinforce their entrepreneurial capabilities and skills, as well as spend months in order to gain experience and the needed information that could influence their teaching/learning and professional practice. Some staff that has the flair and required qualification is then made to undergo further teaching practice certification before joining the undergraduate training team, which is at the core of the university's strategy of building an entrepreneurial university.

The Undergraduate Enterprise Training

Through teaching and learning, at the undergraduate level, there is conscious effort in shaping the thinking and minds of the students towards entrepreneurship and innovation. Entrepreneurship education is compulsory for all undergraduate students in the university irrespective of the field of study. All second year students who are typically within 17 to 18

age brackets undergo a one-year programme that exposes them to how entrepreneurs recognize opportunities, make value propositions, birth their business concept and test it in the marketplace. They are exposed to the principles and practice of venturing. During the period, people they are likely to meet as entrepreneurs are brought to class as part of interactive sessions with the ecosystem. This is profound in sharpening their nascent minds in order to get them thinking like entrepreneurs. The university cultivates and curates an environment in which the students get ground-level entrepreneurial training especially in opportunity identification, business planning, accounting, marketing, operations and so on. The students gain experience in working in teams as they jointly plan, conduct and manage activities. They also learn to agree, cooperate, make compromises, make decisions jointly and connections with business leaders (Bikse et al. 2013).

The entrepreneurship course at the undergraduate level is designed in a way that enables students to be taught weekly while learning independently and within their assigned groups. After the first term, they are expected to start a business of their choice on campus in teams. Each team has a maximum of ten students and an adviser. EDC provides a small refundable seed capital to every team. They are expected to raise additional capital through equity (among team members) or debt if they so desire and have the capacity to do so. Towards the end of the programmes, investors are brought in and each team is made to pitch for investment. Though this is a simulated session as no real investments are made, the investors, however, award points to each team and this forms part of their credit for the course. Otherwise, they spend the rest of the year building and operating their venture on campus. Apart from the advisers, experts in the chosen sectors are brought in to deepen the group's knowledge and understanding. This provides practical exposure to the students.

At the end of the second year, the various businesses are ready to be showcased to the world. In June of every year, EDC then organizes an exhibition tagged "EXPO" where all the teams not only showcase their business ventures but actually sell them to the invited guests. The invited guests usually include other students, staff, parents and friends of the university. In the recent past, students from other schools and universities

have been invited. The special guests of honour are the invited entrepreneurs, typically more than 50 in number. They assess each team based on the criteria provided which include business innovation, team presentation, if the business is truly meeting the needs of customers and so on. Points awarded to each team by these entrepreneurs are then aggregated and used as part of the credit for the course.

After completing the course in their second year, each team has the liberty to decide what next—close the business and share the assets (mostly cash) or continue with the venture in their years three and four. Interestingly, a few choose to continue. At the end of their study at Pan Atlantic University, an outstanding student gets the Professor Albert Alos's award for the most enterprising student. This award is aimed at reinforcing the entrepreneurial mindset built in the students from their second year. Professor Albert Alos is the pioneer Vice Chancellor of the Pan Atlantic University.

The Post-Graduate Entrepreneurship Practice

Apart from the undergraduate level, enterprise education and practice occurs at the post-graduate level. At the Lagos Business School, which is the oldest unit of Pan Atlantic University, entrepreneurship education at the MBA level goes beyond the classroom. The full-time MBA students undergo a 100-hour consulting practice during their training. From the tail-end of their first year, the MBA students are assigned in pairs to selected SMEs within the EDC network. They jointly identify a major challenge being faced by the SME, jointly plan a line of action with timelines and work towards achieving the expected outcome. Each MBA pair is guided by one EDC consultant while the MBAs serve as sub-consultants. EDC consultants are experts in different business management areas. A typical consulting cycle is about seven weeks during which the identified challenge would have been solved. This consulting experience not only brings to life the application of principles being taught in class, it also allows the MBA students gain valuable practical experience as they get their hands "dirty" in solving real-life

problems. They often bring these experiences back to class, which in turn enriches teaching and learning.

This interaction between the MBA students and the SMEs often trigger a positive attitude to problem-solving. It improves their ability to empathize and see the business succeed. On completion of the MBA programmes, and when the MBA students are employed by large organizations, the feedback is that they behave like business owners within such organizations. This is classic intrepreneurship and a reflection of the entrepreneurial mindset that is being built in these students. Alternatively, a few of them also go ahead in establishing their own ventures within a few years of completing the MBA programmes. The university through EDC continues to support them whenever there is need. Other post-graduate students across the university are also exposed to some form of enterprise training and practice though in varying degrees. However, one thing that is fast becoming a tradition is that entrepreneurship education and practice across the university is a way of life.

University-Industry Interactions

In terms of engagement and partnerships with institutions outside the university community, Pan Atlantic University through Enterprise Development Centre University has been very strategic in its stakeholders' engagement. This has positioned the university as an enterprising university in everyone's minds as the university leads implementation of various national programmes and interventions. From research to policy, from teaching to practice, EDC continues to demonstrate its commitment to nation building through its integrated approach to entrepreneurship promotion and practice. At the public level, EDC has been an advocate for SMEs in Nigeria. Through the "Market Access Nigeria" that brings together SMEs, large organizations and public sector agencies, various issues affecting the growth of SMEs are addressed on a continuous basis. Through this, the costs of business registration by SMEs, for example, were reduced, access to

finance conversation helped in the formulation and implementation of different interventions including those championed by the Central Bank of Nigeria in which EDC is an accredited institution for the implementation. EDC has also been invited at various times to be part of the Presidential Committee on Micro Small and Medium Enterprises. In addition, it champions the cause of SMEs through its leadership of the Global Entrepreneurship Network, Nigeria, over the last ten years, which has led to a partnership with the Ministry of Industry, Trade and Investment. It continues to partner with agencies such as the government apex body responsible for the development of SMEs in Nigeria—the Small and Medium Enterprise Development Agency of Nigeria (SMEDAN)—and the Bank of Industry (BOI). These external relationships with the public sector go beyond advocacy. Intervention programmes have also been implemented at one time or the other, which reinforces the university's commitment to building an entrepreneurial mindset beyond the university. Some of the programmes implemented include:

- **Youwin!:** The national business planning competition for young persons within the 18–35 years age bracket, starting or expanding their business. They got trained and grants were awarded to some of the beneficiaries. Over a period of three years, more than 200,000 applications were received and processed.
- **Business Innovation & Growth (BIG):** Another intervention aimed at addressing youth unemployment, business support and access to finance. EDC led the capacity building segment of this intervention over a two-year period.
- **Youth Entrepreneurship Support (YES) programmes**: Using blended learning, EDC trained 7000 youth while the Bank of Industry provided a number of them with capital to finance their business.
- **YouwinConnect:** This is the fourth year edition of Youwin! that leverages on technology. EDC built a learning management system that enabled over 50,000 SMEs to learn online while conducting their businesses.

University-Industry-Government Interactions: The Youwin! Example

Youwin!, which is an acronym for "Youth Enterprise with Innovation in Nigeria", was a national business plan competition run by the Nigerian government in collaboration with the World Bank, DFID, some private organizations and EDC of the Pan Atlantic University. EDC was active in the grading of applications and training of shortlisted participants. The intervention sought to unearth innovative businesses by youth across Nigeria and then provide grant funding especially to the businesses that have great potentials to grow and create jobs. From the public sector perspective, the selection of winners has to be inclusive; however, the private sector was also mindful of merit. Thus, the winners came from each of the six geopolitical zones of the country, yet they were based on merit. The winners were classified into two streams—25% were national merit winners, based entirely on the highest scores from the business plans, and the regional winners, which were 12.5% from each of the six geopolitical zones which accounts for 75%. The project had several phases including selection, training, grant disbursement and monitoring.

Selection In the first year of the competition, over 24,000 applications were received online. Prior to marking and grading of the applications based on the agreed criteria, the personal details of each applicant were separated from the business concept. This was to ensure objectivity. At every stage of the marking process, supervisors from EDC randomly double-checked and ensured that the marking and grading were in line with the criteria. A team of auditors from UK universities also double-checked the process and selection.

Training Out of the 24,000 applicants, 6000 were selected and trained by EDC in 20 locations across Nigeria. The training was to ensure that the participants were grounded not only in writing a winning business plan but also on how to run a business efficiently. EDC collaborated with other academics in curriculum development and teaching/facilitation in

Lagos and Abuja out of the 20 locations. This ensured that the curriculum was of international standard but locally relevant.

