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**Drivers, enablers and barriers of developing
commercialisation in an oil-dependent economy: the case of
Saudi Arabia**



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**Submitted in part satisfaction of the requirements for the degree of
Doctor of Philosophy in the University of Edinburgh
2017**

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Abstract

Faced with depleted oil stocks from 2035 onwards, the *Kingdom of Saudi Arabia* has a strategy of becoming a more knowledge-based economy by indigenously exploiting transferred technologies. However, despite significant investment in university-based technology transfer and incubation facilities, there is little progress in establishing high-growth advanced technology companies outside of the oil sector.

The thesis explores the commercialisation of university knowledge in university-based incubators in the Kingdom of Saudi Arabia and contrasting with arrangements in the UK, to identify the cause of low spinout rates and what can be done.

Beginning with a systematic review of literature on innovation and entrepreneurship as it applies to commercialisation, the thesis identifies gaps and areas of controversy in the literature.

From previous research an initial conceptual framework is developed to guide data gathering, its presentation and analysis.

Using a qualitative method a sample of twenty-four Saudi interviews and eight UK interviews is justified.

Significant new data on Saudi incubator policy, processes and outcomes is presented alongside new data from the UK. This is then analysed from an in-case and cross-case perspective and then re-integrated with literature. A revised conceptual framework is presented and conclusions for theory and practice drawn.

The thesis adds to the multidisciplinary bodies of knowledge for example by updating Gerschenkron's (1966) theory of catch-up, challenging the validity of Etzkowitz's (1983) triple helix theory, and arguing that North's (1990) neo-institutional theory is ethnocentric. I argue that culture is a major influence on commercialisation in developing countries and consciously changing cultures necessary for Saudi Arabia's transition from a rentier state. I find little empirical evidence in either the UK or Saudi Arabia for theories (Shane 2004) of academic entrepreneurship.

I conclude that major reforms of Saudi universities and commercialisation processes are necessary if the strategy is to contribute significantly towards diversification of the economy.

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Abbreviations

ERI	Edinburgh Research and Innovation
CPI	Corporate private incubators
FDI	Foreign Direct Investment
GDP	Gross domestic product
GEM	Global Entrepreneurship Monitor
HE	Higher education
HNWI	High net worth individuals
ICT	Information and Communications Technologies
IFDI	Inward Foreign Direct Investment
IIIT(B)	Indian Institute of Information Technology (Bangalore)
IIM(B)	Indian Institute of Management (Bangalore)
IMF	International Monetary Fund
IT	Information Technology
KACST	King Abdul-Aziz City for Science and Technology
KAUST	King Abdullah University for Science and Technology
KBE	Knowledge-based economy
KSA	Kingdom of Saudi Arabia
NSI	National System of Innovation
OECD	Organisation for Economic Cooperation and Development
OFDI	Outward Foreign Direct Investment
PCI	Private company incubators
PSI	Public sector incubators
R&D	Research and development
SSI	Sectoral System of Innovation
SWOT	Strengths, weaknesses, opportunities and threats
TEA	Rate of Early Stage Entrepreneurship
TH	Triple Helix
TT	Technology Transfer
TTO	Technology Transfer Office
UBI	University business incubators
UIL	University-industry links
UK	United Kingdom
VC	Venture Capital
WB	World Bank

Note on dates and currency: the Islamic calendar used in the Kingdom of Saudi Arabia and other Muslim states begins from the year of the *Hijra* (622 CE) having a 354 day year organised around twelve lunar months. To avoid confusion, throughout the thesis I use the western Gregorian calendar. The Saudi *riyal* (SAR) is a historic currency, to aid non-Saudi readers all money amounts in the thesis are in US dollar (US\$). One SAR is worth £ 0.19 and US\$ 0.26.

CHAPTER-1 INTRODUCTION

1.1 The problem being investigated

To paraphrase the economist Simon Kuznets, there are three types of countries in the world: developed countries, developing countries and the Kingdom of Saudi Arabia (KSA) – the subject of this research. The KSA as I shall show below, is characterised by a deeply embedded Islamic and Arabic culture, vast oil reserves (predicted to decline after 2035) and a strong desire and commitment to modernise through innovation-based entrepreneurship to address future falls in oil revenue. KSA's people have a sense of their own destiny and exceptionalism: non-conformity with prevailing international mores is unproblematic.

By 2024, the economy of the Kingdom (of Saudi Arabia) will have made great strides towards becoming knowledge-based, relying on a society that provides individuals with quality education, skills and experience, and will have begun to approach the levels of developed countries in this respect. So reads the 9th KSA development plan (KSA 2014). Like many other developing economies/societies, the lure of replicating Silicon Valley, shortening the gap between science and successful technology (Pisano 2011) aims to achieve successful trading in international markets not from selling raw materials but rather from created a knowledge-based economy in which entrepreneurship and innovation in advanced industrial sectors drive growth. There is a long history of US technology transfer to KSA, primarily associated with oil extraction, refining and distribution technologies (OTA 1984). At the heart of my research is to understand knowledge commercialisation of university-related knowledge in KSA, the processes employed and their effectiveness. This leads me to investigate the social setting in which commercialisation occurs in KSA and the influence of Islamic/Arabic culture, institutions and resource-richness.

1.2 KSA context and culture

Saudi Arabia is a rich country with US\$ 646 billion annual GDP at US\$21,395 per capita for its 29 million population the KSA is the 19th largest economy. In Jeddah, Ad Dammam, Jubail and Riyadh house building and prices are booming. GDP growth averages 5%. Life

expectancy is 74 years, with 14 spent in school: literacy is 83%. Living standards are high. KSA has 83% urbanisation; almost free supply of energy and air-conditioning. KSA is a young country, with 19% of the population under 14 years of age. The gender ratio is 1.5 men per woman, population growth is 1.5% per annum with the average woman having 2.1 children: a demographic dividend.

Historical development of KSA's meta-institutions

Ottoman suzerainty over Arabs began in the 10th century and was completed with the 1517 conquest of Egypt it was succeeded by British and French colonialism after 1918 (Gil'adi 1992) and in 1932 the third Saudi state. Article-1 of the KSA's 1992 Constitution begins, *The Kingdom of Saudi Arabia is a sovereign Arab Islamic state*, which encapsulates its two dominant institutions: Islam and monarchy. Since these institutions can be misunderstood and since they predominate KSA's polity, society and economy, this section explains how these meta-institutions originated, why they continue to dominate KSA and how they influence technological innovation and commercialisation in KSA.

The Saud clan which had ruled central parts of Arabian peninsular since 1727, in 1744 formed an historic alliance with representatives of Islam, representing a (purifying) reformation tendency in Sunni Islam with a goal of permanent expansion: the Islamic and Saudi pledged a shared destiny, that continues to persist (Brown 2014).¹ The details of the Whhabist position are given in Madelung (1997) and Alkhateeb (2014). This first Saudi state was overturned by Egypt's Mohammed Ali Pasha in 1818 at the behest of the Ottomans; returned as a second state in 1824, only to be ousted by Al Rashid in 1891 (McMeekin 2015). Following the 1927 Treaty of Jeddah with Britain and after 1945 with the US, the Saudi Kingdom emerged as a distributive state, with Islamic mutawwa'a supporting the monarchy and the monarchy giving exclusive religious power to Sunnis (Abu Hakima 1967). Orthodox Sunni never supported the Ottoman Caliphate, deeming it

¹ Terminology matters. Commins (2015) prefers the use of Salafi to denote a Sunni tradition wider than KSA, however, many authors (such as Valentine 2015) use Wahhabism to denote the particular school representing Islam in KSA, however, these are external commentators – I follow KSA practice and refer to Muslims.

illegitimate and therefore justifying khurij ala al-hakim i.e. rebellion against illegitimacy and blasphemy (Teitelbaum 1998).²

Initially, the Saudi King's distributive powers relied on the collection of the *zakat* or Islamic tax, income from the *hajj*, and British subsidies; a situation dramatically altered when oil well Dammam-7 began pumping in 1939 (Leatherdale 1983). As oil revenues grew, the King began building a state infrastructure (including roads, education and healthcare services, telecommunications), palaces for the Saud family and a strong military (Vassiliev 1998). US President Roosevelt endorsed this arrangement by in his famous meeting with King Ibn Saud aboard USS Quincy in 1945 (Anderson 1981; Grayson 1982).

For the purpose of my research several points arising from the origins of the Saudi state are important. Firstly, as Brown (2014) shows, innovativeness (*bida'*) and creativity are blasphemy to Islam (though secular innovations may be treated differently. Abdullah (1995) shows that the monarchy and Islam are mutually dependent, including external relations such as the (1974) Islamic Solidarity Fund and Islamic Development Bank and since 1982 the Gulf Cooperation Council. As King Faysal, a committed reformer, found and Aslan (2011) shows, building a change constituency in KSA is problematic. Secondly, unlike Egypt, there is history of industrialisation and associated social change in KSA. State largess in the form of benefits, education grants and employment (46% is public sector) and public sector contracts to private firms. Cordesman (1984) points to three-million (temporary) inward migrants doing work Saudis consider menial, whilst oil (and health and often education) companies and agencies continue to import skilled labour. These difficulties building change constituencies and culture of state dependency feature prominently in this research.

Destabilising events

² The Arabic Sunni view is that in only three Islamic periods did legitimate Caliphates exist (the four rightly-guided Caliphs succeeding (peace be upon him); the 661-750 Umayyads and their successor 'Abbasids, 750-1258). From the Whhabist perspective, the Ottoman Caliphate illegitimately promoted Sufism, attacked true Muslims and was not Arabic. Despite being protector the Medina and Mecca mosques, few Saudis (unlike extreme jihadists) now call for the restoration of a Caliphate; and it is unlikely that the majority of Muslims in Africa and Asia would accept a pan-national Caliphate.

Internally KSA's economic achievements are strong: in 2014 (IMF) KSA had a GDP per person of US\$ 21,395 (ranked 11th with only 1.6% debt to GDP ratio), despite the lowest oil price in fifty years. Yet the Kingdom has faced a series of destabilising events. Militarily, after 1945, a series of Arab-Israeli wars, insecurity arising from wars in Yemen, Kuwait, Iraq, Syria and Afghanistan destabilised Saudi society and following 9/11 in New York, resulting in serious terrorist attacks within KSA.

Ideologically, the Saudi regime has been challenged by pan-Arab nationalism (spreading from Gamal 'Abd al-Nasir's coup in Egypt and later pan-Islamism resulting from the 1979 Iranian revolution). The 1970s and 1980s high oil prices are now distant and diversifying from oil-dependency is a major strategic objective: though because of meta-institutions, the country targets modernisation without westernisation, highlighting the important Rodrik (2011) gives to alternative development models – a major discussion point in this research. Here I note, that KSA has a vibrant (online) debate around governances and the interplay between Islam-monarchy and democracy. Current arrangements depend on oil revenues and these revenues seriously decline after 2035 (Simmons 2006; Moser, Swain and Alkhabbaz 2015): economic diversification and commercialisation of technology is now a major preoccupation for KSA policy-makers and across Saudi society.

Sustainability and challenges

Aware that oil reserves will rapidly diminish after 2035, the KSA Government has a diversification policy - currently 70% of GDP is oil-related. Oil extraction, logistics, petrochemicals and energy are capital intensive employing few indigenous people: 46% of all indigenous employment is public sector. Even successful service sectors such as health and financial services are often staffed by the 3-million international migrant workers in KSA, recruited for the administrative and technical skills many Saudis lack. Most manufactured goods are imported. Rather than converging with developed economies, KSA appears to be diverging: trapped by a curse of natural resources (Sachs and Warner, 2001): whilst oil is 30% of GDP, it is 90% of exports and 93% of Government revenue. Though the recent fall in oil prices effects Saudi Arabia, given reserves, the main implication is to strengthen the need to diversity the economy.

In Boyer's (1990) terms, current social practice misaligns with current strategic intent, again a theme of this research. For example, imported labour performs menial and advanced jobs because young Saudis avoid such employment. Another example, unlike most major economies with a female workforce participation rate of over 70%, KSA's rate is only 10% (Detalle 2000).³ Another major social issue facing the Kingdom is youth unemployment (currently 28% of under-25s) many are part of the 20% of the indigenous population living below the official poverty line. Achieving alignment between social structures and technological vision of the future is a major challenge for KSA.

Innovation and growth

Since 1984, KSA has systematically made oil exports to the US conditional on TT in return (Ramady 2005): the Economic Offset Programme, which targeted oil-related and military technologies (Cordesman 1997) later widening TT to include advanced service technologies, agri-processing and life-sciences (Economic Offset Office 2001). However, as Ramady (2005) notes, in the case of KSA this has not resulted in the commercialisations benefiting the growth of the Asian Tigers and now China.

Business formation and incubation

GEM (2012) found that 69% of Saudis believe they have the capability to run their own business whilst 39% expressed a fear of failure. Only 1% said they intended to go into business and join the 9.4% of 18-64 year olds, owning their own business; (I discuss the detailed figures below). For most Saudis, Sadi and Al-Ghazali (2010) argue, working for an international company or the Government seems preferable to owning their own business – this is especially so for young women. As Alshemari (2005) notes, in KSA there are 23,000 businesswomen, 213,000 women teachers and 2,300,000 women students (66% of the total). Saudi women invest an annual US\$ 5-billion and increasingly occupy

³ It is not the purpose of my research to comment on the theology of women in Islamic society (see Alkhateeb 2014) or the extent to which cultural and religious traditions intertwine (as Llewellyn-Jones [2003] makes clear – veiling preceded Islam by a millennium). Liberal Saudis, such as Al-Awdah (Alshamsi 2011 and on Twitter: [@salman_alodah](#)) continue to defend the position of women under Islamic guardianship and women continue to press for independence, voting and driving rights – largely through social media, rather than physical protests.

public space exemplified by Lubna al-Olayan CEO of Olayan Financing and Nura al-Feyez a previous deputy Education Minister (Al-Rasheed 2013).

Learning

Learning is important in Islam; the Quran mentions knowledge (*ilm*) 750 times (Boyle 2006): knowledge is either revealed (by God) or the result of sensory perception (Halstead 2004). Güther (2006) states, *from the eighth century to the sixteenth, there was a continuous tradition of Arabic-Islamic scholarship dealing with pedagogical and didactic issues, reflecting a range of individual scholars' theological stances, ethnic origins, or geographical affiliations*. Hence the Islamic tradition is replete with empirical science discoveries such as Ibn Athir (history), Ibn Kathir, (Ophthalmology), Al-Nafisi (Medicine), Al-Jabbar (Algebra) and Abu Biruni's Chemistry, Physics and Astronomy. Prophet Muhammad (pbuh) commanded Muslims; *To acquire knowledge is an obligation on every Muslim, male or female and to Seek knowledge from the day of your birth until the day of your death*.

School learning is primarily rote learning: the country is ranked 66th (behind Macedonia, Tunisia and Albania) for its quality of maths and science teaching, in the lowest quartile of World Bank rankings: Women rank 90th in international indices of educational attainment. As Roy (1992:479) notes, education in Saudi Arabia tends to be formalistic and authorities avoid any antimonarchic or religiously liberalising curricula. Education is gender segregated (Ahmed 2010; Taleb 2010). Inactive pedagogy and the reluctance of Saudis to take vocational programmes, helps explain why substantial investment in education appears to have little economic impact (Kahn (2011).

Knowledge transfer and creation

KSA faces challenges in the inward transfer of knowledge, production of knowledge and its commercialisation. Partly this is the result of a low modern knowledge base and absorptive capacity (UN IDO 2012). The King's Arab Content Initiative and King Abdul-

Aziz City for Science and Technology (KACST) acknowledge these issues, into which my research delves deeply.

KACST has 200 R&D units attached to universities and private companies about 50% of which are in Riyadh, 20% in Jeddah, 13% in Dammam and the rest spread around the country. These units focus on medicine, agriculture, engineering and emergent technologies such as nanotechnology and life-sciences. Around 10% of this activity is basic research; mainly it is applied (Frascati 2014). KACST dominates Saudi R&D with seven institutes, four research centres and five national research programmes. Overall, KACST supports some 2,500 R&D projects at a cost of SR800 million.

Amongst its successes are patents in desalination and solar technologies, communications satellite launches, an Electrostatic Particle Accelerators, automated diacritizer of Arab text, catalytic fuel materials, fire-resistant polypropylene plastic and cloning camel insulin hormones. KACST has established to incubators (ICT and biotechnology) and plans eight more. Some 800 scientific papers are published annually with KACST support (between 1996 and 2006 26,854 in aggregate). Alongside the Ministry of Economy and Planning, KACST oversees a US\$ 2-billion budget supporting 190 national projects in water technologies, oil and gas, petrochemicals, nanotechnology, biotechnology and genetic engineering, photonics, aerospace and aviation, energy, new materials and the environment. The King Abdullah University of Science and Technology (KAUST) offers MSc and PhD programmes in 11 fields grouped around resources, energy and environment; materials and life sciences and bioengineering; and applied mathematics and computer science. As Jones (2015) notes, KAUST was established with the legitimacy of King Abdullah to prepare a modernising agenda for KSA. There are several Government research centres, mainly in medicine. Private sector R&D facilities include the Saudi Basic Industries Corporation, and the Saudi Aramco, which helped register a total of 8,000 patents (2010 figure). These private R&D centres cooperate with international institutions. Whilst between 1977-2010 KSA registered 382 US patents, in the same period by comparison South Korean registered 85,000: KSA registers less than Moldova and Uzbekistan.

Knowledge exploitation

The Saudi Government funds a plethora of organisations aimed at exploiting transferred or generated knowledge from its universities. These include the National Strategy for Fostering Giftedness, Creativity and Innovation; the King Abdul-Aziz and His Companions Foundation for Giftedness and Creativity, and the King Abdullah University of Science and Technology. Most universities now have commercialisation units and managers, alongside technology licensing organizations and associated technology parks; incubation centres and technology transfer centres. There is an array of supportive venture capital funds, Government grants and support from banks for new ventures. As we will show, however, these institutional arrangements are failing to deliver significant new products and companies and have only tenuous links to business, international markets and the private sector.

Institutional and cultural setting for commercialisation

Applying his national systems of innovation framework (1990), which prominently features endowment and clustering as variables, Porter (2009) suggests that the following constrain commercialisation in KSA.

- The absence of an entrepreneurial culture
- Lack of a skilled Saudi workforce
- Absence of general and industry specific training programs for employees
- Regulatory processes including startup, taxes and contract enforcement
- Insufficient startup programmes including incubators, technical assistance, and entrepreneur networks supporting SMEs
- Lack of focus and visibility of clustering development, including supplier and big company linkages

These are all points to which my research will return. Even amongst other resource-rich economies, KSA has a low business birthrate, with only 4.7% of the population involved in startup activity. The particularities of KSA as a developing, resource-rich, Muslim

economy are perhaps understated in Porter's analysis. In particular, as Gerschenkron (1962) argued, and the development states seem to have proven, there are advantages to relative backwardness where TT is available and target markets enable leapfrogging; though as I discuss in a knowledge-based era, these advantages may wane.

Why has KSA not benefited more in terms of innovation and diversification from the availability of TT? Peck (2008) for example, suggesting that the export-driven Asian tiger economies, notes that the success of Arab economies has been limited to turnkey TT such as hospitals, military systems and refining oil. In my view, Porter references culture in a deterministic manner – without explaining why particular cultural predispositions came into being and how they might be altered: his analysis, whilst sharply posing questions, fails to give an answer beyond Asian exceptionalism. My research delves more deeply into these 'explanations' of KSA tardiness in commercialisation in particular the impact of culture.

Commercialisation, TT and incubation

Researchers such as Pappas (2003), Volkmann (2004) and Alshumaimri, Aldridge and Audretsch (2010) have pointed to the relatively low impact of TT and incubation initiatives in KSA relative to other economies. In particular, researchers such as Peters, Rice, and Sundararajan (2004) and Lalkaka (2006) point out that incubators cannot be separated from institutions, culture and business structures: indeed, in a developing economy context, they argue, part of the role of incubators is to sharply highlight barriers to innovation and entrepreneurship, bringing them to the attention of policy-makers. Whilst policy-makers in KSA have responded to these challenges, as Salem (2014) notes, deeper structural and cultural changes will be required in KSA for TT to successfully and sustainably diversity its economic base.

In 2010, KSA launched a *decade of entrepreneurship* programme (Michelle 2003), inspired by Etzkowitz's (2003) triple helix, drawing together universities, private capital and TT incubators. The 2010 Saudi Fast Growth-100 initiative for example, particularly targets TT adaptation by small to medium-sized enterprises (SMEs). University linkages, as

Grimaldi and Grandi (2005) point out, are especially important where firms in life-sciences, nano-technology and advanced information and communications technologies (ICTs) begin from a low knowledge base and (Al-Kurdi 2002) encouraging SMEs to reference international standards.

A wide array of incubation-related initiatives include the Prince Sultan Fund to Support Women's Small Enterprises, Saudi Arabian General Investment Authority (SAGIA), the Prince Salman Young Entrepreneurship Awards, the National Entrepreneurship Centre, the Prince Salman Entrepreneurship Institute, and the King Abdullah University of Science and Technology (KAUST).

Numerous researchers celebrate the success of these initiatives. For example, Radwan and Al-Kibbi's (2002) case-based study applauds the SME inter-firm linkages and enhancement of individual competence and capabilities resulting from accelerator programmes, including testing calibration and warehousing. Other researchers, such as Ramady (2005) and Al-Thawwad (2008) point to the adoption of international standards by SMEs in sectors such as ICT software and pharmaceuticals.

In summary, since the 1930s KSA has created a top-20 world economy and now faces the strategic challenge of diversifying from oil-dependency. From the viewpoint of innovative firms, seeking to commercialise transferred technology into profitable products, my research digs into the detail of the constraints and opportunities faced in KSA.

1.3 Motivation

I am a proud Saudi citizen and hope my (eight) children enjoy a happy future in KSA. The future beyond oil is therefore important to me and I hope to contribute to identifying and resolving some of the barriers towards a sustainable, diversified future for the country. As a Saudi, I bring a deep understanding of the cultural traits around which issues of commercialisation orbit, enabling me to answer research questions (number 3) comparing the Saudi and UK.

This research connects closely with my professional work as Associate Director of R&D Project Management Office at King Abdul-Aziz City for Science and Technology (KACST) in Riyadh and previously in a variety of commercialisation projects: between KACST and the UK (2011); Biotechnology Incubator in Riyadh (2009); National Medical Strategic Research Planning in Riyadh (2007); and KACST and South Africa (2002). I bring to this research my professional training in electronics engineering (Cardiff University and Wentworth Institute of Technology).

1.4 Research Questions

As I note in section 1.2 above and illustrate further in the literature review: most research on incubation as a means of exploiting knowledge in developing economies explores small numbers of cases; outcomes such as return on capital or spinouts; or relationships between universities and entrepreneurs. My research answers these research questions.

- RQ-1: What is the contribution of state science parks and business incubators in Saudi Arabia towards commercial innovation and entrepreneurship?
- RQ-2: How do financial, social, cultural and human capital blend in KSA's innovation and entrepreneurship processes and how might their impact be improved?
- RQ-3: Why do innovation and entrepreneurship processes in KSA appear less effective than those in the UK?

My approach to research questions was as follows.

- My own experience in Saudi commercialisation and reading of the literature suggests an unclear picture of the performance of incubators and success of commercialisation. Indeed, the nature of success (jobs, companies, profit, innovations) is itself contested (Hausmann and Rodrik 2003). I therefore decided to begin with a what question that maps the terrain and gives some basic performance data: what is the contribution of state and privately owned science parks and business incubators in Saudi Arabia towards commercial innovation and entrepreneurship? Hence RQ-1 maps the terrain focusing on the actual contribution of incubation to commercialisation in KSA.

- Noting Al Thawwad and Rashed's (2009) important point that the study of incubation and associated innovation is multidisciplinary, quite simply because the processes connect with policy, finance, strategy, HR, operations and marketing and since my unit of *analysis is the innovating firms, which are* necessarily multi-faceted, I decided to ask a *how* and a *why* question to capture the holistic nature of these processes. An important implication of this approach is that my research is at the point where entrepreneurship and innovation meet: there can be no innovation without entrepreneurial risk taking, leadership and resource assembly; and innovation success is adjudged not in simple technical terms, rather as Freeman (1982) argues, in terms of market (and wider social) success. RQ-2 covers this ground.
- My interest in understanding how and why KSA commercialisation-related innovation processes are shaped and how effective they are needs a standard by which to judge them. Since I wanted to capture the richness of current and planned processes, I discounted a chronological approach over time and instead opted for an international comparison. My choice of the UK was influenced by (a) a large body of research; (b) as a student in the UK, access opportunities; and (c) suggestions in the literature (Al Thawwad and Rashed 2009) and reports that UK practice is a high standard and successful. RQ-3 poses this comparative question.
- All systems of innovation and innovated systems (see Hughes 1983 on the US railways or Bijker (1987) on the bicycle) face reverse salience i.e. their efficacy is hampered by uneven performance or constituent parts (Dedehayi and Makinen 2011). From the perspective of incubators as part of a commercialisation innovation system, inter-linkages with important system parts (such as entrepreneurial culture, availability of risk capital, absorptive capacity, fiscal rules, IPR law etc) draw my research questions towards the impact of financial, social, cultural and human capital. My aim therefore is use active agency (Archer 2000) as a link between an institutional level of analysis and risk taking activities at the level of the incubating firm: an idea drawing on Ogle's (2007) work and justified in chapter two.

Each of my three research questions references clear gaps in the literature and in figure-1 is related to relevant data that I will gather, present and analyse.

Question	Literature issues/gaps	Data	Method	Presentation	Analysis
RQ1: What is the contribution of state and privately owned science parks and business incubators in Saudi Arabia towards commercial innovation and entrepreneurship?	<ul style="list-style-type: none"> • North (2009): alternative models • Etzkowitz (1983): theory-lite? Applicability? • Gerschenkron (1966) relevance in KBE? 	<ul style="list-style-type: none"> • Interviews • Reports • Observation 	<ul style="list-style-type: none"> • Reports • Interviews 	<ul style="list-style-type: none"> • Background chapter in thesis framing empirical issues 	Connect case analysis to culture, context and state-of-the-art
RQ2: How do financial, social, cultural and human capital blend in KSA's innovation and entrepreneurship processes and how might their impact be improved?	<ul style="list-style-type: none"> • Auty (1985) and rentier mentality • Active agency in institutional theory • Informal and re-combination knowledge flows 	<ul style="list-style-type: none"> • Interviews • Reports • Observation 	<ul style="list-style-type: none"> • 12 cases structured for cross sectional comparison 	12 analytically structure case studies (Yin 2008)	Coding, patterning and theming, In-case, cross-case and triangulation with previous research
RQ3: Why do innovation and entrepreneurship processes in KSA appear less effective than those in the UK?	<ul style="list-style-type: none"> • Bowles and Edwards (1993) socio-economic alignment 	<ul style="list-style-type: none"> • Cross-sectional analysis 	Deep analysis of CS themes triangulating with literature	12 cross sectional CS Triangulation	In-case, cross-case, triangulation with previous research

Figure 1.1: summary of research approach

1.5 Theoretical significance and arguments

Commercialisation and innovation processes

Commercialisation involves adding capability and competence from learning and embedded technology, enabling the recipient company to create novel products, address new markets and/or adopt new business models. This is a wide-angle lens perspective on commercialisation, unlike Kumar (1995) and Madu (1992), who define commercialisation in terms of formal knowledge. In taking this wider approach, I align with Schumpeter (1934) who emphasises the holistic nature of the invention-innovation-diffusion process. I also align with Freeman (1982) who argues that in a commercial setting, market success (coupled to social acceptability) are part of the success criterion for innovation i.e. not only does the product (including service) work, but also does it solve a problem people have and are prepared to pay to be resolved? This is why Autio and Laamanen (1955) focused their study on sales rather than technical success. As El-Hadidy (1983) notes, implied in

this approach is the price of the product results in profit for the firm i.e. the business is sustainable. My definition of commercialisation endorses McIntyre and Papp's (1986) view, that whilst it may be inter-regional or cross-sectoral, it is increasingly international. Connecting the technical with the social aspects of commercialisation, links closely with the points in section 1.4 above (see also Kedia and Bhagat 1988; Tsang 1977) that the incubating firm inter-relates with the context and culture in which the innovation is occurring; in particular, as Alk-Ghailani and Moor (1995) point out, with the cultural dimensions of entrepreneurship influencing success. This is especially important when as Lewis (2007) points out, processes of knowledge exchange or joint-venturing invariably pose issues of cross-cultural understanding and negotiated meanings. We will see that culture plays an important part in Saudi and UK commercialisation.

As Rosenberg (1970) and Lindqvist's (1984) study of transferring steam power into Sweden illustrated, TT is not simply the transplanting of physical technology; TT necessarily involves understanding embedded and operation knowledge and the ability to adapt the transferred technology into the institutional, physical and market setting to which it is targeted. The latter point on market success is especially important for commercial technologies, echoing Schumpeter (1934), Cottrill *et al* (1980) and Geijerstan (2004) argues that without market success commercialisation is a failure. For Bell (1997) such success necessarily involved adaptation of the transferred technology to match the competences and capabilities and target markets of the target location. Whilst as Backer *et al* (1995) note, meta-data (such as FDI return on investment) is important in evaluating the success of commercialisation, most research focuses on outcomes and little on the processes of adaptation – the focus of my research. One reason for this is the difficulty in gathering data on relationships and knowledge flows between supplier and customer, compared with the relative ease of assembling macro-level financial data (see Lee *et al*, 2010:136). Additionally, adaptation suggests options, ambiguities and risks, which as Szongs (1989:120) notes add further complexities for researchers. In the case of KSA commercialisation, as Alshumaimri, Taylor and Audretsch (2010) found in the US, despite significant expenditure and inward knowledge flows, outside of oil and gas, KSA rarely reaps commercial rewards from commercialisation: my research explores this proposition

with a view to explaining why it might be so. Both Ramady (2010) and Jordan (2011) call attention to “human capital” in particular social relations of production (as opposed to technical knowledge and technical absorptive capacity. I discuss later, the argument of Al-Thawwad (2008) and others that this is culture – determinism? Pack (2008) contrasts Asian success with Arab failure to adapt.

KSA’s target technologies are not dissimilar to those targeted by other developing and developed economies. Like other developing and developed economies, KSA seeks to reduce the risks and costs of adopting its target technologies by reducing failure rates; specifically by importing exogenous (i.e. an external cause of change) proven knowledge and exploiting it (indigenization) using incubators. A burgeoning suggests that incubation is an appropriate strategy for developing economies: Barse (1988) and Al-Mubarakhi et al (2013; 2014). Significant research, albeit somewhat dated, suggests that incubators can successfully lower innovation costs and reduce risks: (Lumpkin and Ireland, 1988; Merrifield, (1987) and Kuratko and LaFollette (1987). Country studies such as Al-Mubarakhi et al’s (2014) study of the UK and city studies such as Castells and Hall (1994) argue that at a macro-level incubation processes correlate with creativity and growth.

Reducing risk and costs of adapting new technologies is especially important in developing economies, which are characterised by a low (technological) knowledge base and high demand on resources for social and infrastructural development.

Obstacles and Solutions to Commercialization of University Research

With the entrepreneurship mission incorporated into the education and research missions of universities, their role in the economic and social development in societies has increased. Thus, subjects revolving around academic entrepreneurship and knowledge commercialization have drawn the attention of many researchers and politicians in different countries in the world. In Kingdom of Saudi Arabia, too, the knowledge commercialization phenomenon is in its prime and is in its early stages of taking shape and development. Therefore, this research aims to identify obstacles and solutions in the commercialization of university research in Kingdom of Saudi.

Evidence and examples of the growth of technology based ventures in the valid universities in the world such as Cambridge (Siegel 1995), Stanford and MIT (Roberts and Malone 1996) indicate that starting new university ventures and spin-offs and commercializing of university research are easily viable. The only requirement of its success is creating and implementing supportive values and cultures in such risky business ventures. On one hand, many researchers believe that in essence, universities are not entrepreneurial organizations. Perhaps, one reason for it could be the dimensions and largeness of these organizations. Nevertheless, there are many reasons to account for it such as the nature of relationships, the hierarchal structures and organizational levels, intense monitoring of rules and processes, time constraints and the tendency to achieve results quickly, lack of entrepreneurial skills, inappropriate incentive methods and systems, etc. Besides these barriers and constraints, many university professors and staff believe that being an entrepreneur practically prevents them from their main mission as researchers, which is to continue learning and teaching (Zahra and Garvis, 2000).

Key arguments in literature

Accepting Al Thawwad and Rashed's (2009) argument that researching incubation is necessarily multidisciplinary, I will present a wide-ranging literature review. The challenge of a widely scoped literature review is avoiding lack of focus. I frame my literature review around the key points in my research questions: commercialisation, innovation, and entrepreneurship in developing economies (referencing in particular resource-rich, Arabic cultures). Here I indicate some of the main arguments in the literature review.

Reviewing literature on knowledge and learning, I argue that active, social learning (in adaptation process to address the new target context) is a better perspective than (more passive) knowledge management. Thus a key element in successful commercialisation-related innovation becomes active agency (Archer 2000; Ogle 2007) and the creativity of entrepreneurs: the ability to not only absorb but also adapt knowledge – active learning.

Analysing research on knowledge-based economic development, I argue with Pisano (1997) that shortening the gap between knowledge and technology innovation, rather than a particular technology (such as ICT) constitutes becoming knowledge-based: in Kessler and Chakrabarti's (1996) terms the journey from *concept to customer* is shorter. From the viewpoint of developing economies this provides opportunities for technological leapfrogging (Davison 2000), however, it poses the challenge of creating sufficient absorptive capacity (Kinder 2002) to understand the transferred technology to a sufficient degree that allows adaptation and its formulation to address new problems and markets, some of which are already contested by the originators of the transferred technology.

I discuss the nature of institutions supporting commercialisation in developing economies, noting the importance of trust-based institutions (risk capital, IPR) and the 'thick' institutions necessary to support entrepreneurial risk (fiscal policy, absence of corruption and importantly culture incentivising risk-taking. The latter point I consider in the light of research on resource-rich economies and Islamic culture.

In all developing economies, that state plays an important role (tariffs, tax, rule of law, GEM-type business-friendliness criteria). My research questions two and three explore the connection between the innovating entrepreneur and her context, including the KSA state from the perspective of literature on the development state (Chang and Grabel 2004). I note for instance Rodrik's (2015) argument that only two out of three of democracy, globalisation and growth are achievable and discuss the balance the Saudi state policy and actions aims to achieve.

Following a discussion on the nature of universities in developing economies, I discuss university-industry links in this context mounting a critique Etzkowitz's (2002, 2003) triple helix theory as inapplicable to countries with 'thinner' i.e. developing institutions and how UILs can be 'thickened' in particular by attracting international R&D project and spilling-over knowledge and ways-of-working.

I construct a new framework for sectoral systems of innovation to use as a mapping tool in answering research question one, based on Geels (2004) idea of multiple-level institutional linkages and Ogle's (2008) notion of active agency and in doing so criticise applications of systems theory (such as Porter 1995 and the triple helix) to commercialisation and innovation.

1.6 Practical significance

Diversifying its economy from reliance on oil and gas to one that is internationally competitive in growing, high-value sectors that exploit knowledge rather than natural resources is *the* key strategic objective of the KSA Government. Currently, non-carbon sectors contribute only 10% of KSA's GDP (AME 2013). In addition to medical devices, life-sciences, and nanotechnology the 9th Development Plan envisages private sector growth in value-added services (logistics, banking and financial, creative industries) private sector construction companies and agri-food processing.

With 18% of verified petroleum reserves and as its largest exporter, petroleum accounts for 92% of KSA's revenues, the Saudi Arabian Monetary Agency (2013) calculates that 55% of GDP and 90% of exports relate to petroleum. Oil-dependency has characterised the KSA economy since the late-1930s, prior to which subsistence agriculture dominated. Per capita income remains largely dependant on the international price of oil, creating an average currently around half the US level, though with significant uneven distribution of wealth. Saudi Aramco (the Saudi Arabian Oil Company, which is 100% Government-owned) dominates KSA's oil industry and has a US\$ 10,000,000,000,000 valuation producing around 3.5 billion barrels of oil a year overseen by the Ministry of Petroleum and Mineral Resources, which also oversees other activities such as gold mining. KSA GDP growth rates increased from 5.1 to 7.1% from 2010 to 2011.

KSA's Eighth Development Plan (2005-2010) centred on the challenge of becoming a knowledge-based economy. It included a National Science, Technology and Innovation Policy; the National ICT Plan, a National Industrial Strategy, and the Strategy and Plan for Giftedness, Creativity and Supporting Innovation; the Knowledge Economic City in

Medina, and the Technology Zone of the Saudi Organization for Industrial Estate and Technology Zones in Dammam; favoured privatisation of state companies and a vocational turn in higher education. KSA's aim is to dedicate 1% of GDP to RD&D by 2014 (the end of the 9th Development Plan) and 2% by 2024, with a quarter of this coming from the private sector and thereby increase the output of technology-based production by between 30% and 45% and exports from 18% to 26%.

Human resources

Tatweer, King Abdullah's programme for modernising education in KSA sets improvement goals for education quality, training of teachers, a vocational turn in curricula development, skills-based learning, language training and entrepreneurship education (including an emphasis on emerging technologies). One aspect of creating the absorptive capacity necessary to exploit knowledge from emergent technologies is participation rates in postgraduate education. Here KSA performs poorly, despite generous financial support. Between 1994 and 2006 enrolment in MSc grew from 5,312 to 9,768 and in PhDs from 615 to 1,219 (comparative % figures). Saudi education has been criticised as inadequate in mathematics and sciences. It faces the challenge of Arabisation i.e. migrating scientific work, often in English, into indigenous language. Low levels of tertiary education participation correlate with low levels of life-long learning.

Islam

I am aware of a western academic narrative suggesting that whilst Arabic societies were for a period (when is disputed) intellectually vibrant and economically innovative; that anti-innovation is somehow part of modern Islam or some Islamic societies. A range of meta economic histories comment on this debate including Mokyr (1990) who emphasises state institutions; Landes (1998) who emphasises individual entrepreneurs exploiting innovations; North (1990) who focuses on company-level innovativeness; Bowles and Edwards (1993) alignment between production and consumption; and Rosenberg and Birdzell (1986) who emphasise the importance of free markets. Popular authors (Huntington 1996) pose these issues in terms of the inferiority of Islamic culture. Earlier work by Tawney (1962) focused on the protestant attitudes towards usury and exploitation

of the natural environment. In answering my third research question, I will comment on the empirical veracity of these arguments and their intellectual integrity.

One particular strand of this argument is important: are resource-rich economies prone to denigrate risk-taking and innovation: the argument stimulated by Aury (1997; 2001) and later Sachs (2001) and Collier (2008) in his analysis of Africa. In answering RQ-3, I will comment on these debates, noting that numerous Islamic countries are developing successfully (Kazakhstan, Turkey, UAE) and as my research will report are creating successful and innovative global companies.

1.7 Overview of research process

Figure 1.2 illustrates the intellectual flow of the thesis, showing that my research objectives are to understand commercialisation-related innovation and entrepreneurship in KSA, I review relevant literature (chapters 2 and 3), arriving at three research questions (what, how and why) and then drawing together in a new conceptual framework (chapter-4) definitions and a perspective from which to analyse my findings. Following methodology and method (chapter 5), chapters 6 and 7 present rich data gathering from two incubators in the KSA and UK and six incubated firms in each country, in addition to an analysis of institutional arrangements and entrepreneurial culture in both countries. Following in-case, cross-case and cross-country analysis, (chapter-8) using my new framework, I then reintegrate with previous literature, answering the research questions, including polishing my conceptual framework into its final form (chapter-9). The thesis concludes (chapter-10) by highlighting its theoretical, empirical and policy conclusions.

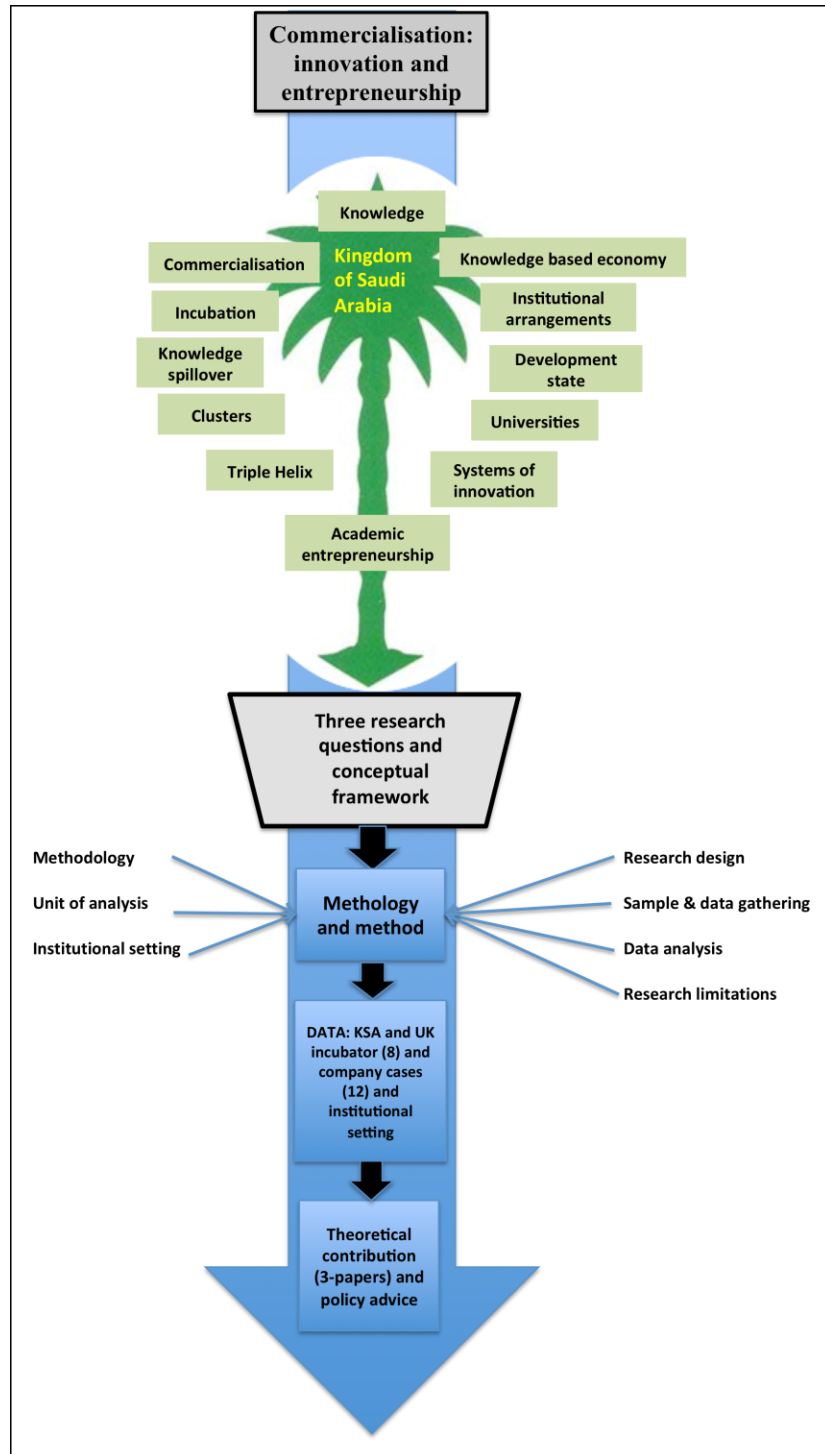


Figure 1.2: intellectual flow of thesis

This research is qualitative. I follow Charmaz's (2007) constructed grounded theory approach, characterised by creating an initial framework from literature, which is then used to structure analysis and inform an amended (final) framework. Data is analysed using thematic analysis supported by theoretical coding and patterning of data. My unit of

analysis throughout is the firm seeking to commercialise transferred technology in the Saudi context i.e. the cultural and institutional parameters enabling or constraining commercialisation.

1.8 Structure and flow of thesis

Figure-3 illustrates the structure and workflow of my thesis.

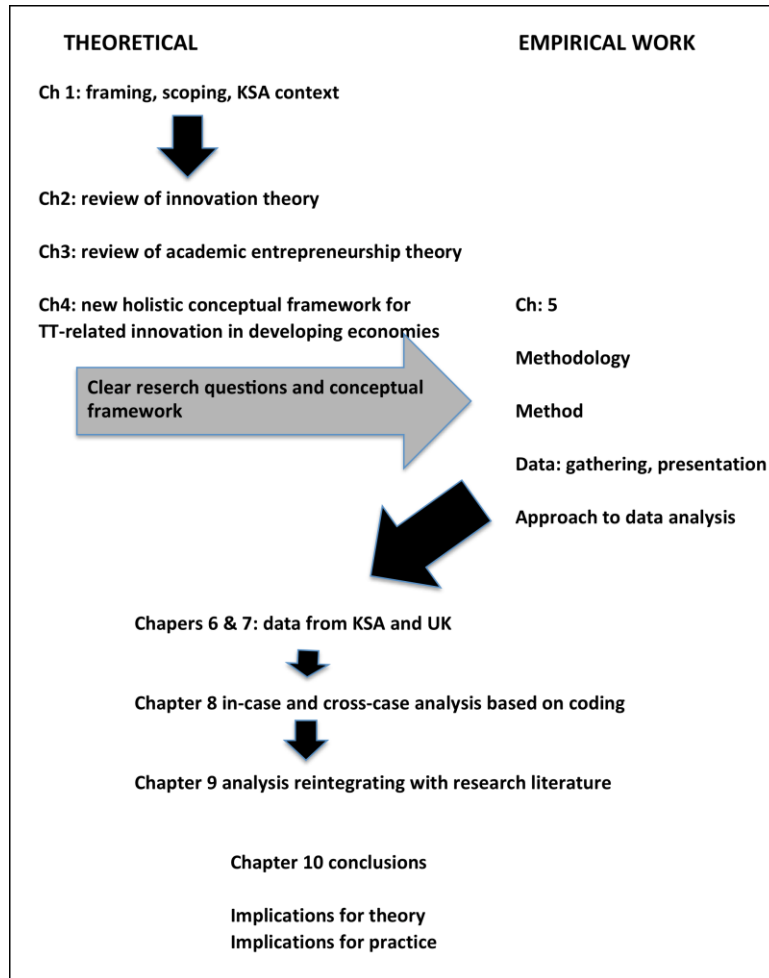


Figure 1.3: structure and workflow of thesis

CHAPTER-2 INNOVATION AND COMMERCIALISATION

My literature review is in three chapters. In this chapter I analyse previous research on the context of commercialisation, the following chapter focuses on the nature and activities of academic entrepreneurs and chapter four presents a new, holistic analytical framework, which guides my data gathering and later analysis.

This chapter brings together an extensive range of literature drawn from innovation studies, economics, economic geography, pedagogy, philosophy of knowledge, strategy and the processes of building businesses. This very diversity of research, each with its own epistemological roots and definitions is one of the reasons why research on commercialisation is complex: the context is complex.

In deciding what to include and exclude from the literature review three decision-rules predominated: firstly, is the literature necessary to an intellectually robust answering of my three research questions? Hence, though important Krugman's work on new economic geography (1993) and unproductive investments (1999) were excluded since my research questions are answerable without centrally featuring these fields of literature. Literature on the nature of knowledge and the knowledge-based economy are included, precisely because no answer to the research questions would be complete without concepts from these fields.

Secondly, given the aim of the research is to produce a new integrated framework with which to analyse and understand commercialisation processes in a developing economy, is the previous research (definitions, findings) a necessary component of the new framework? Important work on fiscal regimes and risk investments (Lockett and Wright 2005) and details of intellectual property regimes across borders (Siegel 2003) were thus excluded, since I refer to these as background material whilst not considering them critical to understanding commercialisation processes in KSA and other developing economies. I have incorporated a critical review of literature on universities, incubation and Etzkowitz's

(2003) triple (quadruple) helix; because these concepts are important in the literature, though in each case I offer critiques of the literature.

Thirdly, I excluded bodies of literature, which whilst important and are referred to, do not for the purpose of this work require problematising. An example is research on venture capital (Bell 1992), the processes and tools of which now appear well understood; alternatively, I included a short review of neo-institutionalism in order to evaluate the application of the development state thesis (Woo-Cummings 1999) to KSA. Similarly, I consider that systems of innovation literature is important, but too often deterministic and without active agency. In a similar vein, I include a brief review of research on clustering as scaffolding towards considering knowledge spillover process in a developing economy. In my analysis chapters I comment on how these theories inter-relate. For example, the development state thesis presumes strong state direction of university-industry linkages, despite the fact that triple helix institutions may be thinner in a developing (as opposed to a mature) state context.

Figure 2.1 indicates the scope of literature included in this chapter. Note the interconnectedness of these literature fields. Further, note that beginning with ‘knowledge’ at the top of the tree, the sequence of discussion (and structure of the chapter) follows an out-to-in trajectory, ending with consideration of commercialisation itself and its economic impact.

Since technological products (along with service innovations) are the targets of commercialisation, it would be possible to take an overarching framework such as actor network theory (ANT) and apply this as a framework. To an extent ANT is the dominant discourse in sociological innovation studies. Founding works include Callon (1986, 1991), Latour (1987, 1988), Latour et al (1992), Law and Callon (1992) and Law and Bijker (1992). This social constructivist approach features interpretative flexibility and is therefore attractively argues that *actants* interact to shape technology and its social acceptability and success. However, on closer inspection all *actants* including physical artefacts are accorded (discovered Callon *et al* 1992) conscious intervention during

innovation processes (see Molina 1999). This fatally flaws ANT since technology is socially shaped (MacKenzie and Wajcman 1985) and the idea that *the sociotechnical moulds the sociotechnical* (Law 1988) sophistry. My aim is to show how the perspectives on commercialisation shown in figure-1 interconnect and causally interrelate, in doing so it is the social forces and entrepreneurial decisions that are ontologically privileged precisely to avoid the danger of technological determinism.

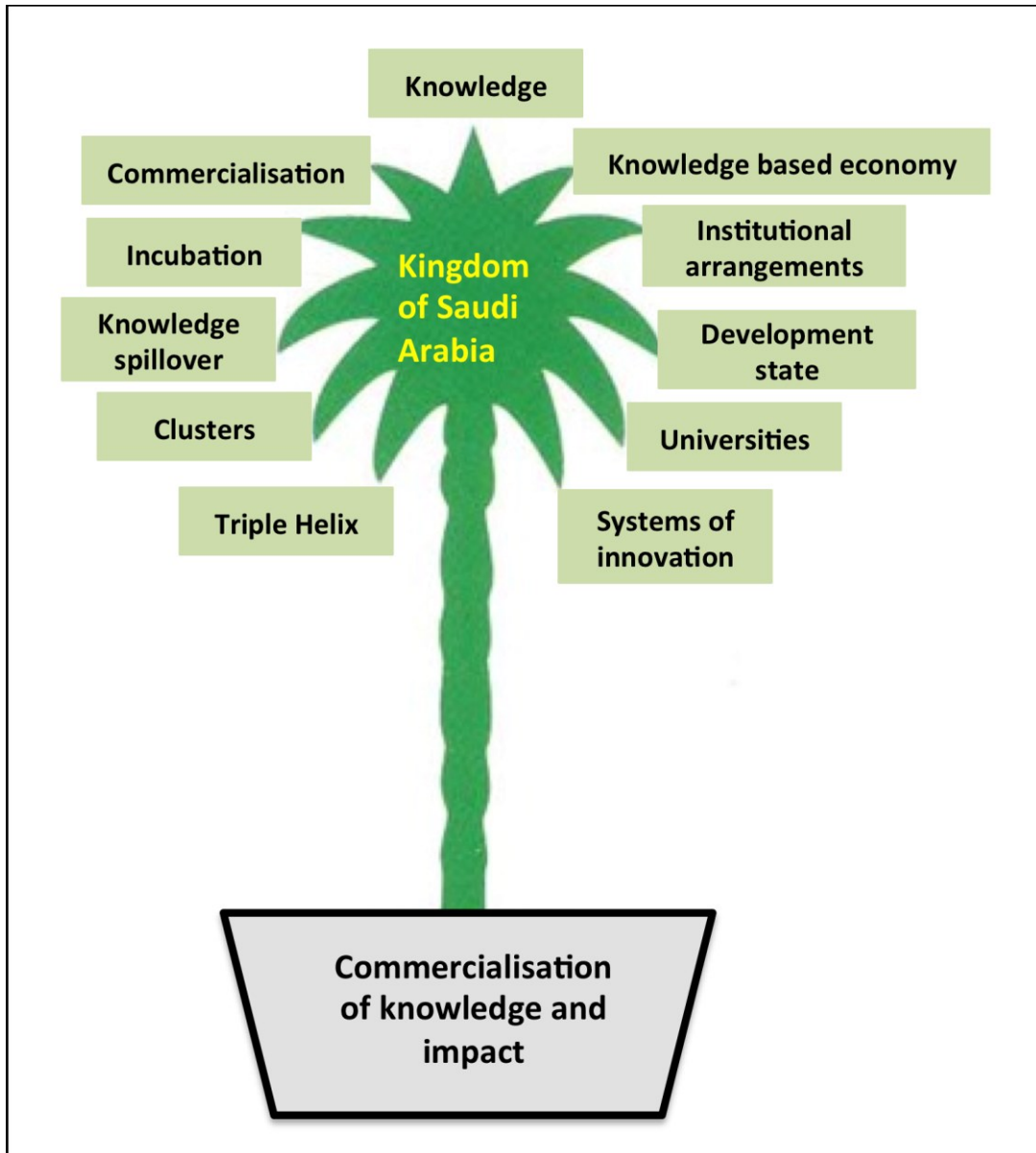


Figure 2.1: Scope of innovation literature review

2.1 Knowledge and learning

Knowledge is central to this research here means *evidenced understanding, sufficiently or useful to guide thought and action and valuably aligns with other knowledge and ways reliable ways of sense-making*. This section argues three points: firstly, I use Vygotsky's socio-cultural pedagogy to show that knowledge use is impossible without active learning - a social process. Secondly, that the codifiability of knowledge is not a significant characteristic, rather its usefulness to people in problem-solving is most significant. Thirdly, I argue that whilst people learn in organisations, organisations cannot learn since learning requires cognition and presumes sentient beings.

Knowledge and active learning

For Vygotsky (1934), cognition (i.e. higher mental processes) occurs for groups of people *and* individuals only by referencing the social setting sharply disputing the behaviourist/cognitivist-constructivist cognition and consciousness paradigms (Wertsch 1985). Consciousness unifies all cognitive learning processes (Nardi 1996); in the process of *internalising* learning, individuals make new combinations and interpretations creating new knowledge using socially constructed semiotic mediations (Daniels *et al* 2007). For Vygotsky, zones of proximal development enable children to develop (with instruction) into adult thinkers by internalising the ability to mediate socially constructed artefacts in their thinking, becoming able to exercise higher mental powers and reach consciousness. Human cognition results from interaction between people and artefacts: Lave and Wenger's (1991) socially situated learning resulting in situated cognition. Consciousness involves thinking - a *first-person* bodily effort (except when unconsciously occurring, see Velmans 2000). We may not fully understand what consciousness is and to exercise it, but as Rosenthal (2008) points out, it is perverse to reduce that most human of characteristics to a simple biological function. Rational cognition appears effective when it is unconscious or conscious. We learn during conscious effort to learn, *and* when we are not making conscious effort since as Rosenthal (2000) points out meta-cognitive judgement such as *feeling-of-knowing* and *ease-of-learning* can occur without consciousness.

In summary, knowledge is never a transferred package, as every teacher and parent knows, people make sense of new knowledge in the context of their previous learning and purpose.

Problem-solving versus codifiability

Nonaka and Takeuchi (1995), Swan and Scarborough (2001) and others envisage an almost mechanical cycle in which organisations codify transferred-in knowledge or knowledge resulting from learning-by-doing. Figure 2.2 presents an alternative picture drawing on pedagogic theory in which learning occurs at different levels, each of which involves cognition by individuals and to which codification may be irrelevant. Indeed, especially where learning is the result of experienced feelings (attachment) as is often the case in services (Kinder 2014) accurate codification may be impossible.

	Level 1 learning	Level 2 learning	Level 3 learning
Argyris	Skills Passive	Context, structures	New premises Deutero-learning
Argyris & Schön	Type 1: tests for errors	Type 2: tests against facts contextualises	Type 3: decontextualises, tests state theory against practice/needed theory
Schön	Training	Integrative Education	Meta-cognition Reflective practice
Raelin	Skills training	Action learning	Transformative Action science
Habermas	Technical knowledge Predictive learning	Metaphoric knowledge	Emanipatory knowledge

Figure 2.2: Levels of learning using distinctions drawn by selected theorists

In summary, purposive business-related learning codifies learning into routines and operations when necessary. In other instances, codification may be dysfunctional because of cost or information overload in knowledge-management systems. Figure 2.3 illustrates components and contexts of knowledge. A final point on informal knowledge is that it may be procedural (i.e. know-how) rather than declarative (know-why and know-what). Often, informal ways of knowing (e.g. customer needs in services) can create competitive advantage.

This research uses the distinctions and meanings in figure 2.3 to more subtly interrogate knowledge - its origins and use for business purposes – and is particular looking for (figure 3.2) transformative knowledge that might create disruptive products or services.

Distributed learning versus learning organisations

Engeström’s (1987) third-generation activity theory cycles of expansive learning, widens activity scope to mediating with background (e.g. network) and foreground (e.g. team) artefacts constituting an activity system. Dialogically, learners (implicitly or explicitly) in interpreting artefacts, have the effect of reinforcing or challenging interpretations and their embeddedness into social structures.

Components of knowledge		Learning Modality
Formal knowledge	Theories, formulae, etc. usually available in written or diagrammatic form e.g. textbooks	.. through formal education
Instrumentalities	Knowledge 'embodied' in the use of tools and instruments; requires other components - informal, tacit, contingent - for effective mobilisation.	.. through demonstration and practice
Informal Knowledge	Rules of thumb, tricks of the trade, etc., available in verbal and sometimes written form: e.g. guidebooks, manuals	.. through interaction within a specific milieu
Contingent Knowledge	Distributed, apparently trivial information, specific to the particular context; sometimes available as data which can be 'looked-up.'	.. by on spot learning
Tacit Knowledge	Rooted in practice and experience; wholly embodied in individuals	.. by apprenticeship and training
Meta-Knowledge	General cultural and philosophical assumptions: values, major goals, etc.; some parts are peculiar to a particular organisation, other to wider society.	.. through socialisation
Context of knowledge		
Domains	The more or less defined areas or 'parts of the world' to which the particular expertise applies.	
Situations	Assemblages of components, people, domains, and other elements present at any particular instant of expert activity.	
Milieu	Essentially the immediate environments in which expertise is exercised; comprising sets of situation occurring regularly at particular locations, e.g. laboratories, offices, operating theatres, etc.	

**Figure 2.3: Taxonomy of knowledge and their contents
(Adapted from Vincenti 1990)**

For activity theory, distributed cognition frames learning (whether conscious or not; embedded or not; widely or narrowly scoped). Distributed cognition involves individual humans thinking: organisations and machines cannot think. Where groups of individuals within an organisation or using machines share knowledge, including knowledge sharing with the agreed goal of solving a particular puzzle, then the social setting in which individual cognition occurs benefits individual cognition by distribution. This is the sense in which activity theory supports the idea of distributed cognition: learning organisation is a metaphor whereas enabling and encouraging distributed learning is a practical management tool enabling entrepreneurs to create and mobilise what Itami terms invisible assets – an absorptive capacity capable of exploiting a knowledge base.

In summary, this section provides a view of the nature of learning and knowledge for the rest of the thesis emphasising active and social learning as a necessary component of all knowledge use and contesting views of knowledge that diminish human cognition and the use of knowledge to solve puzzles by purposive learning involving knowledge distribution.

2.2 Knowledge-based economy (KBE)

Since KSA's aim using commercialisation is to build a KBE, clarity of the concept is particularly important; the contribution of this section. My argument is that emergent new modes of production are not *new* because they use knowledge - all modes of production use some knowledge - rather what is new is closing the gap between science and technology and shortening of innovation cycles. Whereas in manufacturing economies it was possible to leapfrog stages of development by importing advanced technologies (Gerschenkron 1966), the challenge of development is more problematic in the knowledge-based era.

Originating in the in the sociological work of Touraine (1971); Bell's (1974) technology-of-control post-industrial society thesis, argues that information and knowledge would become more important than physical resources and knowledge workers more important than physical work, which would be increasingly automated. Post-industrialism merged from labour process and post-Fordism debates (Braverman; Aglietta) and the post-

modernism perspective (Foucault 1991; and Loyotard 1989) problematising the legitimacy of knowledge and education, with the position of science and technology in terms of power.

Governments readily adopted the idea of modern economies driven by new knowledge and knowledge workers. A UK (1998:2) paper defined a KBE as ...

... one in which the generation and the exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also about the more effective use and exploitation of all types of knowledge in all manner of economic activity.

Typical terms include the *economics of abundance, the annihilation of distance, de-territorialisation of the state, importance of local knowledge, and investment in human capital*. The idea of a KBE is now the dominant discourse in the WB (1996) and OECD and as Peters (2002) notes, the primary development policy is one of filling knowledge gaps and moving up knowledge value chains.

Neoclassical models ascribed economic growth improvement (the Cobb-Douglas function) to factor substitution i.e. replacing labour with capital. Since Solow (1956) and the subsequent critique of neoclassicism, it is understood that learning and knowledge exploitation are the key residual determining endogenous growth rates (i.e. self-generated technology improvement). When Solow (1987) quipped that *You can see the computer age everywhere except in the productivity statistics*, his meaning was the learning (to use the potential technology releases) is just as important as possessing the technology. OECD (1996) suggests that *more than 50 per cent of Gross Domestic Product (GDP) in the major OECD economies is now based on the production and distribution of knowledge*.

2.2.1 Contested interpretations of the knowledge-based economy

Thinking about KBE reflects societal divisions and normative debate. This section uses the neo-liberal (market) and institutional perspectives on the KBE to illustrate contested terms and policy.

From the market perspective Drucker (1959) and Machlup (1962) highlighting the importance of education and knowledge exploitation laid the foundations for work in Chicago theorising knowledge as driving innovation and economic growth in the 'free' market tradition promulgated by Hayek (1991), summarised by Wit (1997:1) as the proposition *that markets do things more efficiently than governments do*. Important work in this field includes Becker's (1964) theorisation of knowledge workers as human capital: education is an investment in people upon which there is a calculable (individual) return and similarly investment in knowledge creation should give a (social) return on investment. Aghion and Howitt's (1998) endogenous growth model attributes costs and returns to education in a quantitative modelling of the impact of investment in education and knowledge creation on economic growth.

This perspective on KBE is criticised (Stehr and Ericson 1992:111) as privileging economic above social factors. Whilst as Smith (2000) notes, *knowledge has been and continues to be core foundation of the economic process*, he goes on to argue that knowledge is also an inherent part of social life, including pre-industrial societies. The difference in industrial society, as Marx (1865/1970) points out is the *conscious application of science* to technological product and process needs. Noting with Magalhases and Stoer (2003:43) that the neo-liberal view of KBE redefines people as human capital with competences and performance levels, Carlton (2001:13) argues knowledge ceases to be non-rivalrous and non-exclusive and becomes itself capital to accumulate and paid-for (Klees 1999) and its dissemination shaped by the largess of the World Bank (Klees 2001).

The institutional view of KBE is complex since it interweaves with social theory and labour process debate; its ontological foundations are institutions and relationships, of which markets are one part not the dominant only institution. Fordist economies 'pushed' products and focused thinking on production. KBEs focus more on products 'pulled' by customers and changing patterns of consumption. If developing economies are to successfully enjoin international markets their products must conform to international standards and appeal to target customers. From the perspective of information and knowledge networks, Castells (1997) argues that networks are the paramount institution in

knowledge-based societies, highlighting along with Florida *et al* (1996) how organisational forms and motivation are quite different in a network society than command-and-control hierarchies, where 80% of jobs and GDP are in the service sector. Knowledge (including subjective assessment of consumer experiences) thus becomes critical in KBEs and societies. This is important, since KSA is not simply a developing economy or emerging market – it is a society undergoing rapid change and modernisation.

2.2.2 Conclusions and relevance to developing economies

This discussion illustrates widely differing perspectives on the KBE highlighting the importance of definitional clarity in using this and associated terms. Clearly the nature of work, products and production is becoming more reliant on knowledge and knowledgeable workers, perhaps it is worth noting with Joan Robinson, that *the only thing worse than being exploited by a capitalist, is not being exploited by a capitalist.*

From the above discussion, I endorse Leadbeater's (2000:43) contrast between old and new economy:

... organised around physical, material, and tangible assets and products. The old economy had a large service sector, but it was organized to service physical products: processing paper, taking orders, managing production, selling, servicing, and repairing.

The market perspective correctly emphasises that knowledge has value only if accepted by markets. As Lyotard (1989:4) argues

Knowledge is and will be produced in order to be sold; it is and will be consumed in order to be valorised in a new production: in both cases, the goal is exchange.

By way of summary, new products in KBEs have shorter innovation cycles resulting from a speedier migration of science into (saleable) technologies (Pisano 1997, Chesbrough 2011); in Kessler and Chakrabarti's (1996) terms the journey from *concept to customer* is shorter. However, the market perspective needs coupling with social change including premiums paid to knowledge-workers, changing tastes, service sector expansion – the issues raised by the regulation theorists, explored in Bauman (1988) and including CSR

issues such as sustainability and ethics. As Chisholm (1999:3) notes, for developing economies, KBE paradigm is both threat and opportunity. Threat if education levels are low, exclusion from IP appropriation persists and exclusion from knowledge networks inhibits entry to international markets. Alternatively, KBE is an opportunity to readjust the world economic order to the advantage of developing economies if they can create and exploit a science base (Das and Kinder 2016), rapidly internationalise (chapter 2) and create the institutions including markets that attract mobile knowledge workers and companies. It is to the last of these points to which I now turn.

2.3 Institutions and the developing economy

Since part of my purpose is to identify how institutions and agents and their interactions can improve KSA's commercialisation, this short section defines terms and critically reviews previous research in this field.

Freeman and Soete (1987) note that institutions matter because some contexts prove more fertile for economic growth than others. Long views of economic growth agree, though disagree on which institutions are important: Mokyr (1990) emphasises state institutions; Landes (1998) exploiting innovations; North (1993) companies; Bowles and Edwards (1993) alignment between production and consumption; and Rosenberg and Birdzell (1986) free markets. Here I argue that institution-building is crucial in KBE economic development; that institutional thickness and untraded inter-dependencies take more time and resources to create than technology transfer; and that creating an entrepreneurial *habitus* depends on active agency.

Institutional theory explains stability *and* change by referencing social hierarchy, laws and cultural predispositions, what North (1990 terms the *rules of the game*), which influence people and organisations and are in turn shaped by the patterned acts of agents (March and Olsen 1989:170; Clemens and Cook 1999). Veblen (1965) and Commons (1934) and Sleznick (1949) and more recently Sen (1979) uses institutional theory to predict patterns of individual behaviour and resource allocation as an alternative to rationalist neo-classical economic models. Old Institutionalists tend to privilege economic factors as drivers of

change or stability (Commons 1934; Alchian 1965, Minsky 1986) though without the *homo economicus* of neoclassical economics, focusing on property rights, state and ideology. Neo-institutionalist theorists (North 1990; Di Maggio and Powell 1983; Williamson 1985; Scott 1995) are characterised by three points of difference from their predecessors: (a) rational choice (Elster 1979), (2) explaining change rather than stability by adopting an evolutionary perspective (Hodgson 1993), from a methodological individualism perspective, and (3) ontologically more strongly feature culture, such as Scott's (1995) idea of *legitimacy*. The cultural turn in institutional thinking (Jepperson and Meyer 1991) frequently employs Bourdieu's (1977) idea of cultural reproduction and North's (1990) notion of path dependency to explain stability, sometimes (Pfeffer and Selnick 1978) highlight the key role of individual entrepreneurs in extracting resources or (Tolbert and Zucker 1983) legitimising routes to resource capture and incentivising organisational isomorphism.

Old institutionalism is correctly criticised as functionalist and determinist (Giddens 1982). Powerful criticisms of neo-institutionalism revolve around structure and agency. Adopting the evolutionary perspective (for example of Nelson and Winter 1982) opens institutional theory to Popper's (1992:24) critique that the theory is untestable; and to debate on whether the biological metaphor is too ontogenic (environment influences) or Lamarckian (cumulative conscious choices) evolution. Elster (1979:18) makes this criticism arguing for methodological individualism, which as Hodgson (1993, 2007) points out is an odd argument in a framework essentially social in nature. Archer's (1988; 2007) work on agency and structure argues that if social theory denies autonomy to one side of a relationship this conflates active agency, the alternative being to attribute interdependence of both structure and agency; thus the entrepreneur and the institutional environment can *both* respond to an opportunity in different ways and overtime alter the actions of the other. This is a particular important point for developing economies, where institutions are often built and alter rapidly and is a point Arrow (1974: chapter 2) makes forcefully: institutions and agents mutually shape each other.

Institutions and developing economies

To understand commercialisation in developing economies this field of literature has important lessons, including the importance of leadership and active agency, the interaction between nested levels of institutions and how Rutherford's (1995) idea of *cumulative causation* in social events results in unintended consequences including perverse incentives. As Storper and Salais (1997) argue, institution building is not only a process requiring laws and structures; it requires changes to cultural predispositions: ways-of-working and thinking: this illustrated in Castells and Hall's (1994) work on cities and Flamm (1988) on creating the computer. Storper's (1997) idea of *untraded interdependencies* is important in these processes, as is Amin's (1994) notion of *institutional thickness*.

An important aspect of informal institution building is the entrepreneurial *habitus* legitimising risk-taking product innovations. Habitus is Bourdieu's (1977) term for the *matrix of perceptions, appreciations and actions* constituting *regulated improvisations*. It is the *endless capacity to engender products, thoughts, perceptions, expressions, actions - whose limits are set by the historically and socially situated conditions of its production, the conditioning, and conditional freedom it secures is as remote from a creation of unpredictable novelty as it is from a simple mechanical reproduction of the initial conditioning*. Habitus can be used deterministically (Elster's 1983 critique), unless causalities are grounded. Potter (2000) who cites a range of persuasive uses of the concept rejects LiPuma's (1993) argument that he it fails to connect the individual to society. Jenkins (1992) argument against Bourdieu, that embedding predilections in the unconscious opens up the charge that they cannot be altered, is answered by Bourdieu (1977) argument that such a view invalidates the whole of social science, which also addresses Farnell's (2000) critique that habitus contains the danger of dualism, external imprinting and Kind (2000) that the term could be employed deterministically. I use the idea of entrepreneurial habitus in the framework developed in the next chapter, agreeing with Sender's (2001) that the concept of habitus can be subtly used and taking comfort from its successful use in a range of empirical studies including Atkinson (1983), Delamont

(1989), McClelland 1990) Engler (1990), Reay (1995), Horvat and Antonio (1999) and Dumais (2002) in addition to Bourdieu's own work.

In summary, whilst institutions matter, thick institutions and untraded interdependencies take time and resources to create: they are a social construction and can only take root at the pace by which habituses alter. My research investigates the institutional arrangements relevant to commercialisation in KSA and qualitative issues of institutional thickness, interdependencies and entrepreneurial habitus an important influence on these matters is the state, especially in a development context; it is to the nature of the KSA state that I now turn.

2.4 KSA and the development state?

As I showed in discussing TH theory, it fails to translate into the context of rapidly emerging economies, a gap filled by Development State theory, which as we shall see I use later to interpret opportunities facing KSA as an alternative to oil-centred analyses.

For Auty and Gelb (2000) the resource-rich state's strategy seeks to retain legitimacy by redistributing rents in the form of social welfare: the *rentier state*. One aspect of unpacking the dynamics of KSA is the extent to which two seemingly contradictory strategies (development state and rent distributive state) co-exist. Other seeming contradictions are more easily resolved: the development state is an open economy that at the same time protects infant industries from international competition – the mercantilist model found in 1970s Japan and later South Korea, Taiwan and currently China and KSA. Resource abundance without a development state model can lapse into the clientism and the corruption Knack (2006) argues characterises Central Asia. This is not so in KSA, where the developmental aspect of Government policy is resulting in a steady increase in non-oil income (up to 14% in 2011).

One aspect of the *burden of backwardness* is the significant role of the state in the economy (hence Bouckaert's (2007) focus on bureaucrats and changing property rights). However, as Chaudhry (1994) argued what differentiates developmental from rentier states

is the role the state plays in using rent distribution to create a market culture and business incentives. The question for this research is to what extent can current KSA rentier-relations migrate to a development state trajectory? This is important since *modernisation without westernisation* rejects the neoliberal dominant discourse favouring western institutions adopted by the US, WB and IMF: the Washington Consensus (Chang *et al* 2004: Brautigam 2009) – what Hirschmann (1981) criticised as *monoeconomics*.

2.4.1 The idea of the development state

Whilst Gerschenkron (1966) had analysed the important role of the state in economic development; it was Chalmers (1982) who challenged neo-liberal development and cultural particularism theories (Wolf 1984; Wolferen 1989) with his idea of the development state (DS), the characteristics of which, figure 3.4 summarises. The *golden thread* in Chalmers’ (1982) study of Japan’s post-war economic development is a nation sacrificing in order to re-establish independence by becoming economically successful a theme also strong in DS analyses of Korea and Taiwan (Johnson 1982) and later China (Leonard 2008). Economic growth becomes a post-colonial strategic route to independence and national integrity, though as Pempel (1999) Korea and Taiwan depended heavily on US economic support.

DSs are only effective in an expanding world economy (open to exports); downturn jeopardises the strategy as events recently in China and earlier in Japan have shown. Budget deficit and instability are also potential problems (Sachs (1995). Parker *et al* (1997) highlights the challenge of property rights; this is important as Bouckaert (2007) shows when *bureaupreneurs* transfer state to private property. In Japan’s case (Woo-Cummings 1991) DS was consciously adopted, whereas in China, Deng Xiaoping famously *stepped on stones across the stream* - improvising as opportunities unfolded (Vogel 2013) or as Coase and Wang (2012:166) suggest *Not by design, the dual structure of reform provided an effective and flexible institutional framework for Beijing to navigate China’s move to a market economy*.

Development state characteristics	Explanation
Nationalism	The DS uses economic growth to achieve and protect national integrity and independence; economic development is late

Internationalist	DS is mercantilist and international in outlook for export-led growth and technology transfer; the DS is open and imitative of advanced technologies and structures
Shared goals	The DS embodies an economic development vision that is widely shared by its institutions, people and businesses
Autonomous economic bureaucracy	Expert, rational planners guide economic development without recourse to special interest groups
Technological learning and adaptation	Public and private organisations are technophile and capable of adapting technologies and ways-of-working to the local context
Industrial policy	There is a clear and achievable industrial strategy including strong business networks capable of its implementation.
State control of finance	Central controls over borrowing; exchange, inflation and interest rates ensure stable state finances
Labour relations	Sanguine and benign industrial relations; staff motivated around competitiveness
Incentives and command structure	Absence of perverse incentives, market discipline; without special interest groups distorting growth
Equity/efficiency balance	DS is benevolent authoritarian privileging development is above the rule of law and democratic engagement; thin civic society

Figure 2.4: overview of development state characteristics

A DS strategy is always catch-up – late development reliant on TT (often inward-FDI) and exports; leapfrogging also quickens the pace of catch-up (Freeman 1997) i.e. by-passing vintage technologies without the costs of displacing existing capital investment or jobs (Soete (1985:416; Perez and Soete 1988; Krugman et al 1993; Lee and Lim 2001). Simple examples include mobile communications rather than fixed line networks (Steinmueller 2001:194); improving productivity using lower input costs (Goldemberg 1998) or new business models such as Gallagher (2008) found in Korean steel. Other advantages of leapfrogging Unruh *et al* (2006) suggest may be avoiding ‘dirty’ development stages; moving directly to customer-focused technologies and business models (Davison *et al* 2000, Vogel *et al* 2000) or innovative adaptations such as the Kenyan mPENSA and National Payments Corporation of India (NPCI) in India (Webb 2014; Mody and Sherman 1990).

A shared destiny future vision is essential to a DS, since urbanisation and modernisation involves altruistic inter-generational wealth transfer from old to young (Pempel 1999) and reordering of vested interests: for example provincial Governments in China only endorsed Deng’s NEZs in exchange for transfer of power. The DS is a value creating rather than value-distributing state; weaker in democratic processes than in development actions, a

socially accepted trade-off (Rodrik 2011) based on equality of sacrifice in which state and society are *mutually embedded* (Evan 1995). In Asian models businesses take responsibility for welfare (Dore 1986) and HR reward policies are subsumed to industrial policy (Terry 2002); labour markets are credentialist (Fleisher 2005). *Semi-permanent socioeconomic coalitions* (Tsebelis 1990) shape domestic institutions to suit success in international markets using *hegemonic projects* (Jessop 1997) capturing advanced technologies using I-FDI. Modernisation becomes the dominant ideology (Liao 2010).

An autonomous meritocratic economic bureaucracy guides the DS, MITI in Japan and MOST in China – absent in South America according to Schneider (1991) offering *administrative guidance* yet (Evans 1995) argues is *embedded* in society and the articulated shared vision. This bureaucracy holds tight control over state finance (Johnson 1987; Woo-Cummings 1991) i.e. state budgets, exchange rates, inflation and interest rates. It promotes in Stiglitz's (1992) high not low equilibrium state.

The DS state model is criticised for its rigidity (Low 2004), lack of democracy (Deans 2004) and dependency on TT (Beeson 2009). Beh's (2008) analysis draws attention in the Chinese case to the importance of the Chinese business diaspora as enabling China's rapid internationalisation.

Social challenges to the Washington development model and unavailability of the thick institutions required by the Nordic model (Castells and Himanen 2002) means that many African countries now follow a Beijing model of development (Brautigam 2009). In KSA the DS is prominent in discourse: my research asks if the DS strategy is suitable for KSA?

2.4.2 Can KSA become a development state?

Previous research, for example Sachs and Warner (1995; 1999), shows that resource-poor economies between 1960 and 1990 grew GDP two or three times as fast as resource-rich economies. Explaining this *Dutch disease*, Corden and Neary (1982) argue that export revenues increase importation and prices of tradable goods, appreciating the currency and

labour prices, making the growth of manufacturing difficult and (Krugman 1987) loss of competitiveness making industrialisation difficult.

KSA is a *capital* surplus (Auty 2001) resource-abundant economy - rents from oil exceed other earnings. This *Santa Claus* state creates a dependency culture effecting entrepreneurship (Al-Hegelan and Palmer 1985; Luciani 1990). To diversify and avoid social disruption when oil revenues dissipate (2035), as Bellin (2004) argues, KSA needs to forego its rentier state model and move to a model privileging entrepreneurship and innovation. My research comments upon trends in KSA towards becoming a successful development state.

2.5 Universities

Universities, as recipients of TT and creators of absorptive capacity play a crucial role in development (Galbraith 1979) alternatively, Wolf (2002) argues that whilst there are individual returns to education, *there is no economic imperative justifying ever-greater enrolments*. This section explores one important arena in which knowledge is disseminated, created and (sometimes) exploited: universities. I argue four points: firstly, developing economy universities need to teach, research and commercialise; secondly, that basic research is necessary if transferred ideas are to be adapted; I then consider publish/patent duality, arguing that universities in developing economies need both, not either; and finally, I argue that whilst corporatism is problematic, universities in developing economies best assist development by paying close attention to social and business needs.

2.5.1 What is a university?

The European view of universities as a *community of scholars* (Newman 1952) is rooted in their origins in European as defenders of religious orthodoxy (Geuna 1998) and the 19th German notion academic freedom (Fuchs 1963). Asian universities traditions differ, the Japanese state made funding conditional on applied and collaborative research (Kunio 1986). Thus, universities reflect the society to which they are accountable, for example in the academic disciplines they create and the activities pursued (Gibbons *et al* 1994). Techno-nationalist states, such as India, intervene regularly to guide university activities

(Stevens 1990; Yamada 2000); other states (Thailand) focus on vocational education. KSA's 68 degree-awarding institutions and 200 R&D units research the target technologies featuring the 5 year plan: medicine, agriculture, engineering and emergent technologies such as nanotechnology and life-sciences. My research returns to the issue of how appropriate KSA's universities are to its KBE strategy.

2.5.2 Basic research

The balance between applied and basic research in KSA is not clear, in part because of terminological confusion (Calvert 2006:199). I follow the Frascati Manual (OECD 2012) characterising basic research as aiming to *acquire new knowledge of the underlying foundation of phenomena and observable facts*. Such research is only possible by researchers at the cutting edge of their field. Though Nelson (1962 and 1998) and Verspagen (1993) point to difficulties auditing the direct economic benefits of basic research, as Rosenberg (1990) argues, private companies would not conduct basic research without benefits. Salter and Martin (2001) give numerous examples of basic research opening up new technological products; one example is Flamm's (1988) work on creating the computer. Pavitt (1998) and SPRU (1996) endorse the view that without basic research, university's ability to conduct developmental research wanes. In summary, whilst applied research is important, conducting basic research characterises those universities most able to contribute to long-term economic growth.

2.5.3 Publish or patent

The Economist (2002) argued that the Bayh-Dole Act was the most impressive piece of law making in the US in the second half of the 20th century making it easier for universities to retain IPR from academic research by filing patents. As a result of the Act, between 1980 and 1993, university patents rose 315%, from 390 to 1,620. Yet, has this been achieved by sacrificing publishing in favour of patenting or can the two go together. Here I argue for the latter case, noting Cohen *et al* (1998) and Henderson *et al's* (1998) argument that applied research can crowd out basic research in the long-term. In the short-term as Agrawal and Henderson's (2002) empirical study of MIT shows the two can co-exist; a finding endorsed by Markiewicz and DiMinin (2005). Similarly, Van Looy *et al* (2005)

find that patenting and publishing are complementary in Europe as does Buenstorf's (2005) study of the German Max Planck Institutes, Carayol's (2005) study of French universities and Breschi *et al*'s (2005) Italian study.

Noting that if patents become a university KPI, researchers become incentivised against basic research, Henderson *et al* (1998) fails to find evidence that this is happening and Mowery *et al* (2004) show that where it does occur it is the result of inexperience in patenting, and Murray and Stern (2005) find that publications associated with patents enjoy a higher citation rate (by 9 to 17%). In summary, the argument that universities either publish *or* patent *or* commercialise is flawed: the best universities do all and more (teaching); the question is which scenario applies in KSA?

2.5.3 University-Industry Linkages (UILs) in Developing Countries

The criticism from Stromquist and Monkman (2000) and Giroux (2006) that focus on the needs of industries is corporatist now finds voice in New Public Management's influence on universities (Lapsley and Miller 2004) and partly relates to the sector's accountability (Leys 2001). Axelrod (2002); Steck (2003); and Clark's (2004) argument that HE's impact on the global economy can and should be measured. Neo-liberal thinkers promote corporatisation of HE, as part of a package (Harvey 2005) hallowing-out the state and in the case of HE refocusing teaching towards student careers and a further (first in the 60s) massification of HE.

From a developing state viewpoint, education is a pre-condition for modernisation (Liefner and Schiller 2008). Hobday, 2000:156), Wong (1997:201) and Lall (2000:41) argue that as firms move from imitation and TT into technological adaptation and new product development firms increasingly need university-educated staff. In Thailand, Brimble and Doner (2007) find that university strategies are agreed in consultation with industry rather than with Government. The World Bank 1998/99 on knowledge development and the main topic of the 2005 UNIDO Industrial Development Report too stress the importance of human capital development for value-added industries.

Of course close UILs presume companies who are willing and able partners (Bell and Pavitt 1997:116). Initiatives such as the Knowledge Integration Community (KIC) model (for example between Cambridge [UK] and US's MIT) are based as Acworth (2008) found on a 'thick' institutional heritage of both companies and universities with advanced technologies and research capabilities (O'Shea 2005; Howells 2006). Studies such as Di Gregorio and Shane (2003; Wright, Lockett, Clarysse, and Binks (2006) additionally mention the availability of risk capital in the environment surrounding successful KICs; Lecuyer (2006) the social arrangements allowing easy staff exchange between business and universities; and Roberts (2002) the possibility of long-term cross-governance research projects. By definition, developing economies lack such institutional thickness.

Studies such as Gaspar and Glaeser (1998) and Kim (2000) emphasise the role of universities as providers of skilled labour in developing countries. Lack of university-level education is often cited (for example D'Costa's 2006 work in Bangalore) as a constraint on economic development. Chen and Kenney (2005) ascribe differential levels of 'knowledge-based' economic development in Chinese regions to the presence or not of research universities as does Basant and Chandra (2007) in the case of Pune in India. It is clear as Wu (2007) notes from studying two research universities in Shanghai (Fudan and Jiaotong) that however good linkages with businesses are a necessary but insufficient condition for commercialisation, which also requires thickness in the wider institutional framework.

2.5.3 Summary

KSA is able to fund universities, attract international researchers and transfer technologies and scientific knowledge inwards. My research investigates the degree to which KSA universities and their partners are able to generate basic and applied research: in short to create a triple helix and commercialisable technologies.

2.6 Sectoral systems of innovation: active agency and business models

National and regional innovation systems (Lundvall 1992) and learning region theory (Morgan 1997, Gertler, 2001) help to understand why some nations and city-regions are more able to adopt new technologies. If for each target technology to be successful the developing economy needs to create a sectoral system of innovation (SSI), two points follow. Firstly, as Memon *et al* (2014) argue, networks by definition are loosely coupled (requisite variety and loose ties that bind) whereas systems have a clear purpose, boundaries, governances, agents and causal relationships. It is therefore important to conceptualise SSIs as purposive systems not loose networks. Secondly, to successfully achieve the purpose of commercialising target technologies, SSIs require transparent leadership – active agency that creates entrepreneurial legitimacy, marshal resources and guide the SSI towards particular products, markets and partnering, one important aspect of which is adopting appropriate business models for the target technology and its markets.

2.6.1 The SSI framework

Systems approaches have two dangers: drawing the system boundaries and establishing causal relationships; especially difficult in social systems (Beer 1979). Breschi and Malerba (1995) argues that grounding particular moments of technological and market opportunity and in the actions of people, is the best protection against systems being deterministic or merely descriptive. Additionally, as Saxenian (1994) Nelson and Rosenberg (1993) and Carlsson and Stankiewicz (1995) argue, establishing interactions between system-levels (SSIs and its firms) requires auditable causal relations. Though Geels (2004) envisages SSIs as networks rather than systems, my approach accepts his point that effective SSIs have active agency: the people (and organisations) responsible for inputs, transformations and outputs have clear remits, roles, relationships and responsibilities.

SSI governances are contingent upon opportunities and heritage: in this case the KSA socio-economic context and the types of rule-making powers are important: regulative (formal), normative and cognitive (intellectual paradigms) that Scott (1995) envisages will set boundaries and governances appropriate to that context what Kay (2004) terms *disciplined pluralism*, outside of which the loose agents are not direct SSI participants.

These governances are dynamic as the SSI matures and enters *phase transitions* (Gladwell's 2006 phrase) towards new products, markets and partners.

2.6.2 SSI, active agency and learning

SSIs are not simply technical networks *al la* Hughes' (1984) and Malerba's (2002) technological systems. Lundvall (1992:2) argued that a *central activity in the system of innovation is learning, and learning is a social activity, which involves interaction between people*. Ogle's (2008) notion of *ideas space* is important; the SSI is a collective knowledge base from which new solutions to customers problems can be created: commercial products. Whereas socio-technical paradigms (Dosi *et al* 1988) guide thinking within corridors, *ideas space* encourages boundary-hopping and novel knowledge combinations: it is a *community of practice* combining diverse disciplines intent on innovation.

Whilst Geels' (2004:915) SSI is a mapping framework, figure 3.5 models an SSI capturing supply and demand, social and technical characteristics at the centre of which are active agents occupying ideas space. In figure 2.5, supply and demand creates a *habitus* within which the agents operate, operations shaped by Saudi culture and ways-of-working aligning production and consumption. Supporting and shaping the SSI is an array of supply and demand, social and technical factors: the more social to the left and more technical to the right. Demand influences include customers, since as Porter (1990) points out, *discerning* customers at home are a good base from which to enter international markets: KSA construction firms are a good example of this. Also, important is the availability of the professional services entrepreneurs require (accounting, logistics, tax, law, design): important linkages to Government policy (section 2.3 above) are shown by NSI connections. The supply side of figure 2.5 begins with the science and technology available to the SSI, followed by the sources of this knowledge and the SSI's ability therefore to exploit the knowledge. Particularly important here are university-industry links, this sector is at the cutting edge of science-technology development. Also important, as Herrmann and Peine (2011) stress are the right mix of leadership, scientific labour and operator level labour, and the supply of resources (capital in all its forms, including state aid). Cross-fertilization of ideas between foreign direct investors (FDIs) and indigenous

firms, either via supply contracts or staff mobility (Østergaard *et al* 2011) is shown to be significant. Thus the issue of evolving standards suitable for British/Indian and international markets and the processes of arriving at decisions on standards, is of crucial interest to the SSI and one of its important interactions with its own and other NSIs.

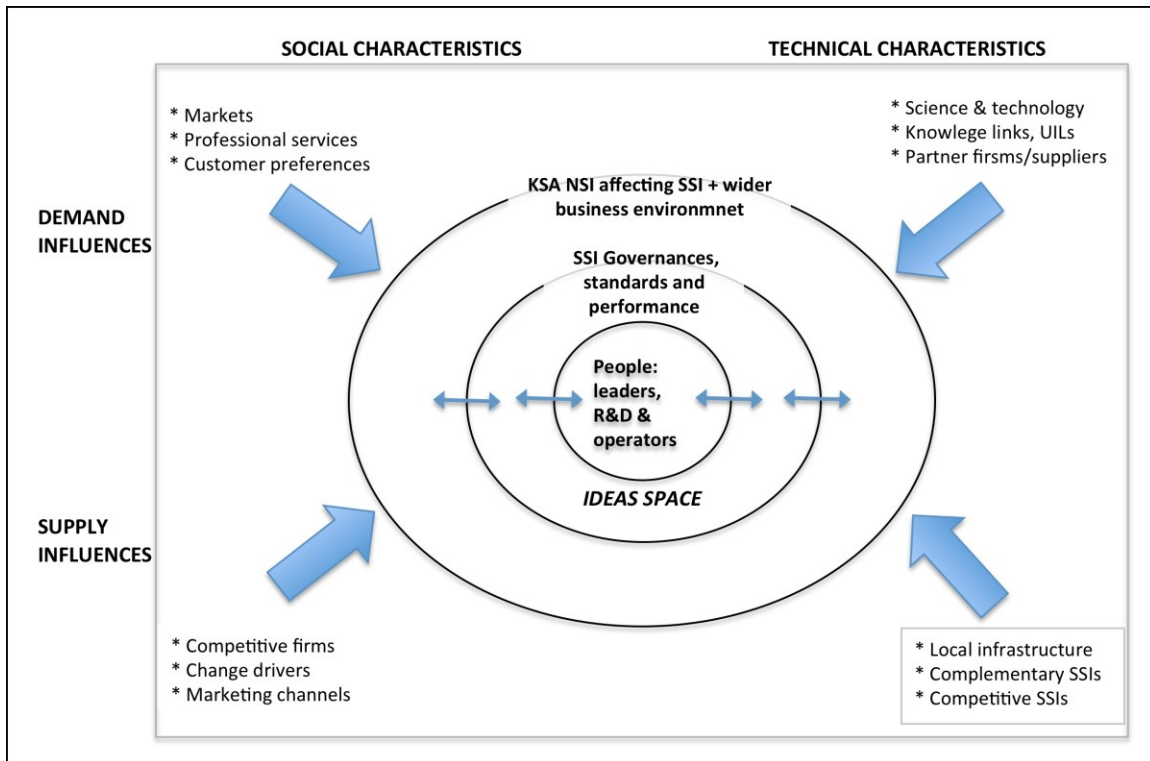


Figure 2.5: Conceptual representation of SSI (Source: adapted from Webb *et al* 2014)

2.6.2 Business models

Schumpeter (1939) argues that each phase of creative destruction comes with its own relevant sets of institutions that enable diffusion a particularly important institution are business models (BMs) since they alter with technology and over time and space. One critical task of the SSI is to evolve BMs appropriate to the target technologies that align with customer preferences. Additionally, as Teece (2010) notes, the BM shapes the *organisational and financial architecture* of a firm.

A BM schematically represents choices around how the business creates and distributes value amongst stakeholders centring on costs, sales/price and margins and predicting

profitability. For the customer this becomes the value proposition, for the investor the business plan. Whilst the BM guides action, it is not an unchanging recipe since as Baden-Fuller and Morgan (2007; 2010) argue entrepreneurial leaders conduct *thought experiments* continually tweaking the business model in particular in the *activity system* (Zott and Amit 2007) mediating supply and customers. This is McGrath (2010) a *discovery approach* to evolving business models in opposition to Demil and Lecocq's (2010) static approach. My point is that (for example) the business models evolved by a life-science SSI will differ from those of the medical device SSI and each may adopt a different model for target Chinese than US customers.

2.6.3 Summary

In the ninth 5-year plan medical devices, life-sciences, and nanotechnology are target technologies. My research will investigate at a policy level the suitability of KSA SSIs in these areas for the commercialisation of knowledge, inquiring particular on the *thickness* of institutional arrangements to support commercialisation processes (including innovative business models) and to achieve the targeted outcomes: in short, do the SSIs operate as loose networks or focused systems? As this section has argued, SSIs are populated by people, especially leaders and entrepreneurs as active agents are important is goals are met. My research investigates how effective SSIs are from the viewpoint of their leaders and entrepreneurs.

2.7 Triple Helix - a heuristic?

The dominant conceptual framework for commercialisation is Etzkowitz's (1983) triple helix (TH). I argue that the TH is neither a testable model nor a theory; indeed, its lack of intellectual integrity in relation to other theories is a major weakness. After a brief overview of how the TH approach originated and developed, I argue (2.7.2) referencing section 2.4 above that institutional *thinness* limits the usefulness of the TH in developing economy contexts; its ability to act either as a policy guide or a comparator tool is curtailed. TH may however be a useful heuristic metaphor (2.7.3).

2.7.1 The origins and use of the triple helix

Origins and development of the TH

The triple helix (Etzkowitz 1983; 2000) is a neo-institutional framework designed to map and analyse the inter-relationships between Government, universities and business that commercialise university research challenging Lowe's (1982) the dyad that excludes universities. Each triad is conceptualised as a sub-system (Luhmann 1984), evolving together to support commercialisation (Leydesdorff 1996; 2008; Leydesdorff and Etzkowitz, 1996, 1998). Premised on non-linearity of innovation processes (Freeman 1982), the idea of an entrepreneurial university is important: educating and researching to meet the needs of industry and adopting a *third mission* to commercialise.

Development of the idea

The original (mode-1) version of the TH was Government-led – statist – (Turpin *et al* 1993; Leydersdorff and van den Basselaar 1998; Shinn 2002; Etzkowitz and De Mello 2003) was replaced (Etzkowitz 2003:302) by a mode-2 according equal importance to business and universities. Colapinto and Porlessa (2010) and Ranga and Etzkowitz (2013) now synthesise the TH with systems theory highlighting five processes: technology transfer, collaboration and conflict moderation, collaborative leadership, substitution, and networking in three *spaces*: knowledge, innovation and consensus. Ranga and Etzkowitz (2011) discuss Central/Eastern European transitional economies using a TH-NSI approach, without theorising the synthesis, or the basic/applied research relationship and institutional setting (IP, professional availability etc). A current incarnation of the theory Todeva and Etzkowitz (2013) emphasises learning and knowledge development viewing the TH as a *highly charged intellectual enterprise*.

Various authors have sought to add dimensions to the TH making it a quadruple helix. These include Arnkil *et al* (2010) who add users as the fourth leg; Lindberg *et al* (2010) adding the gender dimension; MacGregor (2010) adding eco-systems and Datta and Saad (2011) including international migration. Perhaps like razors shifting from one to multiple blades, we now await the hexagon helix. In 2008, Etzkowitz suggested that the TH gives rise to knowledge capital: this important idea is discussed below in section 9.3 below.

Taking an alternative route, Dezhina and Kiseleva (2008) argue that such is the debilitating impact of the Russian state on innovation and entrepreneurship that Russia is a double-helix, in want of a third leg.

My point is that quite fundamental characteristics of TH theory remain unresolved: as does its relationship to existing bodies of literature (innovation theory, diffusion economics). By way of example, Deakin (2014) argues that conventional rankings of city innovativeness or smartness miss the point that advanced social networks, embedding communications and other technologies, are a major spur to innovation often neglected in TH theory. Perhaps his significant contribution is to highlight the importance of learning, as opposed to knowledge transfer as important. Although the author self-cites twelve times, Castell's (1998) on social networks and innovation is not cited: TH theorists often find no need to locate their contributions within existing bodies of learning. To reinforce this point, since Massey and Quintas' (1992) pioneering work on *high-tech fantasies*, we have understood that science park developments as a business model are only successful if the property aspect of the business repays capital investments (in commercial rents and housing sales) and if the park's businesses are situated close to a relevant pool of labour/choice of employment for labour. Bellgardt *et al* (2014) pose the intriguing issue of migrating a business park into a self-sustaining city using housing developers as an intermediary between the TH constituents. They do not cite Massey's work and provide only sketchy evidence in a Berlin-Adlershof case study. Nevertheless, their approach of identifying key intermediaries necessary to inject sustainability into geographically bounded TH initiatives is worthy of research.

Popularity

Leydesdorff and Fritsch (2005) note that following the UN (2000) Millennium Development Goals, balancing knowledge, social and business goals, the TH became mainstream policy alongside Porter's (1995) promotion of clustering. Etzkowitz (2002) positioned it at the ideal tool framing policy, resources and knowledge. TH's popularity arose from the perceived failure of linear technology transfer (Chang 1994; 1995; Saha *et*

al 2004) and its alignment with other policy trends such as open innovation, adoption of ICTs and interdisciplinary development projects. In Dawes and Eglene (2004) terms it became a framing approach suitable for integrating popular policy perspectives also including the idea of international entrepreneurship (Blumenthal and Schlissel (2007) and interoperable systems (Solomon and Brown 2005).

Another reason for the popularity of TH is its use as a chameleon theory: changing linkages and vocabulary as new ideas emerge. Gebhardt (2015) introducing a special issue of *Triple Helix* on the city point to the limits of neo-institutionalism (without saying what these are) preferring instead the idea of a *smart city*. They Cite Sassen (2006), who actually uses the term *global cities* and focuses primarily on financial services and international company headquarters, surrounded by professional services. Take a different perspective, Burgos-Mascarell *et al* (2016), reference a science fiction utopia (Roth's *Divergent*, 2011) as a case study shows that *inter-faction coordination* is the key to successful innovation and that without it TH models unravel.

In summary, TH became popular as theories of linear innovation were challenged (principally by evolutionary economists and entrepreneurship theorists); its enduring popularity in some academic circles is because of its eclectic nature and seeming usefulness despite not proposing a policy agenda and irregardless of studies failing to give it empirical verification.

Empirical studies

Empirical studies framed by the TH abound: South American studies include Mello and Rocha (2004); Etkowitz, Mello and Almeida (2005); Saenz (2008); Bianco and Viscardi (2008) and Luna and Tirtido (2008). African examples include Konde (2004), Kruss (2008) and Booyens (2011). US studies Campbell *et al* (2004); Feldman and Desrochers (2004); Boardman (2009); Wang and Shapira (2012) and European studies (Klofsten *et al* (1999); Inzelt (2004); Geuna and Nesta (2006); Lawton-Smith and Bagchi-Sen (2010); Geuna and Rossi (2011) and Svensson *et al* (2012). Section 9.3 below will argue there is little evidence for TH working either in KSA or the UK.

Methodologically these are mostly qualitative case studies neither triangulating with other evidence nor reintegrating with (critical and alternative) literatures. TH remains a framework i.e. a set of variables without clear causal relationships (which would make it a model capable of prediction) or robust grounding in testable theory. For example, Raza and Saad (2011) note that the TH approach has had limited success in Malaysia but do not draw connection to institutional thinness (Storper 1997) for example by failing to develop IP systems, risk capital and availability of business professionals. Vargas (2011) analyses the relative success of South Korea compared to Mexico without referencing the absence of basic research in the latter; a similar absence can be found in Bouraoui *et al's* (2011) analysis of South-south JVs. Other examples include Farinha *et al's* (2016) Portuguese case study, which examines the TH from a regional-innovation perspective (in this case olive harvesting) focusing on academic-industry relations, noting that where market growth is a restraint, attracting development finance for both academic applied research and business innovation is a problem: hardly a new conclusion and certainly not verification of TH theory. A final example, is Breznitz's (2007) use of TH theory to compare innovation regimes in Ireland, Israel, and Taiwan; a study with empirical insights yet since it only superficially charts the culture and context of each case, ends up revealing little that is new.

Some newer studies are quantitative; itself troublesome, since without accepted definition of boundaries, variables and causal relationships quantitative testing of a systems theory appears precipitate. Isaksson *et al* (2016) for example study patents in US high tech sectors, concluding that where buyers and suppliers are innovative, this creates mutually stimulus of innovation as a result of knowledge spillovers, whether or the buyer and supplier are in same sector; best if long-term relationships. This hardly verified TH theory, especially since the conclusion has been known since von Hippel's (1988) work. Applying a quadrilateral TH (i.e. including arbitrageurs) and (as I show below) the equally policy-lite NSI at a state-level, in this case Ghana, Bartels *et al* (2016) survey 578 relevant agents and after a factor analysis conclude that skill capability, market sophistication, financial markets and organisational risk are the main factors inhibiting innovation in Ghana. They

make only general policy recommendations, such as *recalibrate skills training*, concluding that developing countries will benefit from policy initiatives strengthening their institutional and financial frameworks. Again, use of the TH framework for an empirical study reveals nothing new. A third example of quantitative empirical work using TH is Petersen *et al* (2016) who revise the TH model into supply, demand and technological capabilities, analysing meta-data on medical innovations (they incorporate TH in first) showing interaction between the three correlates with successful (market) innovation i.e. evolutionary economies uncertainty: another conclusion without making a new contribution.

In summary, both the qualitative and quantitative empirical studies using TH as a research framework fail to be convincing in the validity of TH, which added to the fact that most offer re-definitions or new variables suggest that the theory remains too loose to be applied or alternatively cannot be robustly tested. I agree with Mowery and Sampat (2004): the TH is problematic when empirically tested.

2.7.2 Criticisms and analysis of developing economies using triple helix

Recent research criticising TH reach the similar conclusions of earlier research: that the theory lacks rigour. Farmer *et al* (2016) analysing the diffusion of 53 technologies show that while aggregated data provides predictable spread rates, the actual speed of a particular technology's diffusion relates to the factors Schumpeter identified i.e. applied research migrating knowledge into products and the availability of finance and markets. Other recent research similarly questions any new contribution added by TH. Noting that entrepreneurial risk necessarily involves uncertainty Vaivode (2015) suggests an algorithm for use in business modelling that allows for degrees of technical, commercial, organisational and social uncertainty. This would be break-through research supporting TH if it were not the case that simplifying assumptions in an algorithm would be a poor way of building a business model.

Partnering is one way of trying to create the TH interactions. Zaini *et al* (2015) explore the Skolkovo Institute of Science and Technology (Moscow), a graduate school,

partnership with MIT (Boston) seeking to create a “world class” innovation centre. They find that ambient network factors (risk capital, clear commercial law enforcement) are inhibitors, not technical expertise, which is abundant especially in software and Internet security knowledge: hardly verifying any notable new contribution from TH. Similarly, Inzelt (2015) points to the desire for effective TH-type innovation in Armenia, however, her analysis shows universities only beginning to build the absorptive capacity to productively transfer knowledge; the absence of independence from the state, HR shortages; in short no realistic way in which the TH applies and no policy-agenda to make it apply.

Other recent research similarly fails to offer a robust defence of TH. Balzer and Askonas (2016) set themselves the daunting task of comparing Russia and China using the TH model at a meta-institutional level of analysis and Etzkowitz’s (2008) precondition of effective state institutions. Citing previously published data on universities, patents and key sector outputs, they make the case for China’s superior achievements, noting the important role of indigenous and IFDI private investment. No deep discussion is offered of the role of advanced (development state) bureaucracy in China’s case, its entrepreneurial culture and history of experimentation, and the size of the Chinese market. In short, TH seems to lead to mechanical simplification, rather than attracting researchers to the complexities of innovation systems. A final example of apply TH is using it as an example of post-modern hybridity of organisational dichotomies, in particular legal intermediaries. Reich-Graefe (2016) suggests that such legal entities act as a fourth dimension of the TH offering coordination, centralisation and control functions in the TH system, he cites hybrid legal entities supporting innovation and goes on to explore a biotechnology university spinoff, startup in Helsinki (plant productivity) the failure of which he attributes to suitable legal frameworks for the technology. However, in the absence of serious information about the product and market it is difficult to accept the research as verification of TH or the failure of the company as resulting primarily from the absence of legal organisation hybridity.

TH has criticised for underplaying the importance of governances (Tuunainen 2002), especially important since bridging academic and business governances as Vohora *et al* (2004) argue is often a barrier to commercialisation: few universities employ incubation managers with business experience according to Kirkland and Stackhouse (2011). Section 2.5 above considers patenting versus publishing, as an example of conflicting governances. TH theory offers to guide university startups, bereft of legitimacy and facing (Stinchcombe 1965) the *liability of newness*, without saying how to overcome these governances challenges. TH is theory-lite Saad (2004) argues; it fails to integrate with other fields of literature representing nuanced understandings of innovation processes. Systems approaches focus attention of goals, causal relationships and outcomes, yet in its recent synthesis with systems approaches, little of this literature is referenced. Another example is the recent adoption of knowledge capital (Etzkowitz 2008). Bourdieu's (1985; also Burt 1992 and Putnam 2000) idea of social capital, along with human capital (Becker 1962) and sexual capital (Hakim 2011) as Fine (2001) points out, inflates the concept of capital to make it awkward to use without qualificatory explanation. *Capital* in these senses is no longer a 'hard' resource with exchange value deployed to create profit.

As I argue in section 2.4.1, Chalmers' (1982) idea of the development state (see figure-2.4 for characteristics) has been applied only in Asian context and to some (Pempel 1999) constitutes an Asian development model. My argument is that to successful shift from oil dependency to a KBE, KSA might examine the development state model and look to adapt it to a Saudi context. In particular, the idea of national integrity and shared destiny seem important to KSA. One important aspect of the development state model is using university-industry linkages to create new knowledge and leapfrog existing technologies and business models. China appears to be successful doing this at the moment: deploying UIL in export orientated industries such as electric vehicles, biotechnology and ecommerce using UILs to develop science and technologies. At first sight TH theory aligns with the development state perspective. However, the wider socio-political aspects of the development state thesis (shared destiny, generational sacrifice, autonomous economic bureaucracy, industrial policy and labour relations) are a far wider perspective and policy content than TH theory. Additionally, as I argue above, TH assumes a level of institution

thickness (including non-competitive institutions) unavailable to developing countries such as KSA (or indeed China). Agency in the development state is led-by, but not limited to the state and its economic bureaucracy, agency in the TH rests with academic entrepreneurs with the state providing context rather than leadership.

Authors such as Balzat and Hanusch (2004) note how difficult it is to use the TH framework in developing economies. Institutional thinness (above) affects innovation within developed economies and Chang (1995) shows how technology transplants often fail because basic physical and people infrastructures are lacking. Referring to *the set of factors surrounding a phenomenon that exert some direct or indirect influence on it as a context effect*, Whetten (2009:31) criticises TH as framing problems without creating a policy agenda to resolve them. As Shapiro (2011) a dominant point in developing economies is that institutional thinness inhibits cross-governance working and knowledge spillovers. TH as a heuristic metaphor: useful despite its theoretical shallowness and difficulty migrating to the developing economy context.⁴

Metaphors can be *theory-constitutive* (Ortony 1993) but only (Polanyi 1958:175) if used to structure the search for evidence; in this sense, a metaphor is a nascent theory (Llewelyn 2003), but not a theory in Weick's (1989) sense of ordered assertions predicting generalisable behaviour. TH fits with Bhaskar's (1979) notion of *practical adequacy*: ways of thinking the validity of which is contextual (Burrell and Morgan 1979), relating to a particular conceptual system (Lakoff and Johnson 1980) but falling short of precision or propositionality (Black 1979). It is in this sense that the triple helix is a heuristic metaphor.