Grant Winners After the training, the 6000 wrote full business plan leveraging on the concept note they submitted initially. Using a similar process as in stage one, EDC selected 1200 as the final awardees. Over the three years, there were modifications to the final round selection. At some stages, 2400 were again selected from the 6000 and they defended their business plan before a panel of judges and the number was reduced to 1200. At a point, randomization was used in the selection after prequalifying about 2400 possible winners. The winners were then awarded grants up to a maximum of 10 million naira (approximately USD 40,000).

Disbursement and Monitoring The disbursement was done through the commercial banks in line with the agreed milestones on the business plans. This was done in three tranches. Other organizations including Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) were also involved during monitoring and evaluation. Their visits to the businesses and positive reports of meeting the milestone were the bases that triggered payment for the subsequent milestones. This helped in lowering the risk and ensured that the business plans were implemented.

The Youwin! programme not only stimulated an enterprise culture across Nigeria, but it also made the young people focus on venture and job creation. Knowing full well that the government will support and provide seed capital for good business ideas objectively made more youth start their enterprise. The intervention ran for three years with more than 200,000 applications received. This intervention showed how the coordinated effort of an entrepreneurial university, industry and government can lead to positive economic dividends.

Beyond the public domain, the university through EDC engages the private sector extensively through various partnerships and programmes delivery. The university is well known for gender-focused programmes. In the last 12 years, for instance, through its partnerships with organizations

such as Goldman Sachs foundation for 10,000 women programmes, World Bank for Women X programmes and Cherie Blair Foundation for Women on Road to Growth, EDC has maintained an unbroken chain of building and supporting women in business. Even little details like having a crèche within the learning environment ensure that no woman is left behind. As of today, EDC maintains a highly motivated gender desk, trained to support women as they grow their businesses. A work-life balance is one of the regular features.

Youth programmes have also been a focus of the university as youth unemployment has always been a national issue. Beyond leading and being part of various government youth intervention programmes, EDC continues to work with various private sector organizations in their quest towards increasing economic activities among this age group. For example, EDC is partnering with MasterCard Foundation in its ambitious goal of providing 30 million dignified jobs in ten African countries over a period of ten years. EDC through the Global Entrepreneurship Network, Nigeria, platform has been running a new ventures challenge and hackathons in the creative sector for youth across Nigeria. These programmes are being supported by various private sector organizations.

Increasingly, however, EDC is now taking the sector approach and focusing on growth sectors for job creation. This includes the agriculture value chain, creative industries, solar, health and education. In all of these interventions and partnerships, the whole idea is to be the positive change in the society, going beyond grooming entrepreneurs within the university to those in the larger society. Being at the intersection of theory and practice in national developmental issues Pan Atlantic University is thus positioned as an entrepreneurial university, fulfilling its mission as set out in its mandate.

Practical Implications

The two theories—Institutional Economics and Resource Based View—under consideration apply to the transformation process of an entrepreneurial university. The theories consider institutional factors affecting transformations and also recognize the structure and processes in

institutions which help transition from a conventional university to an entrepreneurial university. With regard to institutional economics, Pan Atlantic University reflects entrepreneurial practices in its internal mechanism, governance structure, leadership functions and decision-making. As highlighted earlier, the university encourages both staff and students to pursue entrepreneurial ventures during and after entrepreneurial courses. An entrepreneurial mindset is also reflected in the norms, behaviour and attitudes in the university. In terms of governance structure, at the core of the university mission is entrepreneurship and this has influenced the support measures in terms of new venture creation and research facilities to staff and students.

The Resource Based View emphasizes resources and capabilities as key to competitive advantage. The university recognizes human capital as strategic in the entrepreneurial university transformation. The leadership of Pan Atlantic University is with strong management abilities and leadership attributes. Leaders are always conscious of the fact that producing entrepreneurial graduates and staff is a strategic component of the university mission and thus ensures that both human and physical resources are available for the achievement of entrepreneurial university purposes. Here, the university has always explored and maintained links with external bodies including investors, development finance institutions and advisers and so on to deepen entrepreneurial practices. This is reflected in the different projects and programmes the university has handled through the Enterprise Development Centre. The university through engagement with experts ensures that potential entrepreneurs receive assistance in the areas of venture capital sourcing, market research, business plan formulation and so on.

Conclusions and Future Work

The Pan Atlantic University case study has been presented as an entrepreneurial university in Nigeria. Its intention in fulfilling its mandate has been deliberate and strategic in nature from staff development to students' engagement. This has enabled it to systematically build a

community of persons that are entrepreneurially minded. This has also given it the impetus to take on national issues on policy, advocacy and implementation of intervention programmes.

Being an entrepreneurial university requires leadership in practice. This positions the university as a solution provider and relevant to the society it serves. While Pan Atlantic University can be classified as an entrepreneurial university, much more can still be done both internally and externally. Over the next few years, its School of Science and Technology will be fully operational with an increase in the patenting and commercialization of inventions. The university is working on providing the needed infrastructure to support these processes. As the university has done over the years, this will require the building of an ecosystem of those involved in the entire patenting and commercialization process within the public and private sectors.

Using the Pan Atlantic University as a case study, we have provided insights on the entrepreneurial transformation process as well as practices that can stimulate the entrepreneurial activity of universities especially in developing economies and thus foster innovation and competitiveness. This is evidenced by the deliberate efforts of the university in exposing both staff and students to entrepreneurial training and practices aimed at showcasing entrepreneurial ventures. Practices in terms of teaching and learning, leadership and governance, partnerships and interventions that define entrepreneurial university journey have also been highlighted.

Of particular importance are the various interventions by the government and private bodies that the university has implemented and the relationships with key industry stakeholders. The roles of entrepreneurial universities especially in developing entrepreneurial mindsets and competencies have been discussed equally. Efforts should be made to consider specifying the roles of the different stakeholders including academics, government, development organizations, enterprise-friendly institutions, entrepreneurs in building a vibrant entrepreneurship ecosystem in Nigeria and other developing countries.

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7

Revisiting the New Entrepreneurial University in Times of Uncertainty

Lee Gray, Simon Adderley, and Ross Jordan

Introduction

In this chapter we take a snapshot of a moment in the development of entrepreneurship as a discipline and the nature of the New Entrepreneurial University. The context of the UK at a point of great political and economic uncertainty and risk heightens both the sense of opportunity and the fear of failure for academics with a high entrepreneurial orientation. We employ a small-scale empirical study to provide insight on the lived student experience of the UK university environment and we consider the influences on a marketised education system from a supply and demand perspective. Our aim is to stimulate debate as to the future paths of the New Entrepreneurial University, and whilst acknowledging the challenges, enthuse our peers as to the transformational possibilities.

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Context

If the casual observer was to read one of a host of government reports or press articles about universities and entrepreneurship, they could be forgiven for thinking that the primary aim of entrepreneurship, and interchangeably Enterprise Education, is to help students launch start-up businesses. The world's changing environmental, social, demographic and geopolitical landscape has fostered a need for innovative graduates who are able to think critically and build and deliver coalitions of change (Buser 2013). Culturally and politically driven economic initiatives have arguably made the UK one of the most supportive environments for entrepreneurial activity in recent years. Tax-efficient investment schemes such as the Seed Enterprise Investment Scheme (Gov.uk 2019a), visas for international graduate entrepreneurs (Gov.uk 2019b), funds distributed via Innovate UK (Gov.uk 2019c) and a media interest in entrepreneurship (Kelly and Boyle 2011) have served to encourage start-up initiatives.

As this chapter was written in late 2019, Brexit continues to dominate the national news and it is unclear as to the nature and effects of a final Brexit deal (or even "no-deal"). In these circumstances it is worth re-examining the role of Entrepreneurship Education as a tool for preparing graduates for an uncertain world, and the New Entrepreneurial University as a model for the development of Enterprise Education within Higher Education. The new university would plan to educate students for jobs that have not yet been invented (Hagen 2012). Students in turn have growing demands for more 'real-world' integration to support their entrepreneurship development and deliver skills and resources which they currently feel are unavailable. The new university's focus would also be on developing the ability to prepare students to adjust to a rapidly changing world by developing their capacity to adapt to new technologies and learn new skills in an ever-changing economy (Hagen 2012).

In the ten years since the global financial crisis of 2008, business has had a re-centring (or at least rebalancing) towards social value. Brexit's slowly unfolding drama has yet to fully impact or change current initiatives, other than perhaps to offer more emphasis on the employability skills of enterprise to extend further beyond the start-up motive. It is

striking that the discussion has not been dominated by economic growth, of value propositions or market exploitation. Indeed, Enterprise Education may no longer be understood by the Calas et al. (2009) redefinition of entrepreneurship to be "a process of social change which can be understood without attention to economic or managerial logic". We have moved away from this relatively narrow definition of what Enterprise Education is towards the more abstract discussion of what is it for (Blenker et al. 2011). From this discourse has emerged the concept of the 'New Entrepreneurial University'. Nevertheless, to first understand that concept it is necessary to recap the way in which the concept of Enterprise Education is centred within the narrative of economic development.