2.7.4 Summary

⁴ Kuhn (1970:210) suggests that metaphoric thought is essential to science. In musing around comparisons Gummesson (1991) argues, similes create new meanings or suggest other logical similarities i.e. analogies. Dawkins (1986:195) argues that, *the human mind is an inveterate analogiser*. For Lakoff and Johnson (1980) metaphors aid understanding by linking the unfamiliar to the familiar: imagineering in which meanings evolve, become redundant (Schwarz 1988) or disconnect from their origins - what Penfield and Dura (1988) call *quotes from the ancestors*. Metaphors are often used declaratively for textual emphasis or as Kövecses (2002) suggests *they render intelligible the acquisition of new knowledge* by saying no to old associations and inviting new ones (Garfield 1986).

Reviewing almost two decades of research on TH reveals that empirical studies (both empirical and [more recently] quantitative, have failed to substantiate the theory. A string of critiques over its inapplicability to developing economies, characterised by thinner institutional arrangements, is unanswered. Theoretically, as the above section demonstrates, the theory remains loosely constructed in terms of what the variables are, how they are defined and how they causally relate to each other. Many of the empirical studies fail to make contributions adding to existing understanding, for example on the need for risk capital, stable legal arrangements and universities with the absorptive capacity to translate formal knowledge into new products. Other research shows the limited usefulness of TH in comparative research. I conclude that although TH is part of the dominant discourse on developing economies and universities, it is best used as a heuristic metaphor and not as either an analytical framework or policy guide.

2.8 Clustering / knowledge spills

Clustering and knowledge spills only adjacently connect with my research, however some of the concepts feature in interviews and policy documents; therefore this short section defines terms and maps the terrain.

The allure of Silicon Valley is making the desert fertile: knowledge-based jobs creating world-leading products and technologies: technological cluster with a silicon landscape (Hall and Markusen 1985), a new western sunrise (Hall *et al* 1987). Effective clustering may take 50 years (Saxenian 1985): to establish social networks (Castells and Hall 1994) and knowledge-laden supply chains (Oahey 1985). This helps explain, the multi-dimensional nature of clustering represented in figure 2.6.

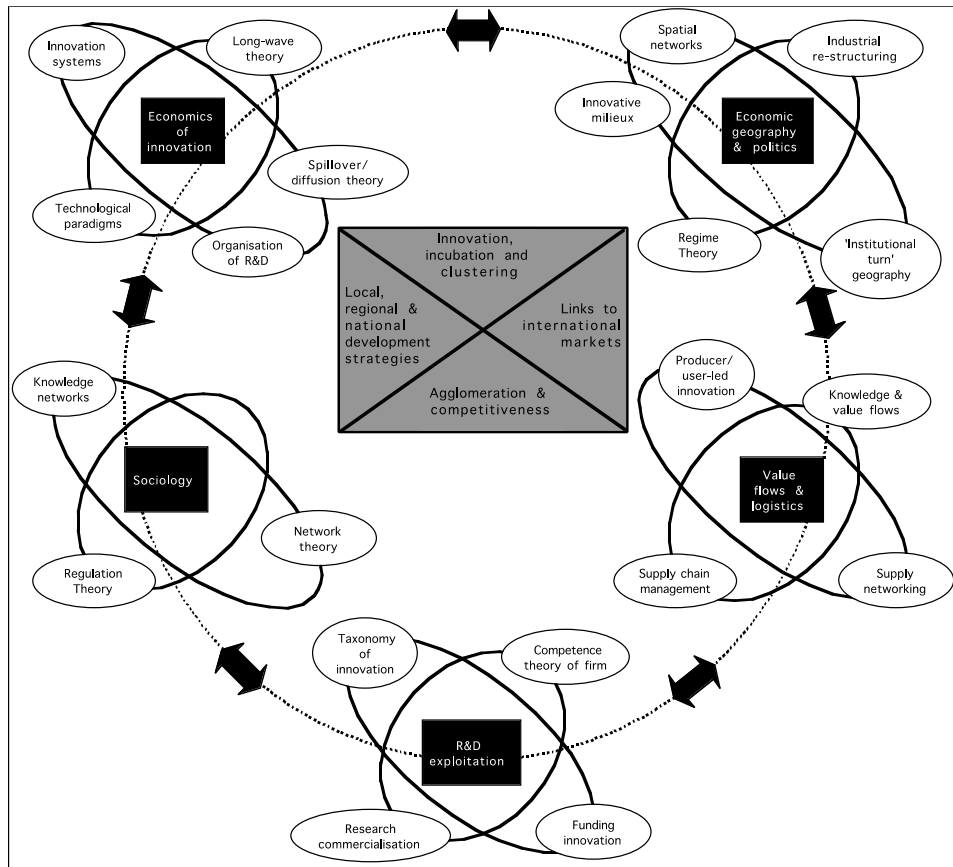


Figure 2.6: Five institutional Approaches to spatially focused innovation showing theoretical frameworks important

My focus is on creating and spilling knowledge spillover and supporting purposive business networks, noting that physical infrastructure does not guarantee success (Massey *et al* 1992); that insularity endangers cluster sustainability (Harrison 1994) and that cluster governances entail some degree of loose-coupling (Grabher 1993).

Figure 2.7 conveys the interaction between place (physical) space (social): Yi Fu Tuan's (1977; 1979) *sense of place* as more multifaceted than simple agglomeration of businesses (Marshall 1919) and now found in new economic geography (Harvey 1996; Soija 1996 and Krugman 1998). Ironically, as Castells and Himanen (2002) and Stiglitz (2002) point out the more economies globalise – in the knowledge-based era – the more localised relationships and knowledge flows matter.

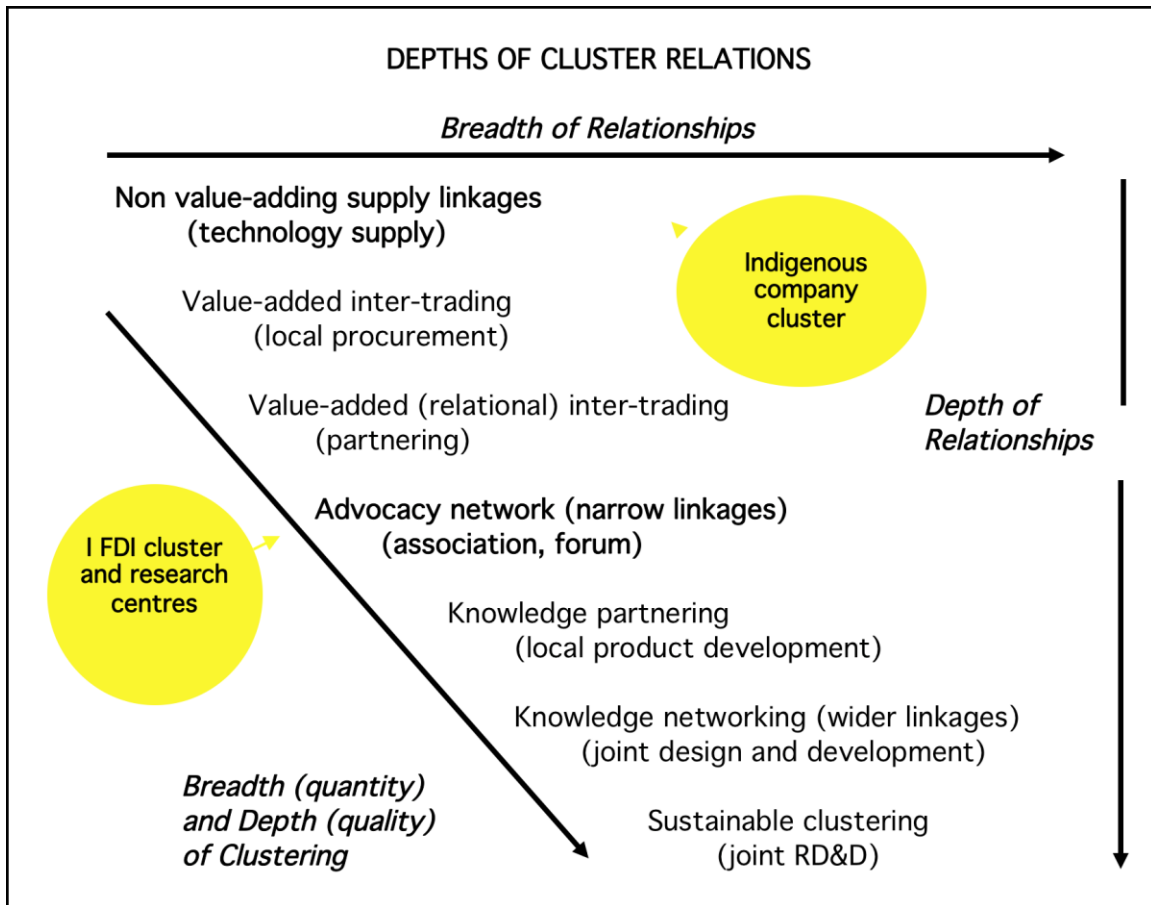


Figure 2.7 depths and breadth of cluster relations
(Source: Kinder and Molina 2001)

Learning and knowledge flows are then an important result of clustering: my research examines why the location of incubators contiguous with universities, targeting incubation, so often fail to deliver where requisite variety (Lundvall 1992) is lacking.

Unlike academic knowledge that is based around excludability (Zuker et al 1994) spillover in business networks overcomes Baldwin and Scott's (1987) appropriability problem by sharing standards, exchanging staff and social discourse. The costs of gaining from knowledge spillovers are continued membership of the business network and maintaining sufficient absorptive capacity to appreciate the learning (Langlois and Robertson 1996). Audretsch and Stephen (1999) argue that cluster members *give because they get* though spilling knowledge he also argues (1998) can be incentivised by good relationship at a personal level especially where knowledge is sticky (Langlois 1997).

2.10 Commercialisation of knowledge

Here I argue that figures on university commercialisation are opaque and even more so their subsequent growth and diffusion i.e. the final desired outcomes. Spinouts UK (2014) list 2,000 UK university spinouts surviving at the end of a ten-year period (i.e. 200 a year from 162 universities - less than two per university per year). Some universities (2000 to 2010 figures) perform better: Imperial (59) Edinburgh (49), Cambridge (44), Warwick (36) and Strathclyde (35). Given that university spinouts have a higher survival rate and often exploit research, their economic impact may be greater than typical startups. In the UK, 90,000 businesses start each year, adding a net 50,000 to the total of 2.8 million UK businesses. An unknown number of companies follow the Xerox strategy and spinout companies each year. University spinouts are then a small proportion of company startups or total spinouts making evaluation of their lasting impact important.

2.10.1 What is commercialisation

Professionalised (often university) research (Mowery and Rosenberg 1998; MacGarview and Furman 2005) and university-industry links (UILs), especially applied research (Rothaermel *et al* 2007) is intended to create product and process innovations. Many universities Markman *et al* (2008) note, now feature commercialisation (figure 2.9) as part of their mission (along with teaching and research). UIL suggests also embedding business problem solving in pedagogies and a focus on career preparation (Abreu *et al* 2009) and close interactions with businesses (Perkmann and Walsh 2008) eg in conferences, shared staff and wider networking (D'Este and Patel 2007) including joint projects, contract research or services such as consultancy or testing (Bonaccorsi and Piccaluga (1994).

Businesses rarely fund basic university research: as Perkmann (2011) suggests commercialisation more often involves universities setting business-related parameters to applied research. Since only proprietary knowledge has financial value, (Shane 2004), protecting intellectual property (IP) is important and often (Mayer 2003) part of formal commercialisation agreements. The incentive to commercialise may be individual or

organisational or joint (Agrawal 2006); for example with researchers being given equity as sleeping partners or knowledge advisors to companies.

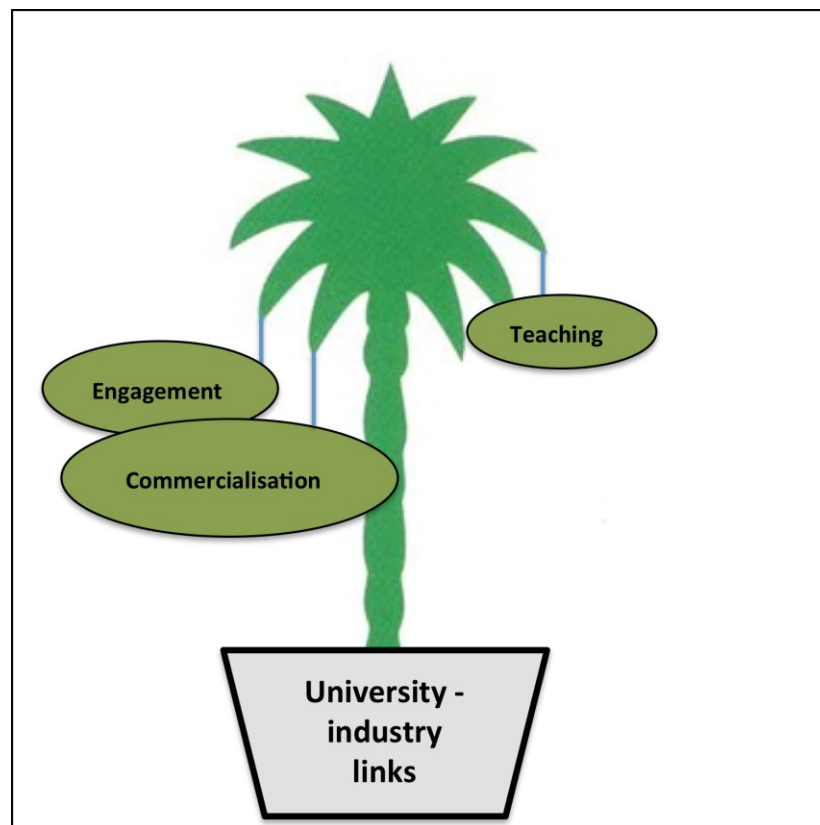


Figure 2.9: Three dimensions of UILs

Research (Klofsten *et al* 2000; De'Este and Permann 2011) suggests that whilst c20% of academics participates in formal UIL, less than half of these (i.e. 10%) participate in commercialisation. Participating researchers, Bozeman and Gaughan (2007) and Boardman and Corley (2008) argue, are more likely to be male, senior, attached to dedicated research centres, to also be successful at publishing and (Carayol and Matt 2004) to work in larger research centres. Markman *et al* (2005) and Phan and Siegel (2006) find that universities with commercialisation units are more likely to commercialise than those without (Audretsch and Lehman 2005). Some disciplines, such as medicine and engineering Bekkers *et al* (2008) are more prone to commercialise. Institutional arrangements such as the US Bayh-Dole Act and intense competition for tenure and promotion incentivises commercialisation argue Henrekson and Rosenberg (2001);

however, Mowery *et al* (2005) suggest that EU universities have now closed this gap by establishing commercialisation units.

My research focuses more on processes and outcomes than inputs, specifically university-related incubation as a form of commercialisation and the influence of institutions and culture on its success.

2.10.2 Crossing governances and commercialisation strategies

Much of the literature on commercialisation is from the university perspective when as Barnes, Pabsby and Gibbons (2002), Lambert (2003) and Wilson (2012) point out, from the business perspective academics and universities can be challenging partners: crossing between public and private sector governances is problematic.

Generic UIL appears quite successful in the UK. Wilson (2012) for example points to action learning pedagogies, Professional doctorates; skills and careers including business mentoring; workplace placements and active learning projects, and business people on advisory boards. As Murray and Stern (2007) note, the impact over time of such initiatives is difficult to measure; also the case with patenting, which may or may not result in innovation or economic activity (Lissoni *et al* 2008). Collinson and Gregson's (2003) study of CONNECT in Edinburgh noted that whilst initiatives may bring researchers and business people together it cannot be assumed that scientific breakthroughs address market gaps, a conclusion Lockett *et al* (2005) endorses. Noting the limited success of university commercialisation efforts, Chapple *et al* (2005) argue that they lack business skills and recommend school-level units led by business people.

Some of the issues frustrating potential business partners include overvaluation of historic IP, the time taken to register IP (Markman *et al* 2005), deviation (back into basic research) rather than sticking to a business plan. However, the most significant issue businesses raise in relation to cross-governance working with academic (BioEnt 2014, is their unwillingness to allow business people to take the business decisions.

2.10.3 Commercialisation in other developing countries

Appendix-two gives some detail of commercialisation in China and India noting in particular the state intervention in creating joint university-industry applied research projects and close UILs and including access to risk capital. This lengthy section is placed in appendices so as not to interrupt the flow of my literature review.

In summary, governances and their embedded cultured significantly effect processes of commercialisation – a prominent theme through my research.

2.11 Chapter summary: gaps and arguments

In this, the first of two literature review chapters, I have analysed the relevance to commercialisation in KSA of previous research and the theorisations shown in figure 2.1, setting the context in which commercialisation occurs. My next chapter turns to the position of the individual entrepreneur and how s/he operates within this context; this will be followed (chapter 4) by the development of a conceptual framework. Here I summarise gaps and arguments in the literature.

Section 1 argued for an active Vygotskian social perspective on learning on knowledge, disputing theorisations, such as Nonaka and Takeuchi's (1995) theory of learning organisations and Wenger's (1998) communities of practice from the viewpoint that they decentre individual cognition. I further argued that from a commercial viewpoint, the usefulness of knowledge in providing new solutions to customer problems is privileged. I will therefore argue that successful commercialisation of TTs (presuming absorptive capacity) requires active learning processes, evidence for which data will reveal (or not).

Citing regulation theorists such as Boyer (1988) and the work of Freeman (1982) on innovation, section two argued that a KBE is characterised by shortened innovation cycles between science and technology; doing so requires alignment between society and economic strategy, evidence of which will be analysed in chapter 8 and 9.

Institution-building is a crucial factors in KBE economic development; that *thick* institutions and untraded interdependencies take time and resources to create (far more than technology transfer); that creating an entrepreneurial habitus (referencing chapter 2) is difficult and that active agency by key individuals makes an important difference. Referencing the discussion in section three and Amin's (1994) idea of *thick* institutions able to learn, innovate and reach international markets: I argue that some KSA institutions are too thin to successfully deliver their target technologies also that NIS and TH are poor guides to action in developing economies.

The phenomenal growth rates and technological innovation in East Asia highlights the importance of the state in development processes (Chalmers 1982). Figure 2.4 in section 4 suggests a set of characteristics for the development state, of particular importance in the autonomous economic bureaucracy. Research on KSA has focused on resource-abundancy and oil economics (Auty 2001); I argue that KSA could become an Arabic development state and analyse the implications of this for policy making and its implementation, in particular Bellin's (2004) argument that at some stage in development the state privileges entrepreneurship and private property rights above other social values.

The role played by universities in developing economies seems to switch from primarily training to applied and later basic research (Liefner and Schiller (2008). It is not clear in relation to its (5 year plan) target technologies what absorptive capacity exists in KSA universities and how much basic research is undertaken. My research will analyse the extent to which (section 2.5) tension between publishing and patenting are resolved by doing both and cultural inhibitions and enablers of commercialisation amongst academics.

Section 6 explored the nature of SSIs arguing that they are best conceptualised (Memon *et al* (2014) as closely coupled systems rather than looser networks and critically depend on the their quality of leadership for success i.e. effective active agency. My empirical research will reveal to what extent KSA is developing effectively-led SSIs.

My research explores the degree to which social networking in and knowledge flows operate in KSA clusters (section 8 above), the metrics for their measurement and effectiveness at achieving outcomes; I will draw attention to the differential relationship with global knowledge flows between the UK and KSA.

Section 9 highlights the wide range of value-adding services necessary to incubate high-value, knowledge-based products, I will argue that to bridge academic/business governances management of incubators and their industry linkages is best done by business management of incubators.

Finally, arising from section 10, which considered the nature of commercialisation and its measurement I will argue that existing quantitative and cost-benefit data in both the UK and KSA is inadequate to properly evaluation its outcomes, outputs and costs.

CHAPTER-3 ENTREPRENEURSHIP AND COMMERCIALISATION

3.1 Introduction

Rapid technological change, shorter product lifecycles and intensifying global competition have radically transformed the competitive position of many developing economies. With the drive to generate knowledge based employment opportunities, policy makers now place a greater emphasis on the role of universities in the commercialisation of scientific and innovations.

Etzkowitz's (1998) term *entrepreneurial university* describes universities having proven themselves critical to regional economic development. Although some authors refer to European universities (Chiesa and Piccaluga, 2000; Jones-Evans, 1999), the case of MIT is the reference example (Roberts 1991; Etzkowitz 2002). By encouraging faculty members to pursue private ventures outside the research lab, the Bank of Boston (1997) calculated that MIT start-up companies generated \$240 billion worth of sales per year and provided an additional 1.1 million new jobs to the US economy. The University of Texas at Austin is similarly cited for the Austin Technology Incubator (Gibson and Smilor 1991), with *academic entrepreneurship* describing individual contributions.

Knowledge creation and knowledge exploitation and technology-based entrepreneurship is now a strategic priority (; section 2.1); acknowledged by the World Economic Forum global competitiveness report (2003) as competitive advantages replacing comparative advantage i.e. accumulating knowledge capital.

Economies looking to meet the aim of developing a comparative advantage based on the enhancement and exploitation of the national knowledge base must look to foster university-based entrepreneurship as a central component of their strategy to develop a knowledge-based society (OECD 1998). This is particularly so because of the closing time gap between science and technology (section 2.2). The ability to develop technologically sophisticated and knowledge led regions has already provided Greater Boston and Silicon

Valley regions with wealth creation and quality of life improvements (Kenney 2000; Roberts 1991). As a result, governments increasingly recognise the need to support the process of technological change with the aim of spawning high-growth, knowledge-intensive companies from university research.

3.2 Academic entrepreneurship

Wood (2011) suggests that business innovations supporting entrepreneurship are increasingly emerging from university research giving rise to *academic entrepreneurs*, which Gulbrandsen (2005) defines as,

... researchers that have patented their research results, started a new science/technology-based firm or otherwise contributed to the commercialisation of research-based ideas and knowledge.

Note that the academic entrepreneur has commercial intent (Henrekson and Rosenberg 2001) in addition to research i.e. patenting/licensing and/or spin-off company formation. Meyer (2003) distinguishes academic entrepreneurs (adapting to applied research and grant opportunities) from entrepreneurial academics who have business intent i.e. a dual role. I use the term academic entrepreneur to refer to a wide range of activities various emphasises by researchers: invention disclosure to TTOs (Goktepe-Hulten and Mahagaonkar 2009), applied research for industry consultancy to higher involvement like patent licensing (Mowery and Ziedonis 2002), technology transfers and spinoff creation (Gartner 1988). My focus is on the processes by which academic entrepreneurs migrate scientific knowledge to a commercial purpose, similar to Renault (2006). Academic entrepreneurs here are individuals that have,

...patented an invention or are intending to patent their past research results or have started a spin-off or are planning to start a spin-off based on their past research results.

I include both spinoff companies and patenting following previous researchers including Lam (2010), Ambos, Makela, Birkinshaw and D'Este (2008), Renault (2006), Gulbrandsen (2005). As D'Este and Perkmann (2011), researchers doing (for example) joint or contract research or consultancy often have shorter time frames and more limited aspirations than researchers patenting or spinning out companies. As Shane (2004) notes, such is the time/expense of IP protection, academic entrepreneurs undertaking such work demonstrate

a higher order of commercial intent than those doing short-term work. Finally, I note with Dasgupta and David (1987) that unlike industrial R&D professionals, with whom academic entrepreneurs may share activities, the latter face a conscious choice to commercialise.

Many European universities now provide dedicated support staff and facilities in science parks or incubators to support commercialisation (Albert et al 2002; Dahlstrand 1999; Dahlstrand and Klofsten 2003; and Stankiewicz 1998) accompanying industrial liaison offices (ILO) and technology transfer offices (TTOs), (Rasmussen 2006; Rasmussen et al 2007).

The spin-off process takes place in the interface between the university or research organisation and industry, and the process will to a significant extent depend on specific features of the university environment and milieu as well as the more general industrial and socio-cultural environment (Virtanen and Laukkanen 2002, Spilling 2008). The ability to identify and develop business opportunities will depend on a number of factors in this environment, including the entrepreneurial culture of the academic milieu, and so will the further processes of commercialization. The key driving force, however, is entrepreneurial leadership, act between academic and business governances and create effective business linkages. The institutional set-up may facilitate these processes, and in our analyses we will briefly comment on these aspects. My main focus, however, will be on the processes of commercialization and the role of academic staff in these processes, contrasting KSA with the UK.

3.3 The Determinants and Consequences of University Start Up Activity

Roberts' (1991) work on spinoffs at MIT initiated research on academic entrepreneurs, followed by Clark's (1988) cross-national study of five highly successful European universities that identified elements common among successful entrepreneurial institutions, including the following.

- Strong top-down leadership that supporting and encouraging processes of academic entrepreneurship and merging an entrepreneurial objective with the traditional values of the university;

- Strong ties between the university and industry in research projects of mutual gain and robust structures, policies and procedures to enable such activity (for example, industrial liaison offices and flexible contracting procedures);
- A diversified funding base such as industry and private benefactors, though much of university funding is still derived from government sources;
- A strong academic base, what the authors referred to as a steeple of excellence approach, whereby the universities recruited the top candidates in those fields where it has built its steeple. Tenure and academic promotions are granted solely on academic achievement and not due to individual entrepreneurial endeavours;
- An entrepreneurial culture that embraces change and sustains the fundamental values of the institution.

A body of research that has explored individual determinants of spin-off activity underpins such findings.

Existing literature can be divided into six distinct research streams: (1) the individual and personality correlating with spinoffs; (2) organisational configuration studies explaining spin-offs in terms of university resources allocations; (3) socio-cultural studies explaining spinoff activity in terms of culture and the rewards; (4) studies explaining spinoffs in terms of external environmental; (5) studies measuring spinoff performance; and (6) studies measuring economic impact. I structure my literature review around these themes.

3.4 Spin-offs and commercialization

Section XX above analyses commercialisation from an innovation perspective, here I tease out its implications for a key set of agents: academic entrepreneurs. Although patenting is important, spinout companies are the archetypal commercialisation, often used as a vehicle to exploit a patent or some form of IP protection. I define university spin-offs similarly to Nicolaou and Birley (2003) as the transfer of a core technology from an academic institution into a new company, where the founding members include the academic inventor who may or may not be currently affiliated with the academic institution. Unfortunately, much of the literature on academic entrepreneurship adopts a superficial (stages or deterministic) perspective on the entrepreneur, a gap my research helps to fill, by focusing on the entrepreneurial process i.e. quite different from simple ‘output’ surveys.

3.4.1 Commercialisation

Spinoff and technology transfer (TT) processes aim to commercially exploit new knowledge (Chiesa and Piccaluga 1998). As Spilling and Godø (2008) argue, the concept of commercialization may be identified as the process of transferring and transforming theoretical knowledge as existing in an academic institution into some kind of commercial activity.

In the literature, I find a number of different approaches for analysing commercialization processes, and generally these approaches are based on a stage model approach (Jolly 1997, Virtanen and Laukkanen 2002). For instance, Ndonzuau, Pirnay and Surlemont (2002) distinguish between the following four stages:

1. Generate business ideas from research
2. Finalise new venture projects out of ideas
3. Launch spin-off firms from projects
4. Strengthen the creation of economic value by spin-off firms.

As discussed by Spilling and Godø (2008), an important aspect of commercialization processes is shifting from mainly technology-driven (push) activities towards processes that are mainly (pull) market-driven. This implies that scientific concepts and principles are turned into viable technologies and products or services, which means that knowledge is transformed from one mode to another (Chisa and Piccaluga 1998; Fontes 2003, 2005).

During the commercialization process, agents may go back and forth between the stages, partly they may combine elements from different stages simultaneously, or important elements from different stages may come in a different order. The agents will also depend on interaction and communication with a number of other actors belonging to the business community as well as the research community. So, interaction across stages and organisational boundaries are most important for the process.

On this background, the innovation process may be termed as ‘chaotic’ and as an *innovation journey* (Van de Ven *et al* 1999). However, a basic feature of commercialization of R&D is that it implies some kind of linearity in the sense that the

process necessarily will take the existing knowledge base as its point of departure, and the new project will start out based on the existing knowledge base.

3.4.2 Academics in academic spin-offs

A spinoff is a company is based on knowledge resources from a parent organisation becoming autonomous from the parent organisation (Birley 2002; Carayannis et al 1998; Dahlstrand 1999, 2000; Nicolaou and Birley 2003, Shane 2004, Steffensen et al 2004). Different terminologies may be applied, such as academic spinoff, university spinoff or R&D spinoffs; the concept of spinout is applied synonymously. The spinoff is originated in an academic institution, and the entrepreneurs generally have their background as academic scientists. New ventures are based on the intellectual assets of the parent organisation (Birley 2002), and the process is typically characterised by an employee exiting (entirely or in part) from this organisation in order to start the new company (Carayannis et al 1998, Steffensen *et al* 2004). To qualify as a spinoff, the new business must be based on a business idea which originated in the previous organisation (Dahlstrand 2000); the new business is based on intellectual property developed in the parent organisation (Birley 2002; Carayannis *et al* 1998) and may include the transfer of IP rights.

Pirnay *et al* (2002) argue that a spinoff fulfils the following three conditions.

- It takes place within an existing organization, generally known as the ‘parent organization’
- It involves one or several individuals, whatever their status and function are within the ‘parent organization’
- These individuals leave the ‘parent organization’ to create a new one.

While much of the literature is focused on spinoffs resulting in wholly new firms, the concept may also include cases in which the new business activity is developed in an existing firm by way of selling licenses for obtaining the rights to exploit commercially the new technology (Shane 2002; Hill 1995). This also is a common way of organising technology transfer. The main point is not whether the spin-off ends up in a new firm, but that the result of the process is the creation of a new business activity, and independent of

it is organised as a new legal business unit or it is adopted by an incumbent firm which organise the new business activity internally.

According to Roberts and Malone (1996) and Carayannis *et al* (1998), four types of agency are important: the parent organisation, the technology originator, the entrepreneur and the venture investor (see figure 3.1).

A typical way of organising a spin-off is that one or more of the scientists who have contributed to developing the technological innovation, organise the new business and leave the parent organisation when the new venture is started. This is what Birley (2002) characterises as an ‘orthodox’ spin-off, which is characterized by a ‘clean break’, that is the scientists previously employed by the parent organisation, leave to start the new business. This implies, referring to the types of actors summarised in figure 3.1, that the scientist initially has the role as technology originator, and then follows up by taking the role as entrepreneur.

Agent	Examples	Primary role
Parent organisation	University department, Research laboratory	Host and organise R&D activities to create technological innovations. May also serve as a facilitator for spin-off processes
Technology originator	Individual or group of engineers or scientists	Bring the technological innovation through the innovation-development process; bring the process to the point where technology transfer is possible
Entrepreneur	Engineers, scientists; ‘external’ person with business knowledge	Identify the business idea and develop the new business venture based on the technological innovation; take the technology to create a new venture from it
The venture investor	Venture capital organization, business angles, informal investors	Provide the financial resources to develop the new venture, may also provide needed business management expertise

Figure 3.1: Main actors and their primary roles in the spin-off process
Source: Based on Roberts and Malone 1996 and Carayannis et al 1998

Birley (2002) introduces two other categories of spinouts: technology spinout and hybrid spinout; the former entails an external agent (investor, manager or company) buying or leasing the IP rights, the academic entrepreneur remains in the parent organisation, creating no overlapping personnel although they may contribute to the new venture development as

consultants and equity holders. The third category, the hybrid spinout, represents a combination of the two previous categories; the new venture is based on a joint organisation of external and internal actors.

Figure 3.2 summarises other typologies of spinouts suggested by Dickson, Coles and Smith (1998); Fontes 2003; Jones Evans (1997); Radosevitch (1995). Fontes (2003) is quite similar Birley (2003). While Birley distinguishes between orthodox, technology and hybrid spinoffs, Fontes differentiates insider and outsider-conducted commercialisation and intermediary conducted process as the third category. The insider conducted process corresponds to the orthodox spinoff as it is the scientific staff – the insiders – who conduct the process, while the technology spin-offs corresponds to the outsider conducted process. However, while the orthodox spin-off as defined by Birley implies that the scientific staff involved in the process leave the university – it is a ‘clean break’ - this is not the primary focus in the typology of Fontes; her emphasis is on who conducts the process, whether they maintain their relationships with the research organisation or not. Furthermore, there is also a difference in the way the third category is defined. While Birley regard the hybrid type as a mixture of the orthodox and the technology spin-off, the third category in the case of Fontes focus explicitly on intermediary organisations as potential actors in the process of commercialisation.

Radosevitch (1995) distinguishes two models of commercialisation of public sector technology: the inventor-entrepreneur model in which the scientist takes the role as entrepreneur and organises the new venture; and secondly the surrogate-entrepreneur model in which an external actor takes the role as entrepreneur. The advantage of the first model is that the technology originators organise the entrepreneurial process, and in this way provide greater technical capacity and have commitment to the technology and good relationships with the technology source. On the other hand this model implies disadvantages in terms of less experience from entrepreneurial activities and less business knowledge (Radosevitch 1995). The champion of the business idea is seldom the best to manage (Clarysse and Morey 2004). The advantages and disadvantages of the second model, the surrogate entrepreneur model, go in the opposite direction. Advantages are

related to entrepreneurial experience and good contacts with the business community, while relationships with the technology originators will be less developed.

Author	Typology of spin-offs/ entrepreneurial roles	Definitions/comments
Birley 2002	Orthodox spinout Technology spinout Hybrid spinout	Scientist(s) leave to form the new company – ‘clean break’ Outside actor organizes the commercial exploitation Combination of inside and outside actors
Fontes 2003	Insider conducted commercialization Outsider conducted commercialisation Intermediary conducted commercialization	Insiders of the research organisation (RO) exploring knowledge originating from RO Outsiders who establish relationships to gain access to an RO to assist development of business ideas Outsiders or (more rarely) insiders who operate as intermediaries in technology transfer as a business
Radosevitch 1995	Inventor entrepreneur model Surrogate entrepreneur model	Scientist(s)/inventor(s) organise the new venture External actor with entrepreneurial experience organises the new venture
Dickson, Coles and Smith 1998	Academic entrepreneur Entrepreneurial scientist Scientific entrepreneur	Scientist who engages in entrepreneurial endeavours, but maintain their identity as academic scientists. Scientist operating full-time in the new business essentially dedicated to scientific interests. Integration of scientific and business interests, utilising a high level of scientific intelligence to identify new business opportunities
Jones Evans 1997	Research technical entrepreneur Producer technical entrepreneur User technical entrepreneur Opportunist entrepreneur	Terminology based on the background of the entrepreneur

Figure 3.2: Spin-offs and entrepreneurial roles

Jones-Evans (1997) suggests a different framework distinguishing types of entrepreneurs by their background; that is in research or as producer, user or opportunist. The first category will coincide with the inventor entrepreneur model, while the other three relates to the surrogate entrepreneur model in which the process is organised by external actors with backgrounds from different positions in the business community.

3.4.3 The role and culture of academic staff

The degree to which academics transgress governances and become involved in business building is thus an important differentiating aspect for types of commercialisation: does the academic remain or cease to be an academic? The typology suggested by Dickson *et*

al (1998) is interesting in this respect as it distinguishes between academic entrepreneur, entrepreneurial scientist and scientific entrepreneur. The academic entrepreneur maintains his or her identity as academic scientist, remaining affiliated with the parent organisation. In contrast the entrepreneurial scientist migrates full-time to the new venture dedicated to scientific interests. The third category, scientific entrepreneur migrates to the new venture participating fully in business decisions (Dickson *et al* 1998:36). Samson and Gurdon (1993) find that a majority of academic entrepreneurs prefer migrating to the new venture, adopting business governances and cutting ties with academic governances, though a minority adopt Dickson's halfway house stance. Birley's (2002) findings are similar.

3.5 Academic entrepreneurship factors

General entrepreneurship literature often focused upon the individual attributes of the entrepreneur whereas Clarysse *et al* (2011) find that academic entrepreneurs literature concentrates on the outcomes rather than contribution of individual agents to the processes. Clearly as Owen-Smith and Powel (2001) argue, the individual acts within the context of the academic organisation, such as the quality of technology transfer and commercialisation support units and related university governances. Here, I take Rothaermel *et al*'s (2007) list of contextual factors affecting academic entrepreneurship and explore their influences on commercialisation processes such as incentives, status, location, culture, faculty, intermediary agents, policy, experience, defined role and identity and technology.

3.5.1 Effort – Entrepreneurial commitment

To what extent do levels of commitment to exploit knowledge influence academic's exploitation route? Yang and Chang (2009) argue that limited commitment pulls academics into consultancy rather than spinoff companies, whereas Smith and Parr (2003) suggest that many academics are simply not interested in commercialisation.

Currently, the primary focus of university and majority of faculty members is on teaching and research work; therefore, time accessibility is an important determinant whether an academic scientist will be willing to engage in entrepreneurial activities. (Chang, Yang and

Chen, 2009, Lach and Schankerman, 2004) By exploring different knowledge combinations scientists can achieve innovation. The primary factors that lead to the innovation are individual's effort, ability and knowledge (Zenger and Lazzarini, 2004, Sauermann and Cohen, 2010). Allocation of effort will determine the performance of the activity. Going beyond the standards of effort will lead to higher ability; additionally as Kahneman (1973) notes, all risk taking entails an emotional commitment. Since academic entrepreneurs are expected to wear two hats (i.e. basic and applied research), it is important to see how much time (effort) do they devote for commercialisation activities (cooperating with industry, doing applied research, filing patents or starting/working on spinoff company) and for traditional science (teaching, basic research, paper publication, attending conferences).

Some empirical tests have shown that academic scientists who have engaged in entrepreneurial activities such as filing patents or/and starting spin-off activities, or just collaborated with industry have allocated less time for teaching and basic research activities (Fini, Lactera, Shane, 2010). However, there is not unanimous opinion on the impact of entrepreneurial effort and if it sacrifices basic research activities. Stephan et al (2007) finds that patents do not crowd-out researcher's publications amount. While Yang and Chang (2009) outline that faculty members will need to devote substantial time for applying and also maintaining the patent – in many cases the researcher will need to consult the licensee on how the patented technology works and should be developed (Smith and Parr 2003). These findings are also very dependent on academic's age and tenure position – older faculty members are more likely to do both patenting and publishing without sacrificing the other (Geuna and Nesta 2006). Another belief is that if an academic entrepreneur allocates more time for applied research relative to basic research it does not mean that the basic research is receiving less time than before but rather that leisure time will be sacrificed (Thursby et al, 2007). Despite these findings, the concerns of the majority of faculty members are still based on the prejudice that engagement in research result protection and commercialization will be very time-consuming and will take time off their academic activities. As a result some researchers are reluctant to put even the slightest effort into commercial activities. (Smith and Parr, 2003). If only scientists would spend

more time with industry people it would already increase the probability of patent filing, based on empirical findings of Fini et al (2010). Thus leading to the derivation of *the actuality that the more time individual spends on cooperating with industry, doing applied research, filing patents and/or starting/working on spin-off, the higher the probability that the individual will be an academic entrepreneur.*

3.5.2 Effort – mediating effects

Numerous studies find that higher incentives improve mean performance. Extrinsic and intrinsic incentives can affect individual's attention and therefore affect cognitive functions (Camerer and Hogarth, 1999). However, some incentives not only improve average performance but sometimes can also hinder it. For example, an intrinsically motivated employee will not increase performance in an easy job if the extrinsic incentives are raised (Camerer and Hogarth, 1999) or extrinsic incentives might even reduce creativity of intrinsically motivated individual (Amabile, Hennessey, and Grossman, 1986). At the same time, some studies have shown that monetary incentives do increase scientist's productivity (Lach and Schankerman, 2003). Therefore, it is important to identify the appropriate incentives for commercialisation activities so that the individual would decide to spend more time on it. Effort only improves performance if the match is good, (Camerer and Hogarth, 1999). According to Owen-Smith and Powell's (2001) study, an academic researcher's decision to disclose and commercialize his/her invention depends on the following factors: (1) perception of personal and professional benefits of commercialization – motivation; (2) perception about time and cost of engaging in commercialization activities – decision on the amount of effort to devote; and (3) general attitude of technology transfer/commercialisation activities. Only if individuals are motivated enough they will devote more hours for entrepreneurial activities that will lead to commercialization outcomes. Therefore from this reasoning we can conclude that the *Level of effort is a mediating effect between individual's commercialization motivation and academic entrepreneurship.*

3.5.3 Individual Attributes as Determinants of Spin-off Activity

A number of studies highlight the importance of entrepreneurial attributes in shaping the individual's behaviour and whether an academic will establish a spin-off business. Other researchers have stressed the role personality; motivation and disposition play in influencing academic entrepreneurship. Some studies have used psychological models to explain spin-off departure from universities. These studies emphasise the impact of individual abilities and dispositions on the entrepreneurial behaviour of academics. This stream of research shares a common theme: that spin-off behaviour is a reflection of individual actions and therefore is largely due to the personality, ability or willingness of the individual to engage successfully in entrepreneurial behaviour. Roberts (1991), for example, found that academic entrepreneurs with outgoing, extroverted personalities were more likely to engage in spin-off activity. From a study of almost 130 technical entrepreneurs and almost 300 scientists and engineers, he concluded that personal characteristics such as the need for achievement, the desire for independence and an internal locus of control were common in both groups. Tenure in universities and occupational and research skill levels amongst academics are also found to impact university spin-off behaviour. Audretsch's (2000) analysis of academic entrepreneurs found that university entrepreneurs tended to be older and more scientifically experienced than typical high-technology entrepreneurs. Similarly, Zucker et al. (1998), using data on California biotechnology companies, found that scientific stars collaborating with firms had substantially higher citation rates than pure academic stars.

3.5.4 Incentives of academic entrepreneurship

Here I consider the personal, professional and political incentives to academic entrepreneurship.

3.5.4.1 Personal income incentives

One of the reasons why academic entrepreneurship emerged was because scientists such as creators of biotechnology firms in 1970s and 1980s realized the significant financial benefits that potentially could come from their research outcomes. First the thought of making money out of research results was unacceptable but with time many academics started to see the opportunities it did provide. These advancements in science were not

present only in biotechnology but in other disciplines as well, even linguistics research found its place and commercialization potential in computer and software industry. (Etzkowitz 1998)

The main form of payment to academics is salary. However, this provides no incentive to further research inventions towards commercialization since the remuneration is not tied to the outcome of researcher's activities. Therefore, different monetary structures have been introduced that link commercialization activities with performance-based payment and/or equity compensations. (Goldfarb and Henrekson, 2002) This has been done with the argumentation that researchers will disclose their invention to TTO only if they see proper benefits of patenting, start-up formation, industry collaboration (Owen-Smith and Powell, 2001) especially due to the scarcity of research resources (Markman, 2004). Monetary compensation and profit motives are emphasized in Etzkowitz (1998) work of entrepreneurial scientist. Some research has emphasized that universities that provide higher monetary rewards linked to commercialization involvement shows higher individual motivation to commercialise (patent) more (Goktepe-Hulten and Mahagaonkar 2009). Sieget et al. (2003) found that secondary motive of university scientist is financial gain and a desire to secure additional research funding and if technology transfer office will be perceived as productive and offering personal compensations for engagement, scientists will be more motivated to disclose their inventions to TTO. Lach provides similar findings and Schankerman (2003) that shows empirical findings that monetary rewards linked to scientist's inventions increases the incentives to patent. Another argument in favour of importance of monetary incentives is scientist reflection on commercialization barriers. According to empirical study of Siegel et al (2003), significant amount of scientists reported insufficient rewards to faculty members for university-industry involvement activities. The incentive effects work both on the level of effort and selection of academics (Baldini 2010).

However, the view, whether personal financial incentives increase commercial activities of academic scientists, is not unanimous since previous results have shown contrasting empirical results (Baldini 2010). Several studies have hypothesized for significant and

high relationship between commercialization rewards and commercialization outputs but have resulted in minor importance (Friedman and Silberman, 2003). Colyvas et al. (2002) also find small or no role of financial incentives on faculty member motivation to engage in innovation producing research projects. Gulbrandsen (2005) researched academic's different motivations to patent and financial incentives were not among the most important. Markman and his colleagues' (2004) research results showed in contrast to the theoretical predictions that monetary incentives are actually negatively related to the number of equity licenses in young ventures, and to the number of start-ups. Furthermore, some scientists retain the traditional academic mindset that is illustrated in Etzkowitz (1998) work: academic scientist signifies purity of motives that does not have place for material concerns and commercialization gains. The rewards for their research should not be found in pecuniary advantages but rather from recognition from their peers.

Therefore, it is not entirely clear how important monetary incentives play role in motivating academics to put effort in commercialization activities. As argued by Lam (2010) money could be a hygiene factor and not a motivation factor based on motivation–hygiene theory and positive psychology. Therefore, her argument is that money influences scientist's satisfaction or dissatisfaction but is not strong enough to motivate people to put more effort. A similar finding comes from Hayter (2010) who finds that financial rewards is not the primary motivation but rather a beneficiary side effect that does cover the extra hours individuals put in commercialisation activities. Thus, the *Importance of financial incentives plays small or no role in motivating scientists to spend more effort in commercialization activities and has higher likelihood of becoming an academic entrepreneur.*

3.5.4.2 Intellectual Challenges

Intellectual challenge refers to the intrinsic satisfaction/ curiosity fulfilment that academic scientists gain by engaging in knowledge application and technology transfer. Academic scientists often are characterized as dedicated individuals that desire to advance knowledge. The motivation behind the dedication is the intellectual curiosity and the desire to engage in creative puzzle solving (Cotgrove 1970). This motivation is due to the

embedded norms of science institutions – to advance knowledge by - commitment to the disinterested pursuit of truth (Merton 1957). Research by academics is seen as a puzzle-solving game where solution is the reward (Stephan and Levin 1996). According to Stephan et al (2007), there are two key reasons why scientist engages in research – interest in solving the challenge and importance of winning the game. Therefore, academics are seen as being intrinsically motivated where they are enjoying the research process (Goktepe-Hulten and Mahagaonkar, 2009).

Considering general characteristics of academic scientists the same motivation of intellectual challenge and creative puzzle solving could be applied in the context of research application and commercialization activities (Lam, 2010). Winning the game may be considered as creating something new that can be done by filing a patent or by starting a spin-off. This, however, will depend on the university's culture and if the faculty members share the same view on commercialization activities as being intellectually challenging. Sauermann and Cohen (2010), who show that motives have significant effect on innovative effort and performance, find intellectual challenge as very important motivator. Thus we can conclude that the importance of intellectual challenge has positive effect on motivating scientists to spend more effort in commercialisation activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.3 Learning

Learning from the industry and from engagement in commercialisation activities is another motivation for the faculty members. The learning motivation may include benefits such as gaining novel insights, feedback on research outcome, and opportunity to access new knowledge and technology. For example, by resolving problems in technology development can lead to more information in research agendas, follow-up research projects and even new science disciplines. (D'Este and Perkmann 2011) Applied projects with industry create exploratory learning possibilities; it might not lead to new scientific outputs but may lead to new research problems (Perkmann and Walsh 2009). From faculty member interviews in US, 65% of the scientists described industry collaboration as having positive influence on their research work (Siegel et al 2003). According to Meyer-Krahmer and

Schmoch (1998) who conducted a research on German academic scientists, found learning from the industry together with acquisition of additional research funds as the main motive to engage with industry. However, learning as a motivation is more evident in collaboration activities such as collaborative research and industry consultancy and not in more commercialization driven activities such as patent applications and spin-off formation (D'Este and Perkmann 2011).

The project Benchmarking Industry-Science-Relations identified main incentives of academic researchers among which was also mutual learning where the public research sector from the enterprise sector gets access to knowledge and absorption of new knowledge (Polt et al 2001). Hence it is apparent that the Importance of learning possibilities has positive effect on motivating scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.4 Application and Exploitation of research

Similar to learning possibilities, many academic researchers want to find application and exploitation possibilities for their research results (D'Este and Perkmann, 2011). Some researchers want to see wider social application of their research and therefore application and exploitation of research outcome is especially important. Application and exploitation of research can be seen as one part of the challenge and curiosity only in a non-traditional academic norm setting. Scientists consider commercialisation as extension of their research – pushing the boundaries of the research (Lam 2011:15).

This motivation can also be seen as knowledge exchange, where it is important for the scientist to advance the research and generate economic and technological development. This motivation for entrepreneurial engagement was evident in Baldini et al (2007) work. In addition, through the possibility of applying and exploiting further one's research, the scientist creates more opportunities to find novelty and possible originality in the research outcome which is also very important criteria in researcher's publications. Thus, leading to the Importance of research application and exploitation of research has positive effect

on motivating scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.5 Research funding

A significant motivation to engage in commercialization activities is the research grant incentive to gather more money for continuation of existing or past research projects. (Baldini et al, 2007) In such situations scientists see commercialization activities as means to get research funding; however, some scientists associate industry funding as —selling their soul...ll (Lam, 2011). Nevertheless, acquisition of research funding has been found as one of the primary motives in several empirical findings (Meyer-Krahmer and Schmoch, 1998. Lam, 2011).

Research grants from the industry are one of the most favoured forms of involvement by academics since they usually can continue with their research in their lab with condition to consider what is relevant to the grant provider. From a survey in Sweden over 50% of respondents reported that potential research grants and the users of the research results influenced decisions of research topics. (Goldfarb and Henrekson 2002) However, such research grants at many times take away scientist's time from more basic research (Geuna and Nesta 2006; Goldfarb, 2007,).

D'Este and Perkmann (2011) find a distinction between different kinds of commercialization engagement in terms of motivations. They find that joint research, contract research and consulting are driven by academic's motivation for research funding; however, this motivation does not have positive effect on spin-offs and patenting activities. Therefore, the literature does not show unanimous findings on research funding motivation and its effect on patenting and spin-off activities. Nevertheless, one of the main motives for commercialization endeavours that appear in many academic papers is the desire to secure additional funds (Meyer-Krahmer and Schmoch, 1998, Siegel et al, 2003, Meyer 2003, Lam, 2011); therefore the derived proposition predicts a positive relationship. Importance of acquiring research funding may have a positive effect on motivating

scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.6 Better work conditions

The same arguments go for motivation to provide better work conditions. Etzkowitz (1998) even argues that a prerequisite of doing science is also the ability to get access to better work conditions (lab equipment) and better conditions for students by securing job opportunities. From scientists' interviews in Siegel et al (2003) study a scientist told that his involvement with industry allowed him to purchase better lab equipment that enabled him to conduct more experiments. A widespread view is present that for researchers good work conditions with high-level lab equipment is even more important than higher salary. (Sauermann and Cohen 2010)

Importance of better work condition has positive effect on motivating scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.7 Job opportunities for students

Since a large proportion of faculty members' responsibility is on the work with students through teaching and dissertation supervision, job provision for students can also be an important motivator (Lam 2011).

Importance of providing work placements for students has positive effect on motivating scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.8 Recognition and prestige

The science institution has incorporated a reward system that is designed to recognize and praise scientists that have fulfilled their roles to make original contribution to the knowledge stock (Merton 1957). The primary motive premise of faculty members is to fulfil their role and the role fulfilment can be observed from the recognition in the scientific community. The recognition comes from publications in top-tier journals, participation in prestigious conferences, and national research grants. (Siegel et al, 2003) As a result, academics are motivated by rewards of recognition and prestige from their fellow

colleagues and they are intrinsically motivated by the intellectual challenge and driven by the desire to win the game (Merton, 1957). The need to make original contribution corresponds with patenting activity. Patent creation shows novel scientific contribution and can show the usefulness of science that can foster individual prestige (Owen-Smith and Powell 2001). Scientists can use patents to indicate the newness and quality of their research results and thus increase personal visibility and reputation (Goktepe-Hulten and Mahagaonkar 2009).

The question is whether scientist peers see patents and other commercialization activities as novel and useful. Scientist merits are not evaluated by the commercialization activities and it does not improve the promotion possibilities within university, at least in traditional universities. Therefore, scientists that are surrounded by traditional academic views that promote open science would be less motivated to engage in commercialization activities (Goktepe-Hulten and Mahagaonkar 2009). If commercialization activities do not receive the same amount of peer recognition as research activities it is important for TTO and university administration to encourage the faculty members to disclose their inventions (Thursby et al 2001).

Despite the open science counterargument of invention disclosure, Baldini et al (2007) found that Italian academic inventors valued —prestige/visibility/reputation as the main motivator to engage in university patenting activity. As already referred, the most important motivation together with intellectual challenge is the ability to win the game that gives scientists the prestige and recognition (Stephan et al 2007).

Importance of gaining recognition and prestige has positive effect on motivating scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.9 Personal and professional network

Scientists are becoming not only interested in receiving recognition from fellow peers but also from wider external university network (Lam, 2011). Strong network (diverse network with interactive relationship and partnership) is especially important to succeed in

start-up formation (Meyer, 2003). By opening a strong personal and professional network will enable scientist to succeed both in academic and commercialization activities (Debackere and Veugelers 2005).

Proposition 11: Importance of gaining personal and professional network has positive effect on motivating scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.4.10 Independence

In entrepreneurship literature, independence has played an important role to individuals as a motivator to start a new company (Hayter 2010). Also employees working in R&D centres are incentivized to engage in patenting behaviour by independence motivator (Hessels et al. 2008). At the same time, engagement with industry collaboration in many cases might not give faculty members with more independence. On contrary, these scientists would be constrained in their research focus to meet the paying party's interest. Therefore, the importance of independence might not have positive results on commercialization activities such as industry collaboration. However, forming a spin-off is seen as a means of preserving autonomy since the researcher can proceed with their research and activities independently from a larger company sponsorship (Lam, 2011). Furthermore, if patent application were considered as potential step towards firm formation then independence motivation would also apply as a driver force.

Proposition 12: Importance of gaining independence does play a role on motivating scientists to spend more effort in commercialization activities and on the likelihood of becoming an academic entrepreneur.

3.5.5 Other Individual-level factors

In order to make the theoretical model more comprehensive and account for other influential predictors of academic entrepreneurship, other individual-level factors are considered.

Many scientists are still confronted with the idea of basic or fundamental research where the research outcome should be open and publicly available to everyone (Gulbrandsen 2005). Attitude towards commercialisation activities was mostly negative in the early stage

of entrepreneurial university development. Many scientists did not realize that they had a choice of both doing science and also making money from their research. (Etzkowitz 1998) The attitude of scientists is very important determinant of academic entrepreneurship (Baldini, 2010) and by some empirical evidence has been found that personal attitude is the most significant determinant of the actual academic entrepreneurship behaviour (Renault, 2006).