History of the New Entrepreneurial University

The aim of developing policy which capitalises on the economic potential of knowledge development within Universities is hardly new. As early as 1971, the Bolton Report (Great Britain 1971) aimed to identify mechanisms to advance direct links between "research" and "industry". Much of this early work concentrated on technological advances but it has grown to incorporate more diverse areas that drive economic change (Gibb et al. 2013).

Authors questioned the 'idea' of a university exclusively as a place of academic learning (Coaldrake and Stedman 1999; Maskell and Robinson 2001; De Ziwa 2005) and instead proposed a significant shift to the "culture" (Daumard 2001; Davies et al. 2001; Mendoza and Berger 2005; Anderson 2009) leading to the commercialisation of knowledge (Cook et al. 2008; Collier and Gray 2010) through a process of technology transfer (CVCP 1999; Leydesdorff and Meyer 2003; Sainsbury 2007; Mittelstädt and Cerri 2008; Zhou 2008) and the engagement of university with industry and other stakeholders (Charles 2006; CIHE 2008). This led to the development of the 'Triple Helix' model, defined as the partnership of universities with government and industry (Etzkowitz and Leydesdorff 2000; Thorn and So 2006; Etzkowitz 2008). Originally designed as a strategic approach to innovation, the Triple Helix became a

resource to stimulate employment, education and training (Etzkowitz 2003).

Within the Triple Helix, universities were seen as responding to social, economic and development issues that were both local and regional (Charles 2003; Smith 2007; Arbo and Benneworth 2007), resulting in the New Entrepreneurial University model. First established by the Kaufmann Report in 2001 and refined later by the QAA (2012), the model highlighted the economic benefits of Entrepreneurship Education. To be successful Entrepreneurship Education needed to be grounded in university traditions whilst simultaneously exploiting multiple external facilities, local businesses, and community interests, mentors, employers, entrepreneurs and investors. Kaufmann (2001) argued the key challenge for aspiring higher educational institutions was to develop "Entrepreneurial Eco-systems". He contended these must emerge simultaneously from top-down university-led initiatives and bottom-up student initiatives.

Significant studies have highlighted an impressive rate of growth in entrepreneurship curricula and programmes during the past 40 years (e.g., Brush et al. 2003; Dickson et al. 2008; Gartner and Vesper 1994; Katz 2008; Kuratko 2005; Neck and Greene 2011; Solomon 2007; Vesper and Gartner 1997).

Today Entrepreneurship Education is keen to explore various mechanisms for developing entrepreneurial students. As Adderley and Kirkbright (2015) have pointed out, there is a clear connection between entrepreneurial students' skill sets and those existing in entrepreneurs launching new ventures in the community. Approaches linking pedagogy with centralised enterprise support functions and a freeing up of financial and human resource processes have been explored in depth over the last decade (Yemini et al. 2014; Matlay et al. 2013; Rae et al. 2012; Rae 2009). A key outcome of these works is that a sustained investment in Entrepreneurship Education develops students' skills in business.

Entrepreneurship has arguably grown faster than any other disciplinary area in Higher Education. The key phase which appears to be foremost in activists' and strategy makers' minds now is the extension of entrepreneurship beyond the conventional home of the business school (or engineering department), to reach across the disciplines and across the campus (Kuratko and Morris 2018). However, questions have arisen

as to the efficacy and impact of these types of Enterprise Education initiatives. For example, the Royal Society has funded dozens of 'Entrepreneurs in Residence' (Royal Society 2019) at UK universities, tasked with decoding the institutional systems and determining why so few spin-out businesses have emerged from UK universities' initiatives (with a few notable big-name exceptions) (Hewitt-Dundas 2015).

Kuratko and Morris (2018, p. 14) suggest a fair analysis is that development Entrepreneurship Education, whilst impressive, has been "chaotic and disjointed"; modules and programmes added in a "happenstance manner, rarely guided by any sort of curricular model or cogent strategy, and often with considerable overlap among offerings". They also suggest that the new structures that have emerged within departments and by association from the organisational centre in terms of enterprise support are often unclear in their missions and objectives. This does not appear consistent with the position of the university within the entrepreneurial eco-system cited by Guerrero and Urbano (2014). Universities have attempted to truly adopt an entrepreneurial management style, with all internal stakeholders enabled to act entrepreneurially, and in turn interacting with the external regional environment in an entrepreneurial way (Clark 2001; Klofsten and Jones-Evans 2000). The narrower perspective of industry-university relations focusing upon commercialisation, technology transfer and capitalising upon intellectual property (O'Shea et al. 2005; Wright et al. 2007; Grimaldi et al. 2011) is far easier to analyse, and, outside of a select few, also appears to be poor in the UK.

This process (and indeed this chapter) is likely to be part of an ongoing self-reflection as the start-ups from Silicon Valley continue to dominate the global competitive environment, whilst attracting the best of UK talent (Galloway 2017). At the same time the rise of Chinese money and intellectual property (Thiruchelvam 2018) is seen as a threat (or opportunity) for a country experiencing great uncertainty and diminishing power. Within this broad context it is critical to understand the challenges to enterprise pedagogy's supply and demand construct.

It is this desire for an entrepreneurial university and a recognition of the systemic problems in creating one that highlights today's New Entrepreneurial University concept. Gibb (2008) highlighted the challenge for universities, suggesting an emphasis needed to be on changing

the 'contract' with students to reflect their personal career development and a feeling that is more entrepreneurial.

Within the context and environment of uncertainty which we have drawn in this chapter it is worth reminding ourselves of the failure of some institution-wide entrepreneurship programmes in the US (Kuratko and Morris 2018) and that as with all things entrepreneurial there are exciting opportunities but also associated risks which may be magnified by the relinquishing of disciplinary ties to the business school.

The challenge of the maturing discipline of entrepreneurship is also an added complexity. The field needs to continue to develop a unique identity and whilst it is invigorated by the wide lens of interest, the discipline and its incumbents must be aware of avoiding the dangers of dilution by applying entrepreneurship in all contexts. If entrepreneurship becomes a synonym for 'being different' then the richness of thinking around the identification and exploitation of opportunities for economic or social gain may soon be lost.

The agents and beneficiaries of change in this environment are critical (Kuratko and Morris 2018). From the structural perspective of the entrepreneurial university the academic entrepreneurs as activists see an opportunity (bottom-up) to influence the strategy makers (top-down) in addressing the next phase of development of the entrepreneurial ecosystem. However, the nature of the market, from the perspective of top-down measurement of performance and in terms of knowledge development from the academic perspective means that the critical players in this environment are the students. The result is a supply and demand relationship, where universities offer knowledge and skills and the student is the consumer.

Demand: The Student as a Consumer

Much has been written about the changing attitudes of students and educators as the UK transitioned from government-funded to student-funded education (Molesworth et al. 2009). The impact of the fee structure in the UK produced student consumers, driving a highly competitive market, based on a new measurement of student satisfaction as

the key performance indicator which produced a league table resulting in several unintended consequences (Rudd 2017; Cheng and Marsh 2010), which are only now becoming apparent. Initial signals from the recently elected UK government (Dec 2019) are that whilst there may be some control of anti-competitive measures (such as unconditional offers) from the Competition and Markets Authority and Office for Students, the growing confidence alongside a majority government will result in the fee and loan structure likely remaining unchanged (OFS 2019).

In most UK universities this will have a far greater financial impact on undergraduate than on postgraduate courses (Universities UK 2018). However, postgraduate applications in a culture of uncertainty around the UK position in the world have fallen significantly (ibid). This has furthered the emphasis upon undergraduate income, and often on business schools, as the potential cash cow of the organisation (Moules 2018).

Within this economic environment, the Teaching Excellence Framework's (TEF) has focused universities towards student satisfaction, and employability skills have become a critical influencer over university decisions. Heightened competition in recruitment between universities has created an opportunity to emphasise the student experience (Gibb et al. 2013); therefore, determining what will attract, satisfy and employ students is critical to the university remaining economically competitive.

The development of a competency-based view of entrepreneurship such as that proposed by Enterprise Educators UK (HEFCW 2020; QAA 2018) or Morris, Kuratko and Cornwell (2013) as a means of developing the discipline can be easily linked to the skills and competencies for employability. This opportunity is being grasped by entrepreneurial academics to 'spread the word' beyond self-declared interested students to nascent entrepreneurs and across the university. The extensive work within the discipline around elements such as resilience, attitude towards risk and uncertainty, and innovation and creativity can be extended to all students as relevant to the employability landscape. However, we recall the earlier warnings of the challenges of the university-wide approach and the dangers of dilution for the discipline itself. Critically, the nature of the market at present means that the response of students to these types of initiatives is likely to influence their development and proliferation.