According to academic life cycle theory, academic scientists develop their human capital and reputation during the first phases of their career and once these aims have been fulfilled they look to engage in entrepreneurial activities for financial gain (Lam, 2011). It is also consistent with Shane and Khurana (2003) findings that researcher's highest academic rank has positive effect on individual's commercialization endeavours.

Different academic papers have observed the effect of age on the likelihood of commercialization engagement. Some claim that younger scientists are more inclined to engage in commercialization activities since they are not yet pushed into academic-norms and are more open to entrepreneurship (Owen-Smith and Powel 2001); however, other view advocates that more experienced professors are more likely to patent and form spin-offs since they have acquired bigger social capital and are not pressured by tenure acquisition (Renault, 2006). Since it is found by previous studies that higher academic rank has positive effect on the likelihood of engaging in academic entrepreneurship activities, it is also more likely that age has the same relationship. Scientist's research quality also influences patent and new spin-off formation. The so-called *star scientists* are more likely to be successful in both academic and commercial activities. (Di Gregorio and Shane, 2003) In addition, scientists' skills and knowledge plays an important role on academic entrepreneurship.

Despite several findings that show positive commercialization results coming from basic research, these researchers are mostly hands-off, researched focused and are less likely to engage in academic entrepreneurship activities (Gulbrandsen 2005). Empirical findings support the claim that Researchers that are not engaged in applied research and mostly

focus on basic research are less inclined to engage in commercialisation activities (Lam, 2011).

A lot of research has been done on gender differences on academic performance in terms of scientific achievement, rank advancement, productivity and publication amount but not so much on the commercialization performance. Nevertheless, gender seems to also play a role in the prediction since it is found that female scientists have negative likelihood on engagement in academic entrepreneurship activities. (Azoulay et al 2007)

3.5.6 Environmental factors: influencing university spinout activity

Social scientists operating at the organisational level have adopted a different approach to the study of spin-off activity. Organisational theories of university spin-off behaviour are generally concerned with the impact of environmental forces on academic entrepreneurship. Rather than focusing on broad social or economic forces, such researchers have centred their attention on organisational and human resource aspects of the university. Specifically, researchers have sought to establish links between spinoff activity and the level and nature of research funding; the quality of the researchers, the nature of the research within the university; and the presence of technology incubators and technology transfer offices.

Level and Nature of Research Funding

Several investigators have focused their attention on the level and nature of funding for R&D activities within the university. For example, Lockett and Wright (2004) find that the number of spin-off companies created from UK universities is positively associated with R&D expenditure; the number of technology transfer staff; expenditure on intellectual property protection; and the business development capabilities of the university. Blumenthal *et al* (1996) surveyed 2,052 faculties at 50 universities in the life sciences field and found industry-funded faculty members to be more commercially productive (i.e. patent applications and new products brought to the market) than those who are not industry funded. Powers and McDougall (2005) found a positive and statistically significant relationship between annual university wide R&D expenditure and spin-off

activity. Furthermore, Wright *et al* (2004) found evidence to suggest that involvement of industry functioning as venture capitalists via joint venture spin-offs may facilitate the emergence of university spin-offs because they have the necessary financial resources and commercial expertise to transfer technologies successfully to the marketplace.

One of the main differences on organization-level is the type of academic discipline. This factor has been found to have influence on the level of interaction and collaboration with the industry (D'Este and Perkmann 2010). Type of discipline determines the focus of the research and how closely it can be related to the industry and entrepreneurial activities (Lam 2011). Faculty members from life sciences are expected to be more entrepreneurial compared to faculty members from engineering sciences (Renault 2006). According to Lam (2011), computer sciences and medical sciences should have higher probability that an academic will become an academic entrepreneur relative to academics from physical sciences.

TTOs play an important role in fostering academic entrepreneurship (Clarysee *et al* 2011). The expertise, culture, experience and support that it can provide have direct positive effect on academic entrepreneurship activities (Baldini 2007). External funding has also positive effect on commercialization activities within university (Ponomariov 2007).

3.5.7 Institutional Determinants of Spin-off Activity

The central tenet of the third stream of research is that university spinoff activity is a reflection of institutional behaviour. This research suggests that universities that have cultures that support commercialisation activity will have higher levels of commercialisation and higher rates of spin-off activity. In contrast, university environments that do not encourage entrepreneurship will have less spin-off activity. Roberts (1991) argues that the social norms and expectations of the university are a key determinant of commercialisation activity. He suggests that MIT's tacit approval of entrepreneurs was a key factor in explaining successful academic entrepreneurship at MIT. Golub (2003) supports this perspective and credits the growth in spin-off activity at Columbia University, at least in part, to the knowledge spillovers provided by academic

inventors in life sciences who had established companies in the early 1990s. Similarly, Kenney and Goes (2004) argue that Stanford University Faculty members were more motivated than their Berkeley counterparts to become entrepreneurs because of the inspiration provided by prior academic entrepreneurs at their university. Shane (2004a) argues that faculty members' decisions to start companies in MIT were socially conditioned. He suggests that efforts by pioneering entrepreneurial faculty members to create start-ups led new academics to believe that firm formation was an acceptable and desirable activity.

By contrast, university environments that do not encourage entrepreneurship have been shown to inhibit spin-off activity. More specifically, an academic's reluctance to engage in spin-off behaviour may be exacerbated by the attitudes and behaviours of superiors such as professors or departmental heads. For example, Louis et al. (1989) found that local group norms were important in predicting active involvement in commercialisation. They argue that this may be due to self-selection, which produces behavioural consensus and behavioural socialisation, where individuals are influenced by the behaviour of their immediate peers.

Universities that lack a culture supportive of commercialisation activity may take a number of actions. For example, studies in the UK suggest universities that are favourably disposed toward the use of surrogate entrepreneurs are more likely to be effective at university spin-off activity (Franklin et al 2001). Similarly, Siegel et al. (2004) propose that in order to foster a climate of entrepreneurship within academic institutions, university administrators should focus on five organisational and managerial factors: reward systems for University Industry Technology Transfer (UITT); staffing practices in the technology transfer office; university policies to facilitate university technology transfer; increasing the level of resources devoted to UITT; and working eliminate cultural and informational barriers that impede the UITT process.

3.5.8 External Determinants of Spin-Off Activity

This stream of research emphasises the impact of broader economic factors on academics within universities. Three factors that it could be argued will impact on spin-off activity are access to venture capital, the legal assignment of inventions (or, more specifically, in the US, the enactment of the Bayh-Dole Act) and the knowledge infrastructure in the region.

Florida and Kenney (1988) highlight the central role of the availability of venture capital (VC) in encouraging the formation of high-technology companies. Several studies have provided empirical support for the geographic localisation of VC investments. Sorenson and Stuart (2001) found that the probability that a venture capital firm will invest in a start-up decreases with the geographical distance between the headquarters of the venture capital firm and the start-up firm: the rate of investment in companies 10 miles from a venture capitalists headquarters is double the rate of investment in companies located 100 miles away. However, more recently, Di Gregorio and Shane (2003), using a dataset collected from 101 universities between 1993 and 1998, found no evidence that the number of VC investments, the amount of VC invested, the number of venture capitalists, the amount of their capitalisation or the presence of university VC funding are related to the amount of spin-off activity in a locale. In terms of seed capital, Franklin et al. (2001) found that those universities in the UK that generated a large number of spin-offs tended to provide their spin-offs with better access to sources of pre-seed stage capital than universities that did not generate a large number of spin-offs.

According to Shane (2004b) another significant impetus in the generation of university spin-offs in the US was the enactment of the Bayh-Dole Act whereby inventions were assigned to academic institutions rather than individual inventors. According to some European studies, national policies, which allow inventions to be assigned to academic inventors, have inhibited spin-off activity. In Sweden, for example (Wallmark, 1997), academic inventors are reluctant to bear the upfront costs and risks associated with patenting technology. Other researchers suggest that national policies of assigning inventions to individuals can lead to an anti-entrepreneurial attitude among faculty and

university administrators who do not gain from inventors' entrepreneurial activity (Goldfarb and Henrekson 2003).

The knowledge infrastructure of a region is also cited as a key factor determining spin-off activity. For example, Saxenian (1994) has shown that spin-off activity is more likely to occur in high-technology clusters because of ease of access to critical expertise, networks and knowledge. My research integrates UK and KSA data with these findings.

3.6 Critical evaluation and identifying gaps in the literature

Academic Entrepreneurship and university spin-offs have received increased attention from both scholars and policy makers during the last decade. While this research has provided many insights into why some universities have higher levels of spin-off than others, there is still a lack of research about the limitations to determinants of spin-off activity and to the policy context of the research.

Many of the studies conducted to-date are theoretical and lack empirical grounding. As a consequence, there is a need for more studies to systematically explain why some universities are more successful than others at generating technology-based spin-off companies (Di Gregorio and Shane 2003; Vohora et al 2004). Insufficient attention has been paid to the importance of culture and governances and the individual motivation of academics to commercialisation their work. Although Shane and Roberts have carried out very insightful work in an MIT context, constructs of personality have yet to capture in a reliable fashion specific attributes, which underlie individual responses to experiences within different institutions of higher education. I return later to arguments about the extent and nature of academic entrepreneurship challenging the figures in sections 3.7.9 and 3.7.10. My research findings suggest that the notion of academic entrepreneurship is flawed principally because crossing the governances gulfs is challenging for academics, funders and businesses.

3.7 A Conceptual Framework for academic entrepreneurship

I now turn to developing a framework for analysis of university commercialisation that integrates my findings from entrepreneurship and innovation literature. The framework suggests that four factors influence the rate of spin-off activity.

1. The academic's reasons for engaging in entrepreneurial activity (individual characteristics studies);
2. The attributes of universities such as human capital, commercial resources and institutional activities (organisational-focused studies);
3. The broader social context of the university, including the barriers or deterrents to spin-offs (institutional and cultural studies);
4. The external characteristics such as regional infrastructure that impact on spin-off activity (external environment studies).

CHAPTER-4 CONCEPTUAL FRAMEWORK

This chapter outlines the conceptual framework that I will use to structure data presentation and conduct data analysis, linking closely with the previous literature reviews. This is my Framework-1, from which I will derive a Framework-2, which (following Charmaz's constructed grounded theory approach) is created after integrating the findings from my analysis.

The chapter begins by clarifying the status of a framework in my research and how this differs from existing framing, such as prospect theory. Then, referencing back to my chapter two and three critical review of existing theory, I justify the need for a new framework with which to analyse commercialisation processes in developing economies. Explaining the nature of the holistic framework I construct, I reference other eclectic frameworks as legitimating my approach. Section 4.5 presents my conceptual framework justifying its variables and explaining what this new framework brings to analysis that existing frameworks do not. I conclude by explaining how the framework will be used in my research.

4.1 Framing: type and use of a framework

Many conceptual frameworks in entrepreneurship and innovation literature are either rational or non-rational; the framework I develop is both. For example, Mintzberg et al's (1976) sequential framework usefully targets unstructured decision-taking, yet fails to include emotional/non-rational elements of business decisions. My conceptual framework, as chapters two and three have argued necessarily combines both rational (technical, market analysis, return on investment) and non-rational elements, such as animal spirits, entrepreneurial self-belief, emotional commitment to the new product /project.

My approach is quite different from Brundin and Nordqvist (2008) who whilst insisting upon the importance of affect in business decision taking, look at group dynamics in established firms: my focus is on emerging firms and the individual academic entrepreneur. Busenitz and Barney (1997) offer a framework for entrepreneurial decision-taking, but without holistically including the innovation element necessary in successful

commercialisation processes; Foo (2001) focuses on opportunity identification without referencing the essential commitment of the entrepreneur.

My framework follows the tradition of Kahneman and Tversky (1973; 1979) and Tversky and Kahneman (1974) and Kahneman's (2003) *prospect theory* centrally placing the rational/non-rational entrepreneur as the leader of the emergent firm at the centre of explaining (in this case) commercialisation processes (see Chapter-3 and in particular section 3.7). Whilst building on this approach, my framework takes the wider perspective outlined in Chapter-1 and section 3.6) beyond simply the decision (to invest) and instead explores the holistic (technical and social) processes of building the new firm around an innovative product. Additionally, prospect theory seeks to model decisions: it aims to be predictive, whereas the framework I develop is closer to Bateson's (1972) original idea of a conceptual frame for analysing a holistic process; what Levin, Schneider and Gaeth (1998) term *attribute framing*. The point of Bateson's approach, is to include sufficient variables to mount an explanation, without at this stage in the analysis being either completely specific over definitions of the variables or the causal relationships between the variables.

In summary, unlike prospect theory, my framework explores the processes of building a new business not simply the behavioural finance decision and unlike attempts to incorporate affect into decision-taking (Snow et al 2008; Pfister and Böhm 2008) my conceptual framework follows Bateson and includes all dimensions influencing the building of the business: it is not a simplifying (predictive) model. I discuss, in the methods chapter, the implications of these choices for the generalisability of my research conclusions.

4.2 The need for a new framework for commercialisation

My journey so far (chapter two and three) illustrates the inadequacy or inappropriateness of existing frameworks, my basic criticism being that analysing commercialisation needs grounding in both entrepreneurship and innovation concepts and theories, rooted in active

agency and to reference the target context and culture (in this case, the KSA, its institutions and people).

In sections 2.1 and 3.3 above I criticise as passive frameworks for successful TT based on knowledge management, as inadequately featuring the active learning and adaptation roles of academic entrepreneurs. Active agency is crucial to all innovation-entrepreneurship processes a point of criticism made in section 2.6 of sectoral system of innovation models. In section 3.4, I have argued that academic entrepreneurs are idiosyncratic boundary-hopping individuals capable of combining a high level of technical expertise with the ability to pursue commercial opportunities. As section 2.9 notes, viewing incubation simply as a technical process, ignores the emotional commitment the academic entrepreneur needs to succeed. Active agency then is a crucial dimension of successful TT commercialisation and is centre-staged in my framework.

KSA's Development Plans target emerging *knowledge-based* technologies as a diversification strategy. Section 2.2 notes the importance of clarity over creating the absorptive capacity to do basic and intermediate research necessary to create innovative products and in doing so criticises frameworks that see TT as a linear process. An important part of my argument for straddling innovation and entrepreneurship theory, (section 2.3) is that in a developing economy, the state's role (section 2.3) is crucial in strengthening the institutional context necessary for academic entrepreneurship to flourish. Figure 2.7 and section 2.8 captures this argument, noting that emerging technology clustering requires both breadth and depth.

For successful innovation and entrepreneurship knowledge flourishes only in an appropriate culture and context. Important aspects of this are universities with the appropriate absorptive capacity and links with industry (2.5 and 3.2). Entrepreneurial resource assembly and risk management only occurs when the adapted transferred technology is embedded in competitive products and (existing or emerging) markets. As section 2.7 notes, the institutional aspect of my framework needs to address the KSA institutional context. I detail this in sections 3.5, 3.6 and 3.7: analysing the processes of

successful commercialisation by academic entrepreneurs requires appropriate incentives and a culture supporting commercial risk-taking. Unlike frameworks that focus only on the individual (section 3.8) or organisational parameters of commercialisation, my framework takes the firm as the unit of analysis, drawing evidence of change processes from macro- to micro level.

4.3 Justifying an eclectic framework

Dunning's (1977, 1988a and 1995) framework explaining foreign direct investment (FDI) - a holistic, integrative approach to international production - is a well-known and oft-cited eclectic approach. He employs organisation, firm, trade, location and FDI theory in his ownership, location and internalisation *envelope*. Dunning's aim, similar to this paper, is to explain multi-dimensional, multi-governance, multi-scalar and multi-layered processes from the holistic perspective required by decision-takers and policy makers; incorporating *both* top-down and bottom-up influences on FDI. His broader recent work includes social factors such as knowledge generation and its flows (see Brouthers *et al* 1996). Following Dunning, this paper aims to show that an eclectic framework captures interaction between the particular (space, organisation and technology) and the general (institutions, international markets and technological trends) associated in my case with commercialisation. Additionally, like Dunning (2000), this research demonstrates the complementarity of the featured theoretical schools, each theoretical school offering significant insights into economic development processes (whilst differing in method and focus).

Eclectic theory works best when the constitutive theories refer to similar facts and events. Nobel's (1999) criticism of eclecticism is that it mixes theory from conflicting epistemological foundations. Both Dunning and this research use complementary theory, addressing related issues and questions. Similar to Dunning's work, my framework is applicable at micro and macro levels. The analysis of KSA's commercialisation processes and those of the UK avoids distortion from inappropriate scaling by using an approach to scaling inspired by Harvey (1982; 1985; 1992) and developed by Moulaert and Swyngedouw (1989; 1992). As with Dunning's theory, my commercialisation framework

is *not* testable as a general theory: validity lies in its ability to explain events and guide policy. A final resemblance with Dunning's work is that my framework is not a new general theory but a fruitful analytical framework emphasising and exploiting complementarity between existing theories. Whereas Dunning's research focus is patterns of FDI, here the focus is on changing technological regimes at a sub-regional level. Eclectic frameworks for economic development analyses are not new: see also examples in Porter 1990; Hall 1985; 1990 and Sternberg 1996).

To avoid a top-down deterministic causal hierarchy, some physical and social sciences employ Harvey's (1982) theory of scaling (developed by Moulaert and Swyngedouw 1989; Eoyang 1989; and Harvey and Reed 1997). Scale suggests similarity of transformation and interconnectedness across dimensions. Scaling is not a simple a static hierarchy in a geometric formulation, instead it is characterised by processes of autopoietic interaction between scales since the results of change may be similar regardless of scale (see von Krogh and Roos 1995). Scales are therefore phenomenological formulations, relative to one another. This relativity arises from both context and vantage point. In socially constructed scales, the degree of consciously intended and planned purpose can vary. Early Regulation theorists, for example, focused upon international-order scale. Like some of the later Regulation theory, my framework envisages multi-scalar to include the regional scale (see) and national scale (Boyer and Drache 1996 and Jessop 1997 and 2001). This paper illustrates how four scales (local, regional, national and international) can feature in one analysis.

It is insufficient to explain economic or cultural development as uneven, since development is both combined and uneven. One of Lenin's criticisms of imperialism was that despite suffering unevenness, it is difficult for countries/regions to opt out of combined development processes (see Chossudovsky 1997). In this sense, Harvey's theory of scaling explains differential development to be a result of its combined nature – markets encapsulate power relations. These trends appear to be growing in strength, if as Collinge, (1999) argues, services are becoming more internationally marketable and knowledge flows of transnational companies reflect political power structures. As Rodik

(2011) notes achieving globalisation, democracy and national autonomy is an aspiration rarely achieved.

4.4 Proposed new analytical framework

Figure 4.1 shows my new framework in four columns, which going from left to right are firstly the culture and context of the developing economy that enable or constrain the firm's ability to commercialise; secondly the direct inputs into commercialisation; thirdly the actual commercialisation processes and finally, the outcomes and outputs of these processes. Drawing from my literature review, each column shows the variables contributing towards commercialisation, particularly the concepts in Chapter-2 and entrepreneurial factors discussed in section 3.7.

In column-1, the emboldened rectangle shows the policy framework (institutions, state, entrepreneurship and knowledge-based activity) from which are derived measurable characteristics enabling or constraining academic entrepreneurship, which can be evaluated against the needs of the innovating firm: referencing particularly sections 2.3, 2.5 and 3.6 in the literature review. My framework draws from neo-institutionalist approaches (North 1990; Di Maggio and Powell 1983; Williamson 1985; Scott 1995) to which I have argued (section 2.3) need to more explicitly embed active agency. I do this by drawing upon Archer's (1988; 2007) approach to the mutual shaping of institutions by agents active within them, by acting within and continually recreating habituses Bourdieu's (1977) term for pre-dispositional cultural and cognitive approaches to understanding and decision-taking. In doing so column-1 addresses the stability/change conundrum in institutional theory, by positing ideas space (Ogle, 2008; section 2.6.2) as learning agents; bringing to the fore my discussion of a socio-cultural model of learning in section 2.1. Column-1 therefore integrates the institutionalism of innovation theory, with the active agency central to entrepreneurship research found in Chapter-3. My framework intends to avoid the determinism and universalism too often found in systems theories. I have criticised such approaches extensively, for example Breschi and Malerba's (1997) conceptualisation of NSI in section 2.6; Etzkowitz's (1983; 2000) Triple Helix in section 2.7 and non-processual approaches to clustering such as Porter (1990) in section 2.8. My framework also begins

in column-1 by citing enablers and barriers to entrepreneurship (see figure 3.2) and in particular for academic entrepreneurship (Shane 2004), a detailed discussion of which in section 3.7 draws attention to motivational issues (Lach and Schankerman 2003) and institutional level factors (section 3.7.5) for example Gulbrandsen's (2005) work on multiple goals. Column-1 therefore closely links with my discussion of literature and represents in figures 4.1 and 9.17 the culture and context in which commercialisation occurs.

Column-2 shows inputs to successful commercialisation: legitimacy creation and resource assembly, TT, leadership and internationalisation capacity. These are the practical inputs of that sort that GEM measure and compare and in which section 2.9 and 2.10 review previous research emphasising legitimacy and resource assembly. Throughout my literature review, I have emphasised that while quality of inputs into commercialisation processes are important, my interest is in the processes of commercialisation leading to successful outcomes. Column-2 references the idea (section 2.2.1) that a KBE is (Castells 1997) is typified by shortened innovation cycles: a closing of the gap between science and technology. Hence the importance of section 2.5 discussing the changing nature of universities (Yamada 2000), balance between basic and applied research (Pavitt 1998) and the multiple goals arising from the patenting/publishing debate (Agrawal and Henderson 2002). Given the importance of thickening institutions in KSA, my arguments in section 2.5.3 against Stromquist and Monkman (2000) and Giroux's (2006) vocational universities in developing countries is an important aspect of column-2 (see also section 3.2). The column also draws on literature advocating the discovery approach to business models (McGrath 2010) and entrepreneurial leadership in commercialising universities, capable of providing effective TT and incubation facilities (see my discussion in 2.9.1 using Becker and Gassmann 2006), an international orientation (Kenney 2000) and close UILs with successful business to act as exemplars within the context and culture (section 2.5.3). I emphasise, using Blumenthal *et al's* (1996) work the quality of TT and incubation services necessary for effective commercialisation, citing Siegel *et al's* (2004) point that this necessarily involves promoting close UILs at all levels and functions (teaching, research and incubation). Column-2 envisages commercialisation activities in a developing

economy overcoming the *burden of backwardness* (Bouckaert 2007) by adopting some of the characteristics of the Development State shown in figure-2.4 i.e. shifting from resource-dependency (Auty 2001) towards a KBE, led by a clear strategic vision and rational policy-making.

Commercialisation processes in column-3 cover the main choices and challenges the academic entrepreneur faces. The checklist is not exhaustive nor in order of importance since each commercialisation process is unique, however, I expect the data to show patterns and to revise this section in framework-2. The list integrates contextual factors facing academic entrepreneurs (section 3.7 above) and the results of discussions in section 2.5 on motivation and 2.62 on business models. Section 3.9 brings together the practical results of research by Di Gregorio and Shane (2003) and Vohora *et al* (2004) on how academic entrepreneurs can build legitimacy and assemble the resources necessary to launch successful enterprises, see also Rothaermel *et al* (2007). The importance of UILs (section 2.10.1) is argued from the work of Markman *et al* (2008) and Abreu *et al* (2009) to be important in providing mentoring and exemplars in particular (2.10.2, for example Wilson 2012) on crossing governances: the central challenge facing academic entrepreneurs. I note too, in section 3.7.7 using the work of Kenney and Goes (2004) that knowledge spillovers is two-way and not simply a technical transfer from abroad or into markets, knowledge spills from businesses and market institutions into universities. Following Florida and Kenney (1988) and important work by Shane (2004b), column-2 centrally features access to risk capital without which venturing is impossible, noting that secondary markets to raise subsequent rounds of finance or exit via private equity markets remain a major challenge in developing countries. In summary, column-3 of my framework includes the practical contributions necessary to commercialise a business based on university research.

Finally, column-4 lists the concrete, monitoring and improvement aspects of (measurable) outputs and (evaluated) outcomes from the commercialisation processes. In particular, I will be looking for firms to establish themselves sustainably in their target market; points discussed from the widest perspective in section 2.4, also drawing upon the discussion of

success criteria in section 2.9 of the literature review. In section 3.7.9 and 3.7.10, I note the dearth of robust research on firm and economic performance associated with commercialisation. In this sense, column-4 represents not only the outcomes of commercialisation processes; it also represents the results of my research.

Note that the framework features multiple levels of scaling (such as international markets, state structures and policy, university arrangements and firm-level actions. My intention as I argued in section 4.3 (citing Harvey 1982) is that the framework operates at these multiple levels of scaling and *from the point of view of the innovating firm* references variables impacting on the commercialisation processes. The framework bridges variables from innovation theory (systems, absorptive capacity) and those from entrepreneurship theory (resource assembly, legitimacy). Since I apply this framework at the level of the firm, led by the academic entrepreneur, column-3 is particularly important, representing decisions and choices by the active agents. Insisting on the importance of active agency differentiates this framework from others that focus on policy, structures or organisational form. Each column, beginning with column-1 references the particular culture and context of Saudi Arabia and the UK. I avoid one-best-way approaches to commercialisation by grounding and explaining events and decisions within the culture and context in which they occur. My framework is not an abstract prescription of what ought-to-be in place to successfully commercialise transferred technologies; rather it is an aid to analysing actual processes.

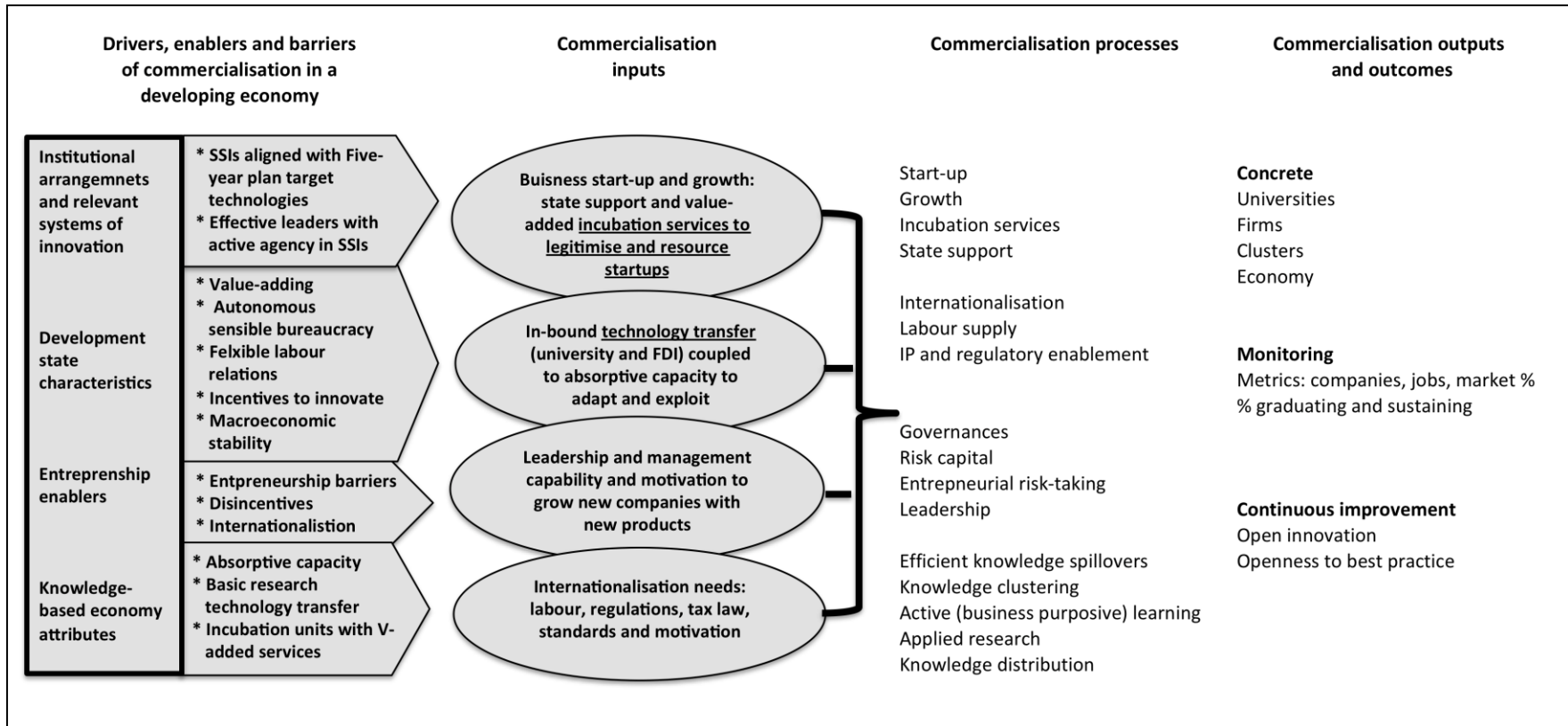


Figure 4.1: Conceptual framework

4.5 Using the framework

As I explain in my methods chapter, this framework is used in data gathering to design interview schedules and guide the assembly of public data. I then use the framework (chapter-6) to structure the presentation of case studies. My analysis chapters (seven and eight) use the framework to aid comparison between KSA and the UK and analysis of the data and reintegration with research literature

CHAPTER-5 METHOD AND METHODOLOGY

The purpose of this chapter is to set out and justify the methodological choices made in this research, justifying them in relation to methods literature and previous work in the field.

5.1 Summary of method and structure of chapter

In summary, my methodological choices are a constructivist epistemology for quantitative research using a constructed grounded theory approach and multiple case studies based on a carefully selected purposeful sample of interviewees and observations.

Beginning with a summary of the method used and the research questions, the chapter considers methodological options and then research strategy and design. Details of sample and data gathering techniques are followed by a justification of data presentation and analysis choices. The chapter concludes by considering the type of theory generated by this research and its generalisability and examining ethical issues associated with the research.

5.2 Research objectives

This section explains how I use Blaikie's (2008) guide to setting research objectives: my over-riding objective is to better understand incubation processes in KSA in order to theorise their particular culture and context and therefore guide their effectiveness.

Blaikie's (2008) four-part approach to research objectives guides this research: exploration, description, explanation and understanding. My research is *exploratory* since there are few studies of incubation in Arab contexts and none focused on public sector incubation in the Kingdom of Saudi Arabia (KSA).

My literature review reveals that whilst there is extensive commentary and research justifying the need for commercialisation (sections 2.10 and 3.2) and significant research on its outcomes (section 2.5.3 and 3.3), my focus – commercialisation processes – is an

under-research and emergent arena of study, as section 2.11 demonstrates. Major theorisations such as the TH and innovation systems (section 2.6 and 2.7) are shown as lacking in intellectual rigour, especially when analysing the factors influencing individual academic entrepreneurs (section 3.7) in commercialisation processes. I therefore regard my study as of an emergent area in which concepts and their causal relationships have yet to be firmly established into dominant discourses. The under-explored nature of my subject is my principle justification for adopting Charmaz's (2006) constructed grounded theory (CGT) approach, since it enables me to propose conceptual categories and their relationships in an initial framework, which I can then amend in the light of evidence. My three research questions are 'what,' 'how' and 'why' based on Blaikie's (2008) three other research guides: description, explanation and understanding. Using categories in my initial framework (figure 4.1), I gather evidence *describing* what is happening in public incubation centres using a cross-country comparison to generate reference points. Chapter-8 focuses on *explaining* (in-case and cross-case analysis) how the variables operate in both KSA and UK incubators, comparing and contrasting actions and results between centres, between agents and between incubators in two radically differing sets of institutional arrangements. *Understanding* these actions, events and outcomes is the focus of chapter-9, in which I reintegrate my results and sense-making with existing theory and (figure-9.17) revise my initial framework to take account of new theory generated as a result of my analysis.

In summary, using Blaikie's (2008) guide to setting research objectives, this section begins my explanation and justification of method based around exploration, description, explanation and understanding.

5.3 Methodological approach

This section justifies a constructivist epistemological stance, using a CGT approach and multiple case studies for this qualitative research.

5.3.1 Epistemological stance

Agreeing with Easterby-Smith *et al's* (1991) ontological approach that people construct social reality, it follows as Miles and Huberman (1994) note that social research is interpretivist. It is therefore necessary as Cochran-Smith and Lytle (2009) argue to explicitly clarify ontological and epistemological assumptions in order to avoid sinking into relativism. There is no objective social data, removed from social context: the categories, such as incubation, I have chosen only has relevance to the social settings that I construct to explore and understand (Burrell and Morgan 1979). Selecting events and agencies associated with incubation as Pauwels and Mattysens (2004) note is not random, but nor are these choices beyond dispute; rather their justification rests on the believability of the narrative I construct: my interpretation. Every event, as Sztompka (1994) argues has some idiosyncratic particularities and in each event active agents influence outcomes: there is an array of events and 'facts' from which I choose in order to provide a persuasive interpretation (Kvale 1996), persuasive to the reader (hopefully), writer and agent. As Saunders *et al*, (2003) suggest:

It is necessary to explore the subjective meanings motivating people's actions in order to be able to understand these... [the] role of the interpretivist is to seek to understand the subjective reality of those that they study in order to be able to make sense of and understand their motives, actions and intentions in a way that is meaningful for these research participants (Saunders et al 2003:84)

From an interpretivist standpoint, as Schoenberg and McAuley (2007) note, both the researcher and agent/interviewee's epistemological stances are subjectively constructed, perhaps especially so as Hine and Carson (2007) suggest in an emergent field of research such as adopting western technologies and commercialisation processes in an Arabic and Islamic context. To capture and understand motives, judgements and actions, as a researcher I need to 'get into the head' of the respondents, adopting as Saunders *et al* (2007) and Pettigrew (1997) suggest an empathetic stance. My protection against bias is the cross-referencing of grounded data, triangulation with previous research and deep reflexivity in sense-making: these are the hallmarks of rigour. An advantage of the grounded theory approach, is inducting meanings, relationships and causalities from experiences, rather than assuming that a range of concepts, definitions and relationships are already established, which my literature review reveals not to be the case and section 2.11 justifies.

Since as I explain, none of the incubator centre keep (or are prepared to share) important quantitative data (such as cost-benefit analysis or value-added), my research is qualitative; my focus is on the processes incubating ideas into businesses in the incubation centres, making quantitative testing of hypotheses impossible. My research stance is post-positivist in that I whilst I reference what quantitative data is available the main evidence I assemble and interpret is inferred from quantitative data. Following Peirce (1955); Miles and Huberman, (1994); and Dubois and Gadde (2002), I recognise that my conclusions are not embedded in my premises or data, rather they are revealed in sense-making processes including social morés, rules and cultural significances.

In summary, for this qualitative research, I take a constructivist epistemological stance, gathering multiple case studies from KSA and the UK structured by an initial framework that is later amended in the light of data: the constructed grounded theory approach.

5.3.2 Research approach

Conceptual, see figure-1.2, I draw upon a range of theory drawn from innovation and entrepreneurship disciplines. The theoretical frameworks guiding the conduct of my research are constructed grounded theory (Charmaz 2006) and Yin's (2003) idea of multiple case studies; which I explain and justify in this section.

Constructed grounded theory

In their Discovery of Grounded Theory Glaser and Strauss (1969) argue that *theory – as explanation or prediction - can be generated from data systematically obtained from social research*. Their aim is to provide an alternative to logico-deductive models of research, whilst retaining rigour and systematicity and argue for a particular definition of theory.

a strategy for handling data in research, providing modes of conceptualisation for describing and explaining. The theory should provide clear hypotheses so that crucial ones can be verified in present and future research; they must be clear enough to be readily operationalised in quantitative studies when these are appropriate. (Glaser and Strauss 1967:3)

Charmaz (1995) and Bryant and Charmaz (2007) set out to reinstall previous research into a grounded approach suggesting that there is a middle ground between realism and

relativism; that it is epistemologically valid to take existing theory as an artefact (along with data and suggested new theorisations) repositioning grounded theory into what Charmaz terms constructed grounded theory (CGT, Charmaz and Mitchell 1996). As Bryant and Charmaz (2010) argue, this places research theorising processes closer to ‘interpretive conceptual frames and further away from determinist variables.’ They avoid realism by insisting that CGT is an interpretation and representation of reality, rather than its replication.

Interpretivist in acknowledging that to have a view at all means conceptualizing it. Data are always conceptualized in some way. Thus the generalizing impulse in classical grounded theory, its strain towards parsimony and subsequent reductionism, the beliefs in discovery and distanced observation, all become problematic. A repositioned GTM bridges defined realities and interpretations of them. It produces limited, tentative generalisations, not universal statements (Bryant and Charmaz 2010:52).

The significance of both human and non-human artefacts are interpreted by the researchers in CGT the validity of which relies of limiting theorisations to that which flows from the data. Unlike Merton (1949) who Glaser and Strauss (1967:2) suggest was ‘preoccupied with how verifications through research feed back into and modifying theory, not grounded generating of theory,’ new theory is generated from the data and verification intentionally sought: the lesser the falsifying data and deeper the data, the stronger the emergent theory (1967:27). Overemphasis on validation and testing, they argue limits the generation of new theory: what they term ‘*plausible interpretation versus genuine verification*’ (Glaser and Strauss 2008:13). It is the absence of a generally accepted set of variables (defined and causally related) that justifies the use of CGT. Had clear variables been established in the field (which section 2.11 shows is not the case) then I would have adopted a quite different research approach, such as hypothesis testing.

Charmaz (2006) picks up this theme disputing Swanson’s (1960) argument that verification processes are more important than generating new theory. She goes on to dispute Blauner’s method (*Alienation and Freedom*, 1964) as sacrificing theorisation in order to retain structuralist certainties even where they contradict the felt experiences of agents. For Glaser and Strauss, verification is not a lower-order of importance; rather it comes after theorising a sense-making interpretation of the data. Comparative studies (such as my own) they regard as especially relevant to establishing validity.

Generating theory carries the same benefit as testing theory, plus one additional one. Verifying a logico-deductive theory generally leaves us with at best a reformulated hypothesis or two and an unconfirmed set of speculations; and, at worst, a theory that does not seem to fit or work. A grounded theory can be used as a fuller test of a logico-deductive theory pertaining to the same area by comparison of both theories from an accurate description used to verify a few propositions would provide. Whether or not there is a previous speculative theory, discovery gives us a theory that 'fits or works' in a substantive or formal way since the theory has been derived from data, not deduced from logical assumptions. (1967: 29).

Comparative studies are important in validating research and theorisations because it draws in potentially falsifying evidence giving the 'fullest generality for use on social units of any size' (Glaser and Strauss 1967:22). For example, are the conceptual categories constituting entrepreneurship the same in KSA and the UK; the 'facts' relating to successful commercialisation the same and do they illustrate the same causal relationships? For Glaser and Strauss (1967:24) comparative studies increase the 'generality and explanatory power' of social research. Theory generated may be substantive or formal, in both cases,

Joint collection, coding and analysis of data is the underlying operation. The generation of theory, coupled with the notion of theory as process, requires that all three operations be done together as much as possible. (Glaser and Strauss 1967:43)

These are best not viewed as linear processes; rather iteration between collection, coding and analysis gives the best results – a process I adopted.

Comparative analyses, according to Glaser and Strauss (1967) support two types of theorisation: conceptual categories and the relations between conceptual categories, each of which has analytic and sensitising features. Analytical features are generalisable and not limited to the observed entity. Sensitising features are the meanings and significance attributed to actions, events or representations, by the actors themselves – their meaning in context. They go on,

While the verification of theory aims at establishing relatively few major uniformities and variations on the same conceptual level, we believe that the generation of theory should aim at achieving as much diversity in emergent categories, synthesised at as many levels of conceptual and hypothetical generalisation as possible. The synthesis provides readily apparent connections between data and lower and higher level conceptual abstractions of categories and properties. (1967:37)

Theory generation they argue does not require an absence of Popperian falsification or proof, rather sufficient evidence to make the theory plausible and testable by further research. However, they also state that:

In the beginning, one's hypothesis may seem unrelated, but as categories and properties emerge, develop in abstraction, and become related, their accumulating interrelations form an integrated central theoretical framework – the core of the emerging theory. (1967: 40)

Taking this idea further, Charmaz (2006:178) argues that '*grounded theory depends on using constant comparative methods and your engagement. Both constitute the core of the method.*' Constant cross-referencing between comparators and empathetic interpretation of meanings, she argues are the foundations of CGT.

Comparative methods lend you basic tools, yet myriad interactions occurring in multiple forms at various levels shape the content of your grounded theory. Ultimately, the emerging content shapes how you use the tools. Your grounded theory journey relies on interaction-emanating from your worldview, standpoints, and situations, arising in the research sites, developing between you and your data, emerging with your ideas, then returning back to the field or another field, and moving on to conversations with your discipline.....In short, interaction is interpretive. (Charmaz 2006:179)

Parting company with Glaser and Strauss, she argues that the 'cloak of objectivity enshrouding grounded theory of the past reduced visibility of its interactive strength' (2006:179). This is my approach to research and like Charmaz builds on Glaser and Strauss (1967), Glaser (1978), Strauss (1987) and Strauss and Corbin (1990, 1998).

Whilst Glaser (2002) argues that everything observed is data, Charmaz (2006:16) further suggests that the '*logic of grounded theory guides your methods of data-gathering as well as of theoretical development*' proposing that '*people construct data - whether researchers construct first-hand data through interview or field-notes or gather texts and information from other sources*' (2006:16).

For Charmaz (2006:17) each research has a 'points of departure:' a desire to understand or puzzle through an issue: for myself the point of departure is the heavy investment by KSA in incubation as part of its diversification strategy and the relative failure of incubation to produce the new products and companies intended.

CGT then avoids quantitative hypothesis testing, since framing of issues in order to construct the hypothesis significantly influences subsequent theorisation. Rather CGT is pulled by the problem towards relevant data and from sensitising concepts and coding the initial framework guiding data gathering may well be amended: a route to new theorisations. It is the grounding in data that give CGT 'its rigour and resilience on emergence' (Charmaz 2006:183). She links these to the US (Chicago tradition of sociology, which she argues (2006:184) fosters openness to new explanations, encourages empathetic understanding and takes account of the subjective interpretations of participants. The CGT approach is now well established in social science and developed by others including Baszanger (1998); Bowker and Star (1999); Clarke (1998, 2005); and Corbin and Strauss (1988).

For Charmaz (2006) retaining constructivist sensibilities aligns closely with pragmatic philosophy (Dewey) in not discounting nuances of meaning and action as constituting evidence for theorisation.

emergent nature of your data and analyses. In short, returning to the pragmatist foundations encourages us to construct an interpretive rendering of the worlds we study rather than an external reporting of events and statements. (Charmaz 2006: 184)

Multiple case studies

Yin (2003) is clear that the approach to research depends upon the type of research questions being asked. The great advantage of casework is that one can approach the exploration of emergent phenomena, such as incubation centres in KSA, without overly structured preconceptions – provided it is used rigorously. Pauwels and Matthyssens (2004) suggest that rigour, in multiple case study work, involves theoretical sampling, triangulation, pattern-matching logic and analytical generalisation and a single roof of validation through concurrence and iteration. Since the purpose of my study is to understand with a view to improving KSA incubation processes (referencing UK practice), multiple case studies give the depth and variety Ghauri and Grenhaug (2002) argue justifies their use.

My study uses multiple cases of incubation processes (six centres in KSA and two in the UK, and twelve incubated companies, six from each country). Thus in Yin's (2003) terms, I use multiple cases with a single unit of analysis – the incubation process and in each case draw on the case material to answer a 'what,' 'how,' and 'why' question: covering the three types of cases Eisenhardt (1989) identifies: exploratory, descriptive and explanatory.

My pilot empirical work involved interviews with KAST and ERI, which I used to polish an interview schedule (appendix) prepared using the 4.1-framework. Following Miles and Huberman (1994:25) the interview schedule and narrative approach to interviewing encouraged respondents to link the incubation processes to the wider cultural and contextual setting in which incubation occurred, thereby giving richness and depth to the cases. Comparison therefore within and between cases and countries (Eisenhardt 1989; Miles and Huberman 1994) was facilitated at a deep level. Cases were based on 34 original interviews and background research (policy and reporting documents).

In summary, given the emergent nature of the research field in KSA and the need to deeply investigate incubation processes, this research adopts Charmaz's (2006) CGT approach and Yin's (2003) idea of multiple case studies

5.4 Research questions

My research questions are as follows.

- RQ-1: What is the contribution of state science parks and business incubators in Saudi Arabia towards commercial innovation and entrepreneurship?
- RQ-2: How do financial, social, cultural and human capital blend in KSA's innovation and entrepreneurship processes and how might their impact be improved?
- RQ-3: Why do innovation and entrepreneurship processes in KSA appear less effective than those in the UK?

As I explained in chapter-1 these are intended to map the terrain (RQ-1 is a 'what' question); capture the 'how' of holistic incubation processes covering a wide array of

disciplinary fields; and (RQ-3) to understand ‘why’ Saudi incubation processes are implemented the way they are and the extent to which they are influenced by the cultural and contextual setting, by comparing them with those in the UK. I chose the UK as a comparator because it is well researched, access was available and some researchers for example Al Thawwad and Rashed (2009) hold it to be international best practice. I resisted a direct comparison of national systems of innovation, since at the level of the incubator and incubating firm, active agency (leadership, risk-taking, knowledge, emotional commitment) matter and it is the processes of incubation rather than its structural setting that interests me.

5.4 Research strategy and design

5.4.1 Research strategy

Yin (2003; 2009) advocates the use of multiple case studies to explore contemporary, dynamic and emergent issues generating Llewelyn (2003) suggests contextually-specific or mid-range theory. Thematic analysis ideally suits multiple case study work in that the themes structure the cases and allows decomposition of variables below the unit-of-analysis level for analysis, which can then be recomposed into a narrative. To add to the groundedness of my analysis, as Glaser and Strauss (1967:22) suggest, I introduce comparability (between countries and between incubator and incubating company cases), which facilitates validation of emergent theory. Additionally, I follow Charmaz’s (2006) CGT theory approach of structuring research using a framework based on previous research, that I then amend following analysis to form part of my theoretical contribution. This is my research strategy.

5.4.2 Unit of analysis

Innovation and entrepreneurial processes are complex and multidimensional. The choice of unit-of-analysis is far from trivial since as Low and MacMillan (1988) note study is possible of individuals, groups, organisations, sectors, industry, and society. My choice was guided by seeking to identify how agency influences outcomes. Agency here is not only the entrepreneur; it is also the incubation manager and the wider business network of people supporting incubation. I decided therefore to take the incubation process as my

unit-of-analysis to avoid focusing on systems, structures or policy since my experience in KSA and reading of the literature suggests that analysis of systems, structures and policies are unlikely to identify reasons for the relative under-performance of Saudi incubation. Following Archer (2000) my approach to agency within the incubation process unit-of-analysis is one of mutual interdependency with institutions: institutions guide agents, who in turn pattern behaviour and reshape institutions. In all social analysis the danger of determinism is ever-present.

Choosing innovation and entrepreneurial commercialisation processes as my unit of analysis informed my later decisions on data population and samples. To understand the processes requires detailed processual and qualitative data, which I decided was best available from individual academic entrepreneurs (both in KSA and the UK) coupled with contextualising data overviewing these processes. This I decided was best available from university-based incubation units, I therefore decided to interview incubator Managers in both countries.

5.4.3 Research design

Having worked in areas associated with commercialisation in KSA for twenty years, I brought pre-understanding (prejudice?) to my study. Following Hatem (2013) during my time digesting literature, I visited several UK incubators familiarising myself with processes, nomenclature, hierarchies and network connections. Figure-1.1 illustrates my final version of research questions that have undergone multiple drafts. Following Yin (2003:21) I focused on the connections between literature gaps and the practical problems that inhibit commercialisation in KSA.

My research design evolved into several stages and 'levels' from which I interrogated the unit-of-analysis incubation processes. These are summarised below.

- Literature search, digestion and identification of gaps
- Visits to UK incubators for familiarisation
- Preparation of research framework (figure-4.1)
- Preparation of interview schedules (managers, incubatees, policy-makers)
- Pilot of interview schedule in KAST and ERI

- Identification of likely cases and negotiation of access
- Interviews with incubation managers
- Interviews with incubatee companies
- Interviews with policy-makers
- Translation, transcription and archiving of data
- Primary data coding
- Data reduction and analysis for in-case and cross-case analysis
- Overall analysis triangulating with literature
- Sense-making and formulation of framework-2

My research choices were numerous and some of them appear in the following sections, justifying sample, data gathering and data analysis. My main choices were to use cases, adopt CGT, seeking an international comparison and to take incubation processes involving active agency as the unit-of-analysis.

5.5 Population and sample details

This section explains and justifies the logic of my dataset choices. Figure 5.1 shows my primary dataset amounting to 23 interviews in KSA and 12 in the UK (some with extended observation). At an early stage I decided that introducing the additional comparison of private and public sector incubators introduced too many variables. Since all public sector incubators in KSA are attached to universities, I decided only to investigate similar centres in the UK. Whilst most of the UK's 156 universities have an incubation centre or support services, only six universities in KSA have incubation centres. I decided to interview all six of the Saudi centres and that for comparator purposes two would be sufficient in the UK: ERI and Cambridge agreed to participate.

My approach to constructing a database was *theoretical sampling* (Eisenhardt and Graebner 2007) consistent with the CGT approach of creating emergent theory. As Yin (1994) summarises, cases are chosen because they are unusually revelatory, extreme exemplars, or represent opportunities for unusual research access: my access to Saudi incubators is dependent on trust built over years allowing privileged access. This sampling strategy complies with the arguments that qualitative sampling is "purposive" (Miles and Huberman, 1994:27) and "theory-driven" (*ibid*). In my case, I sought incubation centres intent on internationalisation and companies from a range of sectors (software, life-science

and value-adding services). Since my research questions dig into commercialisation processes, I required detailed qualitative data, which I decided was best available from individual academic entrepreneurs and the Managers of university-based incubation units. In addition I interviewed a selection of policy makers, both from Universities and Government. My theoretical sampling choice of entrepreneurs and incubation Managers is further justified by the policy interviews, which though informative about policy reveal little about processes. Only by sampling people involved in the processes did processual qualitative data become available.

To delve into incubation processes I needed to gather data from incubated firms and leading entrepreneurs. My first thought was a mix of successful and failed incubatees. Although the list of the latter is lengthy, the incubator centres were reluctant to give me access, I therefore decided only to interview companies and entrepreneurs deemed by the incubator centres to have had some success: in KSA's case making them '*unusually revelatory*' (Yin 1994) since this is a new phenomenon. Seeking a *theory driven* (Miles and Huberman, 1994:27) purposive sample I tried to source two incubated companies from software, life science and value-added service sectors. This mix remains discernible in my sample; however, I was unable to strictly adhere to my plan. Few other studies of incubation present data from managers, policy-makers and companies. Within the eight incubation centres which I study, are embedded cases of twelve incubated firms: these twenty cases are substantially greater in number than (for example) the triple helix studies referenced above, many of which refer to only one or two illustrative (i.e. not deep) cases. I decided that given time considerations and referencing previous research a sample size of six companies in each country was appropriate: small enough to be manageable, whilst large enough to generate a range of views. My overall approach was theoretical sampling.

Some centre managers migrate between the centres and policy-making. Fortunately Respondent-33 and Respondent-35 (UK), Respondent-9 and Respondent-23 (KSA) fall into this category and were able (in separate interviews) to cover policy and give their perspectives on incubation centre management and strategy.

Figure-5.1 is my sample: on balance I believe it to be imperfect yet appropriate since the sectorally-diverse sample improves the generalisability of conclusions. As Perry (1998) notes, data-richness logic trumps sampling logic. There can be *literal replication* where similar results are found for predictable reasons or *theoretical replication* where contrary results are found for predictable reasons (Perry 1998). Thus the selection of cases is “purposeful”, not random sampling (Patton 2002), involves using replication logic and is dependent on the conceptual framework developed from prior theory (Perry, 1998). Case studies are generalisable to theoretical propositions, not to populations as in survey research (Yin, 2003).

5.6 Data gathering

I considered an ethnographic study using non-participant observation (Easterby-Smith *et al* (1996) but quickly realised there would be insufficient time or that I would need to greatly reduce my sample size. Several of the incubation centres were not keen on detailed observation; I contented myself with an observation visit to each centre and settled on interviews as a data gathering technique.

This study began with two exploratory visits to KAST and ERI of the type developed by Gill and Johnson (2002): effectively using ethnographic techniques of listening, looking, learning and familiarisation as Sharpe (1998) recommends in business research: the *naturalistic modes of inquiry* Gill and Johnson (1997: 96) favour. Each visit last half a day, during which time I also gathered archival data (documents, annual reports, press releases) adding data to my overall data set as Welch and Piekkari (2004) recommend including talking with current clients at varying stages of incubation. In effect, my exploratory visits assisted me as Brannen (1996:264) suggest they might in (a) polishing my interview schedule and (b) in ERI’s case understanding better the cultural morés, standards and ‘feel’ of the incubation processes particular in what is a foreign country to me (Sharpe 2004).