Consequently, we turn to a small-scale empirical study which has informed our thinking in considering the current situation and looking to the future.

In 2019 we conducted a mixed-method study of Oxford Brookes University Undergraduate Business School students, in which 15% participated in an online survey. Of this group, half the students demonstrated a sense of uncertainty due to the socio-political climate surrounding Brexit, growing to almost 80% in their last year at university (Fig. 7.1). As long-term uncertainty impacts this generation (Mayhew 2017), it seems inevitable that the negative effects would become increasingly apparent in their attitudes (Kautonen et al. 2015) and consequently measurable in studies.

This study found that across all years, female students expressed higher concern over their future careers, whilst male students showed more optimism, greater personal detachment from political uncertainty and control over their future career (Fig. 7.2). In a 2016 survey (Eccles et al. 2016) of over 20,000 millennials in the UK and Ireland they found half the men and women were uncertain about their future careers, including

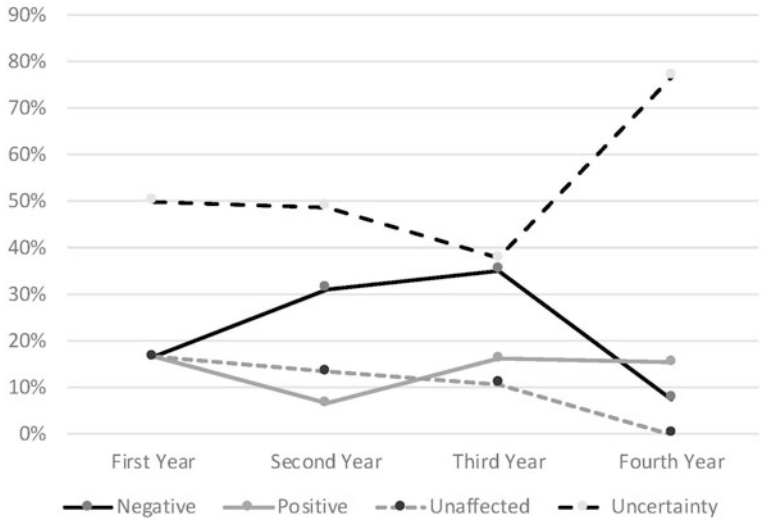

Fig. 7.1 Tracking students attitudes towards Brexit by year in school

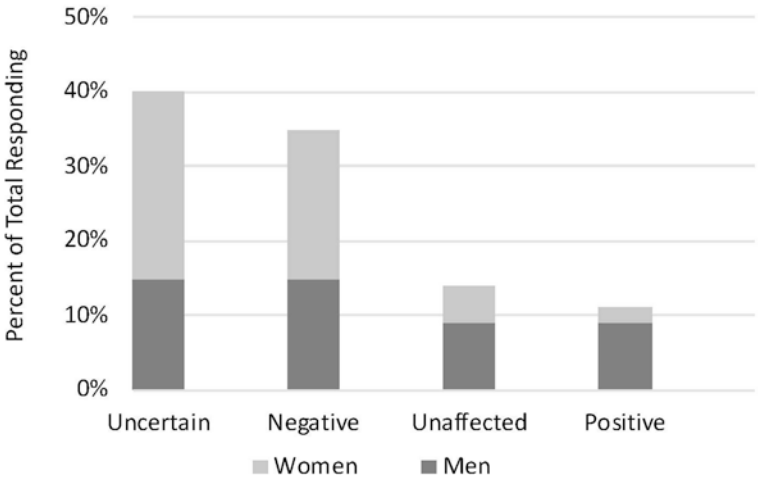

Fig. 7.2 Student responses to the question: "How do you feel about Brexit?"

over concerns about salary, enjoyment and purpose. In their study, women demonstrated 30% more concern than men, due to gender gap, work-life balance and reaching their full potential. Our study reflected similar gender outcomes.

In our study, the students expressed significant frustration with the disconnect between the university's pedagogy and their perception of the practical skills needed for employment. Half of the students shared a desire for more integration between lecture and 'real-world' skills. These students felt the university did not adequately prepare them for changing cultures. Examples were given regarding rapid changes in integration of technology and business, and cultural shifts due to shared workspaces.

> I don't have the skills I need. I am thinking of doing a placement to gain them. It would be better if the university could help by giving us the tools and skills to think about how to prepare for Brexit. (Second-year male student)

More than half the students felt the university should focus on greater partnerships outside the university. They specified relationships with

government and industry, defining the 'Triple Helix' model (Etzkowitz and Leydesdorf 2000; Thorn and So 2006; Etzkowitz 2008) and additionally with third sector organisations as in a 'Quadruple Helix' model (Carayannis and Campbell 2012).

> I want to be in touch with what is happening in industry today and not taught separately. It feels more real. (Second-year male student)

At a minimum, students want to be informed of open lectures at other universities and at most creation of joint events with outside organisations; they considered this as an expansion of their current university resources, and it represented a marketable advantage to the university. Students saw the Quadruple Helix model as opportunities to network, grow relationships and expand their university benefit. As Kuratko (2005) explains, in order to bridge the gap between the 'real world' and academia, universities must go beyond entrepreneurs as guest speakers.

> [I want to see] a variety of different kinds of speakers with different kinds of background. Seeing different areas, especially when people have failed in order to understand what to do when things go wrong and how to handle the stress. (First-year female student)

The study sample was considered highly entrepreneurial. More than 75% of the students were very interested in starting their own business. However, less than 40% thought this was a good time to start a new venture. Students gave many reasons for the delay to start a business. The most common answer was a lack of time or time management. However, the responses fell into four main categories: "fear of failure", "need for more training/skills", "need of motivation" or "need for resources (funding/networking)".

First, we shall address "fear of failure", "need of motivation" and "need for resources (funding/networking)"; 70% of the students articulated a desire for more university experiences that would support their entrepreneurship development in terms of self-efficacy (Fig. 7.3). They expressed this in terms of a desire for developing enterprising competencies and behaviours, including their capability for "problem-solving, risk-taking,

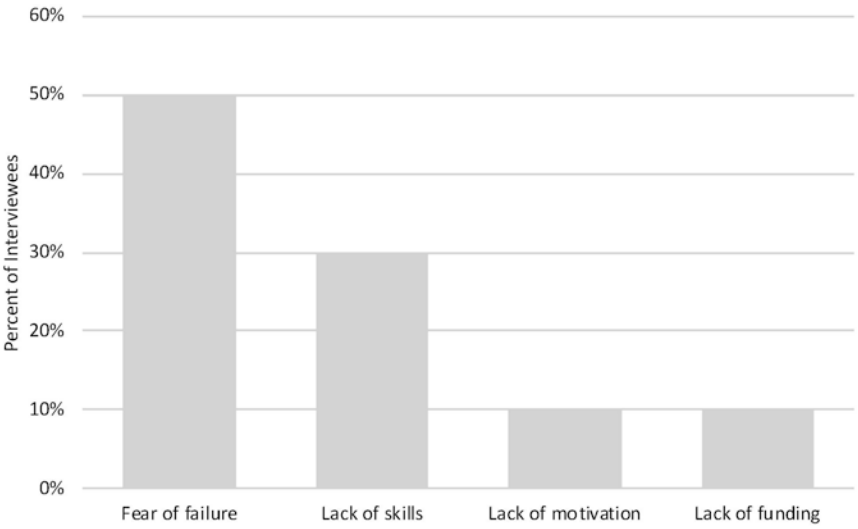

Fig. 7.3 Student responses to "Why delay a business start-up today?"

self-efficacy and resourcefulness" (Hagen 2012). They saw this need being addressed by actively participating in 'real-world' situations. Entrepreneurship Education by its very nature is designed to motivate entrepreneurial intentions and develop new skills resulting in increased confidence towards start-up behaviours (Hagen 2012). Students envision the university's role as one that is responsible for instilling in them entrepreneurial capabilities within a collaborative platform.