Institution/ Sector	Interviewees	Criteria	Justification
KSA companies	(1) Respondent-1	IT for online education	Company CEO using US transferred technology targeting EU markets
	(2) Respondent-2	IT for booking services	Company Manager, using KSA university-based commercialisation
	(3) Respondent-3	Energy/ Programming	Company using US and KSA university technology
	(4) Respondent-4	IT/Programming	Company using technology from Boston
	(5) Respondent-5	Creative Arts	Company using KSA (KAUST) university commercialisation
	(6) Respondent-6	Mobile Application	International idea developed in KSA university
	(7) Respondent-7	E-Commerce/IT/Media	Manager of three companies using technology from LBS, and Australia
	(8) Respondent-8	Recycling	Manager using technology from Malaysia
	(9) Respondent-9	Agriculture	Manager using technology from US
	(10) Respondent-10	Photography	Manager using technology from US
	(11) Respondent-11	IT for services. Food	Company manager using KSA university commercialisation
	(12) Faisal	IT for services	Company manager using KSA university commercialisation
KSA Incubator	(13) Respondent-13	Incubation centre	Manager
Managers	(14) Respondent-14	Badir incubator development and marketing	Manager
	(15) Respondent-15	Incubation centre	CEO Dhahran
	(16) Respondent-16	KSA Consultative cabinet	Policy-maker responsible for commercialisation
	(17) Respondent-17	International commercialisation expert	Contract manager advising on commercialisation
	(18) Respondent-18	Commercialisation policy expert	Ex-Stanford study team in KSA

KSA policy	(19) Respondent-19	Commercialisation policy expert	Dean of planning in KSU
Makers	(20) Respondent-20	Commercialisation policy expert	Was KAST head of R&D, now secretary to Board of KACST
	(21) Respondent-21	Commercialisation policy expert	Prof of entrepreneurship (KSU) and leader in Entrepreneurship Society of KSA
	(22) Respondent-22	Commercialisation policy expert	Vice Principal at KSU responsible for entrepreneurship and innovation
	23) Respondent-23	KSA Consultative cabinet	Policy-maker responsible for commercialisation
UK Companies	(24) Respondent-24	University incubation	CEO Polorum, UK technology
	(25) Respondent-25	University incubation	CEO Maketechnics, UK technology
	(26) Respondent-26	University incubation	CEO, Egyptian/UK technology
	(27) Respondent-27	University incubation	Manager Tala, Portuguese/UK technology
	(28) Respondent-28	University incubation	CEO, UK and US technology
	(29) Respondent-29	University incubation	Manager Freeland, UK technology
	(30) Respondent-30	University incubation	Manger of Teadough, UK technology
	(31) Respondent-31	University incubation	Manager Scientific Editing Company, UK knowledge
UK incubator	(32) Respondent-32	UK incubation manager	Student spinout incubator at University of Edinburgh
Mangers and	(33) Respondent-33	UK incubation manager and policy expert	Commercialisation Director at Edinburgh BioQuarter
Policy-makers	(34) Respondent-34	UK incubation manager	Manager at Free Space, Cambridge
	(35) Respondent-35	Policy expert and UK incubation manager	Commercialisation Director at ERI

Figure-5.1: Dataset

I prepared three interview schedules (Appendix C) for managers, firms and policy-makers based on the 4.1 framework and my exploratory visits (Smith *et al* 1992; Yin, 1994) interviewing the owner-managers of firms, though on two occasions other team members joined me. All the interviews ranged from ninety minutes to 180 minutes in length; those in KSA were conducted in Arabic. On two occasions the interviews lasted for four hours,

as the founder/entrepreneur was so interested in telling the “story” of how he managed to take his start-up venture into new international markets, explaining the different challenges he faced as the company expanded.

Taking a lead from Marschan-Piekkari and Reis (2004:227) I employed the language with which respondents were most comfortable: English for the British interviewees and Arabic for KSA interviews, with the exception of Respondent-15. Although all of the Saudi interviewees are bilingual, some of the technical terminology was not familiar to the interviewees and the author felt it might affect the ease of flow of the narration.

Collecting data in one language and presenting the findings in another involves researchers taking translation-related decisions. Translation took a great deal of time and effort as Broadfoot and Osborn (1993) and Ercikan (1998) suggest noting with Birbili (2000) that translation-related decisions directly impact on the validity of the research. In this case, I reflected carefully on meanings using my knowledge of both languages, familiarity with Saudi culture and intention of the research. Effective translation is never literal. Respondents at times used different word interchangeable, for example *yataallam* (learning), *taaleem* (education), *tadreeb* (training) and *kheprah* (learning from experience); I have been careful to transcribe intended meanings, many of which I double-checked with respondents.

After an outline of research aims and an assurance of confidentiality by the researcher, the entrepreneurs were asked to describe their identification of the entrepreneurial opportunity that they had faced and how they had exploited it, using the “story-telling” approach developed by Magretta (2002). Ontologically, narratives are the essence of human behaviour and a fundamental mode of thinking; we often organise and transfer our knowledge in a narrative form (Linde 2001; Williams 2006). Narrating is what researchers do when they construct case descriptions and what informants do when they convey the details of their experiences (Riessman 2002; Czarniawska 2002).

The interviews were then structured, using open-ended questions, to understand the complexity of the issues and the thinking of the interviewees themselves in as open a

narrative as possible (Yin 1994). The interviews began with the primary objectives for the firm, the strategic decision process, and the major obstacles and challenges faced during planning and implementation, before moving onto discussion of the firm's strategy market entry and network building. The interviewees were then asked to reflect on the most important things that they had learned in their experience of initiating their operations.

Throughout my research, as suggested by Yin (1994) I have gathered archival data from secondary sources enabling triangulation with the primary interview data. Many of these sources are cited in the literature review and chapter-6 and 7 and include official documents, Internet sites, written and visual media documents (e.g. newspaper reports and television programmes) and internal documents and archival data (e.g. firm histories). In addition to primary data from interviews, I gathered from firms and incubation centres annual reports, financial statements, four gave marketing reports and one a VC risk evaluation.

5.7 Data presentation

All primary interview data is translated and included in the appendix. Chapters 6 and 7 give a little background of each centre, firm and policy-maker, cases (of incubation processes) are presented thematically, using categories from the figure-4.1 framework; a technique Eisenhardt (1989) recommends for this type of study. Each centre manager and firm-owner is given voice in extensive quotations under each theme. As Jack, Dodd and Anderson (2008) note, giving voice and allowing the case narrative to develop is the key to effective presentation of narrative and thematic analyses.

Chapters 6 and 7 reveal an unfolding story of incubation processes, what Eisenhardt (1989:540), terms "*unique patterns of each case to emerge before investigators push to generalize patterns across cases... it gives investigators a rich familiarity with each case which, in turn, accelerates cross-case comparison.*" Stories inspire and require reflection and contrasts between narratives and outcomes Gartner (2007:614) often found in the nuances and details of events and thought processes. As Hosking and Hjorth (2004:265) suggest, story construction is a process of creating a reality the storyteller hopes is

plausible. Where possible I indicate the numbers of interviewees agreeing with a particular viewpoint.

In summary, my data presentation creates stories about my unit-of-analysis – incubation processes – structured thematically by the variables in my figure-4.1 framework. Narrative presentation as Gartner (2007:615) suggests depends upon the listener/reader of the stories entering into the reality created by the storyteller and finding it convincing.

5.8 Data analysis

I agree with Yin (1994:103) *that the ultimate objective of analysis is to treat the evidence fairly, to produce compelling conclusions, and to rule out alternative interpretations.* My analysis mirrors Hamersley's (1989) pattern model in which explanation is not separated from description. In other words, this study adopted a method that describes the relationship between one action and others in context, interpreting or explaining the meaning of such actions whilst describing their place and relationships to other parts (Bryman and Burgess, 1994:6) in the given context.

Analysis begins with in-case and cross-case analysis (Miles and Huberman 1994) referencing primary and secondary data, using coding derived from the literature as Yin (1993) recommends. An important point about coding is ensuring that all evidence is interrogated, thereby avoiding confirmatory bias; indeed cross-referencing between data sources as Silverman (1993) and Huberman and Miles (2002) point out identifies whether facts/opinions/events are outliers or typical. Throughout this stage of analysis I referred back to concepts and conclusions in literature, nuancing the primary data coding until new insights dried up (Yin 2009).

Data analysis involved interpretation of the case data and the coding within the paradigms of understanding that, a-priori, appeared to have relevance identifying behaviour in relation to theoretical constructs (represented by themes). Areas of behaviour that were not well understood were collated and associated with other frameworks that appeared to have value. Codes were identified by the themes that were raised in the conceptual framework.

For example, primary coding during in-case and cross-case analysis referenced themes from framework-1; amongst the secondary coding issues of venture or risk capital or finance gained prominence, another secondary coding area was around emotions and commitment. Other secondary coding gaining prominence from cross-case analyses were issues of training programmes and external business mentoring.

After completing interviews and before finally deciding on a structure for presenting data, I spent considerable time familiarising myself with the data, memoing initial thoughts on key points, patterns and significant events and citations. My approach to coding followed Glaser's (1978) recommendations: (a) listing primary coding, (b) listing secondary coding and (c) cross-referencing coding with literature (and in my case the analytical framework. By way of example, my first primary coding list had 21 items ranging from IP law, risk capital, and entrepreneur's motivation to quality of TT and Incubator Unit support. Following Yin (2003) to limit primary codes to approximately six, I reduced this to four.

- Drivers, enablers and barriers to commercialisation
- Commercialisation inputs
- Commercialisation processes
- Commercialisation outcomes and outputs

At this point, I returned to the figure 4.1 Framework and reclassified items in order to achieve correspondence between the framework, representing the literature review conclusions and my analytical approach. I then identified secondary codes. For example under Commercialisation Inputs I began with thirteen items, which I then reduced to four:

- Success criteria
- TT, UILs and absorptive capacity
- Motivation and capability for entrepreneurship
- Internationalisation and standards compliance

Cross-checking the usefulness of these codes with the literature allowed me to distil down the list (I previously had business models as a separate item, but incorporated it into capability). I was then able to unpack each secondary code; for example, under Success

Criteria I added problems in service range and quality (of the incubator unit), its cost and value-for-money and overall satisfaction of the entrepreneur with incubator input. As forewarned by Yin (2003), given that interviewees use different terms, my initial 'Find' coding was supplemented by looking for 'same meaning.' Examples include using different terms for risk capital and IP. I also took Yin's advice and avoided the temptation of adding secondary codes.

Glaser's (1978:83) idea of 'memoing' proved invaluable during analysis, to *develop freely, which is then stored centrally, and readily sortable*. I made many hundreds of memos during analysis, perhaps too literally following the 'free-flowing style' Martin and Turner (1986:151) recommend. In fact, producing ideas to follow-up helped enormously in creating (subconsciously) a clearer narrative from the mass of data. Charmaz (2006) correctly views memo-writing is a 'pivotal intermediate stop' between data collection and the writing of draft papers, as she says it:

constitutes a crucial method in grounded theory because it prompts you to analyse your data and codes early in the research process. Writing successive memos throughout the research process keeps you involved in the analysis and helps you to increase the level of abstraction of your ideas (2006:72).

As Yin (2003) suggests the original (thematic) deductive coding phase was followed by an inductive phase, with secondary codes added until the stories emerging became plausible: clear behaviour patterns emerged. Data coding at this stage involved content analysis of interview transcripts and secondary data as in the previous stage, with the same checks and controls. Elements of the framework were retained, revised, removed or added, as field data provided empirical evidence (Yin 2009), which is reflected in the chapter-10 discussion on framework amendment and theory generation.

Eliminating data not relevant to the analysis at hand and extracting data that are relevant was the simplest form of data reduction, as explained by Miles and Huberman (1994:11), "*Data reduction is not something separate from analysis... (It) is a form of analysis that sharpens, sorts, focuses, discards, and organizes data in such a way that "final" conclusions can be drawn and verified.* My personal experience is that deciding upon the

relevance (or not) of data is a crucial stage after which the ‘pruning’ reveals the clear narrative.

Charmaz (2006) debates the relative merits of line-by-line or word-by-word coding suggesting the latter may best suit documentary data and the former more ethnological data. An advantage of line-by-line coding is that patterns may emerge more easily. I adopted word-by-word coding because using thematic analysis to construct the case narratives, led me to interrogate the meanings and significances of statements, decisions and actions. Of course, the danger is missing emergent sub-plots not highlighted in the original themes (such as the risk capital, emotions and training mentioned above). An open mind and commitment to following where the data leads is the best protection against missing points.

Cross case analysis was used to identify patterns of similarity and differences in the behaviour of companies (Eisenhardt 1989; Gummesson 1991; Miles and Huberman 1994; Yin 2009). Of particular importance is variation in causalities, for example the more mature incubation centres (KAST, Cambridge, ERI) enjoying the benefit of inputs from business networks built up over years; and the easier connectivity of UK centres with risk capital providers (as a result of the UK’s fiscal and legal regimes). Through an on-going iterative process of cross-case comparison, within-case re-analysis and the interrogation of relevant literature, I tried to construct a complex pattern across all cases informing the chapter-10 adjustments to the framework, testing new ideas emerging from the data. Bogdan and Biklenb (1982) view as the most productive stage of original research: the platform from which to answer my ‘how’ and ‘why’ questions.

Chapter-9 reintegrates analysis with the bodies of literature on innovation and entrepreneurship in chapters two and three; as Yin (1994:103) suggests comparing data with the related theoretical propositions and gaps that led to the case study investigation for which I referenced against framework-1.4.

5.9 Limits on generalisation, validity and nature of theory generated

My constructivist CGT epistemology and research strategy necessarily limits the generalisability of my findings. As Kinder (2002) points out, most case-based research requires careful re-contextualisation prior to transfer. In this sense, my research does not aspire to validity; rather I seek trustworthiness. There will be a degree of external validity, in the eyes of KSA and UK incubation researchers and practitioners, however, general theorists of incubation and entrepreneurship may conclude that my work is deeply contextual. Of course, I hope that there is internal validity to my research, in the sense of rigorous methods and careful and honest analysis – the hallmarks of the narrative approach.

For Riessman (2008:195) trustworthiness as opposed to validity is a recognition of the pragmatic limitations on much social science research and is the preferred criteria of numerous authors such as Atkinson (1998); Bush (2003); Lincoln and Guba (1985); Mishler (1990); and Elliott (2005). Trustworthiness flows from a plausible narrative, based on rich and honestly gathered and analysed data, resulting in theorisations that are humble in their claim to generalisability. From this perspective, part of any future research agenda is the limitations pointed to by other researchers Riessman (2008). Plausibility here refers to internal consistency between evidence sources and honest searching for counterfactual points, including those that cannot be explained. Plausibility also references coherence (Atkinson 1998): that whilst other researchers may draw different narratives from the evidence, the narrative presented (albeit subjective) is a reasonable inference from the data. This is what Mishler (1990) means by seeking validation, rather than validity. Atkinson (1998) goes further and argues that deep understanding flowing from persuasive narrative is of greater authenticity and value than validated positivist research. Silverman (2005) makes the important point that honestly conducted research means that another honest researcher would generate similar data, though s/he may interpret it differently: as Atkinson (1998:73) says, ‘no single interpretation of a life is going to be the “correct” one.

In Llewelyn’s (2003) terms my research goes beyond concept or metaphor development but falls short of universally applicable or general theory. My research generates mid-

range theory and should be treated as such i.e. the context and culture of UK and KSA incubation have unique and generic characteristics. Prior to transferring my results to a new context, these particularities need to be decomposed and contrasted with those in the new target situation.

I do make comment and criticisms of general theory such as arguing (chapter-9) that Gerschenkron's (1966) theory is dated in its application to more knowledge-based globalisation; I challenge the generalisability of Etzkowitz's (1983; 2000) triple helix theory; and I argue that North's (1990; 2007) view of institutional change is ethnocentric.

5.10 Ethics

Since as Goodson and Sikes (2001:89) say research is 'an inherently political activity in that it has a bearing on how human beings make sense of their world' my research involves grappling with a range of ethical issues including (Cohen et al., 2006:49) the nature of the research project; its context; procedures adopted; data collection methods; the nature of the participants; types of data gathered; and how the data was processed including its publication. Overall, I was guided by Mason's (1996) advice: clarity about the purpose of my research, an honest approach to affected individuals and organisations and carefully considering the interests of those I interviewed.

Access to data and informed consent

I have worked for twenty years in KSA incubation and therefore know many of the actors. This is an advantage in gaining access but also a potential source of bias (Oakley 1999). I discussed the range of public incubators in KSA and decided to take the six most prominent, the five most influential policy-makers and six company cases nominated by the incubators on the basis of criteria I supplied. In this way I hope to overcome the bias of familiarity; pre-understanding of the people and issues does however give the advantage and filtering comments from interviewees and (Burton *et al* 2008) beginning from a position of being trusted by respondents. For the UK my sample arose from contacts made at the University of Edinburgh Research and Innovation Ltd, who recommended the Cambridge centre as a UK best practice site. I was careful as Elliott (2005) recommends,

obtaining their informed written consent to use the interview material in the thesis (attributing names) and in subsequent publications (anonymised). I exercised a ‘duty of care’ over respondents, since as Clandinin and Connelly (2000) some of the legalities if tested may be insoluble; instead I focused as Atkinson (1998:37) suggests on my own moral responsibility to act honourably (*‘being fair, honest, clear and straightforward’*). From literature such as Robson (1993) and Cohen *et al* (2006) I was conscious of four aspects of informed consent: competence, voluntarism, full information and comprehension and consider each of my respondents to meet these criteria. In particular in the KSA and for the twelve companies, I was concerned as Alderson (1995:20) emphasises that respondents freely elected to participate in my research and (especially for KSA respondents), as Lee (1993) notes under no obligation to participate; I am senior in the KSA hierarchy to some of the respondents and others are long-term acquaintances. Each respondent received a summary of my research objectives and research design. I emphasised that respondents had the right to withdraw at any point (Goodson and Sikes 2001) – none did. As a foreign researcher in the UK, I was particularly pleased to gain the trust of senior interviewees in Edinburgh and Cambridge (Lee 1993) exemplified by the length of candid interviews and the materials and contacts they supplied.

Narrative inquiry Issues

I conducted the interviews in the style of a narrative inquiry (Basse 2003) since my aim was to produce a plausible narrative of incubator processes in chapter-7. I am aware of potential criticisms of this approach: for example Goodson and Sikes (2001:106) suggest it can become an affirming climate – hence my probing questions seeking alternative evidence. I was less concerned about Clandinin and Connelly (2000) suggestion that narrative might blur fact and fiction, since in both cases the plausibility of the narrative rests on the marshalling of evidence. I note Riessman’s (2008) point that narrative inquiry makes a:

major contribution to make to many investigations of aspects of life in social and educational settings, not least, because of the way in which life history accounts can, and should, be readable and accessible, enabling researchers, informants and readers to gain a recognizable impression of how particular lives are lived and expressed in a day-to-day context.

In my case, as chapter-7 illustrates, constructing a persuasive narrative overall was not difficult, since incubator managers told similar stories (within their context), though the chapter notes different perceptions of incubators from policy-makers and some companies.

Research according to Sikes (2006) is neither neutral nor innocent. In this case, my non-interventionist research process was not the problem. A bigger issue was the on-going evaluations of public incubators in the UK and KSA; as Busher (2003) points out a risk to participants is that cited evidence and opinions is used against the respondents or their interests in future. I found that respondents were committed to presenting a full and honest appraisal of their achievements and challenges and take satisfaction that fair-minded people citing my research, as evidence will appreciate the need to explore negative and positives. Additionally, as Atkinson (1998:12) notes, respondents are often grateful for the opportunity to consider their work and in articulating answers sharpen up their own thoughts. In this regard, I pointed out to all respondents that my published PhD is only 'confidential' for a limited period of time and that anonymised publications referencing particular technologies or locations may be used to discern information sources. Elliott's (2005:148) advice was useful:

The researcher therefore has a responsibility to do more than valorise the narrative voice of respondents, rather to conduct an analysis which places narratives firmly within their social and cultural context and which makes explicit the available resources which have been used to structure them.

In summary, there are ethical issues in constructing narratives based on respondent interviews; all of which I hope to have addressed.

Case Study Issues

At an early stage in my research I considered non-participant observation as a data gathering method, whilst this was possible in KSA but not in the UK where echoing Jones and Somekh (2005) incubation centre managers felt it would be intrusive from the client company viewpoint.

Analysis Concerns

Inevitably, having marshalled evidence and interpreted it in the light of previous research, my narratives are likely to differ from individual interviewees, who may not be familiar with concepts, previous research and the ‘bigger picture.’ I addressed this issue by presenting the narratives structured by themes rather than personalised or organisational case studies - building a collective story (Richardson 1990) - thereby limiting the degree to which any individual respondent reading my interpretation will feel that his/her opinion/story is somehow discounted.

5.11 Chapter summary

In summary, having justified adopting a constructivist epistemological stance and guided by Charmaz’s (2006) CGT and Yin’s (2009) idea of multiple cases, this chapter identified incubation processes (rather than organisations or input-output or firms) as the unit-of-analysis, justifying a sample of six public incubators in KSA and two in the UK, each with six embedded cases of incubated firms. A clear logic was set out for gathering, archiving, coding, presenting and analysing this data and the main data gathering technique narrative interviewing was justified. I turn now to presenting the data gathered.

CHAPTER-6 DATA – KINGDOM OF SAUDI ARABIA

This chapter presents data on commercialisation of commercialised technologies in the Kingdom of Saudi Arabia (KSA) based on reports from international bodies (GEM, OECD, IMF); KSA Government and institution reports; my own working experience at KACST for twenty-years and thirty-four new interviews with entrepreneurs, incubation managers and policy-makers. Section 1.2 above set the general context and culture for KSA. The following chapter (seven) presents similar data for the UK. Where appropriate I highlight inconsistencies in evidence from interviewees and areas where practice conflicts with policy.

6.1 Introduction and structure

Chapter-five details and justifies my approach to coding and patterning. My data chapters follow my conceptual framework structure organised under high-level themes (conceptual themes in figure 4.1) and more operational themes. Figure 4.1 gives structure to this chapter and chapters 6 and 7 as shown in figure 6.1. As noted in section 5.7 the structure for my data presentation follows the variables in my initial framework (figure 4.1) i.e. from the firm-level unit of analysis composing a story of how and why commercialisation occurs in KSA and (chapter-7) the UK.

Reports and previous empirical research cited in this chapter are shown with a Harvard reference and citation in the bibliography. When I cite my own experiences, my involvement and role is explained and triangulated support for my view is given. Appendices one to thirty-four in my theses give the raw (translated and transcribed) data from my interviews. In this chapter these are referenced by interviewee or interview number, then followed by a particular question in the transcript. Where interviewees are directly quoted, these are in italics and following by a specific reference to an interview and question.

6.2 Drivers, enablers and barriers to commercialisation in a developing economy

Perhaps it is the circles that I move in in KSA (university and business), it seems that everybody has read or reading literature on economic history and/or the future developing

economies. Debate ranges around existing models (oil richness, US diplomatic alliance, the politico-religious settlement in KSA) and references potential alternatives (the Beijing model, end of oil richness, the benefit of 105,000 internationally-educated graduates and creating home-built exportable products). None Saudis would be startled by the extent of debate around the country’s strategic future. The data presented in this section aims to capture opinion on these debates and in doing so references its internal, regional and global dimensions.

Chapter section	Conceptual themes	Operational themes	Main data referenced
6.2	Drivers, enablers and barriers to commercialisation in a developing economy		<ul style="list-style-type: none"> • Reports • Previous empirical research • Appendices 1 to 13
6.2.1		Institutional arrangements and SSIs: alignment with national plans/strategies and active leadership of SSIs	
6.2.2		DS: value-adding, supportive bureaucracy, innovation incentives and macroeconomic stability	
6.2.3		Entrepreneurship: barriers, disincentives and enablers	
6.2.4		Knowledge flows: absorptive capacity, basic research and adaptation capability and incubation value-added	
6.3	Commercialisation inputs		<ul style="list-style-type: none"> • Previous empirical research • Appendices 1 to 18
6.3.1		Incubation and start-up services	
6.3.2		TT, UILs and absorptive capacity	
6.3.3		Motivation and capability for entrepreneurship	
6.3.4		Internationalisation compliance with standards	
4	Commercialisation processes		<ul style="list-style-type: none"> • Previous empirical research • Appendices 1 to 18
6.4.1		Start-up and growth	
6.4.2		Internationalisation	
6.4.3		Labour supply	
6.4.4		IP and regulations	
6.4.5		Governances	
6.4.6		Risk capital	
6.4.7		Entrepreneurial risk and leadership	
6.4.8		Knowledge flows and distribution	
6.5.1/2	Commercialisation outcomes and outcomes		<ul style="list-style-type: none"> • Previous empirical research • Appendices 1 to 24

Figure 6.1: Overview of KSA data chapter

Evidence is presented in four sections. Firstly, the views of interviewees, business and government reports on KSA's current institutional arrangements, including sectoral systems of innovation and their alignment with national and regional plans and strategies. I am particularly concerned to illustrate active agency: actions and decisions effecting institutions and how they work.

A second section may seem unusual to non-Saudis since it is headed the development state and covers discourse around the Washington or Beijing development models. Given KSA's unique Arabic and Islamic culture and context, the possibility of economic modernisation without adopting 'western' values and institutions is important in KSA and associates with ideas on incentivising innovation coupled to macro-economic stability. Section three presents data on entrepreneurship; including barriers, disincentives and enablers. Saudis regard themselves as entrepreneurial, given their heritage as traders, yet recognise their relative failure to indigenously create globally successful products and services. This evidence links naturally to the fourth and final section on knowledge flows detailed evidence on KSA's absorptive capacity, capability of conducting basic research and adapting new products and services from international transferred-in technologies.

6.2.1 SSIs, NSIs: active agency and leadership

6.2.1.1 The KSA national system of innovation

From the discussion in section 2.5, we would expect to find a 'thin' set of institutions constituting KSA's NSI: this is what we find, however it is not what Saudi's themselves perceive; focusing as they do on top-down infrastructure and facility initiatives. These conclusions echo those of Kayal (2008).

Since the 2002, the KSA has set the goal of becoming a knowledge-based economy (KBE), targeting oil and gas, healthcare, education, ICT, financial services and biotechnologies. Opinions vary on how successful KSA's NSI has become. Mr Albariqui of Acadox in Riyadh, who has developed an online education platform for Arabic states, states that (A/1/17) suggests that whilst the Government often provides funding and premises, the

overall regulatory position for startups remains difficult and shows little interest in growing promising startup into globally competitive business. He says,

.. they will still go for such companies like SAP, or Oracle. They wouldn't support the local product for that project, they will rather go for the international company and that's why I think they can give you mixed messages.

Respondent-15, who moved from Pakistan to KSA to head up commercialisation projects based on his experiences in the UK (A/15/8), argues that the Saudi business model is flawed. He suggests that UK universities run commercialisation centres as property businesses (taking rent and/or equity) whereas in KSA commercialisation services are free. Further, in his view, UK commercialisation centres are managed by business-people, rather than by academics: which is the case in KSA. Also he suggests:

In Saudi Arabia, it is completely different – neither do we have Professors who develop Viagra nor do we have doll-making machines. What we have is oil and gas chemical researchers. Our science park activities, our innovations differ from the western ones because the western ones are driven by the Professors but ours are driven by national champions like the big oil companies and the research is done on the energy sector not into other sectors.

Respondent-16, who works at KACST as part of the national science and technology plan has experience in biotechnology and ICT commercialisation in KSA. Suggests that KSA's NSI fails to respond to the legal and capital requirement of high-growth companies,

When I was managing the organisation we created a consortium of 5 big companies to find what was wrong with or ecosystem – that is why people can't buy or sell their companies? .. we hired a lawyer and an expert from Canada and 5 people and a Saudi Lawyer. They found that our corporate law is not flexible – for example, buying and selling companies is not easy. ... In Saudi commercial law, an individual can only create a single establishment not a corporation. So if you're to acquire a company you can only share with the owner not shareholders. All the start-ups are a single entity and they won't want to change ... the Minister of Commerce has to sign in order to approve this new company (A/16/6).

Two other KSA policy experts endorse this view. Respondent-18, a commercialisation policy expert too contrasts the more mature VC and angel investor networks in the UK with those in KSA as a retardant in the NSI. However, he goes on to suggest that the commercialisation and incubation programmes themselves disincentive entrepreneurial risk-taking by offering long-term subsidies to nascent company concept development, with little marketing expertise offered and no 'dash-for-cash' incentive to get products to market and seek early income. Respondent-34 comments that the National Science and

Technology in Saudi Arabia began incubation at the behest of the Government, which provided substantial financial resources.

There was no consciousness or conceptualisation of start-up programmes, no incubation programmes and basically they were doing it on their own. .. very few successful companies at that time which were home grown ... [the] ... larger family basically incubated them and there was no systematic intervention – whether from private or from the public sector to support that. So this incubator, which was supposed to be the national ICT centre at that time was meant to be a government tasked, government funded and government managed incubator and it was not for profit. All the typical aspects of incubators were imbedded in this whether it was mentoring, coaching, physical facility, virtual support, shared services like accounting and all that all those elements were imbedded in the design the intent was to kick start a bunch of companies in Saudi Arabia between 2008-2010 – that was stage one. By 2010 lack of implementation experienced we had to bring in professional incubator managers from outside to run this programme and a small team was selected through a competitive bidding process and they run it for 2 years. Then we realised that in 2 years time the awareness was pretty good and there were applications coming in through the pipeline, entrepreneurs were getting very interested in the programme and the programme had to be because of popular or public demand had to be expanded to a series of incubators. What you see today, as the Saudi national incubation programme called Buada basically is the current evolution of the single incubator programme that was designed in 2008 (A/18).

Respondent-21, a senior commercialisation policy expert from Riyadh highlights another issue: too many projects and programmes. He says,

I'm responsible for the national plan for science and technology but in the university we have another office for innovation and this one. We have intellectual property office. (A/21/20)

Respondent-21 (A/21/3) refers to commercialisation in KSA as a 25-year national plan to become a knowledge-based economy.

The university concentrate on basic research and administration in 5 technology areas: animal technology; biotechnology; agricultural technology; advance technology; medical technology; and water technology. We have about 300 million Riyad support each year for the research. So normally, professors apply fro the grant and it is taken to Babeson in the US for evaluation and if the a project is accepted, it's supported for 2 years for 2 million Riyad for each project for the technology (A/21/4).

In summary, practitioners in KSA commercialisation and their user-incubating firms, appear clear on the goals of the Saudi NSI (knowledge-based economy, competitive sectors), however, these senior and experience interviewees are unsure (critical?) of the processes for building the new NSI and the perceptions of what has been achieved differ markedly to *Vision 2030* since practitioners recognise the thin nature of Saudi institutions.

6.2.1.2 Sectoral systems of innovation

How then does commercialisation activity seem at the level of the SSI? KSA's Ninth Five Year Plan (2010-2015) acknowledged that simply listing emergent technology sectors as an aspiration, is less useful than identifying sectoral and cross-cutting capabilities that closely fit with achievable strategic objectives – it focuses on electronics, upstream petrochemicals and healthcare technologies and (the cross-cutting theme of absorptive capacity building. Funded by this US\$385 billion plan (Saudi e-Government 2010) are two new R&D centres jointly with Aramco, a new SABIC-led TT complex in Riyadh and two petrochemical plastics R&D centres at the Riyadh Techno Valley KSU complex.

Expressing frustration at the gap between SSI plans and their delivery and in particular technically qualified entrepreneurs, Respondent-14 CEO of an ICT client service Management Company based in Riyadh says,

... maybe it has to change a little bit because while we were in a rush, we did not take our time to target the right people, I think. We had a flow of many people who were lacking the entrepreneurial spirit and ideas by all means. Being the client service manager I had the privilege actually to meet with every single person. I am talking about more than 1,500 meetings with entrepreneurs and inventors. At the beginning we selected 10 people based on recommendation or based on the fact that they were already working on KACST and had to be adopted and taken care of. But we did not know if this guy really entrepreneur or not (A/14/2).

Respondent-15, a Science Park Manager (A/15/1) has experience in an number of oil-related international innovation projects (he mentioned Nippon, Shell and Ex-On Mobile) bemoans KSA's inability to attract off-shore R&D, noting that none of Shell's 76 R&D centres are in KSA despite the proven ability of KSA innovation centres to adapt TT to the Saudi setting. He is CEO of Tehran Techno Valley Science Park (A/15/1).

Outlining some of the processes of sectoral innovation building, he goes on to state that only 10% of projects result in innovation.

Our university has made some landmark efforts in acquiring about 300 issued patents from the US Patent office, which is a great number in the field of engineering. Out of this 10% are in commercialisation scale so as the CEO I have to make a decision on the investment in – does it need to go through the prove of concept or prototyping or going for a manufacturing. Also we do the incubation for the students who come for the idea and we screen them. The Saudi nation oil and petro-chemical companies are normally partners (A/15/1).

Reflected the greater sectoral focus of the Ninth Five Year Plan, Aziz Al Agargan who works in a network of incubation centres (Riyadh, Jidda, Medina etc), says their focus is on:

ICT, Biotechnology and advance manufacturing. Only these three. We can go the Saudi Credit Bank to get our clients loans up to 4 million Riyadh. That's one aspect of funding. Then we can go to other funding agencies in Saudi such as the Saudi Development Fund. That fund supports big donors who can take loans to support their work. One of clients was given 30 million Riyadh. That amount of money, the government couldn't give it and the interest is free. Then we created our own funding network in Jidda and it was very unique in Saudi Arabia. ... It's a way to convince the stakeholders that we're seniors and we're bringing international experience over (A/16/4).

There is a clear gulf between the more positive notes struck by R-15, with an oil innovation background and R-14 in the ICT sector.

What is interesting about Respondent-13's story is how the SSI expanded into "we created our own funding network" i.e. crossed the sectoral (technical) specific boundaries into other governances (finance). Another example of the incompleteness of KSA SSIs is the use of foreign experts, saying that we,

... developed originally with consultancy CRI from the USA in 2007 to do a feasibility study for other ICT companies. Then in 2008 when CREDA from Australia were appointed consultants to assist the establishment and management of Badir ICT working with the Saudi staff. We worked together through the development of the vision and mission as well as the strategic objectives for that incubator. Since then in 2010 a similar process with other consultants was done to develop the vision and mission of the Badir Bio-incubator and then in 2010 again the advance manufacturing incubator. But as from 2011 onwards, a new vision for the whole Badir programme was developed in conjunction with other projects by the management team of what was then the Badir programme (A/16/4).

This too highlights a gap in institutional arrangements that *Vision 2030* claims are resolved. SSIs in KSA, with the possible exception of oil refining are incomplete, particularly the availability of finance and a culture motivating entrepreneurs.

6.2.1.3 The Government, university and industry triple helix

As section 2.7 argues, effective triple helix (TH)-building in developing economies, poses sharply the 'thinness' of institutions. Evidence from KSA supports this view, again contrary to *Vision 2030* claims.

Respondent-7 CEO of a mobile web development company argues that large Saudi corporations partners with universities international, whilst the triple helix for smaller companies is only now taking shape (a majority view of Saudi interviewees).

The other thing when you refer to the triple helix model, we have again the clear cut of funding and ownership again the ecosystem is not matured (A/16/1).

Hussein Al Alattar is CEO of *sawerly*, a photographic technology startup in Jeddah, states bluntly,

I believe we are still not there in creating our ecosystem in Saudi Arabia although there is a push from the government and other entities, we still don't have all the necessary components to create a successful eco-system whether it was lack of government support or a gap in investment from the private sector. But I think the private sector is better. Government has the funding but lack a clear plan and structures. The universities follow the government plan (A/10/18).

Respondent-15 is in no doubt, A/15/8, that cross-governances issues are the problem in KSA's TH pointing to academics running science parks and innovation centres for which they have no business capability. He contrasts this position with the UK, where from his experience, the role of academics is limited to technical development.

Respondent-18 a commercialisation policy expert in Saudi Arabia is equally clear: lack of market-orientation in incubators have held back creating more effective sectoral systems of innovation.

Well, I think the intent of the government was good to encourage or stimulate the sort of technology ownership in the country. However, I think the mandate to make the incubator completely not for profit incubator to the extent that they are not thinking and the event of not pushing themselves about survival in the market place was not a great idea. So what happened was that many of these incubators became perhaps complacent and they started sort of not looking at the market factor but rather just surviving and doing their own technology thing or whatever they were focused on and not really looking at the market (A/18/4).

Perhaps typifying some of the difficulties and inconsistencies in the evidence, Respondent-21 a senior commercialisation policy expert lauds success in patent applications and cannot comprehend why companies do not support these achievements (the view of all five Saudi policy experts)

Actually the government because, for example, myself I have 4 patents and 3 are on the way but I couldn't find any support from outside from the businessman or from private companies because they don't support this kind of business ideas. So we rely on government support and the government support depends on the administration whether they are interested or not. So I think we have a problem with private companies or businesses because they don't support these ideas (A/21/8).

Respondent-7 CEO of an e-commerce company takes a different perspective

We have had no support from academia. In theory the government is more influential when it comes to innovation in Saudi. But in practice there are a lot of frustrations dealing with the government as well. The entrepreneur has to do a lot of things to prove that he deserves support from any of these bodies here in Saudi Arabia (A/7/19).

In summary, KSA's TH is flawed: the governances between the three legs of the tripod are inadequate, goals are not shared (achieving patents or product sales) and in areas financial arrangements disincentivise commercialisation.

6.2.2 Development state attributes

When King Abdullah (2005-2015) announced that it was possible for KSA to modernise without westernising, he set in train discourses that continue. These discourses are framed in terms of the Beijing model against the Washington consensus as economic development strategies and are clearly articulated in *Vision 2030*. Whilst KSA discourse uses different terminology, the issue is the same: is there a Saudi Arabian way to modernisation that allows the retention of valued aspects of its Islamic and Arabic culture and institutions? Needless to say, opinion is divided. This section presents evidence of development state attributes in five sections: (a) a value-adding rather than value-distributive state; (b) a supportive expert national bureaucracy; (c) incentives to innovate; (d) shared national vision – internal and external; and (e) macroeconomic stability.

6.2.2.1 Redistributive or value-creating state

In 1923 KSA GDP was US\$ 1.5 million; currently it is SR 1,500,000,000,000 or US\$ 4-trillion per year. KSA has always been a re-distributive state: the king is expected to reward loyal tribes and family members with gifts: charitable giving is the third pillar of Islam. The size of the gifts (palaces/ infrastructure) grew enormously as oil-revenues expanded. Faced with demands for social change and constitutional monarchy, King Abdullah dramatically expanded the scope of largess to include study grants, social welfare payments. Yet population growth from 6 million in 1970 to 30 million today, with the associated falling average age, unemployment amongst Saudi men is 5.7% (646,845 individuals) and some 4-million live on less than about \$530 a month – about \$17 a day – the poverty line in Saudi Arabia. If a characteristic of the value-creating state is deferred consumption to fund investment, there is no evidence for this in KSA.

6.2.2.2 Expert bureaucracy

The idea of an expert bureaucracy, above everyday politics, rationally directing economic development is central to the development state. Not until the reign of King Faisal (1964-75) did KSA develop a recognisable civil service: then as now headed by members of the royal family. But do its actions suggest long-term, rational directions of the sort MITI gave to Japan between 1950 and 1970?

In KSA it is difficult to disentangle actions of the bureaucracy from those of the King and royal appointments. As the Five Year Plans have evolved from concentrating on infrastructure in general to commercialisation and human capital improvement in particular; the case can be made for a rational bureaucracy directing economic development. Since Faisal and then King Abdullah (2005-2015), who though both enjoyed periods of strong oil prices and revenue flow, both retrenched on conspicuous consumption expenditure, preferring infrastructure and human capital investment?

Of course, there are critics. Respondent-14 CEO of an ICT client service Management Company points that aspects of the distributive state continue cloaked as *Saudidisation*, he argues, instead of giving large project contracts to big companies, who may have failed to deliver in the past, a more rational course would be to favour high growth young companies (A/14/14) and reduce tax burdens on companies expanding employment. His view is that resource-dependency centre-stages bigger companies, that tend to keep their knowledge stores in their home base. Aziz Al Agargan from the KACST ICT incubator centre criticises the Government for providing incubation facilities without encouraging the associated provision of venture capital (A/16/2). In fact, 30% of the world's largest 100 company's R&D is now offshore – though little of it in KSA. Respondent-18 suggests (A/18/5) that it is irrational to offer generous welfare benefits and free incubation services to young people, who then become dis-incentivised from actually starting trading.

6.2.2.3 National vision

In the development state (1945 Japan, 1953 Korea, 1979 China) unity around the need to create national integrity is shared across social groups; the means of doing so being to create a strong economy.

For Respondent-15 shared destiny is an immediate issues: when asked about post-2035 oil revenue decline; he says,

You said in 25 years time? We will have a major problem. We have the oil declining now. Our internal consumption is increasing (A/16/12).

He favours a more open rational bureaucracy directing economic affairs.

I think we're moving towards a knowledge-based economy but which organisation is responsible for the management of the government effort of knowledge based economy? People say KACST and others say no, it is the national plan. So until now we don't have a single organisation, which is in charge. Besides there is the issue of finance, we need huge money (A/16/13).

Respondent-7, who is CEO of an e-commerce company, which provides mobile Internet business development services bemoans that fact that the national vision does not include entrepreneurship education in every university course and systematic Government support for potential high growth companies (A/7/20). Respondent-17 of Badir, a network of business incubators endorses this view suggesting that the interests of the large (international) oil companies distort the nation vision: they are favoured above smaller indigenous businesses. Respondent-17 suggests, that senior academics fail to buy-in to the national vision, preferring academic output to business engagement and joint research.

We really try to match the technology in the science packs and the faculty members. The faculty is not proactive in terms of going to the companies and looking for the projects just because they are much involved teaching and their mindset and the culture of long vacations that we had in the past in Saudi Arabia. Practically our faculty here works only 7-months in a year, the rest of the months, they are either on inter-semester vacation or other holidays (A/15/8).

As the experience in Asian development states show, a great advantage of centralised top-down decision-making, is the pace at which significant resources are marshalled behind national goals. Respondent-17, Manager of an incubation network affirms this view, as do four other experts and half of the CEOs.

... the major policy decisions was for Prince Turkey to request CREDA project to work on the development of a national technology incubation policy framework together with Dr Abdul-Aziz. That process was started in 2010 and it involved workshops with key stakeholders both in the government and

private sector ... [in] ... facilitated workshops with local stakeholders plus case studies [referencing] ... eight other countries in the world. So we got consultancy in those other countries which were involved in incubation ... and all of that came together into a draft national technology incubation policy that was then presented back to KAST and the stakeholders in Saudi ... That framework was then developed further by KAST and so Saudi is one of the few countries in the world that actual has a national technology incubation policy and framework. So Saudi is certainly unique in terms of policy and framework ... the UK doesn't have a national policy on incubation ... So as far as policy constraints, This became a little critical during 2013-2014. When you have a budgetary control of an incubator by government, you do have issues. In the case of the UK, all the incubators are either incorporated associations or companies limited by guarantee. So they may still be funded by Government but they have the ability to raise their own funds by charging or taking equity from clients. Badir has never been able to do that because it was originally funded by KAST and government (A/17/2).

For Respondent-22, a senior commercialisation policy expert responsible for innovation argues the ability of KSA to adopt national goals that seek a new role in global economic structures is important.

Knowledge economy is based on innovation, education, skilful and knowledgeable workforce development, information technology, and scientific management. This is as opposed to agriculture economy or labour-intensive economy. Knowledge economy is innovation/creativity intensive, manufacturing based, and services-driven. Examples of knowledge economy successes in bringing wealth to societies can be seen in the US and Western Europe as well as in the Far East. If citizens of the Middle East and Northern Africa are to attain higher standards of living the strategic transition into knowledge economies must be made in countries in these regions (A/22/1).

In summary, whilst Vision 2030 and my interviewees recognise the knowledge-based vision of a diversified economy based upon technology commercialisation, each suggests that the overall Saudi population and key agents in institutions do not act around this vision.

6.2.2.4 Innovation incentives

Whilst the development state may prescribe who, where, what products and processes businesses development, in partnership with whom, and where (internationally) they can be sold; it favours national champions and supports high-growth businesses. In KSA, Aramco is perhaps the best-known example – in oil exploration, refining and distribution. Does the Saudi state similarly incentivise entrepreneurship and knowledge-based company startup and growth? Most interviewees think not.

Respondent-18 a commercialisation policy expert in Saudi Arabia suggests that the not-for-profit business model for incubators led to complacency by entrepreneurs (A/18/4). He goes on to suggest that only small numbers of entrepreneurs graduate from incubators with sustainable (sales in markets) businesses.

Respondent-20 at KACST suggests a different perspective: incubators allowing lengthy periods to create companies.

... in terms of incubation we discussed and reviewed work length of incubation period for the companies. For IT, it is 2 years. For Biotechnology, it's 5 years. For the industrial and so on we've measured the typical length and we've standardised it and we said that if you're an IT within 2 years you either succeed or fail and you're out no matter what. With Biotechnology, it's the same - within 5 years you either succeed or fail but you can't continue in an incubator. You will have to go. So you cannot go to the Biotechnology sector and say within 2 years you'll graduate because it doesn't make sense. So we've looked at these practices and learnt lessons and yes, different technologies need different time to mature and graduate. And so ICT incubators have 2 years; after 2 years you have to graduate either failed or succeed but they have to get out. They cannot hold the space longer than two years (A/20/15).

These timescales compare unfavourably with the UK, where firms (usually) pay for incubation (sometimes in equity share) and shorter time periods are often strictly adhered to; for example Hewlett-Packard allow only one year. The issue of course is at what stage the companies are at when they enter the incubator.

Dr Respondent-1 of a major online training company in Riyadh, says an online education platform addresses a deeper cultural problem of disincentivising business development, suggesting that welfare and education grant payments to young people make it irrational to undertake business risks and the work of establishing a business, though he qualifies this by pointing to subsidies for employing indigenous labour.

It is not only about the grant support but it is also about the really competitive market for jobs. ... maybe there is a sense of entitlement that is affecting the people. There are other aspects, for example, when it comes to government regulations and government paper that is necessary. I remember talking to my VC at the time. He was telling us about the Saudi market when it comes to government regulation is more tailored towards the real estate business than the entrepreneurship and technology type of businesses. Although the government has some funds that support the starter companies. For example if you're hiring Saudi employees they will help you to pay their salaries. I think it will help you to pay to SAR 2000-4000 of the employees' salary. So there are a lot other incentives. Also, one other aspect is getting the workforce, getting the talent, getting the people, employees, engineers or certain individuals (A/1/8).

Respondent-20 CEO of Tehran Techno Valley points out some perverse incentives facing incubation centres.

... we also try to evaluate these companies in science park. We have very strong criteria where we evaluate how many jobs are created by these companies using the science parks because they don't have many people. They normally have 30-40 people ... We also look at how many Saudis are getting into these technology development in each of the companies because the Saudis get very good jobs in these oil companies but as engineers or as a line manager or as an IT expert and not as technology developer. So

to get Saudis for this particular work function, it not very easy. They have to pay a lot to attract them. So when it comes to job creation, yes, we have a strong element of it ... we have about 15% from the Science park only in terms of job creation. In terms of incubators and in terms of these technologies start-ups, definitely, job creation is an important element. So there has to be some other way for creating jobs other than the large oil and petrochemical companies. That is one of the visions that the King had, that's why he took this initiative over 5 years back and directed everyone to get involve and start making efforts to a knowledge based economy (A/15/5).

Other incubation Manager hinted at similar conclusions. A national level commercialisation policy maker, Respondent-23 points to another perverse incentive: the absence of indigenous risk capital available to KSA startups arguing that rich Saudi's are,

... interested in real estate, oil and petro chemicals is there. Going into high-risk investment, they don't care. We set up a venture capital fund with some Saudi communication companies and they brought a big organisation to manage the fund but when it came to funding and they were told they will get 20% return, they said they can get similar amount on the stock market so why risk it. So, the culture is not there and the government has tried without success. (A/16/6)

I note Hertog's (2015) point, that public service as a proportion of employment in most developing states is around 6%, in the MENA region the average is 15%, however in KSA state employment accounts for over 45% of all employment. In summary, KSA's culture and welfare system act as major disincentives to entrepreneurship, in particular some sections of the Saudi population seem content to live on the benefits of a *rentier* state that disincentivises work ethic in general and entrepreneurship in particular.

6.2.2.5 Macro-economic stability

For the development state stability is crucial, since instability is costly (to the state) and interferes with the nationally accepted goal of building business champions. Of course all states face exogenous shocks and the more open (export-led) a state's economy the more danger it faces from currency instability, commodity price volatility or wars and disruption to trade routes. With 80% of KSA revenue coming from oil and 80% of food imported, the country is highly sensitised to this volatile commodity price. At inflation-adjusted prices, upon accession post-war Saudi kings have faced the following oil price (US\$/barrel; Oil 2014): Saud (1953) \$26; Faisal (1964) \$23; Khalid (1975) \$54; Fahd (1982) \$78; Abdullah (2005) 460; and Salman (2015) \$85. At the time of writing the price is \$35. Of course, as Faisal and later Abdullah and Salman have shown, quantities of oil sales can compensate for falling prices or state spending can be reduced. The point is that exogenous

shocks and oil price volatility make KSA prone to some macro-economic instability; the question is whether the degree of instability is sufficient to destabilise the diversification of its economy?

6.2.3 Entrepreneurship: barriers, disincentives and enablers

This section assembles evidence on entrepreneurship in KSA.

6.2.3.1 Entrepreneurship in KSA – success stories

With 6% GDP growth as the largest Arab economy, KSA has numerous internationally successful non-oil companies in construction (SABIC; Consolidated Contractors), financial services (Saudi American, Riyadh and Saudi Consolidated Banks) and utilities (Saudi Cable; Consolidated Electric). The Jeddah Chamber of Commerce and Industry (sponsored by Saudi *Fransi Capital*) celebrates annually ten Saudi entrepreneurs.

In 2014, the Muslim Entrepreneur of the Year, Shadi Khawandana of *Special Direction* was involved in a wide range of social project and businesses such as date processing and spring water sales. Another candidate, Rashid Al-Ballaa of National Net Ventures is Jordanian. Three businesses have digital products (software configuration, online entertainment production and app investments). The other entrepreneurs run service business including fashion design, Arabic coffee sales, facilities management and PR-events. My point is that despite c100,000 students per year studying abroad, TT agreements with international companies and universities and major policy initiatives on commercialisation and incubation, that there are few Saudi entrepreneurs in high-technology and high growth sectors. There are exceptions, including well-known Saudi entrepreneur/innovator Saleh Al Zaid, the founder of LunarApps that currently offers three Twitter-like apps in Arabic language including TwitMail.

6.2.3.2 Institutional barriers to entrepreneurship

There are two competing narratives around entrepreneurship in KSA. One narrative is rooted in meta-history (Mokyr 1990; Landes 1998; Rosenberg and Birdzell 1986) pictures a centralised state, fearful of innovation, discriminatory towards women, living off oil-wealth. The alternative narrative is of a nation of traders, eagerly embracing new

technologies (Porter’s [1990] *discerning customers*) embarking on a diversification journey to build a new economy, comparable with Singapore and the UAE. This section explores how Saudi entrepreneurs and policy-makers view entrepreneurship in KSA. Noting the absence of (UK or GEM) figures for business birth-rates in KSA, a SWOT is a good starting point (figure 6.2).

STRENGTHS		WEAKNESSES	
• Low corporate tax rate		• Weak culture of entrepreneurship & innovation	
• Light touch regulations		• Poor record of bank lending to startups	
• Easy access to risk capital		• Rate of return deficit relative to oil	
• Young population		• High % of family-owned businesses	
• Strong international connections		• High youth unemployment rate and poverty	
•		• Banks retard business birthrate	
•		• Rentier state, based on oil revenue	
OPPORTUNITIES		THREATS	
• Strong education opportunities		• Negative ‘human rights’ image	
• Entry point into MENA by foreign firms		• Open to exogenous shocks (wars; oil price)	
• Major policy initiatives on entrepreneurship		• Diminishing oil revenues within 20-years: volatility of oil prices	
• WTO member			
• High rates of international technology transfer			

Figure 6.2: KSA SWOT

Whilst the basic rate of corporation tax in KSA is 20%, effective rates after allowances are closer to 10%, including the 2.5% Zakat tax. Regulations governing startup are deemed by GEM (1-week) business-friendly and there is access to risk capital (particularly equity and for amounts over \$US 4 million). Many Saudi’s study abroad and have international connections. Total early stage entrepreneurial activity for 18 to 64 year-olds at 9.4% is above the 8% UK level, though at 39% ‘fear of failure’ is much higher (GEM 2014). Major institutional weaknesses for startups in KSA are lack of bank facilities (especially between US\$50,000 and 4,000,000. Compared with other developing economies, few Saudis want to run micro-businesses (defined by lack of growth potential), which are culturally viewed as subordinate. Many SMEs are family-owned, difficult private sale exit routes.

The number of women entrepreneurs in the Middle East is likely to grow, including in the least likely places. “Well-educated women in Saudi Arabia want to work, but their family often objects,” explained an entrepreneur at the Wamda shindig. “Running an internet start-

up from home is the perfect compromise.” Le Renard (2015) notes that Saudi women marry late or not at all and that divorce rates are high: commitment to family is not therefore the cause of low female entrepreneurship. Some 80% of KSA divorces are initiated by women and 66% occur within the first year of marriage with rates of birth halving in the last 25 years, though fertility is 2.2 and population growth (given rising life expectancy) rising at 1.2% per year.

Many developing countries faced with the list of ‘opportunities’ in KSA’s SWOT would be sanguine about the future: education I/FDI, major programmes and international TT. Oil revenues allowing generous welfare payments, 45% of employment in public sector jobs and a cultural predisposing against working in small companies all contribute towards a culture demeaning entrepreneurship. KSA’s fragility revolves around the absence of an indigenous technological base to compensate for the impending loss of oil revenue.

6.2.3.3 Incentives to entrepreneurship

The World Bank (WB) lauds KSA business friendliness, point to the ease (1-week) time of establishing businesses and each year some 10,000 attend entrepreneurship training, starting 1,000 new businesses a year as a result of the National Entrepreneurship Institute (Riyadh) alone.

National level initiatives promoting early-stage entrepreneurship include the following.

- *Kafalah* offers loan guarantees covering bank facilities for companies with under US\$8 million turnover and offers seminars and business skills development.
- *Wa’ed* a venture capital fund (VC) offers loan and equity, preferring MBA-level applicants or successful completion of a training programme, with investments in companies such as OrderMe, Geophysical Equipment, PayTabs and Virtual Vision. It partners with Schlumberger and Siemens.
- SIRB, established under the BADIR programme is an Angel network for equity investment and annual (US\$66,000) competition. It prefers applicants to participate in a training programme prior to application.
- Oqal is a non-state Angel Network, though it has difficult expanding geographically in KSA, many high net worth individuals preferring the higher returns and lower risk of a property portfolio. Oqal is unproved and yet to negotiate successful exits.

My interviewees point to high quality of (often free) incubation centres available to Saudi entrepreneurs, though on balance, they bemoan the barriers more than applaud the incentives. Respondent-14 CEO of an ICT client service Management Company, a client service management company in the energy sector is an interesting case, having managed an incubation centre and then established his own business, without using an incubation centre.

Actually I left the programme after that I worked for a company as the DM. It is a private company. Then I took one year after which I created my own company – it is a company in Energy – innovative energy and solar energy and also creating some electro-chemical work .. (A/14/10).

... as part of the policy is that if an employee wanted to use the facility independently or as a member of a group, you should make it known publicly and sign an undertaking to be fair in his dealings with other users of the facility (A/14/11).

.. it would have taken me longer to come into existence. (A/14/13).

In summary, KSA has a range of programmes incentivising business startup and commercialisation; however, the social and motivational barriers and disincentives appear stronger.

6.2.3.4 Institutional enablers and barriers

Respondent-20 argues that KACST sourced the best practice around incubation internationally (*we contacted a company which is running and operating incubators which is called 'KIEDA' in Australia; A/20/14*) and from the beginning place centre management in the hands of people with *business sense*.