> There is a fear that the time and effort won't be worth it. That whatever we do will be obsolete in five years. So why bother. (Second-year female student)
>
> I don't have the time while I'm in school. I don't have the skills now. Maybe placement and more entrepreneurial modules will help me get ready. (Second-year female student)

Specifically, 70% of the students preferred mentors from industry (Fig. 7.4). This relationship develops student employment and employability skills by responding to current environmental, social and economic commercial interests (European Commission 2005; ESECT

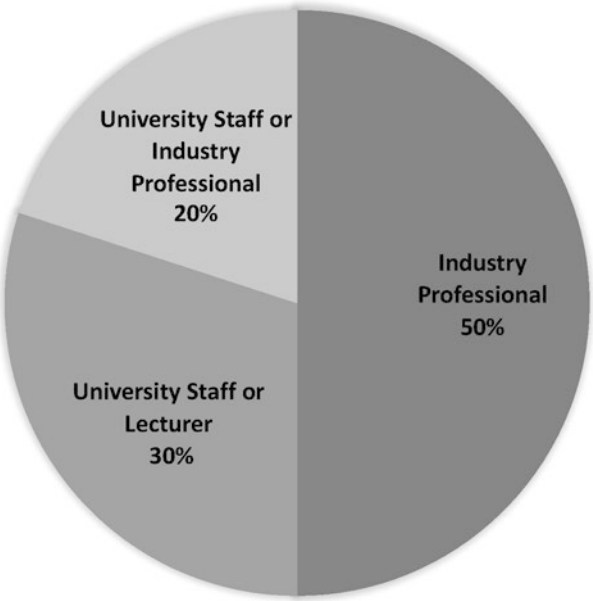

Fig. 7.4 Student responses to "I want a mentor who is an …"

2005; Leitch 2006; Artess et al. 2011). This same study showed students having the highest respect for lecturers, both from personal experience and from a reputational perspective. In fact, they wanted increased or unrestricted access to lecturers in addition to outside partnerships.

> I would like to see other department speakers and have more interaction with them. In the real-world we don't only work within one business unit. It would be good if the school reflected this and gave us a more access. (Second-year male student)

The overall surveyed student vision of the New University is that it acts as a catalyst/hub for their innovation, empowering them as the key players. In this construct, outside entities would be attracted to academia to develop integrated networks in order to facilitate this generation's education and training. Their traditional learning would be underpinned by practice within 'real-world' placements. In particular, students are

seeking significant and proactive engagement between the university, industry and the public sector. Based on this knowledge exchange, they believe that the new educational culture will drive them towards a stronger entrepreneurial ethos which will encourage greater risk taking and stronger innovation and deliver their goal of successful new ventures. Current study data such as what has been presented here is essential for defining and continually updating the role of the 'New University' as a supplier of entrepreneurial education.

Supplier: New Entrepreneurial University

The current entrepreneurial university was envisioned to support the type of student demands described above. What followed was recognition of the systemic problems inherent in creating one. This brought about the New Entrepreneurial University concept.

Global trade highlighted and heightened the challenges of university competition (Gibb 2008). This caused UK universities to experience recruitment problems in undergraduate and postgraduate applications; because the undergraduate programmes were higher income generators (Universities UK 2018) they (specifically the business schools) were the focus of increased attention (Moules 2018). In response, there was a proliferation of university courses specialising in entrepreneurship, and the concept of a university-wide approach or the entrepreneurial university (Audretsch 2012) emerged.

Where universities have in the past invested in physical space to engender entrepreneurship, they create a sense of student-faculty co-creation within a Triple Helix construct. However, in business schools which built a core infrastructure, invested in a generalist environment or, as in many cases, were restricted in their use of physical space, it appears too late to play catch-up to those universities who have embedded enterprise at their core. In part this is often due to investments from venture capitalists or donors, who understand the significance of a dedicated space as a central part of an overall strategy (Bhadwra 2018).

Both types of universities described in the paragraph above recognise a need to engage in enterprise activities with outside businesses. To satisfy

this condition, universities often enable partnerships with a short-term focus developing initiatives that are strategically designed to circumvent the institutional bureaucratic landscape to continue in an increasingly competitive environment (Gibb et al. 2013). It has been argued that this can result in an uncoordinated strategy, delivering on short-term objectives not linked to an integrated core curriculum (Filho et al. 2019). Staff can struggle to engage in these initiatives and students can receive conflicting messages from different parts of an institution. This confusing messaging can result in student frustration and this was reported in the 2019 study above.

With a growing interest in entrepreneurial activities (Universities UK 2018), Vice-Chancellors look towards business schools to make a significant positive impact on their overall performance measurements, in terms of both teaching and income from commercialisation. To ensure student numbers are maintained or grown there is a tendency to concentrate on larger more generalist courses (Jack 2019). Innovative entrepreneurial courses are few in number (Bhadwra 2018). Whilst their non-traditional structure would be extremely attractive to students seeking more flexibility and innovation (Hagen 2012), it is more common to find enterprise learning as a stream or pathway within a general business and management track (even if labelled as a dedicated entrepreneurship award) (Filho et al. 2019).

Gibb (2008) highlighted the challenge for Universities in a competitive environment when they are not the main source of new intellectual property. However, he proposes changing to reflect a personal career development 'contract' with students. In order to meet the student's demands, his writing advocates "being able to feel what it is like to be entrepreneurial … (is) … key to the creation of entrepreneurial values" (p. 5). This presents a challenge to the corporate structures of business schools which value order, formality, accountability, control and planning in a highly competitive environment (Filho et al. 2019). These traits are counterproductive to the entrepreneurial experience. Today's New Entrepreneurial University concept must find an innovative solution to survive.

This prompts us to turn to the oft-discussed and standardised measurement tools of the National Student Survey (NSS) and the TEF. There are

many known issues around the suitability of these surveys and the nature of their questions (Thiel 2019; Rudd 2017).

These evaluators were added to current university staff's already heavy academic burden including their need to publish research and demands of teaching, pastoral care and administration (Martin 2011). We recognise these evaluations focus upon the process and mechanisation of university outcomes and even encourage improvements (Forstenza 2018). This also highlights the contradiction between the university's embedded bureaucracies with highly formal planning processes and standardised accountability versus the agility of an entrepreneurial mindset (Gibb et al. 2013; Heaney and Mackenzie 2017).

TEF has inadvertently created a heighted competition among universities, resulting in a loss of £300 million in fee income over three years (Morris 2018). Additionally, Brexit has caused a slowdown in EU applications to lower-tier schools (UCAS 2018), resulting in pressure on middle league table universities to augment their student numbers (Morris 2018; Mayhew 2017). Top-tier schools, which have not seen as dramatic a slowing in applications (UCAS 2018), are still reaching down into the middle-tier universities as an easy way to bolster numbers and alleviate short-term concerns (Mayhew 2017). How this will affect the long-term outcome of the sector is uncertain. However, the loss of income and heightened recruitment competition is not inclined to result in universities embracing open innovation. This new paradigm positions universities in competition for their very survival.

To reiterate, the goals of the TEF and NSS measurement tools are to meet the student's needs and improve employability (Universities UK 2019). This is moving the New Entrepreneurial University towards developing a paradigm which focuses on preparing students for the rapidly changing world, by developing their capacity to adapt them to ever-changing technologies and learning new skills needed for an uncertain economy (Hagen 2012). TEF's and student's demands have driven the employability focus, which can be seen as an opportunity to emphasise and expand the Universities' inclusion of the 'Triple Helix' model as a promotable benefit (Sewell and Dacre Pool 2010). Doing so can drive recruitment but can also risk the focus of the university as a place for

knowledge transfer. Is this an 'all or nothing' decision for universities or is there an argument for variations within their methods of delivery?

The argument that the autonomy of universities as a knowledge creator has been undermined (Albert 2003) is controversial, as is the debate regarding commercialisation of universities as 'knowledge factories' (Lazzeroni and Piccaluga 2003). The objective of the New Entrepreneurial University concept is not to resolve this controversy. Instead, the objective is to evolve within Higher Education in order to support the sector's impact on the UK's ability to compete internationally and respond entrepreneurially (socially and economically) to pressures of uncertainty and complexity in an uncertain global economy (Gibb et al. 2013).

The vision behind the integration of the 'Triple Helix' model and the resulting transformation of an institution is to move beyond responding to evaluation pressures, instead becoming a significant force for industries and community innovation. In this way, it supports student employment and economic development. The foundation for this must be engrained into the universities' culture and pedagogy, for the development to be an effective transition of knowledge across all disciplines effectively creating the New Entrepreneurial University paradigm.

Future Outlook

Delivering a university education designed for a student as a paying consumer whose primary interest is a job as their ultimate goal (Roberts 2017) is the antithesis of the university which is designed to deliver knowledge for its own sake. This is of greater concern for business schools, which are specifically geared towards entrepreneur development and job preparation. This can also be applied to the research universities paradigm and the Research Excellence Framework (REF) that was initiated in the UK.

Has this fundamental conflict been resolved or at least changed by the New Entrepreneurial University concept and TEF? The legacy model, in which the university's role is primarily seen as one of knowledge transfer, would not be influenced by the student's vocational security. However, with the advent of TEF and the uncertainty surrounding the prolonged

resolution of Brexit, our study shows how students' confidence or lack of security in future employment has changed the landscape. We will know how Brexit is resolved in the coming months and it will take time to determine how students and their universities adapt to the new environment.

Our empirical data represents a cry for 'real-world' experience from students and this demands further research to appreciate students' understanding of this concept. It appears at first that the efforts of entrepreneurial academics to imbue real-world experience within their programmes are not as highly valued as direct external input (and perhaps never will be). This demand feeds into the Triple Helix model in supporting calls for an entrepreneurial eco-system which is highly integrated with its external regional stakeholders. Yet in most cases this seems dependent on entrepreneurial academics as actors and network facilitators rather than the institution itself. Indeed, in the marketised and uncertain climate which we have highlighted in this chapter it is arguable that institutions are more inclined to strategise internally and move towards the commoditisation of programmes. If we add to this a further danger that the entrepreneurship discipline itself, in its efforts towards maturity, may become more akin to existing approaches as the discipline strives for legitimacy, we arrive at the following conclusion.

Conclusion

We have painted a picture of a critical moment in the development of entrepreneurship as an academic discipline, and the New Entrepreneurial University. The opportunities are exciting, the risks great and uncertainty abounds. It feels like a typically entrepreneurial environment which requires individuals with a strong entrepreneurial orientation (Covin and Lumpkin 2011; Rauch et al. 2009) to recognise and capitalise upon these opportunities, and of course requires institutions to enable them to do so.

Pragmatically, from an institutional perspective we suggest that rather than an ad hoc research approach, universities need to establish a clear research plan to regularly update administration on successes and limitations of their initiatives and to provide sufficient data to justify strategic

change. This analysis design should also retrospectively address if the New Entrepreneurial University alienates entrepreneurially inclined students, simply because they may avoid structure, despite the inclusion of the Triple Helix model. This would be an honest consideration of the possible downsides of the marketisation impact in massifying entrepreneurship provision and extending the reach of entrepreneurial competencies. If in revisiting the New Entrepreneurial University it is possible to develop truly entrepreneurial education in entrepreneurship then the possibility for student transformation and empowerment continues to be worth pursuing for academics with a high entrepreneurial orientation.

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8

Entrepreneurial Intentions Amongst African Students: A Case Study of the University of Education, Winneba, Ghana

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Introduction

Due to its contribution to economic growth, innovativeness, job creation and wealth creation, entrepreneurship has gained global attention across most sectors from agriculture, through media and entertainment to higher education (Igwe et al. 2020; Taura et al. 2019; Buame 1996). Ghana as a developing nation encourages entrepreneurial activities in various ways due to the ever-growing undergraduate and/or graduate

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unemployment challenge. Universities and the wider tertiary education institutions across the country offer some form of entrepreneurship in the curriculum either as a full programme or as part of the required course.

In the past two decades, higher education has seen considerable growth both in the development of entrepreneurship as a subject and in the number of entrepreneurship courses offered (Bell 2015) and these courses are largely found in business schools within higher education institutions (HEIs) (Collins et al. 2006; Madichie and Fiberesima 2019; Madichie and Gbadamosi 2017; Fantazy and Madichie 2015; Healey 2019). The aim is to impart entrepreneurial skills among university students before graduation. Consequently, the solution to unemployment and economic problems would drastically reduce if not be eliminated. Outside the academic environment, the Government of Ghana has through some initiatives such as the Youth Enterprise Support (YES) among others encouraged entrepreneurship in order to address the challenges of youth unemployment.

Much of the literature on entrepreneurship in Ghana has concentrated on the development of formal or informal entrepreneur with their respondents being entrepreneurs (see Adom and Williams 2012; Black and Castaldo 2009; Buame 1996; Robson et al. 2009). Lee et al. (2011) argue that recognising the factors that influence entrepreneurial intentions represents a central component of studying the new business creation process. To this end, academic institutions are encouraged to investigate and understand the factors that determine entrepreneurial intentions (Maes et al. 2014). Whereas there is a great body of literature with respect to investigation of entrepreneurial intentions, there is paucity of research

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with respect to factors that determine the intention of students to undertake an entrepreneurial activity, particularly in the Ghanaian context.

The scant nature of the literature on the Ghanaian context, and especially in relation to the higher education sector, renders the study worthy of attention. In this regard, this chapter aims at identifying factors that predict entrepreneurial intentions among university students in Ghana.

Theoretical Background

Theory of Planned behaviour (TPB) is a widely accepted theory in psychology, which sets out to predict and explain human behaviour. This chapter is premised on the backdrop of TPB proposed by Ajzen (1985, 1991). The TPB is used as a theory for this study in that it seeks to present and explain the model that allows the understanding of the influence of attitudes and personal determinants on intentions to undertake an entrepreneurial venture (Kalafatis et al. 1999). This theory agrees that the best way for identifying the actions of people starting their own business is to find out if they intend to (Van Gelderen et al. 2015).

The TPB by far has become one of the most frequently cited and influential models in predicting human social behaviour (Ajzen 2011). According to Teo and Lee (2010), this was, however, an extension of Theory of Reasoned Action (TRA) espoused by Ajzen and Fishbein (1980). Hobbs et al. (2013) contend that the TPB is a parsimonious theory, which identifies two proximal predictors of behaviour: intention and perceived behavioural control (PBC). The PBC was introduced in order to complement the other two components proposed in the Theory of Reasoned Action (TRA) (Ajzen 1991).

As reported in Teo and Lee (2010), Ajzen (1991) explained, "A person's action is determined by behavioral intentions, which in turn are influenced by an attitude toward the behavior and subjective norms". To predict behaviour, the theory argues that the underlying attitude, subjective norm and perceived behavioural control play an important role. Miranda et al. (2017) added that with the TPB, the behaviour of a person is directly influenced by the intention of the person to perform (or not perform) that behaviour. The intention to perform such behaviour also

depends on three major elements: entrepreneurial attitude, the subjective norm and PBC (Miranda et al. 2017). A meta-analytical assessment by Schlaegel and Koenig (2014) also concludes that the drivers of entrepreneurial intentions (EI) are attitudes, subjective norms and perceived behavioural control.

The theory has been shown to be very much relevant in the academic setting (e.g. Miranda et al. 2017; Obschonka et al. 2012, 2015; Autio et al. 2001; Peng et al. 2012; Aslam et al. 2012; Goethner et al. 2012). Hobbs et al. (2013) also echoed Ajzen (1991) that intention is itself predicted by attitudes towards the target behaviour, subjective norm, beliefs and PBC. In the work of Demir (2010), Ajzen (1991) reportedly postulated that "as a general rule, the more favourable the attitude and subjective norm with respect to behaviour, and the greater the perceived behavioural control, the stronger should be an individual's intention to perform the behaviour under consideration". It is for this reason that this study adds the elements of the theory, thus, attitudes, subjective norm and perceived behavioural control among other factors that trigger entrepreneurial intentions among university students in Ghana.

Ajzen (2011), however, conceded that the earlier handlings of the theories of reasoned action and planned behaviour (Ajzen 1991; Ajzen and Fishbein 1980) created the possibility of including additional predictors of intentions. The author further argued that the TPB was developed in this manner by adding perceived behavioural control to the original theory of reasoned action (TRA). This study proposes some additional constructs as predictors of entrepreneurial intentions.