Respondent-19 a commercialisation policy expert in Saudi Arabia, states that their strategy is to help students develop an entrepreneurial mindset (A/13/6). He speaks of the centres activities as a programme, rather than individual business projects, and acknowledges the centres role in changing cultural attitudes, such as sharing ideas.

So we take into account when we design the programme including the incubator programme that we have to work the technology transfer office including the innovation centre and other centres. We make it a point to tell our students that it's all about customers – if you don't have customers, you don't have a business. Our programmes are developed to be practiced based learning exercise and case studies. We also have an existing strategy for students. Finally and perhaps most importantly is that we have to tackle cultural barriers – for instance we always tell our students that it's ok to share ideas with others but don't

tell them how to develop that into a business. It's always better to become a job created than a job seeker (A/13/1).

Respondent-14 CEO of an ICT client service Management Company, is less sanguine, pointing to difficulties bringing budding entrepreneurs into contact with businesses and funders: he suggests that universities are wary of sharing ideas, even with other university incubators (A/14/9): a quite different picture to that painted in the *Vision 2030* state-of-the-art.

Aziz Al Agargan at KACST comments on the difficulties that shortage of exit routes pose for entrepreneurs.

First of all, the minimum capital is 300 million Riyadh and not many companies can afford that. For most of them there is an option and the only option is for them to borrow. The main obstacle is a cultural obstacle. They don't want to sell. For example there is an agency which books hotels and finished apartments. They get deal before hand of about 4 million Riyadh but they refused to sell. For all of over 100 clients, only 2 sold their companies. So it is that culture we want to change. When I was managing the unit that was actually one of the mission to clarify this to the clients. The other obstacle is the venture capital fund – we don't have. We don't have the law for venture capital fund for organisations working here. (A/16/5)

Both Respondent-18 and I have witnessed the market-orientation and close working relationship between the Indian Institute of Technology in Bangalore (IITB) and firms such as Infosys, Wipro and Tata Consultancy: these companies assess student business ideas and then either invest in them or refer them to ex-pat Angel Networks in the US. He comments,

The story is a bit like the story of India. You know when the ICT industry was taking shape in India, lots of people were saying that India has a large body of English speaking people and many graduates were coming in thousands. But the point was that the numbers on that the public education systems prepares about 300,000 graduates from colleges and so on. But if you look at Saudi of about a million plus per year and look at the quality, probably about 80% are not ready for the market (A/18/10).

In summary, KSA policy-makers see the need for institutional change to increase entrepreneurship, however, cultural inhibitions on innovation run deep and universities remain wary of knowledge sharing.

6.2.3.4 Disincentives to entrepreneurship

Interviewees highlighted both policy and cultural disincentives to entrepreneurship in KSA including (for some) the incubation centres.

Policy disincentives

Asked if KSA university incubators are on track, Respondent-20 a senior commercialisation policy expert in KSA expressed the majority policy expert view:

No, they are not really doing a good job but I think some of them have realised that and are changing but others are continuing the same line of work. They think of incubation in a simplistic manner so for an academic person, seeing what's going on it looks like they are treating it like an academic exercise rather than a commercial exercise (A/20/12).

Entrepreneurs such as Respondent-14, are critical of incubators, from the different perspective; that they incentives the search for free cashflow, rather than inspire taking a product to market and generating sales income.

Actually, the support initially was ok and acceptable. But these entrepreneurs kept demanding for more, which I would say, is natural considering that they are entrepreneurs. So they are quiet pushy and quiet demanding. For instance, we are offering offices to those clients, networking, meetings room and conference rooms, consulting sessions, linking them with funding institutions and business people and giving them technical support. So we try to provide all these support within 6 months – from the business plan to launching of the company. Again we have met our target on this and the capacity of the incubator is full (A/14/7).

Such attitudes, as Respondent-18 reports, may be the result of lengthy periods in the incubator at no cost to the budding entrepreneur.

Because the first incubator focused on information technology the original design was to keep the tenants in the incubators for not more than two and half years – 30 months. However we realised that in 30 months time the entrepreneurs were not ready for the market with revenue and the right now of employees and so on. So over time that criteria was so of relaxed. Many of the companies have been in the incubator for more than 3 years. I think one or two have been there for 4 years now (A/18/3).

KSA's incubators are in a deeply Arabic and Islamic context of business, Respondent-20 a senior commercialisation policy expert in KSA wonders whether university incubation is value for money, challenging a fundamental assumption in *Vision 2030*.

Another major policy issue for startup entrepreneurs, particular those with external equity, highlighted by Respondent-18 is the absence of exit routes.

... real estate that takes the trade most of the time and beyond real estate there are other areas like petroleum deliveries for example and heavy metal industry. There is a lot consumption of these things and private players feel comfortable to acquire businesses from outside rather than investing in genuine technology based start-ups (A/18/8).

Too this he adds the criticism that academics rather than people with experience in business startup manage incubators.

Yes and this is at the heart of the problem. If you don't bring someone with the business sense, you don't expect the incubatees to get that business sense (A/20/13).

In summary, there are powerful disincentives to entrepreneurship in Saudi culture and institutional arrangements; rather than ignoring such disincentives policy documents such as Vision 2030 would be better saying how they can be overcome.

Cultural disincentives

To these policy barriers to entrepreneurship in KSA must be added a range of cultural barriers mentioned by interviewees. Respondent-1 of a major online training company poses the cultural barriers as follows.

One of the first things we encountered for example was supervising people within KAUST. You could also see that the instructors or trainers were being brought from abroad being it from Europe or the US. All of them came from a Muslim mentality that talks to a Western audience. I felt that they didn't have the sufficient information or background of the Saudi market and how to actually approach it. There was this cultural gap that I think prevented a very fruitful training session per se (A/1/1 and 2).

Respondent-15 agrees, noting that one effect on academic faculty of commercialisation has been patent registration, seeking licences and royalties. It is interesting to note that the one successful commercialisation he mentions occurred in the US, not KSA.

The most significant problem for a period of 14 years was basically a cultural problem. The faculty was not ready for all these because the faculty was used to teaching a course, giving assignment, grading exams and going for a summer vacation of 3 months and then come back. To convince this faculty to getting into innovative research, a research that will result to IP, which will get you a patent which can be commercialised was the biggest task because this needed a complete overhaul of the system and you know that the faculty is a very sensitive creation with a different mind-set. So that was one of the biggest task. They have gotten to a stage of making more patents, few of them are commercialised, and the royalty flow hasn't started. Once they start receiving 15,000 dollar cheques, they are all in good shape because now they are getting something more than a publication in a journal, having patents with their name, royalty cheque coming in.. Let me tell you that we are very proud of one technology that we developed for a bottle desalination purpose. Now we are trying to commercialise the same technology more here in Saudi Arabia. Coming back to the challenges, all our efforts are basically based on university research faculty and switching the mind set was not an easy task; two, the bureaucracy was terrible; three, it was not easy to find the human resource for this particular business – that's technology commercialisation export. So for that we came to the UK and I hired two people from the University of Manchester who spent 10-15 years of their lives in taking the University of Manchester technology to the market and we have both of them there and then playing a very significant role. These two worked for me with a team of 7 people developing patterns, technologies, looking into the market, looking after customers, clients (A/15/7).

Too these viewpoints can be added a continually repeated point (for example A/21/9) that young people in receipt of long-term education grants or social welfare payments face a perverse incentive: a good income without risk or an uncertain future income with risk and hard work.

6.2.4 Knowledge flows: absorptive capacity and adaptation capability

KSA has been building basic research capability for two decades, often by encouraging successful international researchers to spend time in KSA and Saudi students to study abroad (200,000 do each year). At the best KSA universities there is basic research capability. For example Respondent-20 a senior commercialisation policy expert in KSA reports basic research in:

... animal technology; bio-technology; agricultural technology; advance technology; medical technology; and water technology. So we have 15 technology areas and the university is responsible for the research in these areas. We have about 300 million riyad support each year for the research. So normally, professors apply for the grant and it is taken to Harvard in the US for evaluation and if the a project is accepted, it's supported for 2 years for 2 million riyad for each project for the technology (A/21/4).

When asked (A/21/6) to name a KSA company benefiting from this basic research, Respondent-20 could not name one. Respondent-23 suggests this is because KSA basic research has yet to migrate into science-based technologies.

In KSA most of the technical knowledge comes through international technology transfer as most of the industry in KSA partner with international and multinational corporations and industries. Limited technical knowledge is provided locally by university research and research performed in national/Governmental laboratories (A/23/5).

Of course, basic research and research-led teaching are also important in creating the absorptive capacity necessary to understand and adapt learning from elsewhere into the Saudi context, especially in the form of adaptations creating new products. Respondent-18 makes the point that the first incubators (2008) in KSA were general purpose at KAST; targeting IT innovations, whereas later models are sector-specific and more likely therefore to become an environment for (technical) adaptation (A/17/3).

One aspect of entrepreneurship in KSA, as with other social activities, is social capital. Dr Respondent-1 makes the point that connections outside the incubator can be of critical importance.

Especially for example if you want to talk a specific practical example like developing a pitch. We have something person in Saudi that if you want to successful pitch something to someone especially in the business scene there are a lot of other aspects that need to take into account. For example your personal relationship with the person. Your background in Saudi Arabia for example, personal ties, whether you come from the same tribe, whether you come from the central region or whether you come from the eastern region. You know things like that could always be used to your advantage and that's what I mean by the cultural issue. But if you look at the western concept of developing a pitch, it's a wonderful concept. But if you also come to less say a Saudi businessman, for example, you may want to do it over a coffee or in a more relaxed atmosphere (A/1/3).

KSA is building up absorptive capacity and basic research capability; at present there is little flow from transferred technologies into new Saudi products and no 'star' companies resulting from university incubation.

6.3 Commercialisation inputs

This section explores inputs into KSA incubation.

6.3.1 Incubation and start-up services

Here I assemble evidence on the range and quality of services adding value to business projects inside incubators.

6.3.1.1 Success criteria

Respondent-17 Manager of an incubation network, comments that before incubators are established, they instigate,

independent feasibility studies for every single one of the incubators; secondly, siting the right facility; and thirdly, developing a good business plan which includes an understanding of the business module (this was unique and different to any of its kind globally (A/17/5).

At King Fahad Petroleum (KFP) incubator the success criteria are threefold:

We have three simple CSFs or KPIs – one, we record the number of screened ideas; two, the number of businesses who successfully finish and graduate and three, the number of graduates who receive funding to start their business (A/13/4).

Admissions criteria vary between incubators, at KFP,

We have a screening process. Students are told about this process when they apply. It includes: a minute video pitch of their business idea; they are put into groups and then meet with a team who do the final

selection. The final selection is based on the passion of the applicant, the energy of the team (if it's a team) and the attitude of the applicant. We also do some form of evaluation assessment to their business knowledge. Some are admitted directly but others are advised to undertake some short courses or advised to take a job before they are admitted (A/13/9).

Like all incubators evaluation of applicants covers both the innovativeness of the product and the entrepreneurial ability of the application. Respondent-14 suggests these are reconciled as follows.

Actually we were planning to go alongside the business incubation policy for Saudi Arabia, which was created among key people in the industry and some Consultant came from overseas to see what is the best practice for business incubation. What are the criteria that could be put in place to select the right clients or the right potential clients especially since we are doing technical incubation and not mix incubation? Is was therefore very important to have a real criteria. We put general criteria at the beginning to introduce the idea to people and to encourage them to join. But after a year or two we came out with the full policy stating the criteria that need to be taken into consideration to select the client (A/14/3).

I note that client satisfaction (see 6.3.1.4) does not feature prominently in success criteria. There seems to be an urgent need for a full evaluation (including cost-benefit analysis) of university-linked incubators referencing international benchmarking.

6.3.1.2 Problems in service range and quality

In explaining entry criteria, Respondent-15 raises an important point privileging technology work and university links above marketing, indicating preference for a particular balance between technical and market-oriented services.

... the first thing is that you need to be a technology company; two, and most important that you intend to do technological work, not to use the facility for marketing and sales or other services and three, you must interact with the university in terms of developing a product, in terms of commercialising a product, in terms of start-ups where the university has to participate and that's when the DTVC gets in for investment and for providing the funding or for arranging it from Engels or the governmental agencies which provide the seed funding and advance because it is a pretty expensive business (A/15/6).

Several interviewees, whilst suggesting that incubators provide an appropriate range and quality of services, suggest that universities should do more to encourage entrepreneurship. For example, Respondent-7 says, *The government also need to educate a lot of people on entrepreneurship and universities should promote R&D. They should integrate practical business into the theories they are teaching in the universities. (A/7/20).* Others raise points from personal experiences, such as Respondent-3 who wants more cooperation between the private and public sectors and 24-hour opening (A/3/19).

There are four areas of incubator scope and quality, which interviewees suggest need improvement: training, foreign culture, marketing and finance; these items interrelate. Respondent-1 from a major online training company is one of many interviewees referring to training programmes in the incubators: this is important because the implication is a programme rather than a project (new business) orientation and that the programme contains training (whether the entrepreneur needs it or not). He links this to the importation of foreign incubation models.

.. when it comes to training I will suggest that to take the Saudi market into consideration and the culture into consideration – that's one thing. Another thing is to have more Saudis in the incubator itself because culturally speaking we have this tendency that this creates connection. So it is much easier to have people with the same background. I remember for example the manager of the incubator, he was German. I believe that if you have people who speak the same language, the same culture, the same background as the people you're trying to approach and make them invest in those companies or create it, it's going to be much more fruitful. Basically I'm saying that it's all about the network and connections that you can build. And it will be much easier to build networks and connections if you have the people speaking the same language (A/1/13).

In the same vein, Respondent-14 points to the cultural disadvantages of importing foreign staff as incubator managers unaware of nuances in Saudi culture (A/14/1).

Respondent-8 CEO of a recycling company (A/8/3 and A/8/7) had difficulty raising capital and feel firstly that incubators should have funds available and secondly that they should more actively support companies applying to funds such as the BADIR arrangement with the Saudi Loan Bank to provide startup loans.

Respondent-6 felt the incubator could do more to support market trend and entry analysis.

In terms of development and marketing, we do it personally. Majority of our work is via social media. We prefer social media because newspapers are expensive with less returns. We even tried having a website but it didn't work well. Social media is very cheap and effective (A/6/7).

In summary Saudi incubators appear formulaic, intent on delivering (training) programmes rather than on a project basis developing entrepreneurs and individual new businesses.

6.3.1.3 Cost and value-for-money of incubators from firm perspective

Most of the interviewees report that incubation services were free: (A/7/9) is an example. One interviewee valued the free services they received as costing US\$ 10,000 (A/2/6). Another stated that as a result of being inside the free incubator, they received a Government grant of USD 4,000 (A/4/7). One interviewee (A/3/9) paid the incubator 24% of the company, which he values at US\$ 100,000; though then commented, *I didn't pay anything at KSU incubator in Riyadh Techno Valley*. Interviewee (A/10/7) paid 15% of equity for incubation services. Finally, (A/12/7) said the incubator services cost \$US 10,000 commenting, *But this was paid for us by the university. The accelerator's strategy was that they come after the customer in the first phase for you to realise their importance. Then they sit back in the second phase and expect you to pursue them. This is also to test those who are serious about their business*.

6.3.1.4 Incubator customer contentedness

Not every interviewee was positive about their experiences in Saudi incubators. When Respondent-9 CEO of an agri-food innovation company who distributes organic vegetables, was asked about the KACST incubator, he commented:

I think they are a network of bad people. I don't trust them. They are propagandists. They didn't seem excited about the idea and nobody gave me any encouragement (A/9/7).

Respondent-7 CEO of an e-commerce company who offer Web and mobile development services joined the incubator because it was near his university and offered and advice on finance and accounting (A/7/7). He was disappointed that little network was offered (A/7/8) and was unimpressed by the help given: *No, because they are government employees. You rarely find such employees to be entrepreneurs (A/7/12).*

These critics are a minority. When asked whether they used commodity, professional or networking services of the incubator, most of the interviewees who had spent time in incubators suggests they used all of these services (A/3/10; A/3/8; A/4/6; A/4/10; A/5/5). Many, such as Respondent-5 CEO of an ideas incubator, felt incubation gave encouragement and confidence: *joining VentureLab has given us a great push and the right amount of confidence to get started (A/5/10)*. In particular, he felt the incubator helped him overcome doubts being on 24 years of age (A/5/11). Respondent-12 CEO of a

transcription services provider felt the incubator helped with networking and clarifying the nature of his product (A/12/10).

Giving more detail of the benefits of the incubator, (A/2/5) who moved from KACST to BADIR suggest that consultation services were strong in KACST, whereas BADIR offered a better location and office space. Respondent-2 from an online exercise platform company, who also moved from KACST to BADIR, said that, *From KACST I will say re-shaping the business; and BADIR will be networking at the beginning* (A/2/10), though he found some staff more useful than others (A/2/9). Respondent-3 CEO of an energy programming company (A/3/7) felt *the environment is conducive for business*. Hussein Al Alattar of *sawerly* (a digital photography business) also used the entire incubator services joined the incubator because,

.. we lacked structure and focus. We tried a lot of options on our own but couldn't make a headway after the contest. That is why we joined the incubator. We also needed the mentoring, facility and the opportunity to meet other companies and to network A/10/6).

Respondent-11 CEO of an animation and media advertising company felt the incubator gave him *a very clear roadmap of your business* and see funding (A/11/6). Respondent-4 CEO of an online career-fit guide, said the incubator help identify markets, help with marketing and credibility in the market (A/4/5). Mr Bawazir also benefited from a fact-finding visit to incubators in California. Respondent-12 CEO of a transcription services praised the networking and financial advice give by incubator staff (A/12/11). Respondent-6 a mobile app developer praised the services and facilities offered by the incubator (A/6/8), benefited from relevant training (A/6/12), though he then suggests he became comfortable and *You cannot expand your business when you're in an incubator because of lack of space. But we are hopeful to expand when we leave the incubator. We need a little bit of push and we will graduate from BAIDA* (A/6/15).

Value-addedness by incubators was important to many entrepreneurs. Respondent-3 CEO of a wireless intercom system provider details how the incubator helped him move from concept to product by arranging test sites (A/3/1).

Thus the incubator helped focus product design and enabled product testing. Dr Respondent-1 of a major online training company says,

.. in our project we really needed a limited support from such kind of professionals or things. For example when it comes to IP or when it comes to tax. .. So we had interactions and I think the value added the most (was) the office space – it was an important and a crucial one. That is when the lawyers went through all the contracts and different mechanisms and they proved to be very useful (A/1/5).

In terms of suggestion to improve from the entrepreneurs viewpoint, Respondent-2 felt much of the work in the incubator was *They had a programme which was not really incubation but more of training courses. We thought it would be a good idea to be part of it to understand and get some consultation from people who basically have been through start-ups and the know how to shape your business (A/2/5)*. Respondent-6 suggests after-care services to continue motivating innovation. Respondent-8 CEO of a recycling company who markets wood logs and charcoal (Saudi's love BBQs) feels that risk capital providers take excessive amounts of equity and that incubators should have access to startup funds (A/8/7).

Few of the interviewees refer to discussions on business modelling in the incubators; this seems odd when innovative models form such an important part of online and service businesses. Respondent-6 (A/10/11) is the only interviewee who refers to such discussions.

Clearly entrepreneurs are gaining benefit from Saudi incubators; however, the entrepreneurs' motivation is lacking to go in and out of incubation quickly, exiting with a trading business. Additionally, entry criteria appear loose and time in incubation flexible.

6.3.2 Technology transfer, UILs and absorptive capacity

This section explores KSA TT, UILs and absorptive capacity.

6.3.2.1 Technology transfer

Surprisingly few of the policy or entrepreneur interviewees referred to TT, though KFP deem it important to be located adjacent to the university (A/13/3). Aziz Al Agargan of KACST felt it important to be located near university laboratories and specialist staff

(A/23/3), however, no single case was mentioned of labs being utilised by incubating companies nor of specialist academic staff being consulted.

6.3.2.2 Building university-industry links

University-industry links (UILs), however, appear important to universities, though these are often mediated via incubators (and perhaps other projects) located close to universities. Aziz Al Agargan of KACST referenced the Industry and Professional Advisory Councils found in many US universities (A/23/2) and the importance of close links in guiding research and designing curricula. He did not mention UILs in relation to incubation. It is these network links that many incubating companies crave. For example, Respondent-12 CEO of a transcription services views such links as an important aspect of the enabling role incubation centres can play (A/12/6) and Hussein Al Alattar suggests that linkages to the private sector are *still not there* (A/10/18). The links Respondent-9 wanted were into KSA Ministries, he bemoaned lack of linkages, competition between Ministries, corruption and bureaucracy (A/9/12). Others (for example Respondent-8 CEO of a recycling company) seeking marketing connections, was impressed by the connections made by the incubation centre. *They matched us with a retailer in Saudi who has 25 outlets and he's now our main client*, he said (A/8/4).

In summary, whilst some universities are strongly connected to large KSA businesses, this is less the case for networks of SMEs, especially since larger business are reluctant to trade with new starts. While Saudi universities invest heavily in TT (joint projects and inbound staff), these activities are disconnected from incubators lending greater support to the pessimistic forecasts in *Middle East Eye* (2016) than the optimistic *Vision 2030*.

6.3.2.3 Building absorptive capacity

Examination of absorptive capacity to manage basic research further supports this more pessimistic perspective. Building entrepreneur's absorptive capacity relates to their ability to understand and act upon new areas of expertise – it is project specific and quite different from generic training. For Aziz Al Agargan of KACST, the *Absence of technology transfer offices or units in many industries that would identify basic research outcomes and*

recognize it's production potential, (A/23/6) is a major issue in Saudi incubators along with unclear patenting law and raising risk capital. Respondent-18 points out, that KSA large companies do not do basic research and the universities who do, do not see it as part of their role to increase the absorptive capacity of entrepreneurs, even ones in their own (attached) incubators, (A/16/11). He goes on to contrast the preparedness of large companies in other countries to work with startups, developing new products, whereas large companies in KSA do not see it as relevant (A/18/6).

The process of starting a business is one of action learning – gaining knowledge relevant to the business. There is a clear gap in the ability of nascent entrepreneurs in KSA incubators to access absorptive capacity enhancement either from university or large companies.

6.3.3 Motivation and capability for entrepreneurship

None of the entrepreneurs mentions intrinsic motivation for starting their business; most refer to the extrinsic motivation of solving a problem. Many have benefited from study abroad and technology transfer – adapting ideas from abroad to the KSA context. As we shall see later, though GEM tells us the 40% of Saudis have a fear of failure as entrepreneurs, relative to their UK counterparts, there is no mention of emotional-readiness or emotional drive.

Solving a consumer problem is a major motivation for these entrepreneurs. For example, Respondent-9 learned to enjoy organic foods in the US, could not source them in KSA and this became his business passion, which he pursued despite (he says) lack of support from KACST taking three-years to commence trading (A/9/1). Respondent-4 was inspired by a US experience, in his case online career profiling: SmartAble was trading within a year (A/4/1) a journey shared with a College friend. *Harakat* which accesses cloud databases for online platforms too was inspired by a US example, in this case Ryan Finley's *Survey Monkey*. Respondent-7 was motivated to provide an Arabic product, in his case with more functionality than *Sidiani.com* his Saudi competitor. Dr Respondent-8 CEO of a recycling

company got the idea of processing date palm oil from waste from reading an Indonesian example; he was motivated to establish a company, having lost significantly in the 2009 Dubai Stock Exchange crash. Sawerly, like iTunes and Flickr is a sharing repository for photographs, with the added twist of acting as a brokerage between photographers and clients. Hussein Al Alattar presented the idea at a business competition with a friend and where trading within 6-months having been supported by PLASTICSLABS accelerator and a private investor.

Technology transfer was an enabler and motivator for these companies along with the desire to solve a problem for consumers. Respondent-11 began by transforming books into videos for students and then progressed to animating learning materials (A/11/1) targeting Arabic speaking markets. His motivation at *hroof* was to promote visual communications. Respondent-12 CEO of a transcription services too uses communications to solve a consumer problem, in this case university lecture content capture and distribution in partnership with KSA universities.

In summary, entrepreneurial motivation too extrinsic and short-term i.e. solving the problems of consumers, often based on the transfer of technologies from abroad, rather than the creation of new knowledge/technology in KSA.

6.3.4 Internationalisation compliance with standards

Compliance with formal (for example ISO) and informal (example usability) standards is important for interoperability with complementary products and services and critical for internationalisation. Overall, Saudi startups seem centred on KSA market needs than standards compliance.

Respondent-14 is typical, saying, *So it's great that we know about the western way and there's a lot of things that we learn from there but at the same time let's see how we can adapt it and modify it a little bit so it's also suitable for this side of the market* (A/1/4). Respondent-1 was not sure if *Acadox* makes B2C international sales notes that their online

education platform has B2B customers in seventeen countries, mainly Emirates and Oman and that standards compliance is imperative (A/1/12).

Other interviewees such as Respondent-14 (A/14/15) whilst in principle favouring internationalisation and standards compliance were fixed on the KSA market, pointing out that *We have a huge demand from overseas but we are usually not able to meet all their demands. One good thing however is that the market in Saudi is maturing now, especially in terms of funding existing businesses* (A/14/17).

Internationalising is a complex and important decision for SMEs and from a KSA perspective highly competitive, facing competition from Egyptian and Turkish firms targeting Arabic markets. We return to these points later, in particular cross-referencing with the difficulties KSA startup have in raising risk capital: confining horizons to a market of 30-million will rarely appeal to the return rates VCs anticipate. Our data reveals little focus on international market by startup, incubated SMEs.

6.4 Commercialisation processes

In this section I assemble evidence from entrepreneurs, policy-makers and incubation centre managers on commercialisation processes divided into eight sub-sections: startup and growth; internationalisation; labour supply; IP and regulations; governances; risk capital; entrepreneurial risk and leadership; and knowledge flows.

6.4.1 Start-up and growth

To explore the start up and growth processes I divide this section into time (dash-for-cash) and trouble, meaning difficulties and how they are surmounted.

6.4.1.1 Time: a dash-for-cash?

Companies burning equity or their own sweat capital without generating income are a key challenge facing incubators.

Some companies would feature on the ‘celebration of success’ part of incubator websites anywhere in the world. For example Hussein Al Alattar who began trading after 6-months (A/10/3) says, *We used the lean start-up methodology as a start-up with an MVP. Our KPIs were just a number of bookings on the website and we kept an eye on this to ensure that we were meeting our targets. Until now we have only 5 employees but we might need some more specialised employees in future.* (A/10/5). Respondent-14 (A/14/12) began trading after a year.

However, when asked when did they feel their company became legitimate, several of the interviewees replied like Respondent-5 (A/5/2) when registered by the Ministry of Trade (after one-year in incubation): note, not when it made its first sales. Five of the companies interviewed are still not trading: Respondent-2 after two-years incubation (A/2/4); Respondent-4 after four-years incubation (A/4/4) who says (A/4/2) *It took us over a year to develop the vision of the company.* Respondent-7 took two-years to begin trading (A/7/2) and Respondent-6 is now trading after 1-year development (A/6/1).

Respondent-9 is a special case taking seven years to source organic seeds, rent land and secure supermarket contracts for organic fruit and vegetables (A/9/2).

My point is not to call attention to the patience of incubation, nor time spent (at no cost) incubating, rather that at entry into incubation firms appear far from market launch and that incubations do not impose time limits likely to focus entrepreneur’s attention on time-to-market.

6.4.1.2 Trouble – challenges in incubation processes

In view of the time some of these companies spend in incubation one might expect a long list of challenges faced: this is not the case. Apart from sourcing risk capital (reviewed in section 4.6 below) the major challenge mentioned is having to spend time taking irrelevant training courses to comply with incubator rules: Respondent-2 is an example for whom incubation took three-years (A/2/5). Of course, migrating young students into entrepreneurs does take time. Respondent-7 draws attention to financial discipline he

learned during incubation: *We might have invested our money into a lot things that we didn't need. This would have cost us a lot in terms of result and time (A/7/14).* Respondent-12 CEO of a transcription services, who spend one-year incubating, was encouraged to develop a customer feedback system as a KPI, which is not key to the success of the business (A/12/3; A/12/5).

Respondent-8 CEO of a recycling company is far from impressed by the ability of KSA incubators to help nascent companies overcome difficulties.

To go into an incubator either you have a new idea and you don't have finance; or you don't know how to nurture this new idea into a marketable product. Here in Saudi, having a new idea is not productive. I know a lady from Baida incubator; her products got rejected just within 6 months after launching the product. There is no protection or commercial rights, which is very dangerous (A/8/6).

Incubation involves preparing a product and route to sales often termed the 'valley of death' the business spends before it reaches positive cashflow and then profit. There is little evidence that Saudi incubators urgently address this dash-for-cash or are able to support startups in plotting practical routes to market; lack of practical business leadership shows.

6.4.2 Internationalisation

Many VCs will look for 50% of sales internationally within two-years in order to achieve the growth necessary for a c20% IRR exit. In section 3.4, I discussed the standards compliance aspects of internationalisation; here I look at dedication to internationalisation Saudi startup commercialisation companies. I find that most are not dedicated, in part perhaps because it is difficult to re-export imported business products and also because most are fixated on the KSA market. For example, Respondent-3 (A/3/16), Respondent-7 (A/7/15), and Respondent-12 (A/12/13) each say that they wish to internationalise in the future, but have no concrete plans to do so. Hussein Al Alattar (A/10/14) considers UAE, Egypt and other Arab countries suitable for internationalisation, but again has no practical plan and Respondent-4 (A/4/13) would like a US partner but mentions no practical searching.

From the university perspective, Respondent-15, a Science Park Manager is concerned to expand his research base in publications and patents. He says,

At this point in time, we have out 14 companies, 11 are international companies and only 3 are Saudi companies because the bulk of the technological selling to our oil and gas industry and petrochemical industry are done by these American and European companies. So, they have a lot of business interests here and our job is to basically convince them to get away from transactional approach to coming, selling and going back home. We want them to imbibe their technological centres in the country and we cannot do it unless the countries which buy all these expensive technologies from them ask or force them to establish a centre here in Saudi Arabia. ... the international exposure to the science pack is our basic element ... the innovations that come out during the process of technological development provides the start-ups that provides the jobs creation that provides the manufacturing. Some of the products are right away able to go to the manufacturing, some are still have to go through the proof of concept and to the prototyping, scaling up before they go to the manufacturing. But, most of them originate from these international companies working in developing a technological solution or a technological product for the industry (A/15/6).

In summary, lack of an internationalisation perspective is a major difficult facing Saudi incubators, startups and universities, a view expressed by the majority of interviewees.

6.4.3 Labour supply

Respondent-1 a major online training company points out that recruiting educated Saudi labour for startups is difficult, since their preference is for large MNEs or employment with the Government. This results in importing foreign skilled labour, which can be bureaucratic process (work permits and visas). He goes on,

The most difficult of all is however business development people or marketing individuals. We also faced issues in sales and marketing. For example we faced difficulty in marketing when it comes to recruiting, and when it comes to approaching clients. They will say your company is small and we're looking for something more established. But what we're expecting is for them to ask us something like who does this company belong to but they want to see like a well-recognised name behind it and that gives them confidence to go into business with us. So in terms of marketing we face difficulty in recruiting and we face difficulty in approaching clients (A/1/18).

Respondent-9 points to the additional problem that one Saudi national must be employed for each four foreign workers and sometimes the Saudis regard such positions as sinecures, without the need to attend or contribute (A/9/4). As in many developing countries, the state plays a dominant role and people see Government jobs as secure. According to Respondent-12 CEO of a transcription services, bright young people in KSA take public sector jobs in preference to working for startups (A/12/17). There is no tradition (and legal complexities) in offering share options to startup employees in KSA.

KSA's position is not helped by brain drain. It is normal for developing countries to lose (to migration) some of their most capable people; especially where there is a shortage of opportunities for young and qualified people. For example, 88% of Vietnamese filing for patents do so from a foreign residence (*Economist* 081215). Of the 110,000 Saudis studying abroad some 25% are women (56% of those studying within the Kingdom are women), who often prefer to emigrate. Though no figures are available, there is a shortfall (especially outside of large cities) of teachers and medical staff (only 21% of Saudi doctors and 55% of other medical staff are natives according to Bakhsh *et al* 2012).

Labour supply, particularly qualified labour is a major issue for KSA incubator startups.

6.4.4 IP and the regulatory environment

KSA company law is rooted in the French Napoleonic Code (via Egypt). It poses serious issues for startup companies and their funders in particular relating to intellectual property law (IP), capital gains tax and the governance of risk capital funds. Capital gains tax is hugely important to startups, since invariably (with the exception of low-growth lifestyle companies) the entrepreneur gains his/her reward by exiting or selling equity. IP law and its enforcement are crucial to the value of knowledge-based startups for company valuation and legal protection of products sold internationally. This is again an area where *Vision 2030* claims problems do not exist.

6.4.4.1 Intellectual property

Respondent-23 a national level commercialisation policy maker, is one of the most influential figures in KSA's policy of commercialising technology transfers using incubation centres. We discussed patenting in KSA, where applications are made to the Directorate of Patents at King Abdul Aziz City of Science and Technology (KACST) who are also responsibility for resolving disputes at a Board of Grievances. Dr Al Agargan says, *The ownership of the IP. The law is not well established or vague on this issue and there are grey areas. For example a scientist working in a university, who owns the IP?*

KACST *might claim ownership but so might the scientist. So although the law is there it's not clear*, A/16/8). Explaining the difficulties creating clarity, he says, *For example the company in charge is KACST, which also fund the research in the university. So KACST claims as the custodian of the IP that compares to all other universities which is very difficult. It's clear for them* (A/16/9). He points out that, *most universities rejected the IP of the researcher outside the university* (A/16/10). Uncertainty of IP makes the valuation of companies and the sale of products in international markets very difficult. Confusion over IP-ownership is only exacerbated by documents such as KASCT (2011), which unequivocally (2011:12) states that *Intellectual Property generated through research conducted using National Science, Technology and Innovation Plan Funding will be owned by the Government*. As section 2.5.3 makes clear, IP ownership by Government or university institutions disincentivises academic entrepreneurship and adds complication in attracting external risk finance.

6.4.4.2 Legal issues

Many incubators connect entrepreneurs to lawyers (A/9/11; A/12/17). Respondent-20 at a senior commercialisation policy expert in KSA reports, *Yes, we have lawyers working from all angles of the incubators. So we at KACST as a company have lawyers. We have already done several studies in terms of issues with current laws regarding venture capital and investment as a whole*. (A/20/18). However, legal issues remain an important barrier to commercialisation.

Firstly, (as we shall see in section 4.6 below) access to venture capital is problematic in KSA. One reason for this is that the preferred structure of VC and their investors is a limited partnership. These are possible under Saudi laws (Companies Regulation, Articles 36 to 39), however, the simple or limited partnership (*sharikat al-tawsiya, al basita*) as in French law (unlike UK, German or US law) gives liability of all partner actions to the general partner, making it risky to constitute VC funds since a General Partner would be liable for any losses.

VC (and startup entrepreneurs) rely on exit (often sale of equity privately i.e. not by IPO). Saudi law is complex on private equity sales and especially so for foreign nationals. Added to which capital gains are taxed at 20%, without the ability to offset cumulated losses, if 50% of control passes. For VCs this is a deal-breaker, since their fund is likely to be a portfolio in which losses (or living-dead) investments are offset by a smaller number of ‘star’ investments.

In summary, IP law, company law and fiscal arrangements in KSA are barriers to adopting the VC models successfully used to fund startup companies in the US and European countries.

6.4.5 Governances

Here I assemble evidence relating to the governance of incubators and high-tech startups in KSA. In particular, I focus on the structures, rules and embedded ways-of-working that influence the success of commercialisations. Since this expansive topic generated a great deal of data, I have been highly selected to avoid repetition.

6.4.5.1 Incubator governances

Funding and control

KSA incubators are publicly funded and attached to leading universities. At KFP for example, *this incubator is part of what is called the entrepreneurship institute established basically with the vision to position the university as a leader in entrepreneurship thinking. The whole mission is to provide a care system for university students to become entrepreneurs (A/13/1)*. Respondent-15 sees its vision as diversifying the economy away from oil-dependency and promoting Saudi’isation (A/15/5).

Respondent-17 Manager of an incubation network describes the management structure:

Because we’re not a single incubator, the programme runs as a network of incubators. As a result, the management team at the moment is the programme CEO; industry sector directors (x3), ICT, Bio-technology and Events, Manufacturing and Material; project management office; finance and budget director; entrepreneurship support director, incubator development manager and a director for shared services. Each has their own team (A/17/7).

Incubators are under the direction of academic staff supported by business advisors. At KFP for example incubatees are excluded, *If you miss 3 classes consecutively or if you are not making any progress at all* (A/13/13). I regard academic rather than business leadership of all incubation processes as a major fault in the Saudi system.

Limits on range of services offered

All of the incubators offer workspace, secretarial and digital-access and an assortment of professional services such as accountants and lawyers. Some have marketing expertise on call. None of the incubators have direct access to risk capital funds, instead, (A/16/3) they facilitate access to private and Government funds, though as Respondent-20, for example (A/20/16) readily agree; there are problems accessing VC. Lack of access is not only access to fund, it is also access to VC expertise, critical feedback on business model and business plan and the network connection VCs can bring.

Entry and processes

Incubator entry is for university graduates only, who have technical knowledge and a business idea (however early-stage) and as KFP state show, *passion, energy, flexibility and resilience* (A/13/10). Apart from preparing monthly reports (as does the mentor) for the Incubation Director, entrants must follow a programme of courses, as KFP say, *It's very simple. You have to be there, attend classes and each week do a pitch. Attendance is very important. Of course the university regulations applies to our incubates. Their mentors provide written reports monthly* (A/13/12). Many centres conduct business plan competitions (A/15/5). In addition to working on their business project, entrants to Centres follow a programme of attendance and courses illustrating the academic nature of the incubators. More time spent seconded into active business startups may provide greater insights for the potential student entrepreneurs.

Key performance indicators

Respondent-3 CEO of an energy programming company is typical, saying, *We have KPI for employment; profit and loss; marketing; job creation; customer satisfaction and R&D,*

(A/3/6). As Respondent-15, a Science Park Manager makes clear, *We also look at how many Saudis are getting into these technology development ..job creation is an important element*, especially jobs for Saudis (A/15/5). Respondent-21 a senior commercialisation policy expert in Riyadh who is responsible for the national plan for science and technology confesses that his real passion is research and told me he has 100 publications about bees and bee-keeping equipment (A/21/11).

In summary, academic staff manages Saudi incubators and incubators must follow prescribed courses, illustrating an academic rather than business orientation as does low levels of interaction with existing startups and venture capitalists.

6.4.5.2 SME governances

Detailed coding shows five sub-themes emerging in the extensive interviews with Saudi entrepreneurs: resource assembly; legitimacy; risk; technical expertise and marketing; discipline and leadership development. Section 4.7 below gathers evidence on risk and leadership and section 4.6 on the risk capital element of resource assembly.

Resource assembly

Experience in leveraging external resources varies, in particular with the quality of business networking incubation centres access. Respondent-11 CEO of an animation and media advertising company had the positive experience at Tehran Techno Valley of *partnering foreign companies where we can develop this products cheaper* (A/11/5). However, this is exceptional, for most incubatees resource assembly means apply for Government grants.

Legitimacy

Many companies felt registering with the Ministry of Trade gave them legitimacy, others for example Respondent-7 CEO of an e-commerce company stated when he became 'sure' of his business idea (A/7/4). No single company mentioned typical business theory notions of legitimacy such as sales income, hitting breakeven, securing external funding, contracts with supply or sales partners or profitability.

Technical expertise and marketing

Many developing countries have technically astute products, but fail the marketing test and overly focus on technical development: to what consumer problem is the product a solution; how can the product be taken to market? This trend is evident amongst these Saudi companies. Respondent-4 says, *There is not much marketing story because our focus is to develop the product* (A/4/14), Respondent-6 regards marketing as less important than attending the incubation centre training (A/6/16); Respondent-7 *will get up there and get some businesses* (A/7/16).

Nascent firms needing technical assistance can benefit greatly from Centre connections as the *Jwain* recycling story illustrates (A/8/5). Companies graduating from the Centres, still trading, such as Respondent-9's, have a clear marketing strategy and evaluate market performance regularly (A/9/5); others such as Respondent-11 CEO of an animation and media advertising company use sophisticated marketing techniques, such as online video to explain the product.

In summary, Centres appear de-focused on marketing leaving some nascent firms without a clear marketing perspective.

Discipline

Business planning is now an essential aspect of startup. Many of the firms report benefitting from having to prepare a meaningful plan. For example, Respondent-7 is clear that he would have wasted precious startup capital had it not been for the financial discipline instilled by the incubation centre (A/7/14). However, the process would improve if the plans were assessed by external (potential) funders, rather than academics.

6.4.6 Risk capital

Reports by GEM (2012) and the WB (2013) highlight the shortage of VC in KSA as a retardant on entrepreneurship; this section assembles the evidence on the availability and nature of risk capital for Saudi firms seeking to commercialise university research and transferred technologies. It is important not to simply look for a western model of VC. Research on the MENA region by Sherbiny and Hatem (2015) reveals that many innovative

firms successful launch and internationalise using family-and-friends capital, which though it might act as a break on risk-taking in developed economies is less risk-averse in developing contexts. The section is structured around four sub-themes: Government funds; banks loans and facilities; private equity and international private equity. Section 2.9.1 above references difficulties around private equity sales and IPO, law and fiscal regulations.

6.4.6.1 Banks loans and facilities

KSA has transactional business banking only developing supportive relationships with bigger businesses: they lend against assets not future value. I found not one single example of a Saudi bank providing startup capital in the form of loan or overdraft facilities. This is a major institutional problem.

6.4.6.2 Government funds

Recognising the gap in startup finance, the KSA Government has established the Saudi Industrial Development Fund (SIDF) though mainly targeting large industrial projects; and the The Public Investment Fund targeting large-scale infrastructure projects. Most useful is the Finance Guarantee Programme (*Kafalah*), which offers banks guarantees on facilities up to US\$ 2-million; this is not contracting as part of the Government's austerity programme. Some Centres, such as KACST now have direct access to *Kafalah* and in exchange take an equity stake (A/1/7). Applications for public funding are time-consuming and cumbersome. Respondent-8 reported that after an application in 2012 he is still waiting (A/9/3 i.e. four years later) despite being supported by BADIR and Respondent-9 a series of bureaucratic wrangles, though with personal guarantees he did eventually get a US\$ 200,000 loan.

Respondent-8 amongst others bemoans the inaccessibility of bank and Government funds at startup stage (A/8/8) forcing entrepreneurs to rely on family and friends and/or building up (expensive) credit card debt.

6.4.6.3 Private equity

Respondent-15, who works closely with VC funds, suggests that, *In Saudi Arabia, there are many resources of getting early seed funding through government and private oil companies. There is also a consortium of Angel club where they pull resources together. It is a growing business in Saudi Arabia* (A/15/4). This is also the view expressed in *Vision 2030*.

Of the companies interviewed two reported having a VC investment: Respondent-3 CEO of an energy programming company (A/3/17) and Smartable (A/4/15) *We've had an investment of \$40,000 from a fund*. Others have products not capable of the growth VCs require or possibly access to alternative (and less expensive) source of capital. Another possibility is that like Dr Respondent-1, the entrepreneurs have no interest in a business model that involves exit by sale of private equity (A/1/16). Hussein Al Alattar was given a pre-seed funding grant (A/10/4) by his Accelerator

Respondent-18 a commercialisation policy expert in KSA reported that they had done a survey of VC availability and that,

... it was very clear that there is no cultural of venture capital risk taking particularly when it comes to technology in small companies. But there is a vibrant private equity market in Saudi Arabia. But when it comes to venture networking, venture capital, there is still in the very early stages. First of all there was no culture, the whole country has been technology consumers for the last 50-60 years and even this heavy dependence on the natural endowment, and they've never actually produced or manufactured anything to a substantial degree. So the whole concept of venture support or financial technology is not matured (A/18/7).

He went on to argue that in a rich country like KSA one would expect more VC to be available (A/18/9). Respondent-20 a senior commercialisation policy expert in KSA suggests that major changes in culture and law will be necessary before sufficient VC is available (A/20/16).

VCS everywhere bemoan the lack of good deals and entrepreneurs everywhere bemoan the absence of interested VCs, despite policy claims to the contrary (KACST 2014). Given the international reports and evidence from entrepreneurs and institutions it seems fair to conclude that there is a dearth of risk capital available in KSA.

6.4.6.4 International private equity

Many, particular US, Finnish, German and British VCs are active in international markets, sometimes resulting in complaints that public research is bought cheaply by foreign funds. Foreign VCs are not active in KSA (A/20/17) nor can they be expected to be so until the legal, fiscal and regulatory regimes alters. Meanwhile, entrepreneurs are using their own capital and that of friends and (A/7/5: A/11/15) or when they can, sales income (A/5/3; A/6/17).

6.4.7 Entrepreneurial risk and leadership

All of the entrepreneurs demonstrated the tenacity of moving from concept to product, despite set backs and difficulties. They entered the incubator as young entrepreneurs knowing how difficult the Saudi job market is using the Centre to reduce risk, develop skills and confidence and build a business network (A/3/12). Like many young entrepreneurs their stories of risk-taking and leadership development are matter-of-fact: it seems that they surprised themselves. For example, it was the failure to win the Jeddah business competition that inspired Respondent-5 to enter PLASTICSLABS and as he says, *Now here we are as a company with investors, board members and useful product, which is getting larger and better* (A/10/1). Respondent-5 CEO of a creative arts company too seems surprised at his own leadership ability at selecting co-founders (the key decision in any business) and then making pitches and presentations (A/5/1).

There are recognisable milestones along these entrepreneurial journeys. Respondent-6 and his partner took the risk of working for no salary (A/6/5). Respondent-3, reflecting the importance of recognition and awards, exudes pride in *I was the first from my university to be awarded the King Prize for forming my owing company* (A/3/4) and showing the leadership to adopt a combined free (to universities not using additional services) and subscription (to students) business model. Like entrepreneurs everywhere, Respondent-6 relied on his instinct, *I knew the market and people were looking for such services* (A/6/3): entrepreneurial leadership always has this emotional content. For Respondent-12, taking leadership decisions continues,

We want to take leadership in this sector within the sub-region. We have a bloc where we produce summaries of speeches. We started this as a team of students in the university here in Saudi. We have all graduated now and we are now working independently for the company. It took us one year (A/12/2).

Unlike most of the incubation entrepreneurs, Respondent-14 had previously been in business where he had developed entrepreneurial skills (A/14/10).

In summary, while there are contextually specific ways in which entrepreneurial leadership and risk-taking occur in KSA, there do not appear to be any culturally idiosyncrasies.

6.4.8 Knowledge flows and distribution

Having briefly referred to knowledge flows in section 2.4, this section explores knowledge flows, from the viewpoint of the entrepreneurs and firms in particular four emergent sub-themes: the extent to which new knowledge is endogenously generated or exogenously sources; secondly whether the nature of the knowledge is tacit or formally codified; third whether the new knowledge relates to business or to technical expertise and finally, the degree to which useful knowledge was international transferred.

6.4.8.1 Exogenous or endogenous knowledge

Most of the companies are engaged in R&D; some part of which may be importing knowledge generated outside, however, they actively research and develop ideas within the companies. As Respondent-4 says reflecting the experience of many of the student entrepreneurs, *R&D has been going on since we were in college and it's still going on. We do it on our own (A/4/16)*. A similar commitment to on-going internal R&D can be found at (A/3/18), (A/10/17), (A/11/16), (A/13/17) and (A/13/18). In summary, firm-funded internal R&D is an important part of the on-going development of these KSA companies.

6.4.8.2 Tacit or formal knowledge

Only one of the companies, Respondent-9's agri-food innovation company has done formal research with a university (KACST) and a company in Belarus on the use of ultrasonics. The other companies do not do R&D with universities.

6.4.8.3 Technical or business knowledge

For most of the companies R&D include technical product improvement, however, the majority of R&D is business related, exemplified by the network building by *Smartable* (A/4/12).

6.4.8.4 International technology transfer of knowledge

As section 3.4 indicated, several of the incubation companies brought business ideas back from study abroad. Whilst there is undoubtedly examples of TT-based formal knowledge exploitation in Saudi commercialisation (oil, healthcare, financial services) this formally transferred technology exploitation was not found amongst these incubating companies. *Smartable's* owner brought ideas from the US; Hrakt sources animation knowledge from India and Egypt (A/7/3); Respondent-8 CEO of a recycling company read about processes in Indonesia (A/8/1). In summary, there is exploitation of transferred technologies but these are transferred informally not via universities or formal Government TT programmes.

The TT from which incubating companies benefit is informal and tacit knowledge, often sourced by the entrepreneurs themselves, rather than from the TT in which the Saudi Government and universities invest.

6.5.1 Commercialisation outcomes

In this section I assemble evidence on the wider socio-economic outcomes of KSA's incubator programme, leaving specific (company-level) outputs to section 5.2. In particular I looked for evidence that the incubators are effecting the institutional arrangements discussed in section-1 and 2 above.

For Respondent-5, an incubation unit Manager, association with the incubation network gives important leverage in attracting foreign companies to perform R&D in KSA; he already has 14 MNEs committed to R&D in Tehran Valley including desalination, solar generation and down-stream oil products.

Interestingly when asked to nominate two successful incubated companies, Respondent-23 a national level commercialisation policy maker refers to pharmaceutical and ICT

companies. This perhaps illustrates that KACST's connection to national plan priorities is greater than the throughput of companies in the incubator network as judged by my sample. Respondent-5 also from KACST (A/23/4) suggests that vibrant areas of commercialisation include Petrochemical products and industry, Agricultural and food products and industry and Minerals and mineral products. The 9th National Plan seeks to replicate the innovation cluster in Silicon Valley in Dhahran Valley

One institutional result of the incubator programme is to introduce a third set of goals for universities (in addition to research and teaching), though as Respondent-20 admits the enthusiasm of the universities is variable, and non-existent for evaluation studies (A/20/4).

Section-1 discussed, change and innovation in KSA is not always transparent. The commitment to diversify as oil revenues decline is deep. It may be in future that wider institutional arrangements change to accommodate the needs of incubators and this may be the result of pressure from incubation networks. For the moment, this is not evidenced, though it is claimed in numerous policy documents such as KACST 2014)

6.5.2 Commercialisation outputs

KSA's incubation network is a major budget commitment and a strategic objective that is central to the 9th Five Year Plan. How is this initiative evaluated and is there a clear feedback loop generating continuous improvement? This section assembles evidence on inputs to commercialisation.

Respondent-20 a senior commercialisation policy expert in KSA says,

In terms of assessment, in KACST, yes we have done but in the other universities I don't remember that they have done any evaluation. Our evaluation was not really deep in terms of looking at details but it was an overall assessment of the incubation process and what needs to be done (A/20/3).

When asked if the Government had evaluated the incubation programme he said,

None has been done. Only KACST has done some studies and incubation as a programme is fairly recent. We can say barely 5 years old and you know the first years are more of establishing and testing. Based on that most of the incubators are now stable and so at this time I think it's useful to do a study and an evaluation of the process (A/20/5).

There are changes; for example, Respondent-18 says over time entry criteria have relaxed and extended incubation (over three years) is now frowned upon (A/18/3). He says that profitability of the incubators themselves was never an output; rather Centres were to be judged on the number of events held and entrant numbers (A/18/1) – criteria closer to inputs than outputs.

Respondent-17, Manager of an incubation network

The KPIs for the whole programme basically include: clients outcomes such as the overall number of clients, the number of applications and the ratio of applications that become clients, the revenue of clients and the employment of clients. So there is a whole range of KPIs. So our CSFs include the achievement of these KPIs. Specifically they include: having entrepreneurial management and staff in the programme (i.e. having highly skilled entrepreneurs managing the incubators); having an independent governance system; and having a business module that works for the environment we're operating in (A/17/4).

However, no figures are publicly available measuring these KPIs.

Respondent-5 notes that the university (reluctantly and only as a result of a decree from the Council of Ministers) gave the Valley a land and financial grant (US\$ 20-million) and charged them to *establish a science pack, that you will incubate students, you will commercialise technology* (A/15/3). The Chairman of the Board is the President of the university. As CEO, Respondent-15 is accountable to the Board. Using the grant and income from property, they employ 15 to 20 staff and have made investments, for example US\$ 6-million in electrical technology units. At KFP, of 10 applications for incubation, seven have been successful (A/13/11); like all incubators its services are freely available to students, who may also state receive welfare benefits.

In summary, there is no systematic monitoring and evaluation of KSA's incubation network outputs such as costs per project, time spent incubating, companies launch, products created, jobs supported.

CHAPTER-7 DATA FROM UNITED KINGDOM

As Lewis (2011) points out, it is often the invisible (cultural predispositions) differences that explain actions, emotions, framing and conceptualisations creating distinct habituses (Bourdieu 1990). This is neither a study of cultural differences, nor of national systems of innovation. Rather, my study seeks to explore dissimilarities in commercialisation process and to identify how Saudi processes might improve, by analysing them through the prism of commercialisation research and UK experience.

There are parallels between the UK and KSA: both are countries used to high oil revenues that are predicted to diminish (from 2015 for the UK); each faces exogenous shocks and uncertainties (for the UK, wars, potential EU exit). This comparison is mainly between Scotland as a part of the UK and KSA. Both countries rely on foreign labour, though as an ex-colonial power this is inward migration in the case of the UK, whilst KSA has 3-million temporary workers, reflected in a dominant mono-culture and the sensitivity to identify found in all post-colonial cultures.

This section follows the same structure as the previous chapter (figure 6.1) based on the framework (figure 4.1). I reference material from twelve original interviews and materials from published sources, including government reports such as Edinburgh Research and Innovation (ERI); the UK Office for National Statistics (ONS); International Monetary Fund (IMF); Organisation for Economic Cooperation and Development (OECD); World Bank (WB); Global Enterprise Monitor (GEM); European Union (EU) and the Scottish Government.

Britain has a history since the 1780s of industrialisation and innovation. Whilst in 1948 manufacturing (including oil and gas) was 41% of GDP it is now 10% (ONS 2014). Services constitute 51% of GDP, providing 78% of all employment. Of this 10% of GDP and 13% of exports come from financial services, which since the UK is a small open economy with its own currency leads to high exposure to contagion. Financial services are concentrated in London and Edinburgh.

The UK's investment rate at 15% of GDP is similar to Germany but below international competitors. UK gross value added (GVA) being the GDP less the cost of inputs, is 65% compared to KSA's 57% (WB 2014) and in the UK is rising strongly in non-financial services (at 9.6% per annum) with manufacturing rising at only 2%. Spending on R&D in the UK rises at around 6% pa, being £18.4 billion in 2013 (ONS 2014) with another £1.8 billion in defence-related sectors. Inward foreign direct investors expend some 50% of UK R&D. Overall, businesses in the UK spend 1.9% of turnover on R&D employing directly some 200,000 staff, out of a 30.1 million workforce. In 2014, total business employment in R&D in the UK increased by 7% to 192,000 Full Time Equivalents (FTE).

Innovative sectors in Britain include domestic appliances (for example, Dyson); creative industries (BBC, Spotify, Mind Candy); high-value microprocessors (ARM); design/architecture/consultancy (Arup, Burberry); retail (M&S); UK-based pharmaceutical companies (3M, GlaxoSmithKline, AstraZeneca, Ineos) and financial services (HSBC, Royal Bank, Standard Life).

At 83% the (16 to 64 years) workforce participation rate is high by international standards, with 75% of women working (90% of women graduates) and half of those over state pension age.

7.2 Drivers, enablers/barriers to commercialisation

This section summarises interview and public report evidence on the 'big' institutional arrangements governing commercialisation in the UK, including the national and sectoral systems of innovation, how the state seeks to support entrepreneurship and the barriers and incentives to entrepreneurship and innovation.

7.2.1 SSIs and NSI alignment and active leadership

Here I present evidence on the UK national and sectoral systems of innovation, the state as a value creating or distributive agency, national vision, innovation incentives and economic stability. Although from a Saudi perspective, UK drivers and barriers to successful

commercialisation at first sight look paradigmally different, on closer inspection similar themes emerge including access to startup capital.

7.2.1.1 The UK national system of innovation

Many of the (now) classic NSI studies feature case studies of the UK (Lundvall (1992); Nelson (1993); Nelson (1993); Nelson and Rosenberg (1993). Porter's (1990) study, for example, notes that UK R&D was overly focused on defence and too much public sector. He went on to regret the absence of discerning customers (demanding high quality, innovative products) outside of the southeast area. It is interesting that although the classic push-pull debate on technology innovation concludes that both are necessary for innovation (Mowery and Rosenberg 1979) the nature of this coupling alters as technologies change.

GEM (2014) records a disappointingly total early-stage entrepreneurial activity (TEA) rate for the UK of 8.6% (almost half this figure amongst women and in Scotland) with 3.8% of working-age people owner-managers; interestingly noting a rising rate (6.3%) amongst people over 50. Some researchers less sanguinely suggest that overall formal education contributes little to UK economic growth (Wolf 2002), benefits little from spillovers from inward R&D investors (Audretsch and Stephan 1999) and overall does not do well at commercialisation (Miner, Dale, Eesley MD and Rura-Polley 2001). More recent research by PraxisUnico Spin-outs UK Survey (2012) reviews the performance of a variety of UK regions in terms of spinouts, breaking these down by type (e.g. life sciences, physical sciences, informatics, etc), size and level of investment. The survey reveals, perhaps unsurprisingly, that all investments greater than £5m in new spinouts were made in London and the South-East England; and that, of those securing between £1m to £5m in investment; only 15% of these firms were based in Scotland. Despite Edinburgh's success in creating new firms during the period, the PraxisUnico report claims that no University of Edinburgh company had achieved a successful exit or trade sale in the period 2006-2011.

Respondent-33 Commercialisation Director at a UK university BioQuarter (A/33/4) explaining that the incubation centre aims to create profit emphasises the role of universities in the UK NSI, says:

...you have to understand that universities are not just motivated by profits. They are motivated by high level things. There are lots and lots of public money that goes into universities and so they need to give back to society. That could be given it back in forms of economic gain or educating the population. So universities do these things for a number of reasons not just for profit. But by and large, yes, we're trying to maximise the returns to the university to develop IP.

In summary, the UK NSI is well established, perhaps too well established to respond rapidly to changing technologies and markets: there is a cultural chasm between universities and industry: a view all four UK policy experts agreed with.

7.2.1.2 Sectoral systems of innovation and clustering

Some incubators in the UK see their sectoral focus as on high growth companies, rather than particular technologies, for example, Abdul at FreeSpace says,

We don't have a sectoral focus. However, we do have a focus on companies for example those looking at high impact companies by which we mean that those ones they find a reputable business module will positively impact on millions of people in 2-3 years (A/34/9).

Other incubators, such as ERI who focus (because of the university research output) on biomedical, software, green technology and biotechnology, see resource constraints as limiting SSI-building. Respondent-35 Policy expert and UK incubation manager comments,

I suspect strategically the exploitation of the university sector and knowledge based isn't actually seen as that important or as important as it should be by the Scottish government. There is a desire I think to commercialise at the knowledge base level but there are others that add to the Scottish economy that are seen as more important just now. For instance, resolving the issues on the oil and gas sector but also tourism and relatively large-scale industry and renewable energy – that sort of thing. So with the current Scottish government I think there's been some reduction in the priority given to the commercialisation of university knowledge and I think that came at the same time with the austerity within the UK and also there is less money coming into the universities to support commercialisation. So, I can't say that I feel that the Scottish government has any particular focus on university technology transfer and knowledge transfer (A/35/2).

In summary, UK SSIs in emerging technologies are themselves still emerging. The time gap between science and technology remains a concern.

7.2.1.3 The Government, university and industry triple helix

Etzkowitz and Leydesdorff's (2000) definition of the TH *an innovative environment consisting of university spin-off firms, tri-lateral initiatives for knowledge-based economic development and strategic alliances between firms...government laboratories and academic research groups* shows that its effectiveness is not the existence of three agencies, rather it is the interaction between them. Simply have a high quality education systems, as Wolf (2002) demonstrates do not impact on GDP growth. Audretsch and Stephan (1999) and Pavitt (1991) show that without spillover between basic research and its exploitation by entrepreneurs, the gap between science and technology (Pisano 2006) will not shorten: in Miner et al 's (2001) terms, the beanstalk becomes higher and the exploiters never reach the top.

Respondent-32 manager of a UK university's student spinout service paints a promising picture.

In Scotland we're very well served actually. We've got Business Gateway and Scottish Enterprise for compared to England provides very strong business support. For example they help small businesses all the way up through. So the government is quiet strong in terms of business support in general not just incubation. The private sector and academia offer something different. So I don't know who the weakest link is. They all work together quiet well (A/32/21).

One issue arises from the autonomy of universities to choose which research to conduct, at time regardless of challenges facing technologists and businesses. In Japan, as Hayashi (2003) a more corporatist state 'guides' university research towards the needs of business away from basic research and towards joint projects with industry. Respondent-33 UK Bioquarter Director views the TH as subject to political pressures.

I think it's very political and a tough call. Academics have to be allowed to get on with their work. If you try and prescribe too much you will going to stifle any innovation. So I think it's important they have certain amount of independence. You've then got industry, which is much more applied. What industry has learnt over the past years is that it's not very innovative but very good at marketing. So they've learnt to work together – academics do all the innovation and industry does the marketing. Then government comes along and try to force academics to become more applied in the research that they are doing. So it's getting tricky because academics are seen by industry to be doing their work more and more now. So triple helix can sometimes be an unhealthy relationship because I'm not sure if the three parties actually understand what each of them bring to the market or the equation. And government always take a short-term view. They've always got one eye on the next election and that means they make short-term decisions, which are not always in the best interest of either of industry or of the university. That is an added complication for the triple helix relationship. But I guess the strength is that if you've got the support of the government that helps at least provide the money for academics to be more innovative which then helps to feed into industry and then strengthens the economy. This works better in certain places than others – the US for example. But just having money and throwing money at it doesn't always help. A

classical example is in Singapore where they threw millions into a project they called the A STAR INSTITUTE. They tried to attract industry and the top academics in but it didn't work for them after 3-4 years. You need to build the whole ecosystem – money, academia, VC and industry (A/33/13).

Another challenge facing the UK is the concentrations of R&D spend in the southeast of England i.e. differential regional systems of innovation. For example the PraxisUnico Spin-outs UK Survey, which breaks down spinouts by sector and region, finds that all startup investments spinning out of UK university valued at above £5 million were concentrated in the south-east of England (PraxisUnico/Young Company Finance 2012) of those valued above £1 million, only 15% were located in Scotland; and despite the University of Edinburgh's record of spinning out some twenty-three companies per year, PraxisUnico reveal that between 2006 and 2011 not one of the spun-out companies had exited via a trade sale or IPO.

Discussion in section 2.11 suggests the limited applicability in developing societies with 'thin' institutions. Respondent-35, Policy expert and UK incubation manager, suggests a limitation in the case of Scotland (A/35/6)

... one of the problems here in Scotland is that we don't have companies of scale. We have very few banks in Edinburgh and some few oil companies based in Aberdeen. But actually there is a significant amount of branch office economic activity. But branch offices aren't the sort of business centres that engage with universities except for looking for graduate employee. So we don't have a good local source of companies to engage in a triple helix activity. We also of course just now don't have whole lot of state sponsorship for this activity because of austerity. Also I think it is fair to say that there isn't a consistent policy among Scottish universities. So looking at the sector as a whole its definitely dysfunctional as far as the triple helix is concern. I think it works in Edinburgh more than anywhere else but Aberdeen, Dundee and others had very good of it as well. But I stress again the sector as a whole is dysfunction as far as triple helix is concern and the fundamental problem for me is that we don't have a good enough population or a big enough population of large companies in Scotland.

Respondent-26, an Egyptian entrepreneur, now building a new business in Scotland, comments,

I think in the UK the government supports entrepreneurship very strongly with the help of academia. Back home I would say that it is mostly NGOs that support entrepreneurial activities. So it these NGOs that try to create a more efficient and more productive entrepreneurial eco-system (A/26/14).

In summary, whilst a discernable TH can be seen in the UK, it is not as 'thick' and effective as might be the case.

7.2.2 The UK state and entrepreneurship

7.2.2.1 Redistributive or value-creating state

The British state has a history of interventionism at home and abroad: witnessed by investment in a navy, infrastructure and education (Harris 2004) and post-1945 the welfare state. Internationally, the British state built an empire of colonies, not least of which was the arms-length intervention in the affairs of KSA (Frankopan 2015) and the wider Arab world to secure oil supply and strategic advantage. As Pempel (1999) notes the British state has historically been a development regime, which as Tsebelis (1990) argues ‘nested’ development with domestic and international feeding the other.

Jessop (1994) argues that the strong British state since 1945 has been a *semi-permanent socioeconomic coalition*, overcoming limited natural resources and fragmented land ownership by using *hegemonic projects* or shared goals including international competitiveness and free flow of inward and outward capital. Since the end of a post-war boom (around 1965) Jessop (1991) argues that Britain has migrated towards a *hollowed-out state* sacrificing social welfare goals to those of economic growth, now evidenced in a Government seeking to reduce public expenditure to 35% of GDP. One aspect of this, important to innovation is a rising unequal distribution of wealth and dependence of export-led growth rather than domestic consumption (unless fuelled by personal debt).

The UK is moving away from a distributive state model towards a neo-liberal model the value-addedness of which remains to be seen.

7.2.2.2 Expert bureaucracy

From the viewpoint of commercialisation changing governances from direct state provision to the agency-state are important. For example, as Lythe and Butt (1975) and Lenman (1977) show, Scotland re-structured its economy away from traditional heavy industries at a slower rate than the most successful parts of the UK: its population and living standards went into decline. In 1991 economic development powers and budgets were delegated from the Scottish Executive to Scottish Enterprise and a network of local enterprise companies

(LECs). One of their most successful strategies as Kinder and Molina (1999) show, headed by Locate in Scotland, was (using EU-funding) to attract FDI microelectronic firms, creating £2 billion exports and 85,000 jobs in Silicon Glen (centred on Livingston). These firms were mainly US and Japanese including Motorola, NEC, Mitsubishi and suppliers such as Shin et su. As MacLeod and Jones (1999) argue as China and Vietnam came on stream, attracting I/FDI became more difficult and the challenge became much more how to exploit indigenous R&D: a more challenging strategic objective and closer to the situation now facing KSA.

Scotland then, and other parts of the UK have ‘expert’ bureaucracies supporting economic growth. The advantage of such governances is that people with business expertise and experience are brought into decision-taking, the great disadvantage is that in picking winners, disruptive technologies can be side-lined, which was the case in Scotland for games software and until recently mobile app development. Amongst these experts, as Respondent-35 Policy expert and UK incubation manager makes clear, some of the experts are in university-based incubation centres.

... my role is to oversee all company information activity at the university with a team of advisers who are working with entrepreneurs from the staff base to the student base. I also have somebody who is running to incubation centres and various other proper interests including a science park. We have a small growing investment function with just about 5million investment and an intention to secure another 6million investment for the university's portfolio investment companies (A/35/1).

In summary, UK development agencies populated by an expert bureaucracy have been successful in attracting IFDI manufacturers. Incubating more knowledge-based businesses is more challenging: the evidence suggests that the wrong experts lead some incubation centres.

7.2.2.3 National vision and culture of entrepreneurship

The latest annual UK Innovation Report (DBIS 2014) emphasises the UK’s reliance on knowledge-based economic activity based, having 4% of world researchers, the 7th largest global R&D spend and four out of ten of the world top universities. DBIS however, highlights a continued gap between scientific achievement and product commercialisation, relative in particular to the US.

Although the UK has a modern physical and ICT infrastructure, research confirms the DBIS view that high levels of R&D *inputs* are not matched by levels of *output*, especially in emerging sectors (Cefis and Orsenigo 2001; Cefis and Ciccarelli 2005; Riley and Robinson 2011; Lööf et al 2012). These researchers draw attention to the science-technology gap and the need to compare rates of output rather than input. For example, OECD (2013) Innovation Scoreboard calculates that 27% of the UK workforce is involved in knowledge-based activities, accounting for 70% of UK total factor economic growth between 1960 and 2000 (Aghion and Howitt 2007). This results in the UK ranking third on the Cornell University, INSEAD and the World Intellectual Property Organization, Global Innovation Index for publications. However 60% of UK researchers are located in universities. Respondent-35, Policy expert and UK incubation manager, stresses the importance of problem-centred knowledge commercialisation:

Fundamentally, especially for more matured economies with relatively high cost bases, those economies need to look to exploit whatever advantages that they have especially over emerging economies – for instance India and China. So, I think increasingly it is important for UK, European and the US economies to retain propriety knowledge and exploit that propriety knowledge and essentially sustain their position within the world's economy. So the UK has a strong research base. Edinburgh by some measures is within the top 20 universities within the world. It has fabulous research in a number of areas, the biggest computer science school in the world, one of the best medical schools in the world we generate a huge amount of proprietary research output which can be commercialised and certainly we would be at the forefront of the UK's effort to become a truly knowledge based economy (A/35/1).

Andersen et al (2011), perhaps optimistically, suggests that the UK will ride a new wave of innovation in digital products, low-carbon products and health-related products (pharmaceuticals and medical devices) – a new innovation ecosystem. I note how close these objectives (and sectors) are to those of the KSA and in both cases the urgency imposed by the ending of oil revenues (2025 in the UK and 2035 in KSA). The UK Technology Strategy Board (now Innovate UK, speaks of high-impact SMEs and strengthening UILs. My point is that in terms of strategic vision, the UK is not dissimilar from KSA and many other countries targeting the beneficial results of commercialising university research: the challenge is to successfully implement the strategy.

The UK is strong on basic and applied research; however, as later section will illustrate migrating science into products requires a stronger entrepreneurial culture.

7.2.2.4 Innovation incentives

Located within EU tariff barriers, with tax offsets, clear IP laws and access to research universities and their graduates, in 2011, the UK attracted almost \$7 billion of overseas-financed R&D (equivalent to the combined inbound R&D of Canada, Finland, Japan, China, and Russia) and just below half that of the US; in the UK's case foreign inbound R&D amounts to 25% of R&D spend. In 2012 alone, this brought 300 new R&D projects into the UK (OECD 2013; ONS 2013). Foreign funding of UK R&D is higher when ownership is referenced: half of all UK corporate R&D is done by UK subsidiaries of foreign-owned firms: 22% (US), 17% (EU) and an increasing amount from BRIC countries (especially China and India). Of course, three is outwards (from the UK), with GSK particularly active in Israel. UK firms and universities seem particularly good at accessing EU research funds such as the European Research Council, Horizon 2020 (basic research), and (£6 billion) 7th Framework Programme (applied research).

UK university partners are attractive to foreign corporates as partners, 42 of the top 100 world research universities are located in the UK, according to Times Higher Education (2014), World University Rankings 2013-14, which attract a high proportion of foreign researchers.

Two-thirds of UK R&D is financed by the private sector; this is concentrated in emerging sectors: pharmaceuticals (25%); computer programming and information service activities (11%); motor vehicles and parts (10%); aerospace (9%); telecommunications (5%); and machinery and equipment (6%).

The UK's eight Research Councils are also a source of research funding (£3 billion in 2014) and almost all universities (93%) have an access point for Knowledge Transfer Partnerships (KTPs) with SMEs. These interactions are rising at 11% per year and are included in the £335 million consultancy fees UK universities attract from business.

7.2.2.5 Macroeconomic stability

Macroeconomic stability (inflation, growth, monetary and fiscal policy sustainability and rising living standards) is an essential pillar for corporate investment (Turtelboom 1991); to achieve which the independent Bank of England is empowered to achieve. As Krugman (2013) and others note, targeting around 2% inflation stimulates growth and stability. Between 1956 and 2014 GDP annual growth in the UK has averaged 2.48% (currently 2.1%). As a small, open economy with its own currency, the UK is particularly exposed to external shocks and contagion (Oshikoya 1994) one result of which, as Hausman and Gavin (1996) predict are raising inequalities and associated problems for demand-led domestic growth. Until recently, deep-rooted democratic institutional stability has favoured international investment into the UK, as North (1998) suggests, however currently the UK's institutional stability is questioned by support for Scottish independence and the impending referendum on EU membership.

In 2007, rising oil prices and unemployment in the US resulting in financial crisis as property-based financial instruments lost value, catalysed a similar crisis in the UK resulting in loss of liquidity: banks ceased lending and SMEs lost credit. All crises pose long-term issues (competitiveness, education, structural adjustment, institutions) and short-term problems (unemployment, inadequate demand, poverty). The UK Government has chosen to focus on monetary policy (rather than industrial policy), adopting the neoliberal strategy of reducing state expenditure and providing fiscal incentives to companies and individuals to invest. One result of this is to exacerbate the redistribution of wealth from poor to richest 1%. Brexit is now a major source of uncertainty.

7.2.3 Entrepreneurship: barriers, disincentives and enablers

Entrepreneurship barriers

Why should the State be better at picking winning commercial technologies than the private sector? Henderson's (2002) study of microelectronics in Scotland argues that in targeting sectors using commodity chips (mobile telephones, PC manufacturing) the UK state missed opportunities (such as ARM's system-on-a-chip technology) that became globally competitive. A similar story might be told about biotechnology in Scotland, where in 1996 the therapeutic cloning at the Roslin Institute (part of the University of Edinburgh) was

world-bating technology, commercialised as PPL Therapeutics. Sadly, attempting a licensing model for (what proved to be) a non-proprietary technology meant that currently, of the 84 biotechnology companies in Scotland, most are commodity producers. The UK has two main barriers to commercialising university research: a clash of governances and access to resource assembly.

At one level the clash of governances between academic researchers and business entrepreneurs relates to goals: research publication, organisational prestige and intellectual problem-solving as opposed to profit from sales, knowledge-exploiting with new solutions to consumer-problems (Henderson 2002). As evidence below illustrate, the view of Scottish incubation managers is that skill shortages and difficulties obtaining banking facilities are major barriers to innovation.

Entrepreneurship disincentives

In 1924 the Macmillan report identified lack of smaller amounts of startup capital (today under £1 million) as a major disincentive for entrepreneurs. Literature often focuses on the size of investment forming the *Macmillan-gap* examples being Targeting Innovation (2009) and BIS (2014). However, as Lee et al (2011 and 2013) point out, especially for busy academics focused on important research, the time and detail involved in applying for grants and/or bank facilities is cumbersome – a disincentive incubation centres attempt to ease.

For many academics, entrepreneurship or solving industries problems is outside of their culture, as HEFCE (2009) 35% of academics believe that universities are already too focused on meeting the needs of industry rather than independently pursuing research.

Entrepreneurship enablers

Which forms can commercialisation and knowledge transfer take? Knowledge transfer refers to a transfer of ideas and knowledge from within universities to other users. Frequently, the knowledge created within universities will have a commercial application and a commercial value, which can be exploited through commercialisation activities.

Central to the concepts of commercialisation and knowledge transfer is the notion of IP, which can generate licensing revenue or income from spinout companies. Universities can also engage in contract or collaborative research activities on behalf of and/ or in collaboration with companies and private sector organisations. They can also help businesses and generate income through offering consulting and advisory services.

For the Scottish Government (2004) high quality teaching and research *and* effective commercialisation are goals that make Scottish higher education internationally competitive a fact justifying expenditure on Smart Awards, Co-investment Fund, Catapult Centres and Knowledge Transfer Partnerships (KTPs) all of which are intended to enable entrepreneurship.

7.2.3.1 Commercialisation and entrepreneurship in Scotland – success stories

Taking Scotland, as part of the UK as an example; Scotland is a small open economy: with 70% of economic activity owned outside the region as outside-ownership figures show (oil (96%), financial services (71%), whisky (80%), salmon (83%); only one-third of the £103 billion corporate assets located in Scotland are owned in Scotland. An internationalised economy is not necessarily a problem, especially if there is a pipeline of innovative indigenous companies.

Scottish university spinouts number about twenty-five per year (200 since 1967) according to Targeting Innovation Ltd (TIL 2006) with seventeen employing more than 50 people. Figure 7.1 indicates some successful Scottish university spinouts.

These are other spinout companies are important, especially so since 30% of all commercialisations attract external investment and each of the firms in figure 7.1 have (or could) successfully IPO. Axis Shield and Respondent-28 are already hubs for international R&D.

Startup date	Company	Products	University connection	Employees
1982	Axis Shield	Medical devices and tests	Dundee and Ninewells hospital	400
1984	Wolfson	Fab-less semiconductor	University of Edinburgh	400

		production		
1989	VSLI Vision	Imaging technologies	University of Edinburgh	360
1996	Cyclacel	Oral therapy biopharma	Dundee and Ninewells hospital	75
1998	Kymata	Opto-electronicis	Glasgow	200
2004	RESPONDENT-28	Oil and gas exploration	University of Edinburgh	75

Figure 7.1: successful Scottish university commercialisations (Source: TIL 2008)

- Axis Shield, which now has a turnover of £200 million and R&D sites in Norway and Germany, began life as a conversation around a kitchen table between two doctors and a management consultant (Gordon McAndrew) about commercialising a blood test developed in a local university hospital in Dundee.
- Respondent's-28's story appears below in sections 7.3.3, 7.3.4 and 7.4.6. Having developed geo-imaging technology capable of identifying carbon reserves without test drilling, the company was born global; rising first VC and then via a trade sale sold for US\$ 234 million. It was the second largest spinout by a UK university.

NESTA (2007) argues that in universities can provide regional leadership in restructuring economies and Roper (2006) that these activities are illustrative of the future. There are three problems with these perspectives; firstly, Scotland employs 2,594,000 people: it is unlikely that spinouts in the immediate future will substantially contribute to overall employment or mitigate the impact of process innovations in important sectors such as financial services. Secondly, referring to points made by Rodik (2011) and others, lost jobs (in microelectronics a mechatronics technician workforce) are neither being replaced by the skills available nor the level of skills and knowledge available.

Success stories should not be interpreted as an absence of failures or problems such as governance and culture clashes between academia and business; rather they are illustrative of how effective research, targeting problems consumers will pay to be solved can produce sustainable innovations.

7.2.3.2 Institutional barriers to entrepreneurship

Having presented a KSA SWOT (figure 6.2), the UK SWOT for commercialisation looks as follows (7.2). SWOT shows the UK strong on research, education, IP and fiscal policy. IP is most relevant to large or high-growth companies, since registration may take three-years and is likely to cost c£500,000: as the Berr (2007) argues, if the UK is to have an

illustrious business future, then knowledge is at the heart of it. UK weaknesses, are likely to be found in other advanced economies and relate to startup funding gaps, a low skills equilibrium in sections of what is an ageing population and a cultural gulf between academic research and business exploitation of knowledge. Bodies such as the London Stock Exchange (2015) and the House of Commons report on business funding (HoC 2013) acknowledge problems with risk capital availability to startup and rapidly developing companies bridging what they term the *valley of death*.

STRENGTHS		WEAKNESSES	
• Availability of capital and FDI		• Lowering levels of public spending and innovation support	
• Strong VC and Angel networks		• Funding gap facing startups and SMEs	
• High quality university education		• Low skills in bottom quartile	
• High quality university research		• International below average STEM skills	
• Hi-tech clusters around universities		• Poor record of bank lending to startups	
• Clear IP law and stock of knowledge		• Governance clashes between academia and business	
• Low corporate tax rate		• High youth unemployment rate and poverty	
• Light touch regulations		• Ageing population	
• In some sectors, effective knowledge networks international and across governances		• Academic (business) entrepreneurship disincentivised	
• Fiscal		• Diminishing oil revenues within 10-years:	
•		• R&D confined to narrow sectors	
OPPORTUNITIES		THREATS	
• Strong education opportunities		• Open to exogenous shocks (wars; oil price, currency)	
• Attractive to international knowledge labour		• Internationally low labour productivity	
• WTO, EU member		• Uncertainty over relationship with EU	
• High rates of international technology transfer		• Weak trading links with China	
• Major policy initiatives on entrepreneurship		•	
• English language		•	

Figure 7.2: UK SWOT for commercialisation

The UK is a beneficiary of inward TT (students, researchers, companies) and outward knowledge partnerships, though its weak trading position with China may be a concern (7.0% of UK imports in 2014 and 3.5% exports, with some notable but few knowledge exchange links). The international use of English language gives the UK opportunities that

help cross-cultural divides, though the country's colonial history can be a source of resentment.

Whilst many commercialisations simply recombine existing knowledge in the form of new solutions to consumer problems, the lure of basic research (such as cloning) is to create a paradigmally new way of doing things (Llewellyn Smith 2006), this as Respondent-35, Policy expert and UK incubation manager points out is the most fundamental challenge of commercialisation, a view endorsed by all incubation unit Managers.

I think the biggest problem is where basic research ends and where marketable products begin. So, an entrepreneur or the university will have to take the basic research and rework it into a shape where it can be a marketable product. They may be sufficient to underpin a research paper but before they can work in the commercial world they need to be stress tested, they need to be engineered into an agreeable form and that's before you start to consider things like IP. Basic research is a kind of egalitarian activity and by that I mean researcher will work together with both researchers within an institution and researchers around the world. So when you have a particular outcome from a piece of basic research it is not enough just to presume that it belongs to the university of Edinburgh for instance. One has to look back and see how that research outcome actually emerged and work with other universities potentially to agree on owner of technology, to agree income sharing arrangement, to agree how cost will be shared etc. so the whole thing is quite challenging right from the identification of the technology, who owns it etc all the way through to the fact that products do not come out of vacuum research activity. Products have to be developed and need substantial amount of money. A classic example is drug development. A drug target might come from a research study but it needs to be taken through patient trial etc and that could cost hundreds of thousands of pounds if not millions before that piece of basic research can be commercialised (A/35/9).

In summary, the UK SWOT for commercialisation shows institutional maturity: the challenges are in the 'softer' areas of culture.

7.2.3.3 Incentives to entrepreneurship

Startup capital in the UK comes from family and friends (11.6%), individuals (6%), bank loan (4%), bank overdraft (9.4%), VCs (1.3%), government grant (4.8%) and credit card (5.5%). Various early-stage grant opportunities (Proof of concept and Smart Awards) act as incentives to some innovative startups (SE 2012). Most universities (93%) have some form of technology transfer office arranging KTPs, consultancies and supporting startups. However, as Professor Sir Tim Wilson, states in "A Review of Business–University Collaboration, presented to the House of Commons (2012), *The main challenge for the UK is not about how to increase the supply of commercial ideas from the universities into business. Instead, the question is about how to raise the overall level of demand by business*

for research from all sources. The NHS, or rather its databanks can be a major entrepreneurship incentive (NHS 2014) allowing big data analysis techniques to profile correlations between disease and (ill)-health.

7.2.3.4 Institutional enablers

Respondent-35 (A/35/10) lists what he believes are the institutional enablers of commercialisation in Scotland pointing out the VCs often avoid startups in which Angel networks are more interested.

Here I note five important institutions enabling commercialisation in the UK: design capability, IP, clustering and local state support.

The UK Design Council (2015) echoes Walsh *et al's* (1992) conclusion that design-capability is a major competitive advantage. Major companies, such as Dyson a producer of household equipment, thrive on design. In Edinburgh alone a brief web search identifies over 50 design companies. Recent research on the redesign of public services to take account of research (Radnor *et al* 2013), argues that (Kinder *et al* 2014) service redesign in the UK is less effective given a weaker democratic footprint that in Finland.

Clear IP law and redress in the judicial system is a major attraction for inward R&D investments into the UK. These same advantages SMEs BUT cost/time. Increasingly time-to-market or non-patent

Whilst early work on university science parks, showed that, as property businesses most are not successful, it is now understood that this is a narrow criterion for success and that knowledge spillovers and proximity to universities can act as an incentive to innovators (Varga and Acs (2000). As far back as Porter (1990), the UK's ability to cluster sectorally associated businesses was lauded.

Competition between cities and regions for business development is a competition for taxes and the social benefits of employment. In the UK, the local state undertakes a range of incentivising activities as OECD (2013) notes.

At 6.8% Scotland's total early-stage entrepreneurial activity rate (GEM 2014) is similar to England, though the startup rate in Scotland (16:1000) is half that of England, where more businesses fail. Although starting more lifestyle, less export i.e. service-based businesses, women's TEA rate in Scotland is now 5.2% and rising. Amongst the Scottish entrepreneurial initiatives are the EDGE Fund (Encouraging Dynamic Growth Entrepreneurs), awarding £520,000 to 16 businesses each year and the Prince's Initiative for Mature Enterprise (PRIME) supporting startups by the over-50s. The Scottish Investment Bank's total investment, including deals done through the Scottish Loan Fund, reached £32.4 million, leveraging a further £60.4 million in private sector investment into over 106 companies. Roper and Love (2006) argue that this constitutes a differentiated (from England) NSI an argument it is difficult to accept given the porous boundaries between the two and inter-related actors and causal relationships, indeed Scotland differentiates in two major parameters: lower R&D spend and a higher proportion of US-owned companies. This is not to argue that aspects of Scotland's support for entrepreneurship are not good: for example the University of Edinburgh achieves 40% of all Scottish university research grants and has successfully created biomedical, biotechnology and artificial intelligence enterprise parks.

7.2.3.4 Disincentives to entrepreneurship

For many service companies and companies able to quickly obtain first-mover advantage patenting is increasingly irrelevant (though some copyright protection may be of benefit. The high cost and slowness (often 3-years) of the UK patenting system is such an important disadvantage for some companies that they prefer (Respondent-28 is an example) to register their headquarters in the US.

7.3 Commercialisation inputs

This section presents evidence on inputs to commercialisation, with section 7.4 investigating processes and 7.5 below exploring outcomes and outputs. One point is paramount: the emotional attachment of the entrepreneur to the project and as Respondent-30 food company CEO replies, when asked about her most difficult challenge - *It's just the*

hard work, (A/30/19). Not all of the entrepreneurs cited are university researchers, as Abdul the Director of FreeSpace in Cambridge points out,

I would probably say that's in the minority. The last time we updated our records about 6months ago, about 15% of our community had come directly from the university, about 60% of our community was working with the university but weren't the researchers themselves. And the remaining 25% had no relationship with the university whatsoever. (A/34/10)

7.3.1 Incubation and start-up services

Noting the success in Africa of mobile telephony for e-commerce, undergraduate students at the University of Edinburgh had the idea of using the same network to link tourism opportunities with isolated villages and disseminating health education. None of the students had any business background, as Respondent-24 CEO of a UK university high-tech spinout says when asked to illustrate the importance of incubation for the story of her startup, without incubation *I don't there would even been a story* (A/24/13).

7.3.1.1 Success criteria

Like many early-stage startups, Respondent-30 a food company CEO renegotiated her success criteria as ideas crystallised, saying I would say it has been very fluid so far (A/30/2). Only when she met other young entrepreneurs did she start to believe that she could create a trading company (A/30/3). At Polorum the CEO of a UK university high-tech spinout sets *self-sustaining company* as the success criteria (A/24/14).

7.3.1.2 Problems in service range and quality

Here I present evidence of the range, quality, cost and usefulness of incubation services to entrepreneurs.

7.3.1.3 Cost and value-for-money of incubators from firm perspective

Respondent-30 joined the incubator to share ideas, meet other entrepreneurs and for the (free) support offered (A/30/6) using all of the services available (A/30/7), which she found useful and value-for-money (A/30/9) in particular making business connections and building her own business network (A/30/12). This is typical of the student entrepreneurs. Respondent-24 CEO of a UK university high-tech spinout also a student found the network

connectivity most important (A/24/11), she says, *We won't be a company if we hadn't been in an incubator.* We certainly had the idea but we weren't actually considering turning it into an actual product (A/24/12).

7.3.1.4 Incubator customer contentedness

Most incubatees used commodity (office services) professional (marketing, design) and networking (connecting into business networks) at the incubation centres. In most cases these were free; Respondent-24 CEO of a UK university high-tech spinout (A/24/7) views them as part of what her tuition fee pays for; as did Atli Fanndal, A/29/10). Respondent-27 Manager of a small international technology company (A/27/7) accessed free services, which *are incredibly useful* (A/27/7); she also went to paid-for events:

You know if you go to community events you have to pay for professionals to talk to you. I have done that and I think they are value for money because even if you spend 5 hours talking to people and you find one or two pieces of advice that will help your company then it's value for money no matter how much you're paying for that as long as you get something back (A/27/8). ... So my strategy was to talk to as many people I trusted as possible It was also about trying to find mentors – people who have build businesses before and who can help you with the problems you are about to face because if you can try to avoid those problems before they happen, it saves a huge amount of time (A/27/6).

Respondent-26 was amazed at getting high quality services for free (A/26/7) none of which would have been available in his home country, Egypt (A/26/9) and that,

.. they do also support you with contacts; accountants, lawyers, mentors and other people to support your business idea. They do that for you. Actually one of the mentors the business throughout as well. So I do help out on that side (A/26/8).

Respondent-25 (A/25/6) felt being in the incubator would help attract external investors and paid £800 for some specialist services (A/25/8), which he thinks *.. could have been cheaper than they were* (A/25/10), though these paid-for services created a *websites that I could advertise the product* (A/25/11).

For Respondent-29 professional and networking services were most important (A/29/7), he found also,

I would say the main reason it is to help us develop the idea further. It was very lonely, hard and a bit expensive doing it by ourselves. So coming into an incubator is to help us take decision and network. There is a lot of support and support systems in the incubator and that's what we hope to benefit from by coming into the incubator (A/29/6).

Many incubatees commented that without the incubator they would not have created their business; for example, Respondent-30 (A/30/13) thinks the incubator could have

I think I would open up to more modern way of thinking and focus more on values. So a lot more of value-sharing rather than its current competitive nature at all times (A/30/18).

Joanna Young of SEC, a research student is less satisfied saying I didn't go into an incubator (A/31/7); There were no services (A/31/9) and incubator managers did not help her build a network (A/31/11).

Respondent-32 manager of a UK university's student spinout service is careful to manage expectations about its role.

Looking at this in terms of physical property I would say we're not a traditional incubation centre but we do have space that they can use. So, at the moment they get an office space, they get access to internet, we have some IT equipment, and they have access to meeting rooms. But in addition to all that they get advisory services. So, in terms of physical space it's much more of the case that they are located more close to us (A/32/13).

In summary, most incubatees view their experiences in incubation positively.

7.3.2 TT, UILs and absorptive capacity

Respondent-35, Policy expert and UK incubation manager emphasises the social role of universities in building a knowledge base that addresses social and business problems.

You know in research intensive universities sometimes you end up with graduates that are technically very capable but that miss out on some of the life skills that are available in most of the teaching focused universities. So, there is definitely a greater focus just now on smaller or post-1992 universities – the technical institutes that changed into universities in 1992 – partly because they are churning out high quality graduates who are capable of getting jobs. But the universities are still doing all these research and I think there is the missed opportunity for the Scottish Government. Scottish enterprises are still backing it to an extent but I think to a lesser extent. And I think again that reflects the austerity – the fact that there is just less money in the public purse just now means that less is coming to universities to take care of knowledge transfer (A/35/3).

These are sentiments echoed by Respondent-32 (A/32/16). Many of the entrepreneurs too feel that the part of the role of universities is to address social issues, for example Respondent-25 CEO of a successful UK technology spinout, says

It was created about and for home enthusiast. I mean engineers who work at home. That was the vision of the company to create a product for people who work from home. The timeframe was about one and half years here in Edinburgh (A/25/2).

Several of the entrepreneurs refer to international TT, not formal or purchased TT, rather informal knowledge or new informal combinations embedded in new business ideas, though formal EU research networks play some part in basic research.

7.3.2.1 Technology transfer

Respondent-35 Policy expert and UK incubation manager feels that richer universities in the southeast of England (Cambridge, Oxford, Imperial) have more resources to purchase and stimulate TT. However, he suggests,

In terms of Edinburgh, the exportable knowledge is coming from various areas of science; notably medical sciences, computer science and informatics, engineering in particular and renewables for instance, chemistry, and geosciences. There is a lot of interests in renewables but I doubt computer science is very reliable source of technology as is the medical school. So those are the mainstream activities. In terms of international tech transfer we would love to do more but international tech transfer is expensive and we have a budget. So we do have various reps around the world notable in the US, China, and with other European countries (A/35/8).

Half of the interviewees have benefited from knowledge transferred from abroad. These include Respondent-24 CEO of a UK university high-tech spinout aligning with African usage patterns of mobile technologies and Respondent-26 who's new business offers online delivery of gifts sourced in Egypt and the UK to consumers in the other country. Joanna Young's Scientific Editing Company was inspired by the difficulties English as a second language authors have being published. More formal TT by Respondent-28, the largest and most internationalised of the companies interviewed occurs on a systematic basis with researchers in the US.

Other interviewees have so far on their startup journey depended entirely on knowledge they have generated themselves or identified within their university, examples being Respondent-25 CEO of a successful UK technology spinout (A/25/1), Respondent-27's ideas from Portuguese solar technologies and Respondent-29 (A/29/16). There is no purchase of technology from abroad and the university exports significant amounts.

7.3.2.2 Building university-industry links

For Respondent-35, Policy expert and UK incubation manager building UILs is crucial to effective commercialisation; he says,

I think increasingly so because the university sees or especially research universities see industry as a way of continuing research projects. In the last 10 years there's been a shift from the mid-2000s onwards we saw quite a lot of focus on company formation and licencing of technology. I think universities hoped that would generate a significant income stream for them. But as it turned out few universities make serious amount of money from licencing technology or from the formation of new companies. Some of the big universities in the US do, but very few other universities make a significant amount of money from company formation. We have very few companies in Scotland who are engaging with the universities not just this university but all universities. Scotland has lots of small companies, one or two big ones, and one or two medium size ones as well. But the top end of the company scale, the largest companies are all based in the south, the largest companies in the UK are all based in the South ... So, to really create an impact locally for commercialisation or perhaps the most effective way of doing it is through company formation because those companies setup generally in Edinburgh employ people from Edinburgh, employ graduates from the university of Edinburgh and the wealth creation and the sharing of that wealth through the economy is through Edinburgh. So there need to be a boundary between the clear financial benefit of industry engagement but also delivering impact locally which is primarily done through company formation (A/35/4).

Respondent-33 University Bioquarter Director the Commercialisation Unit as playing an essential role in UILs.

The university formally has a director for commercialisation (one of the vice principals) and sitting below him/her is a director of commercialisation. But we also have ERI, which is the technology transfer organisation. I guess until we came along they had quite a nice little system. People complain until we came along and started doing the job almost as outsiders. ERI still hold all the IPs for the university even though we develop it (A/33/16).

For the entrepreneurs, linking with businesses was important to their startup process, posing (answering?) issues associated with market and supply chain as evidenced by Respondent-25 (A/25/12) and Respondent-30 food company CEO (A/30/14): however, the nature and form of useful knowledge arising from interactions with businesses varies between startups.

7.3.2.3 Building absorptive capacity

Respondent-27 began developing her business idea in partnership with family-friend business owner. Whilst designing a solar voltaic farm, she developed the knowledge to create a new LED light bulb for B2C sales (A/27/1). Family and friends gave feedback on

early prototypes, made small investments in the project and eventually became its first customers.

Over the period of 6-7 months of getting that feedback we were ready to build the product and get ready for the big retailers and companies. That I when we started building the supply chain and developed a product that was ready to go to the market. So we started with small things after we had raised some finances from friends and family. We wouldn't have got where we are without our network and that's the most important thing (A/27/4).

Several of the entrepreneurs built new capabilities in response to market feedback. For example, Atli Fanndal of Freeland (A/29/1) began with the idea of an online investigative magazine, which he then migrated to a subscription news site learning from marketing feedback. Respondent-30 too developed a new model in response to feedback (A/30/5).

The incubator Mangers too have built new capabilities in response to their market feedback i.e. business partners and entrepreneurs. Respondent-33 says they learned quickly that academic management of incubators was disastrous: he represents a strategic shift by the College of Medicine to embed business expertise in its incubation (A/33/1). One example is getting researchers with promising outputs to work with business to solve problems customers have, instead of simply pursuing knowledge for its own sake (A/33/12).

Both entrepreneurs and incubation managers view incubation processes as learning opportunities: extending their knowledge range and building new capabilities.

7.3.3 Motivation and capability for entrepreneurship

What motivates these entrepreneurs and how confident are they in their capability to build businesses? Research in the UK suggests that entrepreneurs are motivated by a desire to make a social contribution and to have control over their own destiny or “be their own boss.” Motivation for startup is rarely to become rich. The evidence from these entrepreneurs supports this research. Respondent-27 believes her new light bulb will help her company and consumers (A/27/1); Atli Fanndal aims to add to the veracity of news reportage (A/29/1); Respondent-31, a high-tech startup CEO hopes to help foreign authors to get published (A/31/5); and Respondent-24 CEO of a UK university high-tech spinout is contributing to social development in west Africa (A/24/4). Helping oil companies

locate exploitable hydrocarbons before drilling motivates Anton Ziolkowski of Respondent-28: a project that operationalized his electromagnetic research. In his case, attracting Leon Walker (ex-Schlumberger) in 2003 added the motivation of having a company with growth potential. Instead of licencing or selling the technical, Anton remained involved and in June 2007 Petroleum Geo-Services (PGS) bought Respondent - 28 Ltd. for \$275 million – Scotland largest university spinout. As the company grew, the entrepreneurs’ motivations altered as shown by Anton’s remarks below on his journey from hydrocarbon researcher to successful businessperson.

We had two competitors but many potential buyers. So it was a sellers’ market. We signed contracts with the lawyers and the corporate finance advice people. Finally when we got our investors in, they wanted 65% of the company and we wanted to get enough money so that we could get to positive cash flow. We wanted all the money upfront. We actually thought we needed £10 million but got £7.4 million with a rather high transaction cost. So we looked for a CEO who was worth about £100 million. So the management team was the CEO, myself and a colleague. The investor put us through a lot of trouble to see if we were a decent team (A/28/1).

Making a social impact and seeing the results of their research work operationalised rather than becoming rich motivates these entrepreneurs.

7.3.4 Internationalisation compliance with standards

By the nature of the industry it was involved in, Respondent-28 was a ‘born global’ enterprise. Every one of the entrepreneurs I interviewed have vision of international growth. For example, Respondent-24 CEO of a UK university high-tech spinout wants sales in Africa and has a team from six countries (A/24/2); Respondent-26 seeks to source and sell between the UK and Arab countries (A/26/4); Atli Fanndal of Freeland speaks of becoming a global brand (A/29/13); Joanna Young of SEC targets customers at international conferences (A/31/5). In VC circles a well-used dictum is “never limit your upside,” meaning avoid putting an upper limit on the value of an investment. For these startup commercialisation entrepreneurs the upside is turnover generated from overseas sales: it did not occur to any of them to only target national markets. Private equity providers (VCs and Angels) consider that for backing high-risk businesses (without a trading record or proven technology) their return should to close to 20% IRR. A concomitant of this is a rule-of-thumb for many VCs that the business plan should aim for 50% of sales abroad by two-years – overcoming the limitations of small national markets.

7.4 Commercialisation processes

In this section assembles evidence on the day-to-day processes of commercialisation incubation in UK universities.

7.4.1 Start-up and growth

Often business startup is viewed as primarily a financial ‘dash-for-cash;’ however, from the entrepreneur’s viewpoint it is a journey of intense learning, emotional commitment and hard work, during which radical new product, process and/or business models emerge. From an original idea disseminating health-related information around African villages, Respondent-24 CEO of a UK university high-tech spinout came up with the idea of a community messaging service and then of a mobile app to support it (A/24/1), saying that *We’ve really tried keeping it simple and cheap. At the moment no one is getting paid and we’re just focus on getting things in place* (A/24/16). Polorum’s journey was from a social need, via information dissemination to a software product-enabled service. Though as she confesses none of the entrepreneurs are yet taking salary despite long hours.

As Frydrych, Bock and Kinder (2016) show, an important aspect of Kickstarter, (an online source of distributed capital for equity and social enterprises), is network building a feedback ideas that strengthen the initial pitch business plan. For Respondent-25 CEO of a successful UK technology spinout, this is precisely what happened. Having benefited from feedback on a Facebook site, he then migrated (A/25/5) to generic 3-D modelling; a journey reflecting his engineering expertise. Respondent-30 was inspired by a family history in consumer foods (A/30/1) and blended her original idea with a knowledge of teas and bespoke eating.

Respondent-33 Bioquarter Director has witnessed the creative pathway of many companies moving from original idea to refined ideas and then further refinement cross-referenced with market research and standards compliance. Of the early stages he says, *So it’s not a company at that stage in time. It’s a series of technologies, a series of projects which we have got in mind and when they are all ready we bring them together, bring a management*

team and look for investment (A/33/2). Respondent-32 too emphasises connecting entrepreneurs with funders and mentors (A/32/14).

7.4.1.1 Time: a dash-for-cash?

Classically, (Bell 1991) a startup raises and burns equity on startup costs and then begins trading, hoping to hit breakeven and later profit: a ‘U-shaped’ is often termed the dash-for-cash i.e. income exceeding costs before equity is burnt. As Bell and others note, under-capitalisation bedevils startups and may then be forced to trade equity at fire-sale prices. Being blessed with sufficient own-resources as Respondent-26 was (A/26/2) avoids the distractions and costs of raising capital. The other entrepreneurs were less fortunate. As already mentioned, Respondent-25 raised capital from Kickstarter and early orders to launch Maketechnics (A/25/4) and avoided cashflow difficulties. Respondent-27 (A/27/2) worked for a family friend for no salary (getting R&D access for the solar project and then developing the efficient light-bulb idea as a way of generating capital from sales income). She spent 3-years without salary subsidising herself. Following another well-beaten track, Atli Fanndal launched Freeland with gift-capital from family and friends, later adding subscriber income to fund expansion (A/29/4): again for 2-years he worked without salary. Joanna Young used spare time (from research assistant employment) to launch SEC, only after 3-years building up the business to a size that paid an income (A/31/2). Whilst taking a similar period Anton Ziolkowski of Respondent-28 and his collaborators were in full time employment; they subsidised the initial launch.

In summary, these entrepreneurs personally sacrificed time, income and emotional-capital during their dash-for-cash periods in order to launch their companies.

7.4.1.2 Trouble – challenges in incubation processes

Company startup is rarely a linear progression; instead it is subject to the vicissitudes presented by opportunity and setback testing the commitment of the entrepreneur. For those with business experience (and own capital) such as Respondent-26 suggests that the main problems seem to be network building in what to him is a foreign context (A/26/5). Having spent three-years in what amounted to unpaid postgraduate business learning,

Respondent-27 only then, she says, *I realised that I can make a career out of it. So we started to make things that people wanted and I think that is the most important thing* (A/27/3): Ms Dawson's tenacity and commitment were tested severely during incubation. For Respondent-24 CEO of a UK university high-tech spinout the challenge was network building (charities, African communities, app developer, mobile companies) all at a distance and involving nuanced cross-cultural understanding (A/24/5). Every startup faces challenges during which committed and tenacious entrepreneurs show determination to succeed. To paraphrase Leo Tolstoy, *All happy startups are alike; each unhappy startup is unhappy in its own way.*

7.4.2 Internationalisation

Section 7.3.4 above concludes that each of these entrepreneurs had a vision of international standards compliance and international sales. This section explores how they went about internationalising. For Respondent-24 CEO of a UK university high-tech spinout using contact in Africa (NGOs; mobile network companies; community leaders) was key. In addition they marketed their service using social media and exploited networks at home, in particular a software engineer to develop the app (A/24/15). Respondent-26 came endowed with a small UK business network (MBA-related and alumni) and an extensive network in Egypt and Arabic countries, based around a heritage business (A/26/10): his achievement was building the new business constituency by mobilising these disparate international networks around his new idea. His Egyptian background proved an asset in the international mergers and acquisitions side of his business, since as Sherbiny and Hatem (2015) explain, heralding from a country in which doing business is difficult is a strong training ground for doing business in other similar counties.

Most other entrepreneurs have little business (still less international business) experience. Respondent-27 Manager of a small international technology company for example aspires to sales in *the USA, UAE and into the far East* (A/27/12) but has not yet developed an entry model (direct sales, agent, licensing). Joanna Young's model of using international conferences as a marketing mode has evolved, though has limited reach (A/31/5).

For the incubator managers, internationalisation is important (to grow sales, employment and attract R&D partners) and sourcing external investors as Respondent-33 says, *we had a nice technology, which became expensive to carry forward. So we contacted a company in Australia because they had the money and the market* (A/33/11). Respondent-35 too is very conscious of the need to operate internationally, citing the need to cooperate with research and sales partners not only in the southeast of England, but also in *in New York and Boston, Chicago too* (A/35/5).

7.4.3 Labour supply

Evidence from KSA (section 6.4.3) showed the difficulties in sourcing trained labour for expanding startups and accessing business professionals, such as accountants, lawyers, marketing planners and design consultants. A major difference between KSA and the UK is that while labour supply may involve costly searches and high costs, the supply of specialist labour is greater. Crucial to the growth of Respondent-29's online business-journalism company was assembling a network of journalists, which he has done. Similarly, Respondent-24 CEO of a UK university high-tech spinout quickly found an app developer and Joanna Young academics to work on potential journal paper submissions. Each also had access to business professionals in the incubation centre or for Respondent-25 CEO of a successful UK technology spinout paid outside experts (A/25/6).

Abdul, Manager of FreeSpace in Cambridge with a current portfolio of 158 companies (A/34/7) suggests that an established ecosystem makes sourcing labour less problematic.

7.4.4 IP and the regulatory environment

Here I assemble evidence on IP and the regulatory environment and their effects on commercialisation processes.

7.4.4.1 Intellectual property

Since IP protects income stream by avoiding imitation, it is important to entrepreneurs and potential investors. Respondent-33 Bioquarter Director stresses the importance of IP for biomedical products.

We come along with our commercial hats on and we introduce them to ways that can give them a 7-year protection in the market. This means it allows you special dispensation to the regulatory authority, giving them a much quicker route to get the product to the market. It's a quicker way, it's a better way and gives you 7 years protection. It's a way of encouraging companies to moving into very specialised diseases they would normally not do (A/33/7).

Respondent-28 were unusual for 'technical' entrepreneurs, in that in 2001 when Ziolkowski, Hobbs and Wright realised the use of their electromagnetic technology in identifying hydrocarbons, they immediately applied for a patent, with support from ERI (at a cost of £19,000 for which ERI took an equity option). Only in 2005 was the patent granted:

D.A. Wright, A.M. Ziolkowski, and B.A. Hobbs, 2005, Detection of Subsurface Resistivity Contrasts with Application to Location of Fluids: United States Patent Number 6,914,433.

A more normal route is to use time-to-market or copywriting as protection (Pisano 2006) the strategy pursued by the other entrepreneurs, for example, Respondent-27 (A/27/5).

7.4.4.2 Legal issues

Each of the interviewee entrepreneurs had the legal advisors associated with their incubator available and unsurprisingly encountered little or no legal challenges; as Respondent-35 suggests (A/35/10) addressing the legal aspects of commercialisation is part of the incubator service. For example, Respondent-27 says, *I did have a very good relationship with the university incubator. They were very useful in helping get the company off the ground and helping me start just the legal processes of the company. They are also helpful in building networks with other people (A/27/9).* Respondent-32 manager of a UK university's student spinout service explains how this works.

We provide what we call clinics. We will provide them with access to a legal adviser, accounts adviser, IP adviser for an initial free meeting. But we don't then necessarily go on to provide them with further assistance to them. It will then be up to the pay for that themselves. So in some cases again through different funding routes we can assistance. For example we work with Scottish Enterprise and they very often have assistance with the IP side of things. It's not often you get SIEs funding that takes care of the IP side of things (A/32/14).

Legal issues for UK startup commercialisations seem well handled by incubators.

7.4.5 Governances

Here I present evidence of UK incubator governances and then firm governances during incubation.

7.4.5.1 Incubator governances

Incubator governances in the UK are project-driven, not training programmes: time limits for occupancy focus entrepreneur's attention of business planning.

Vision and culture and entry

From the viewpoint of the incubating firms, the incubator is a supportive learning environment. Respondent-27 says *There is always something happening and you just need to speak to the appropriate people.* (A/27/9). Respondent-29, an entrepreneur (A/29/6) and four others make similar points. However, such an environment has its limits. Though Respondent-28 were not in the formal incubator (Technology Transfer Office and then SHEINS) the complexity and big company interest shown in their product, meant Respondent-28 says, *at certain point we decided we could get better advice from outside. We had to pay for everything* (A/28/3): Respondent-28 moved into a specialist private incubation unit oriented towards early-IPO.