Proposition Development

Citing Allport (1935), Paula and Shrivatavab (2016) defined attitude as a "mental and neural state of exerting readiness, exerting a directive or dynamic influence upon the individuals with regard to all objectives and situations". An attitude towards a particular behaviour indicates the magnitude of a person's favourable or unfavourable evaluation of the behaviour in question (Ajzen 1991, 2005). The intentions of a person to undertake a particular behaviour are influenced by the attitude regarding

that behaviour. In their study, Yıldırıma et al. (2016) found that university students' attitude towards behaviour loaded high on the factor, which indicates the extent of its significance. Van Gelderen et al. (2008) in their work on entrepreneurial intention using the TPB established that entrepreneurial intentions of students are influenced by their attitudes towards entrepreneurship. Positive attitude towards behaviour is found to improve on the entrepreneurial intentions of an individual (see Goethner et al. 2012; Kautonen et al. 2011; Autio et al. 2001). The work of Demir (2010) established a significant relationship between attitude and intention. In their study on entrepreneurship education at the university level, Küttima et al. (2014) established a significant relationship between attitude and intention. Hence, we hypothesise that:

Proposition 1: Attitude Is Related to Entrepreneurial Intentions

Subjective Norm (SN)

Subjective norm refers to the perceived social pressure to undertake a particular behaviour or otherwise (Ajzen 1991, 2002). Maresch et al. (2016) argue that social norms relate to the perception an individual has about the opinions of social reference groups (such as family and friends), which could determine the intention of the said individual to undertake a behaviour. They added further that a person is highly motivated to start a business when the reference group's opinion is encouraging. Franke and Lüthje (2004) expressed the optimism that academic context is an important part of the students' environment. Armitage and Conner (2001) suggest that the subjective norm construct is a generally weak predictor of intentions. Maresch et al. (2016) also concluded that the subjective norm negatively correlates entrepreneurial intentions for science and engineering students. However, Yıldırıma et al. (2016) report that university activities of "initiation, development and support" by some means "trigger" the intentions of students to become entrepreneurs and encourages them in the direction of business start-up plans. In this study, therefore, SN is used to refer to the academic environment of the student, the

encouragement the student gets to start a business. Consequently, we hypothesise that:

Proposition 2: Social Norm Is Related to Entrepreneurial Intentions

Perceived Behavioural Control (PBC)

PBC as explained by Ajzen (1991) refers to the perceived ease or difficulty of performing the behaviour and it is assumed to reflect past experiences as well as anticipated impediments. Demir (2010) also views PBC as an individual's perceived easiness or difficulty of performing a behaviour. PBC plays a central role in the theory of planned behaviour (Ajzen 1991) and consequently predicts entrepreneurial intentions (Ajzen 2011). PBC was found to have a significant effect on respondents' intentions to use the internet (Demir 2010). The work of Küttima et al. (2014) on entrepreneurship education at the university also established a substantial relationship between PBC and entrepreneurial intentions. In a study conducted by Murugesan and Jayavelu (2015), a significant relationship was established between PBC and entrepreneurial intentions. Therefore, we hypothesise that:

Proposition 3: Perceived Behavioural Control Is Related to Entrepreneurial Intentions

Internal Locus of Control

Rotter (1954) explored personality traits by using the concept of locus of control, asserting that people with an internal locus of control believe that success and failure depend on the amount of effort invested and that they can control their fate (Hsio et al. 2016). By contrast, people with an external locus of control believe that their fate is determined by chance or luck and is not within their control (Lii and Wong 2008). Luthans et al. (2006) indicated that people with an internal locus of control tend to

positively face challenges and obstacles, resolving problems by seeking constructive solutions. People with an external locus of control exhibit higher achievement motivation compared with people with an internal locus of control (Hsio et al. 2016). Consequently, they are more willing to learn and enhance their capabilities and knowledge when encountering challenges (Johnson 1980). Compared with other methods for classifying personality traits, locus of control typically enables effectively distinguishing between subjects; thus, people with an internal locus of control and people with an external locus of control are commonly recruited as research subjects in studies related to psychology and applied psychology for analysing various personality traits (Judge and Bono 2001).

Proposition 4: Internal Locus of Control Is Related to Entrepreneurial Intentions

Risk Taking

Risk reflects the degree of uncertainty and potential loss associated with outcomes which may follow from a given behaviour or set of behaviours (Forlani and Mullins 2000). Yates and Stone (1992) opine that the basic element of risk construction can be identified as potential losses and the significance of those losses. According to Kvietok (2013), the decision to take on the business risk is symptomatic of a certain type of people. A significant part of the motivation to take risks in business follows from the success motivation. To achieve the set goals, successful people are willing to take on reasonable risks associated with feedback about the level of achieved results.

Knörr et al. (2013) mentioned creativity, risk taking and independence increase the probability of becoming an entrepreneur and these characteristics decrease the probability of becoming an employee. Similarly, Almeida et al. (2014) perceived entrepreneurs primarily as enterprising and creative, and to some degree as social and investigative (Kozubíková et al. 2015). According to Beugelsdijk and Noorderhaven (2005), entrepreneurs differ from the general population and from paid employees in that they are more individually oriented and have a greater individual

responsibility and effort (Kozubíková et al. 2015). In this context, Omerzel and Kušce (2013) indicate that the inclination to take risks, self-efficacy and the need for independence are the most important factors affecting personal performance of the businessman. Fairlie and Holleran (2012) assert that people with a higher tolerance for risk use more of their professional knowledge from the past than personalities with a lower tolerance for risk. In relation to that Cassar (2014) states that these people have realistic expectations in business, and this advantage is manifested mainly in areas with a high degree of uncertainty, such as high technology (Kozubíková et al. 2015). Thus we hypothesise that:

Proposition 5: Risk Taking Is Related to Entrepreneurial Intentions

Favourable Support from Contextual Factors

Favourable support refers to the support the student gets from the academic or business environment to start a business. Lüthje and Franke (2003) concluded that universities are in a position to shape and encourage entrepreneurial intentions. The work of Schwarz et al. (2009) on students' entrepreneurial intent found that a positive perception of university actions to encourage entrepreneurship hints at a stronger willingness to start up an own business in the future. Siegel and Phan (2005) postulated that training for entrepreneurship and contact with entities that provide support for entrepreneurs have a tendency to encourage the willingness to start a business. In a study conducted by Rauch and Hulsink (2015) it was stated that entrepreneurial training with access to resources makes it possible for an individual to yearn for a business start-up. Prior studies (Autio et al. 1997; Yıldırıma et al. 2016; Fantazy and Madichie 2015; Healey 2019; Madichie 2015; Madichie 2013) have shown that the support received from the university environment tends to account for one of the factors influencing students' intention to become entrepreneurial. For this reason, we hypothesise that:

Proposition 6: Favourable Support Is Related to Entrepreneurial Intentions

Figure 8.1 presents the model that was explored in this study. It describes the constructs that influence entrepreneurial intention.

Methodology

In this section, we first present a background into the origins of the case university before we go on to explain the survey process and development of the constructs for the study.

Case Background

The University of Education, Winneba (UEW), was established in September 1992 as a University College under the Provisional National Defence Council (PNDC) Law 322 to train teachers. On 14 May 2004, the University of Education Act (i.e. Act No. 672) was enacted to upgrade the status of the University College of Education of Winneba to the

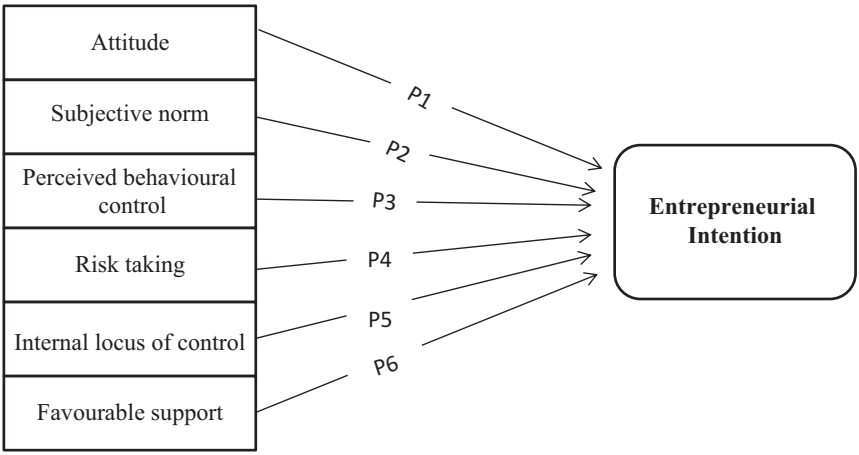

Fig. 8.1 Entrepreneurial intention influences. (Source: Authors' conceptualisation)

status of a full university (www.uew.edu.gh). The University College of Education of Winneba brought together seven diploma awarding colleges located in different towns under one umbrella institution. These colleges were the Advanced Teacher Training College, the Specialist Training College and the National Academy of Music, all at Winneba; the School of Ghana Languages, Ajumako; the College of Special Education, Akwapim-Mampong; the Advanced Technical Training College, Kumasi; and the St. Andrews Agricultural Training College, Mampong-Ashanti. The University has four satellite campuses that together form the University of Education. These campuses are the Colleges of Technical Education located at Kumasi, the College of Agriculture Education located at Mampong, the College of Languages Education located at Ajumako and the Winneba Campus where the main administration is also located.

The Survey Process

Based on a survey of university students in the Ghanaian setting, using self-administered questionnaires on 261 respondents, a range of constructs are developed. These constructs (with their respective indicators) in the study were developed from the review of literature, and these include attitude, perceived behavioural control, social norm, risk taking, internal locus of control, favourable support (i.e. independent variables). The dependent variable for the study (entrepreneurial intention) was also developed from previous studies. The partial least squares (PLS) technique was employed to test the model and this resulted in the use of the Smart PLS software (Ferreira et al. 2012). The PLS method is particularly beneficial in predicting dependent variables from a (very) large set of independent variables (i.e. predictors) (Abdi 2003). Confirmatory factor analysis was conducted first to determine the strength of each statement on a construct they supposed to measure. To ensure a better model performance, factors with loading below 0.6 were dropped, which resulted in most of the constructs having only two factors. In all, 271 respondents made up of university students (Business Administration) were sampled. Through data cleaning, the sample reduced to 261. The smartpls developed by Ringle et al. (2015) was used for the analysis.

Discussion of Findings

According to Gartner et al. (1992) entrepreneurship is the process of organisational emergence. It is also seen as the innovative and creative process with the potential of value addition to products, which would go a long way to improve productivity and to develop the economy (Guerrero et al. 2008). Entrepreneurial intention has also received much attention in the literature. It has been used in the literature to refer to the personal orientations, desires or interest which would result in the creation of a business (Thompson 2009). Bird (1988) considers entrepreneurial intentions as the state of the mind of the individual which directs them towards the creation of new business.

Demographic Characteristics of Respondents

From Table 8.1 it can be seen that male respondents constituted 158 (62.0%) of valid respondents while females were 97 (38%) of valid respondents. This is not surprising because more males are admitted into universities than females. The marital status of respondents revealed that 90.3% were single compared to 9.3% of the valid respondents who were married. This is again expected as most students at the university are direct intakes from the secondary schools and are therefore not employed. Respondents with family members or friends who were self-employed

Table 8.1 Demographic characteristics of respondents

Variable	Factors	Frequencies	Valid percentage
Gender	Male	158	62.0
	Female	97	38.0
Marital status	Married	24	9.3
	Single	232	90.3
	Other	1	0.4
Family/friends been self-employed	Yes	169	64.8
	No	64	24.5

Source: Field study, 2017

Table 8.2 Age of respondents

Variable	Minimum	Maximum	Mean
Age	20.0	39	24.6

were 72.5% of the valid respondents with 27.5% not coming from families with a business background. This is very reassuring as this increases the likelihood of producing future entrepreneurs.

The mean age of respondents from Table 8.2 is about 25, which is not surprising given the fact that university students constituted the sampling unit. The study revealed a minimum age of 20 and a maximum of 39.

Reliability and Validity of Scales

Before establishing the relationship between entrepreneurial intention and the independent variables in the study, the scale used must pass the test of reliability and validity. To test for reliability, Cronbach Alpha, Composite Reliability and Average Variance Extracted (AVE) were used. Before examining the relationship between the key variables, reliability and validity tests were performed. Reliability tests were examined using the Cronbach's alpha and the composite reliability statistics. On the other hand, construct validity and discriminant validity were also checked to confirm the overall validity of scales. To pass the test of reliability a factor must have a value above 0.7 for Cronbach's alpha and composite reliability and above 0.5 for AVE. The results from Table 8.3 showed that all factors passed the test of reliability based on composite reliability and AVE but most failed the test based on Cronbach's alpha. However, once the test of AVE was achieved, the factors could be deemed reliable.

From Table 8.3, it is clear that all the factors loaded higher than any other factor on their scales. Attitude on its scale had a value of about 0.9, which is higher than any other construct on that scale. As Ferreira et al. (2012) argued that the composite reliability is a better measure to Cronbach's alpha due to the latter's assumption of parallel measures, which represent a lower bound estimate of internal consistency. To test for validity, a discriminant analysis was performed and the result presented in Table 8.4. Discriminant analysis requires a factor to correlate

Table 8.3 Reliability tests

Factors	Cronbach's alpha	rho_A	Composite reliability	Average variance extracted (AVE)
Attitude towards entrepreneurship	0.718	0.725	0.876	0.779
Entrepreneurial intentions	0.529	0.549	0.807	0.678
Favourable support from contextual factors	0.623	0.671	0.838	0.722
High risk taking_	0.293	0.301	0.737	0.584
Internal locus of control	0.662	0.673	0.855	0.747
Subjective norm	0.630	0.631	0.802	0.576
Perceived behavioural control	0.508	0.535	0.799	0.667

Table 8.4 Discriminant analysis

	AT	EI	FS	RT	ILC	SN	PBC
Attitude towards entrepreneurship (AT)	**0.883**						
Entrepreneurial intentions (EI)	0.144	**0.823**					
Favourable support from contextual factors (FS)	0.113	0.215	**0.849**				
Risk taking (RT)	0.248	0.298	0.161	**0.764**			
Internal locus of control (ILC)	0.464	0.177	0.208	0.276	**0.864**		
Subjective norm (SN)	0.175	0.223	0.434	0.248	0.127	**0.759**	
Perceived behavioural control (PBC)	0.405	0.236	0.190	0.291	0.385	0.203	**0.817**

higher than with any other construct on its scale (Messick 1988). As can be seen in Table 8.4, EI has a value of 0.8, FS (0.8), RT (0.8), ILC (0.9), PBC (0.8) and SN (0.9).

Regression Results

To assess the relationship between entrepreneurial intention and a set of independent factors, the partial least square model was used and the resultant bootstrap presented in Table 8.5.

Table 8.5 Bootstrap results

Factor	Original sample (O)	Sample mean (M)	STDEV	*T*-statistics	*P*-values
AT -> EI	0.008	0.014	0.083	0.102	0.919
FS -> EI	0.140	0.139	0.072	1.955	0.051*
RT -> EI	0.226	0.227	0.068	3.307	0.001***
ILC -> EI	0.027	0.032	0.079	0.347	0.729
PBC -> EI	0.124	0.132	0.067	1.839	0.067*
SN -> EI	0.031	0.030	0.065	0.475	0.635

NB: *** and * refer to significance at 1% and 10%, respectively

The results from Table 8.5 show that favourable support, risk taking and perceived behavioural control were the factors that significantly and positively influence entrepreneurial intention. Favourable support is said to be significant in determining entrepreneurial intentions of Ghanaian students. This relates to the positive image Ghanaian entrepreneurs enjoy as well as the availability of qualified consultants and service support for new enterprise. The university environment also plays a major role here as the work of Schwarz et al. (2009) concludes that students' willingness to start a business largely emanates from the actions of universities in encouraging entrepreneurship. Similar findings were made by Siegel and Phan (2005) who added that entities that provide support for entrepreneurs have the tendency to encourage the willingness to start a business.

The findings from the study further suggest that *risk taking* plays a major role in determining the intentions of students to start a business. Respondents are ready to undertake behaviour with an uncertain outcome. In this regard, students are ready to try new things and have taken at least a risk in recent times. One of the surest factors that increase the probability of starting up a business is risk taking, which decreases the likelihood of becoming an employee (Knörr et al. 2013; Omerzel and Kušce 2013). Furthermore, there are indications that PBC significantly influences students' intention to start a business. This is associated with the belief in individual skills and capabilities to succeed as an entrepreneur, which makes them perceive easiness in starting up a business. Prior studies (Murugesan and Jayavelu 2015; Küttima et al. 2014; Demir 2010) have variously confirmed the significance of PBC on entrepreneurial intentions. The implication is that perceived behavioural control can

be a strong measure for one's ability to be independent (i.e. being on one's own in terms of taking business initiatives and creating value for society).

Conclusions and Implications

The main focus of this chapter was to highlight factors contributing to the entrepreneurial intentions of university students taken from the purview of the University of Education, Winneba. The theory of planned behaviour was used as the backdrop in an attempt to explain behaviour and entrepreneurial intentions of students. The findings indicate that, first, risk taking, second, favourable support from contextual factors, and, third, perceived behavioural control all proved significant in determining entrepreneurial intentions of students.

These findings are consistent with what is already reasonably well established in the literature—that is, favourable support has both a practical and a theoretical impact on entrepreneurial development. In an enabling environment where there is access to credit at lower cost for start-ups, ease of business registration, protection of intellectual property (among others), people will be attracted to develop their entrepreneurial skills and potential. Risk taking is also a key element in determining who can become an entrepreneur. The business environment is full of uncertainty and risk, and one's ability to take risk amid uncertainty can definitely be a strong measure in determining entrepreneurial intentions.

In recognition of this, universities are well advised to initiate programmes that nurture and support students with identifiable entrepreneurial intentions to actualise their aspirations to the betterment of the wider society. However, considering the unresolved distinction between "intentions to start a business" and "actually starting a business", future research could further interrogate the root causes of this disconnection. Overall, this chapter has implications for theory and practice—especially for universities already teaching, or planning to teach, courses in entrepreneurship in Africa and beyond.

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