It is precisely because of the limitation of generic incubation services, the College of Medicine at Edinburgh University established the Edinburgh Bioquarter: a recognition that generic services do not suit specialist and high-growth potential technologies to which Respondent-33 alludes. As Respondent-33 says, Edinburgh Bioquarter aims to *commercialise IP and maximise return for the university and for NHS Lothian* (A/33/3). They operate with three groups: one business development using UIL such as licensing, a second supporting spinout and a third evangelising commercialisation amongst staff (A/33/6). Respondent-33, Bioquarter Director sees these activities as large part of the *impact* 25% of the septennial research assessment exercise (RAE). He goes on to pose these activities as part of a new culture for universities:

So the culture change we do is getting academics more accustomed to industry because they still believe that industry is kind of a dirty job. They even think that if they collaborate with industry, industry is just going to steal their ideas. They also get worried that it will affect their standing in the scientific world. That people will think badly of them because they are working with industry. So, they are very nervous about all that. It's therefore our job to come in and assure them that industry has changed and that culture change is the third thing we do. We also run all sorts of networking evenings, business seminars, business breakfast and all sorts of things just to get people interact with industry more, understanding what goes on in industry. That's a lot of it – it's breaking down barriers between industry and academia. The

management structure is therefore broken down based on these services we render. So we've got a head of capital creation, head of business development and the head of communications (A/33/6).

Respondent-34 in Cambridge echoes this view, in his case contrasting the entrepreneurial culture there with that in the Gulf region (A/34/12). For Respondent-32, inspiring students *to consider entrepreneurship and to develop their own entrepreneurship skills and to forming a business either while they are still at the university or upon graduation (A/32/3)*, is their core vision. All UK incubation managers then view their role as creating/strengthening/legitimising entrepreneurship as a meaningful activity amongst university staff and students.

LaunchEd was part the University's incubation unit expansion from staff entrepreneurship towards including students, seven years ago and now has a 5-member business team (A/32/4). To attract interest they support the Entrepreneurship Club and business competitions making extensive use of social media, saying

last year we engaged about 1600 students which is quiet small considering that we have a population of about 30,000 students. But out of the 16,000 students we had close one-to-one engagement with probably 400-500 and 30 business start-ups out of that. So that's the kind of business pipeline it comes out quiet small (A/32/8),

She is clear that LaunchEd is not a training programme (A/32/11), rather all students can book space and appointments: the work is all project-based around the student's business ideas (A/32/9) creating 20 to 30 startups each year (A/32/10). They arrange some business internships; typically a 3-month slot with agreed and evaluated aims (A/32/11). All services are free (A/32/18).

Services and improvements

Section 2.9.1 above considers literature on generalist/specialist types of incubator and the range of value-adding services they provide. It is clear that UK universities, such as Edinburgh and Cambridge see the need for both models. In the bio-medical sector, as Respondent-33 says, the need is for even greater specialisation, however, this requires a refocusing by the universities.

I think the model we have here where we've got a team who come from industry, who really understand what industry is interested in and the way industry works and all that we do here doesn't really exist

anywhere else. I think probably less than 3-4 universities in the whole of the UK have such a system – Cambridge, Oxford, UCL and Imperial College in London. So I think it's a model that should be adopted much more widely. But the real challenge to stop all that from happening is the universities themselves. it's the way they are set up, it's the way they are governed and it's difficult to get the people around to understand that this is required. (A/33/15).

University-industry links

Whilst contribution towards a knowledge-based economy is a general goal of UK universities (section 7.3.2 above), building the links with business to operationalise this, despite the reluctance of some researchers as Respondent-33 Bioquarter Director makes clear.

I think it's incredibly important and I think it has been neglected in the past. I also think that if academics are going to move towards applied, it's important they do that in partnership with industry. Because you what, in the Pharmaceutical field for example the academics always screw up. They don't just do things rights because they think it's easy and know what to do. I think if you're developing a product and you know it will eventually involve industry, it's better to work with industry from the start. So academic have the tendency of misunderstanding the complexity of what is required to for instance get a drug through the regulatory authority before it can be marketed (A/33/12).

Incubator/university links

Incubator governances, particularly a culture supporting commercialisation for these interviewees fundamentally challenges the way universities view their incubation activities. For Abdul at FreeSpace in Cambridge, it is important that services are charged for (A/34/2); make profit (A/34/4), and (citing US models) become an important income stream back into the university funding research (A/34/11).

In summary, incubator governances in UK universities attempt to operate with a culture promoting entrepreneurship, operating not through training programmes but rather as business projects and entrepreneur development. They are both generic and specialist, see links with business as an essential part of their own and the university's activities and in some cases have the strategic perspective of becoming important income streams for their parent universities.

7.4.5.2 SME governances

At Cambridge's Respondent-34 is clear that the culture in an incubation centre must grow the individual entrepreneur as the same time as developing spinout companies (A/34/8). For the entrepreneurs a growth in self-belief is evidenced in their incubation journey. Respondent-25 CEO of a successful UK technology spinout began to believe he could succeed when he tested his product and liked it (A/25/3); Respondent-27 grew confident with the support shown by incubator staff (A/27/11). Respondent-28, who used a private sector incubator, suggests that weekly presentations to incubator managers focused attention on the pathway to market (A/28/4). For Atli Fanndal of Freeland, when subscribers began paying into the company bank account, his confidence soared (A/29/3); for Respondent-26, it was applying business skills (A/26/11). Incubation developed these budding entrepreneurs as individuals, increased their self-confidence and honed skills necessary for business judgements.

One aspect of the culture in these incubators that is crucial is the focus on outcomes: getting companies up and running. At FreeSpace, with 102 entrepreneurs on the books, 70 in residence and 70 graduated into trading companies (A/34/6) incubation processes orient towards trading. Entrepreneurs interviewed shared this perspective, for example Respondent-25 sees his company's trading success as model for others to follow (A/25/17).

From the perspective of entrepreneurs the incubators could improve their access to funding sources (Respondent-27, A/27/10), a point echoed by others for example Respondent-26 (A/26/12) and Respondent-32 (A/32/22).

The incubators are learning environments with a clear outcome: trading companies operating in a culture esteeming commercial success.

7.4.6 Risk capital

As a social enterprise, Polorum leveraged startup resources from NGOs and state agencies (in addition to family and friends) rather than capital markets (A/24/4). Respondent-25 made a successful Kickstarter pitch (309 customers) using the income to start Maketechnics (A/25/4); Teadough too used early sales income to launch the company on

a sustainable footing (Hannah Dimsdale, A/30/4). Starting off with paid employment, Joanna Young of SEC was able to begin trading by not incurring new costs, apart from her own time (A/31/4).

My interviews in the UK were towards the end of the 2008 financial collapse (2013 to 2014) when few banks offered facilities (loans or overdrafts) to SMEs in general and startups in particular. Companies with patentable IP may obtain a state grant or grant from the university (Respondent-33, A/33/2) and in exceptional cases from dedicated funds set up by banks, such as the TSB fund.

Since external risk capital (especially VC) can be expensive, it is only appropriate for startups with the prospect of high-growth and profit. In this dataset, VC investment was only appropriate to Respondent-28, who had little difficulty attracting offers (A/28/4). Respondent-28's R&D was funded firstly by research grants and then by subsidy (lab-time and salaries) Edinburgh University and later a £200,000 proof of concept grant from Scottish Enterprise. With promising technology patenting, followed by IPO was possible and therefore attractive to VCs: £7.4M from HitecVision, Energy Ventures and Scottish Equity Partners (the VC arm of Scottish Enterprise) in 2004. The equity was then sold by trade sale in 2007 to Petroleum Geo-Services (PGS) for US\$ 275 million who retired the researchers from active involvement the second-largest spin-off from a UK university (A/28/2).

In summary, these companies launched on sweat equity (unpaid labour) with contributions from family and friends and ploughing-in early sales income; none got significant support from banks. With promising patentable technology, only Respondent-28 was appropriate for VC, which they successful raised and then successfully exited.

7.4.7 Entrepreneurial risk and leadership

Since Kahneman and Tversky's (1979) work on Prospect Theory, we have understood that entrepreneurial risk-taking contains a high emotional element, which research shows (Brockhaus 1980; Busenitz 1999) often remains unarticulated, kept private and referred

too only in matter-of-fact ways. For entrepreneurs outside of universities who for example give up their job or offer their home as loan security, the risks are higher and much more emotionally-charged than for my group of interviewees, further explaining the interviewees absence of comment on their risk-taking. Even reflecting after the period of most risk, Respondent-25 CEO of a successful UK technology spinout is typical in saying, that he was focused on *getting my products to the customers* (A/25/18) or Respondent-24 who matter-of-factly filled in forms and than got on with it (A/24/3). Anton Ziolkowski describes Respondent-28's journey to selling his company for US\$ 275 million almost as an everyday event. Only those with a business back and in Respondent-26's case a MBA) reflect more closely on the risk and leadership associated with starting a business, in his case realising that his first business idea was not what he wanted to do and taking up a completely new strategy of consulting on international M&As seeking to justify the University's decision to support his entrepreneur visa (A/26/4).

7.4.8 Knowledge flows

This section presents evidence on knowledge flows focusing on their endogeneity, formality, business or technical nature and international transfer.

7.4.8.1 Exogenous or endogenous knowledge

Respondent-33 Bioquarter Director is very clear that knowledge of building businesses is exogenous to universities and that a key role of incubators is to bring into the university system the knowledge and skills commercialisation requires. He is focused on developing products and raising startup resources, saying,

It's about networking – the more contacts you have, the more people you speak to the more you're likely to succeed (A/33/10) ... you often hear people complaining about TTOs and that's usually because people who run TTOs have really been a product of the university system ... they don't really have the opportunity to learn how industry works and what industry is interested in. besides they don't have a long list of contacts they bring with them from industry ... the reason why we're here is that the College of Medicine wasn't spinning out the number of companies they were supposed to be spinning out. They hadn't spun out any companies for the 10 years before we came here. The last 5 years we've spun out eleven and we've got another five companies in incubation at the moment. If you look at industrial funding that was coming into the College it was a few million when we came here, now this year there is about £15 million of industrial funding. That's because we come from industry – we understand what industry wants, we know what industry is looking for, but also most importantly when we're building companies because we've been there and done it, we know what investors are interested in ... everyone in my team here come

from industry ... we look for technology around the college and around the university and we actually build companies. We will bring in a management team at that point to sort of front up the company, find investment for the company and spin out. So, my background is I've been in industry for over 30 years ... I've been Chief Executive of about 5-6 companies; all venture backed companies. So, basically I've done it all. I've build companies; I've spun companies and have raised money for companies. I've done IPOs on the stock market I've been involved in trade sales and raised over 60 million pounds of financing in my time. So basically I've seen and done it all. I'm not an academic but I've got a science background (A/33/1).

7.4.8.2 Tacit or formal knowledge

The companies entering the UK university incubators have a product, however, most agree that the incubator contribution is identifying the market and entry route: a combination of tacit and formal knowledge (Respondent-31 of SEC A/31/17; Respondent-27, A/27/13). The other incubator contribution is help finding startup funding (Respondent-32 manager of a UK university's student spinout service, A/32/14). The incubators draw the student and staff entrepreneurs into fields of knowledge (marketing/capital assembly) beyond their experience, some of which is formal knowledge (market segmentation, 4-Ps, financial agreements) other aspects of which is tacit (market orientation, pitching, networking with funders).

7.4.8.3 Technical or business knowledge

Few companies (Respondent-28) radically progress the technical nature of their product during incubation. Entrepreneurs (A/24/6) and incubation Managers (A/32/15) emphasise that it is the development of the business idea, which is the Incubation Centre's focus.

7.4.8.4 International technology transfer of knowledge

Respondent-35 Policy expert and UK incubation manager who believes that only one in a hundred research projects will result in successful commercialisation, suggests that

In terms of Edinburgh, the exportable knowledge is coming from various areas of science; notably medical sciences, computer science and informatics, engineering in particular and renewables for instance, chemistry, and geosciences. There is a lot of interests in renewables but I doubt computer science is very reliable source of technology as is the medical school. So those are the mainstream activities. In terms of international tech transfer we would love to do more but international tech transfer is expensive and we have a budget. So we do have various reps around the world notable in the US, China, and with other European countries. But it's comparatively modest compared to the southeast [of England] institutions (A/35/8).

In summary, the actual amount of commercialisable knowledge internationally transferred from UK universities appears limited, though the amount is much greater than in KSA in the private sector.

7.5.1 Commercialisation outcomes

The Biggar (2012) report on the *Economic Impact of the University of Edinburgh's Commercialisation Activity* suggests that its commercialisation activities add £95 million per year to the Scottish economy, supporting 1,913 jobs directly through 35 spinout companies per year (cumulative total of 213) and technology licensing (income £3 million per year) giving a total value added of £140 million with 2,415 jobs supported in Scotland and a further £23 million and 471 jobs in the rest of the UK.

As section 7.2 above illustrated, universities such as Edinburgh and Cambridge accept that contributing towards a (more) knowledge-based economy is part of their strategic goal. The incubation managers, however, question the commitment of the universities to implementing this goal. Respondent-32 for example, bemoans lack of space (A/32/6). For Respondent-33 of Bioquarter Director apart from strengthening staff commitment to commercialisation major constraints are finding business prepared to joint-venture with universities and external funders prepared to invest in university commercialisations. The latter point is important bearing in mind the governance clashes referred to above. As Respondent-33 says, *It is also a challenge sometimes dealing with academics – some of them are very academic* (A/33/14). He admits that

The one target we've fallen short of is the number of what Scottish Enterprise call high growth companies. We haven't spun out as many high growth companies as they wanted us to. The reason for that is what we learnt very quickly is there isn't the access to VC in Scotland that is required. So we need to build the ecosystem and the ecosystem need to be much stronger (A/33/17).

Respondent-34 too feels that outside of the incubation Centre innovation systems are replete with barriers.

I think every innovation system has to adapt itself to its local environment. The module that we use is much more like a natural ecosystem as opposed to a more industrial manufacturing thing. So we don't have to deal with cultures, values and environment that it's surrounded by. Context matters! (A/34/12)

Pointing too some successes (Vision Group and Lantern in 2004) Respondent-35 hopes that increasing the size of potential deal-flow by coordinating with Aberdeen and Strathclyde universities (the Enterprise Campus project) will help build a more supportive external ecosystem (A/35/7).

Whilst important, particularly in emergent sectors, commercialisation in Scotland support 0.1% of employment – its impact is limited.

7.5.2 Commercialisation outputs

There is no publicly available cost-benefit analysis of UK university incubation centres. From private sources it is clear that Centres such as Edinburgh and Cambridge are net value-adding.

Spun out trading companies that are investible (in Edinburgh, 35 a year) are deemed a successful output by ERI (A/33/9).

CHAPTER-8 IN-CASE AND CROSS-CASE ANALYSIS

This relatively short chapter, as chapter-5 explained is the first part of my analysis; the next chapter reintegrates my conclusions with research literature, pointing out my theoretical contribution. The purpose of this chapter is *not to integrate with literature* rather it is to compare and contrast the institutional setting (including culture) facing commercialisation is KSA and the UK. I use multiple units of analysis as institutions, organisations (incubators and universities) and firms are nested and mutually inter-relate. Since I aim to avoid repetition, I cite sections from the data chapters and interview references from appendices, rather than repeating raw interview data.

The structure of this chapter follows the top-level variables in my initial analytical framework (shown in figure 4.1). These are (a) cultural heritage, which includes wider societal institutions; (b) commercialisation drivers/barriers, which includes a contrast between findings on the Triple Helix in the UK and KSA; (c) commercialisation inputs, which includes sectoral differences within and between the two countries; (d) Commercialisation process, which includes support for entrepreneurs including funding and commercialisation outcomes. Hence the major themes for my research, identified in the literature review and embedded in figure-4 structure the discussion in this chapter.

8.1 Cultural heritage

As Lewis (2011) points out, it is often the invisible (cultural predispositions) differences that explain actions, emotions, framing and conceptualisations creating distinct habituses (Bourdieu 1984). This is neither a study of cultural differences, nor of national systems of innovation. Rather, my study seeks to explore dissimilarities in commercialisation process and to identify how Saudi processes might improve, by analysing them through the prism of commercialisation research and UK experience.

There are parallels between the UK and KSA: both are countries used to high oil revenues that are predicted to diminish (from 2015 for the UK); each faces exogenous shocks and uncertainties (for the UK, wars, potential EU exit and potential Scottish independence). My comparison is mainly between Scotland as a part of the UK and KSA. Both countries

rely on foreign labour, though as an ex-colonial power this is inward migration in the case of the UK, whilst KSA has 3-million temporary workers, reflected in a dominant monoculture and the sensitivity to identify found in all post-colonial cultures.

Institutionally the countries widely differ. Whilst both are monarchies, the Saudi King has absolute power, whereas the UK monarch is symbolic within a parliamentary democracy. In KSA women are under the guardianship of men; in the UK though often unequally treated, women have equal rights. Saudi Arabia has a young demographic profile with 51% of the population under-26, whereas 70% of the UK population is over-25. The UK is a secular society with declining rates of religious observance (except amongst its five-million Muslims), whereas Islam is a dominant social force in KSA. The UK economy is service-based and increasingly knowledge-based; KSA remains highly dependant on oil, though the (religious) tourism industry is vastly important.

8.2 Commercialisation drivers/barriers in a developing economy

Here I assemble evidence relating to the first (from the left) set of influences on commercialisation seen in figure 1.4.

8.2.1 Institutional arrangements effecting commercialisation

I first compare NSI, SSIs and the triple helix (TH).

8.2.1.1 National systems of innovation

Whereas in Etzkowitz and Leydesdorff (2000) terms KSA has a statist TH model, the UK appears more tri-lateral featuring hybrid organisations – much more non-linear and focused on shortening gap (quicker knowledge flows because thicker institutions in place), though commercialisation activity is (85%) clustered in the southeast of England. Evidence suggests that whilst the UK more successfully commercialises scientific research than KSA, there remains in the words of Respondent-33 Commercialisation Director at a university BioQuarter (A/33/4) a gulf between business and universities, with the latter avoiding profit-motivated activities. In KSA, commercialisation policy and initiatives are top-down and centralised, as section 6.2.1.1 shows, creating institutional thinness in areas such as

corporate law, tax and IP law, which despite Government policy favouring communications and heavy investment in international TT purchases, means that incubation centres achieve little, as Dr Mohapatra's comments indicate (A/18); though in time as institutions and cultures change, this may alter.

8.2.1.2 Sectoral systems of innovation

Layton (1972) drew attention to the UK's ability to 'invent' without 'innovating,' i.e. a commercialisation gap. Indeed, Collinson and Gregson's (2003) international comparison of innovation systems reveals that for US VCs, science-based R&D in the UK is a source of under-priced IP. In several sectoral studies Molina and Kinder (2000; 2001) show how systems of innovation in creative industries and software can act as barriers to innovation and exploitation of scientific research in the UK. This section explores the role of active agency within sets of institutions orientated towards innovation and growth in particular sectors: in short, the degree to which Pisano's (2006) science-technology gap is successfully overcome. Commercialisation SSIs in the UK show some spatial clustering successes (such as Respondent-34, A/34/9) at Cambridge refers to in Cambridge and incubation centres focused on a supply of university R&D (such as Respondent-35 Policy expert and UK incubation manager references in 7.2.1.2).

KSA has successfully taken some early steps to create SSIs in emerging technology fields, however, the next challenges are more difficult: encouraging a more entrepreneurial culture and experimental organisational forms. Over the last ten years, the Saudi Government has recognised the need to diversify its economy, faced with oil price volatility and the impending ending of its reserves. It's Five Year Plans and *Vision 2030* now set sectoral targets. In the Ninth Five Year Plan, electronics, upstream petrochemicals and healthcare technologies and (the cross-cutting theme) absorptive capacity building are highlighted. As section 6.2.1.2 indicates, there has been significant investment in the Tehran Techno Valley Science Park; as Respondent-15 (A/15/1) says, they have bought some 300 patents from the US Patent office and established the new Badir network of incubators (ICT, biotechnology and advance manufacturing), aimed at exploiting them (Respondent-16 A/16/4). Both countries face the challenge of embedding commercialisation as a culture

in university-related SSIs: the challenge however is greater in KSA given the top-down control of initiatives and the NSI deficiencies mentioned above.

8.2.1.3 The Government, university and industry triple helix

In neither country does the TH approach the Etzkowitz and Leydesdorff (2000) ideal-type exist since in both countries academic and business governances remain difficult to bridge and amongst academic researchers predominant culture does not prioritise commercialisation.

The UK's TH is more institutionalised than in KSA, however, the same cultural gulf exists between academic researchers focusing on publications and academic entrepreneurs referencing commercialisation. As section 7.2.1.3, indicates and especially the comments of ERI's Commercialisation Director, Respondent-35 (A/35/6) whilst there are exceptions, most academic researchers fail to boundary-hop between academic and business governances (all five UK incubator managers agree). In Edinburgh's case, biomedical and AI research is readily commercialised and Respondent-28 is an example from geosciences; however, the culture of entrepreneurship fails to reach into the mindset of many researchers and some Government initiatives (for example REF impact) are viewed as blunt instruments.

KSA has a less *matured* (Respondent-7, A/16/1) TH as we would expect in a developing economy, as Respondent-10 *sawerly* CEO says, *we are still not there* (A/10/18) referring to an ecosystem that is statist and top-down (picking winners, selecting TTs, controlling funding) and constrained by researchers failure to participate. The Government accepts TH goals and invests heavily in physical infrastructure and purchase of TT, but is not yet prepared for the array of experimental and hybrid organisations necessary to support an entrepreneurial culture. Large Saudi businesses (in oil and finance) accept the goal of TH-type development but lack the competences and commitment to work with technology startups.

8.2.2 Development state attributes

Since the development state (Woo-Cummings 1998) ideas may present a strategic way forward for KSA, this section explores more closely the degree to which it has DS characteristics, contrasting with the IMF/WB neo-liberal model in the UK.

8.2.2.1 Redistributive or value-creating state

Culturally, gift-giving and clientism have been important in Saudi culture with oil wealth increasing the ruling elite's ability to provide largess, often in the form of grants, government (sinecure) jobs and welfare payments. Public debate in KSA often cites the mantra of *modernising without westernising* with attention turning to Asian (post-Washington consensus) models of development and more generally what is a sustainable model for Saudi economy and society. As IMF (2014) and the *Economist* (120116) KSA is currently retrenching state expenditure.

Whilst the debate on the development state is not echoed in the UK, debate on what constitutes a sustainable model is very much alive (EU, Scottish independence, devolution). As a trading nation, international competitiveness is important to the UK and embedded in the dominant neoliberal ideology, which promotes diminution of state spending and range of public services. An important tension in the UK is between central and localised agencies; the latter (local Councils and universities for example) seeking to protect levels of investment. The UK Government aims to become more value-adding than value-distributing, however countervailing democratic forces pulling in other directions mitigates any shift.

8.2.2.2 Expert bureaucracy

Creating and implementing five-year plans and policies such as *Saudidisation*, innovation via TT and building absorptive capacity in an absolute monarchy requires serendipitous state expert decision-takers. For example the Japanese MITI carefully enforced B2B and UIL around R&D. KSA lacks the large manufacturing export companies Japan had in the 1960s and 1970s and instead places TT and incubation under the management of academics (section 6.2.2.2) failing to attract offshore R&D by foreign companies for institutional

reasons. Some respondents point to push back against the inexperienced bureaucracy (such as Respondent-14, A/14/14).

It may be that over time business expertise increases in the KSA bureaucracy. In the UK, 'arms-length' hybrid agencies straddling the public and private sector (such as Scottish Enterprise and ERI) have some amount of expertise. As Respondent-35 Policy expert and UK incubation manager argues, their role is enculturating universities to embed commercialisation, with firms such as Respondent-28 illustrating how this can successfully work.

To summarise, placing commercialisation resources under the control of an expert bureaucracy is unfinished business in the UK; it has yet to begin in KSA.

8.2.2.3 National vision

How we see ourselves and how others see us (identity) is continually renegotiated as achievements, events and environments alter. The UK has the (fragile, misplaced?) self-assurance of imperial power, often (as Respondent-35 in 7.2.2.3 does) viewing itself as a knowledge hub; inventing and designing products for others to manufacture. In this vision, national champion companies and research universities play an important role, as does self-deception since competitive economies fail to readily accept lower places in the international pecking order. Section 6.2.2.3 shows educated Saudis identify dissonance between policy and practice: policies for a knowledge-based economy and practice inhibited by institutional constraints and lack of entrepreneurial culture the result of which is a failure to create the technological products and companies matching the national vision. As an outsider, Respondent-17, Manager of an incubation network sees these dissonances sharply as the A/17/2 quote reveals, overcoming which Dr Tahir suggests is imperative if the national vision is to be achieved (A/22/1).

Knowledge and the ability to create and exploit new knowledge is a crucial building block of a national culture. Having lived in the UK now for five years, I see how much time and hard work are necessary to build a knowledge store; it cannot be bought over the counter.

8.2.2.4 Innovation incentives

Section 7.2.2.4 describes a structure of innovation incentives familiar in WB, IMF and OECD models: clear IP and corporate law, a variety of capital markets, fiscal concessions on R&D and risk-taking, basic and applied (university and corporate) research partners and successfully accommodating international R&D off-shoring. Indigenous knowledge production and initiatives supporting its commercialisation are structured and funded in visible, accountability and impersonal agencies and rules on a meritocratic basis: a clear supply-side to UK innovation incentivisation evolved over time.

Such a structure is not evidenced in KSA (section 6.2.2.4), indeed interviewees point to perverse incentives as alternatives to innovation such as occupying space in incubators for unlimited time without paying fees and receiving welfare payments or grants. The alternatives to being innovators (Government sinecures, investment in a rising property market) further diminish the incentive to innovate. Add to this, issues from an entrepreneur's perspective around IP and company law and tax, and as Respondent-20 notes (A/15/5), the incentives (incubation network, state grants) fail to incentivise (all four policy-makers concur). In practical terms, KSA appears a typical resource-rich country without innovation incentives

8.2.2.5 Macro-economic stability

As an open economy with a single resource export KSA is vulnerable to exogenous shocks adding to the instability arising from internal experimentation with democratic processes. Section 6.2.2.5 suggests that from the viewpoint of long-term institutional adjustment to better-suit innovation, KSA is fragile. With an internationally traded currency and open economy (including some oil dependency) the UK too has fragilities arising exogenously and internal tensions from income distribution and spatial inequities. However, its ability to attract foreign investment and R&D illustrates a higher degree environmental stability for innovation than KSA.

8.2.3 Entrepreneurship: barriers, disincentives enablers and incentives

Here evidence on entrepreneurship institutional barriers/enablers, incentives and disincentives and also using evidence assembled in sections 6.2.3 and 7.2.3 of previous chapters I compare success stories and SWOTs for entrepreneurship in KSA and the UK. The next section examines evidence on commercialisation as a particular type of entrepreneurship.

8.2.3.1 Entrepreneurship: success stories

Unsurprisingly, given the short time KSA has supported academic entrepreneurship, there are few success stories. As section 6.2.3 notes, there are successful and internationalised KSA businesses in many sectors and given the investment in TT and 100,000 students per year studying abroad, a pipeline of spinout companies is likely to development: to date this has not occurred. In other sectors successful Saudi entrepreneurs are well-known, such as the Al Subeaei Group founded by Mohammed Alsobaie, who's first business venture was selling matches as an orphaned youngster and Abdulrahman Alzamel who took over a small textile business converting it into the internationally successful Chairman of Zamil Group in steel and construction. KSA has successful entrepreneurs; it has yet to create them from commercialisation in advanced technology fields. The UK can point to numerous successful academic entrepreneurial ventures, with section 7.2.3.1 summarising Axis-Shield and Respondent-28: both employing over 300 high-level staff and with international sales and R&D facilities.

8.2.3.2 Entrepreneurship: institutional barriers and disincentives

Although KSA has a long history as traders and many family businesses, as section 7.2.3.2 indicates cultural predispositions today view small businesses as subordinate and unworthy; especially since social welfare can be generous. The main barrier to entrepreneurship in KSA is cultural as illustrated by comments from Dr Respondent-1 of a major online training company (A/1/1 and 2) and Respondent-15, a Science Park CEO (A/15/7); all four policy-makers and incubation managers mention this. At a structural level, KSA's TEA-rate at 9.4% is above that of the UK despite other institutional barriers such as (section 7.2.3.2) the unpreparedness of banks to lend to startups and the issues associated with women starting businesses in a strict Muslim culture. It may be as some

interviewees suggest that the nature of incubators is a barrier; as section 7.2.3.4 shows, they are criticised for being managed by academics, ‘pushing’ imported technologies and running programme training rather than business project development. Another structural barrier is the lack of private risk capital and exit (via trade sales) difficulties.

Some the institutional barriers and disincentives (banks, private risk capital, exit routes, management of incubators) can (some already are) be improved. Others such as disincentivising welfare payment and obstacles to women starting businesses are deeply rooted and require more fundamental institutional change.

Cultural factors too are important institutional barriers to entrepreneurship in the UK, including (section 7.2.3) the persistent reluctance of banks to fund startups and SMEs. Whilst the UK has more supportive IP and company law and taxation; alongside exit routes and research capability (both endogenous and offshore) than KSA (section 7.2.3.2), there remains a cultural (governance) chasm between industry and academic research (A/35/9). Patenting in the UK is slow and costly (section 7.2.3.4) and can lead to firms relocating.

In summary, barrier institutions to entrepreneurship and structural disincentives are stronger in KSA than the UK. In both countries however cultural factors are important: the position of women, predisposition against small businesses and personal service businesses in the KSA and in the UK a gulf between academic researchers and industry needs.

8.2.3.3 Entrepreneurship: institutional enablers and incentives

Section 7.2.3 records some of the institutional enablers for entrepreneurship generally and university commercialisation in particular; such as (in Scotland) Scottish Enterprise business advisors; the Co-Investment Fund, Knowledge Transfer Partnership; Smart Awards and funding of Angel networks via Linc. These couple with UK-wide fiscal policy: R&D write offs and capital gains discount on risk capital investments; and the associated trade sales or AIM as exit routes. Section 7.2.3.4 notes the wide array of business professionals available: lawyers, accountants, designers, marketing planners, and

sophisticated logistics and supply chains. Many larger companies have Corporate VC funds and/or arrangements to mentor or partner with startups. Most universities and cities have incubation centres, often managed by business people.

In its core sectors (oil and financial services) KSA has supported national champions, such as Armco; however, interviewees recognise that institutions and structural initiatives remain work-in-progress for university commercialisations (for example, Respondent-18 a commercialisation policy expert in KSA, A/18/4). Nonetheless, the Government profile commercialisation in its Five Year Plan is funding the *Badir* incubation network and invests heavily in purchasing patents and TT by importing international researchers and incubation specialists.

8.2.3.4 Entrepreneurship: SWOT compared

Figures 6.2 and 7.4 take international data (GEM, IMF, WB and Government documents) combined with interview data to produce SWOT analyses for entrepreneurship in KSA and the UK. Sections 6.2.3.2 and 7.2.3.2 present the conclusions of the SWOT analysis. As a beneficiary of inward R&D, a wide basic research capability and EU member, the UK's weaknesses relate to UIL governances and external shocks (currency, oil price and war). In short, whilst imperfect (education levels, weak Chinese links) institutions and structures favour entrepreneurship in ways that KSA is now in the process of building. Like all institutional change this takes time and works best with a clearly directed national vision, with structural factors (law, capital, taxation) undoubtedly being more easily altered than deeper cultural factors (women entrepreneurs and predisposition against small businesses). KSA threats (end of oil revenues and image abroad as a place to do business) are significant as is location in an unstable geographic zone. Success stories are important motivators and models in change process, perhaps focusing support on a smaller number of high-growth potential businesses will achieve success to celebrate and emulate in KSA. A major difference between the SWOTs is entrepreneurial culture: not particularly amongst academics, rather the different legitimacy of founding a business contrasts between younger people.

8.2.4 Knowledge flows: absorptive capacity and adaptation capability

Given my research focus on commercialisation, vibrant knowledge flows shortening the gap between science and technology and addressing consumer's desires in international markets is crucial to my research topic. For the KSA section 6.24 paints a picture of significant investment in basic and applied research capability often via TT, as KACST's Respondent-20 outlines (A/21/4) and as Respondent-18 points out, building a general (from 2006) and now sector-specific network of incubators attached to Saudi Arabia's most research-intensive universities (A/17/3). Given the timescale for creating university research capability and embedding commercialisation in university cultures, it may be argued that KSA is doing well, perhaps especially so compared with other top-ten oil producers such as Russia, Iran and Venezuela or other top-twenty (by GDP) countries such as Indonesia and Turkey. Simple comparisons with the UK (section 7.2.4) reveal little, since it has spent since 1209 (Cambridge) and 1583 (Edinburgh) cumulating knowledge. What is revealing is the ability of the UK to attract international corporate R&D, funding from international bodies such as the EU 7FP and an increasing tendency (not yet as strong as interviewees would wish (A/35/4) to link with industry in joint R&D projects (though Edinburgh works closely with big-pharmaceutical, pet-food, ICT and engineering companies). As research capability and thereby absorptive capacity improves in KSA the attraction of international R&D and subsequent spillovers may prove an important policy objective.

8.3 Commercialisation inputs

I now turn to comparing evidence of practice of commercialisation, rather than policy or entrepreneurship in general i.e. the actual input into commercialisation processes; this is followed in the next section (8.4) by analysis of the relative processes themselves. To avoid repetition of data chapters, I focus on summarising the differences (referencing sections of the data chapters), following the structure of the data chapters, though somewhat condensed.

8.3.1 Incubation and startup services and success criteria

Section 6.3.1.1 suggests that KSA incubator entry criteria relate to the motivation of the entrant rather than the quality and/or marketability of the research idea (UK), few entrants come with ideas resulting from paid-for TT (though many reference business ideas sourced from studies abroad. Since there is no systematic evaluation of Centre outputs it is not clear how many graduate as trading businesses. Length of stay in incubation seems to lack discipline. UK rules on entry and exit are much tighter, though in Cambridge some 25% have no association whatever with the university (A/34/10). Technologies from international research (grant-aided or jointly with international companies), is more prominent in the UK than KSA as 8.3.4 below details.

8.3.2 Service range, quality, cost and value-for-money to users

Incubators offer staff and students free access to space and office, professional and specialist advisors in both the UK and KSA, which from the viewpoint of the entrepreneurs is value-for-money (6.3.1.3 and 7.3.1.4). Where the incubators differ is in market-orientation. UK Centres are able to offer business mentoring, sometimes links with trading businesses and links to potential investors. In KSA incubators insist on programmes of training, UK centres focus on developing the entrepreneur's confidence and the business idea as a project (section 7.3.1). Overall, not unexpectedly given the different chronologies and experience, the Saudi incubators are less focused on the market and have less substantive links to research developed within the universities.

8.3.3 Technology transfer, UILs and absorptive capacity

University Commercialisation Manager Respondent-35 suggests that older established universities in the UK have the research capability links with international research and businesses to effectively build UILs and exploit endogenous and transferred technologies (section 7.3.2). Edinburgh, for example exports/sells technology (renewables, chemistry, and geosciences, (A/35/8), unlike the KSA universities on who's behalf 30 US patents were purchased. Although Saudi incubators are located on university campuses and Aziz Al Agargan of KACST felt this gave access to university research and facilities (A/23/3), no single KSA entrepreneur mentioned using this access.

Half of the UK incubatees have benefited from (informal) knowledge transferred from abroad (7.3.2.1), about the same as KSA, however, a difference is that the most successful (largest, most valuable) incubated companies in the UK, such as Respondent-28 and Maketechnics, were build on indigenous research, exploited through incubation. When asked (A/21/6) to name a KSA company benefiting from this basic research, Respondent-20 could not name one.

In both countries strong UILs are acclaimed as very important: Respondent-35 (A/35/4) and Respondent-33 (section 7.3.2.2) for the UK and section 6.2.4 for KSA. Whilst UK universities work with international companies, this is rare outside of oil in KSA. Indeed, KSA finds it difficult to get Saudi companies to mentor or otherwise support companies in incubation.

In summary, the older more researched-based UK universities with established links to business and international research has stronger TT and UILs than in KSA; that said KSA incubators are much newer.

8.3.4 Building absorptive capacity

Similarly with building absorptive capacity: KSA invests in educating 100,000 students abroad each year, supports visiting scholars, joint research and patent purchases, as section 6.3.2.3 notes. However, building international-level research capability and with it absorptive capacity takes time. In many fields such capability has already been accumulated in the top UK universities, however, Incubation Centre Managers identify as a challenge, building business capacity in Centres and evangelising commercialisation amongst academic researchers, for example Respondent-33 (A/33/12). It may be, given the success of KSA as a centre for health-tourism focusing on building absorptive capacity in areas such as this (for example new medical devices) where there is some cumulated knowledge is better than (say) targeting biotechnology where there is less heritage capability. Alternatively, emulating India's success with the 'lean' GE Scanner, KSA may be able to use its advanced manufacturing capabilities to re-engineer medical devices and equipment.

8.3.5 Motivation and capability for entrepreneurship

I have mentioned several times (section 6.3.3) Saudi entrepreneurs being motivated by ideas or combination of ideas arising from study or visits abroad, motivating entrepreneurship. Given male guardianship, it is difficult for Saudi women to startup businesses and only 30% participate in paid employment; those Saudi women inheriting family businesses run them successfully. 5.7% unemployment does not seem to motivate, possible because welfare payment are high and there are prospects of a sinecure Government job (section 7.2.3.2). Given current reductions in state spending, this may change as the alternative to entrepreneurship becomes less desirable. Those Saudis becoming entrepreneurs do so for similar reasons as in other countries (section 7.3.3.): control, social contribution, operationalising research, with motivation changing as companies grow and new opportunities emerge or as in the Respondent-28 case a business mentor motivates the academic researchers to follow a particular path (A/28/1).

8.3.6 Internationalisation compliance with standards

For those entrepreneurs seeking rapid internationalisation or being ‘born global,’ compliance with standards enabling to trade in international markets is essential. Section 7.3.4 illustrates the importance of this to UK entrepreneurs in incubation.

Another aspect of international compliance is the ability to raise capital from VCs who invariably look towards the turnover from internationalisation as essential to given them their desired return for the risk taken, especially for startups with little trading history.

As section 6.3.4 illustrates neither growth nor getting VC is an immediate concern for Saudi incubator entrepreneurs, who target local/regional markets, which is odd given the wide international reach of the country’s national champions in oil and finance and KSA’s leading position in the Arab and Muslim world. The downside of importing business ideas from other countries is that it is difficult to then re-export them. It would be possible to export into less developed (less contested) markets, such as Africa, however, most KSA into Africa appears to be for agricultural production such as the Saudi Star Agricultural

Development US\$2.5 billion in Ethiopia and Manafea Holdings US\$125 million pineapple growing and processing in Zambia. Export guarantees in KSA are subject to Government approval i.e. not impersonal rules.

To summarise, internationalisation is the norm for many university-based startups in the UK, in KSA it is the exception.

8.4 Commercialisation processes

Here I compare and contrast the actual practices of commercialisation in the UK and KSA, following the same structure as in the data chapters, whilst combining some of the sections to avoid repetition.

8.4.1 Startup and growth: dash-for-cash and incubation challenges

As section 6.4.1.1 in KSA whilst there are examples of early innovation (Respondent-10, A/10/3) and elongated incubation (Respondent-9 A/9/2) the norm is extended innovation as a result of incubation conceptualised not as developing an idea and planning a route to market, rather earlier idea development and training. All five UK incubators are more selective accepting business ideas which, then developing the individual entrepreneur and business plan (section 7.4.1). Stronger linkages to mentors, business, investors or via crowd-funding feedback introduce add to the business discipline and project feel of incubation. In KSA, because incubation is free, often entrepreneurs receive welfare payments and without business mentoring, Saudi incubation processes are relaxed as section 6.4.1.2 illustrates. Time is not money.

Whilst the commitment and emotional sacrifice of entrepreneurs in both countries is not in doubt the Saudi system lacks the business discipline that linkages to the real world of business introduce in UK startup and growth.

8.4.2 Internationalisation

About half of the entrepreneurs in UK and KSA incubation draw upon (recombining) ideas from abroad. However, sections 6.4.2 and 7.4.2 show two important differences. Firstly,

more of the UK entrepreneurs are exploiting international network connections in shaping and launching their business (Respondent-24 CEO of a UK university high-tech spinout and Respondent-27 are examples. Saudi incubating entrepreneurs (section 6.4.2) aspire to international sales but rarely have international network connections, Secondly, encouraged by incubation managers (A/33/11 and A/35/5) UK incubating entrepreneurs are targeting early international sales, whereas for the Saudi entrepreneurs (A/3/16, A/7/15 and A/12/13) internationalisation is more of a dream than a plan.

8.4.3 Labour supply

Respondent-1 a major online training company (section 6.4.3) points to the difficulties recruiting talented staff to startups in KSA (preference to work of large companies or Government or simply to enjoy benefits), in addition to the overall brain drain (especially of women). Using equity options as a recruitment motivator is not an option under Saudi law. Labour supply is a major constraint for Saudi incubator startups. In the UK, equity options are often used; for example, this is how Respondent-28 attracted ex-Schlumberger executive Leon Walker in 2003. As economies develop and the middle-class professionals grow and diversity, it is expected as FreeSpace Manager, Abdul suggests (A/34/7) that business professionals become more available; a trend that should in future benefit KSA. However, at the moment labour supply, including experienced business mentors, is a major problem in KSA and significantly less so in the UK. Generous benefits from a rentier state (see 9.16.2 below) coupled to low women's startup, high emigration rate and workforce participation rates (section 9.16.3 below, add to KSA's labour shortages.

8.4.4 IP, legal issues and the regulatory environment

Patenting and copyrighting are well-established legal processes in the UK, though costly and time-consuming, though many firms prefer time-to-market as protection and/or US patenting (since it is a large market example for pharmaceuticals or Respondent-28 diagnostic equipment (section 7.4.4.1). Speaking of IP, Respondent-23 a national level commercialisation policy maker says, *The law is not well established or vague on this issue and there are grey areas* (A/16/8) in particular calling attention to disputes between individual researcher and university entity ownership of IP. Without clear and enforceable

IP law, not only is defence against imitation difficult also it is attracting external investors becomes problematic.

Too some western business eyes KSA corporate law seems idiosyncratic (its origins are French-Egyptian): VCs want to establish limited partnerships and operate with firms that can trade equity (against salary or further round investments) and very importantly to be exempt from capital gains tax on ‘star’ investments and thereby offset losses on failures. Legal services, such as establishing a company are ‘commodity’ services provided by UK incubators - it takes a hour online (section 7.4.4.2); business partners or larger incubating units (such as ERI) are also capable of documenting more complicated financial and equity ownership structures (Respondent-32, A/32/14).

KSA law and regulatory environment contrasts unfavourably with those in the UK (or US or Germany) and are a constraint on commercialisation.

8.4.5 Incubator governances

Respondent-13, Manager of a KSA Incubation Unit outlines the Saudi strategy: which is to develop research capability, purchase international patents and jointly work with international universities and companies to commercialise scientific knowledge in selected sectors into internationally competitive products using incubators attached to its best universities (A/13/1). In both instances deep connections into university scientific formal research may be tenuous, though not for the most successful UK incubated companies such as Respondent-28.

As sections 6.4.5.1 and 7.4.5.1 illustrate there are sharp differences in incubator centre governances, depicted in figure-8.1, which I summarise as in KSA being an add-on to the university and in the UK a bridge to business.

8.4.6 SME governances during incubation

The market oriented bridge-to-business culture in UK incubators focuses on individual entrepreneur (A/34/8) and the project – the business plan (A/28/4) for SMEs the

governances amount to active participation in action learning towards the goal of business launch (section 7.4.5.2). Entrepreneurs in KSA incubators face exactly the same challenges to reach market and profitability, however as section 6.4.5.2 suggests legitimacy and resource assembly are closely inter-related. Low business connectivity and absence of focus on markets, *for some companies* such as Respondent-4's (A/4/14), means that lack of interest from capital providers and potential business partners is understandable; for others, such as Respondent-9 product and market fit and resource-assembly follows.

Incubator governance	KSA	UK
Incubator management	<ul style="list-style-type: none"> Academics (A/17/7) 	<ul style="list-style-type: none"> Business people (A/32/4)
Entry	<ul style="list-style-type: none"> Idea stage (A/13/1) 	<ul style="list-style-type: none"> Product stage (A/32/9)
Activity	<ul style="list-style-type: none"> Programme orientation (A/13/13) 	<ul style="list-style-type: none"> Project-orientation (A/32/3)
	<ul style="list-style-type: none"> Training (A/13/12) and then business planning 	<ul style="list-style-type: none"> Business plan/project focus (A/33/12)
	<ul style="list-style-type: none"> Length of stay flexible (A/18/3) 	<ul style="list-style-type: none"> Time limited stay in incubation
Links	<ul style="list-style-type: none"> Low business links (A/15/6; A/10/18) 	<ul style="list-style-type: none"> Strong business links (A/33/15 A/33/12)
	<ul style="list-style-type: none"> Limited service connections (A/16/3) 	<ul style="list-style-type: none"> Strong service links (A/27/9)
	<ul style="list-style-type: none"> Limited links to external capital (A/20/16) 	<ul style="list-style-type: none"> Systematic pitches to external capital (A/33/2)
Evaluation	<ul style="list-style-type: none"> No clear output KPIs (A/3/6 A/15/5) 	<ul style="list-style-type: none"> Internal and external KPIs and evaluation (A/33/3; A/34/11) Could be stronger CBA (A/33/6; A/33/6)
Culture	<ul style="list-style-type: none"> Limited business discipline (A/7/20) 	<ul style="list-style-type: none"> Business discipline (A/34/4)
	<ul style="list-style-type: none"> Add-on to the universities (A/3/19) 	<ul style="list-style-type: none"> Bridge-to-business (A/35/3)

Figure 8.1: contrasting governances KSA and UK incubators

8.4.7 Financial resource assembly

Unless a startup can run on sweat equity or private resources it needs external capital from either friends and family or external investors (bank, VCs, Angels or crowd-funders). Assembling capital is therefore a test of how others view the legitimacy of the venture. Again there is a sharp contrast between the UK and KSA: though across the world entrepreneurs are likely to bemoan lack of support for *their* venture.

Section 6.4.6 reveals the reluctance of Saudi banks to fund (loan, overdraft) startups and perhaps commercialisations under (unproven) academic governances. This is a problem too in the UK, especially during recession, though most banks (Lloyds, TSB) have startup units.

Both KSA and the UK Governments offer startup funding in the form of grants (UK Smart Awards or *Kafalah* funds in KSA; in the latter case personal guarantees may be called and/or equity stakes taken. In exceptional circumstances incubators access their own funds – this was the case for Respondent-28 (A/33/2) and Hussein Al Alattar’s pre-seed funding grant (A/10/4).

Funding risk is not new in KSA, as Hoyland (2015) notes, historically Arabian traders have funded trading caravans and new settlements. From this perspective, the Prophet Mohammed (PBUH) and Meccan traders assembled financial resources to fund risk-taking. Private equity is relative new in KSA, though as Respondent-15 (A/15/4) reports there is a new Angel network in Tehran Valley. Respondent-18 a commercialisation policy expert notes the absence of a VC culture (A/18/7) which in any case would require important changes to the law (A/20/16): understandably foreign VCs are not active in KSA (A/20/17) nor did any interviewee refer to corporate venturing funds by large KSA companies. UK entrepreneurs in incubation regularly pitch to investors, often Angel funds and also Kickstarter (A/25/4) and VCs for larger ventures (A/31/2).

The UK has several hybrid organisations funding business startups including the Corporate Venturing Scheme (c100 startups per year with c£30 million investment by 250 corporate venturers enjoying tax concessions) and the Princes Trust and Fund which each year help 56,000 young people start businesses. Given the predilection for online activities in KSA, an Arabic-language crowd-funder based in KSA might be successful.

8.4.8 Entrepreneurial risk and leadership

Both section 6.4.7 and 7.4.7 evidence risk-taking and leadership by Saudi and British entrepreneurs often relying on instinct (Respondent-6 A/6/3 is an example and investing heavily in an emotional journey (A/5/1). Leading a startup, especially commercialisations facing technical *and* market risk involves multidisciplinary activity overcoming problems and barriers. Both sections conclude that Saudi and UK entrepreneurs in a matter-of-fact manner get on with it.

Whilst as figure 8.1 suggests the dominant culture in incubators is more business-focused in the UK, the leadership and risk-taking aspects of entrepreneurship are recognisable in both countries exemplified in similar fear-of-failure and TEA rates (GEM 2014); however, there are differences favouring commercialisation in the UK. Institutional barriers and structures (law, tax, partners) are greater in KSA. Given the availability of talent, the distributed-leadership model (recruiting and empowering staff) works well in the UK (Respondent-28). Risk assessment for UK and KSA incubators is a vital part of business planning. UK entrepreneurs have an advantage in risk mitigation since risk syndication whilst not reduced per se by syndication (only its consequences), but is reduced where the syndicators bring expertise or network connections (international, business and capital section links): much more likely for UK than Saudi entrepreneurs.

8.4.9 Knowledge flows and distribution

Section 6.4.8 and 7.4.8 explore in practical terms the types and effects of knowledge flows on companies incubation the commercialisation of knowledge in KSA and the UK. Taking R&D to include recombining or redesigning existing knowledge into new product (including service) solutions, section 6.4.8.1 indicates that most of the Saudi entrepreneurs have and are undertaking R&D. The same is true in the UK except it is endogenously-generated knowledge from basic or applied research that features in the entrepreneurs' R&D – the knowledge is deeper (section 7.4.8.1). Whilst amongst student entrepreneurs in the UK similar tacit knowledge is referenced to that used by Saudi entrepreneurs, amongst staff entrepreneurs (Respondent-28) like Respondent-9 (who is doing applied research on ultrasonics jointly with a company in Belarus) the knowledge is more formal. UK researchers are often part of international teams, with the Respondent-9 exception,

none of the Saudi entrepreneurs are and none use the (paid-for) technology transfer patents or cite imported researchers. In the UK, it is commercialisation staff rather than researchers who seek international opportunities to exploit research. Sections above (8.4.5 to 8.4.8) show that formal and informal knowledge flows between entrepreneurs and existing businesses are stronger in the UK than in KSA.

8.5 The results of commercialisation: outcomes and outputs

Section 7.5.1 indicates the important yet limited impact of university commercialisations in Scotland citing the Biggar Report (2012) and evaluations by the University, Scottish Enterprise and the Royal Society of Edinburgh. For both Cambridge and Edinburgh enhancing commercialisation outcomes depends crucially on removing barriers and inducing a stronger culture supportive of commercialisation amongst university researchers. Respondent-20 sees a similar cultural change as crucial in KSA by (A/20/4). For now, Edinburgh University is able to spinout some 35 companies a year (A/33/9).

Whilst the UK's capabilities attract some 324 international R&D investments each year UK in 2014 (UKTI 2014), some of which are with UK universities, KSA is just starting on this track setting targets in the 9th Five Year Plan and introducing 14 MNC R&D projects at Tehran Valley in 2014. While Respondent-17 Manager of an incubation network says *there is a whole range of KPIs* (A/17/4), Respondent-20 of KACST says, *I don't remember that they have done any evaluation* (A/20/3). Section 6.5.2 concludes that there is no systematic public monitoring and evaluation of either the outcomes or outputs of Saudi's incubators and commercialisation networks. There may be private evaluations. As noted above, many public evaluations of commercialisation and university incubators are available in the UK, however, these exclude detailed cost-benefit analysis of outputs and (as far as I am aware) there are no follow-up studies of incubated companies – particularly important given the high death-rate for startups.

8.6 Summary of cross-case analysis

Figure 8.2 summarises the results of my cross-case analysis, again structured by the themes derived from my literature review and embedded in my initial framework (shown in figure 4.1).

Figure-8.2 illustrates deep institutional and cultural factors restraining KSA's commercialisation (and diversification) activities. Evolution of these institutions took almost a century in the UK's case and only slightly less for the US. Asian economies using the development state model have shown how these timescales can be truncated into two decades, *provided* that the state leadership empowers expert bureaucracy, oriented towards export-led industries and is directive of R&D efforts that combine business acumen with deepening university research and absorptive capacity, all informed by a shared vision of national destiny behind which key agents enrol. It is to discussion associated with these ideas from previous research and others that I now turn to in Chapter-9 which draws together my research analysis.

Variable	KSA case	UK case
Cultural heritage	Oil dependency Fragile to exogenous shocks Reliance on inward migrant labour Closed consultative democracy Restrictions on roles of women Young population	Lower and declining oil dependency Fragile to exogenous shocks Reliance on inward migrant labour Open democracy Basic equal opportunities for women Ageing population
Commercialisation drivers/barriers in a developing economy		
National systems of innovation	Thin institutions eg law, finance Successful cluster in endowed sectors oil and religious tourism Commercialisation top-down	Thick institutions eg law, finance Successful cluster in knowledge-based sectors Commercialisation embedded bottom-up
Sectoral systems of innovation	Emergent R&D and knowledge base Infrastructure investment Targeted TT investmnet (patents and international staff)	Rich R&D activity and knowledge base Advanced infrastructure (including universities) Successful finance, biotechnology, AI and cultural sectors
Triple Helix	Emergent/immature TH	Institutionalised TH
Development state	Deep academic/business culture gap Emerging expert bureaucracy State economic guidance	Academic/business culture gap State aid to business important, not a development state Expert bureaucracy important
National vision	Shared destiny eg <i>Vision 2030</i> Creating expert bureaucracy Policy/practice dissonance	Market rather than state-led change Dominant neo-liberal acceptance
Innovation incentives	Unclear IP and risk capital in knowledge sectors Only embedded in oil-related international R&D networks	Clear IP, risk capital available and exit routes Embedded in international R&D networks
Macroeconomic stability	Fragile: race to diversify by 2035	EU trading uncertainties and exposure of currency to markets
Entrepreneurship success, barriers/disincentives	Not in knowledge sectors Rentier' employment discourages entrepreneurship amongst young	Many success stories act as benchmarks Lower barriers, especially for profitable products
Entrepreneurship enablers and incentives	"Not yet there" Potential from international students	Widespread advice, financial support and business networking
Knowledge flows	Beginning to buuild research base, only oil sector in international networks	Strong research base and inclusion in international research networks
Commercialisation inputs		
Incubation	Infrastructure without business leadership and networking	Better if imperfect infrastructure with business networking as norm
Services	Standard services (welfare payments)	Advanced services including business and VC interactions
TT, UIIs and absorptive capacity	Paid-for TT, weak UIIs and emerging absorptive capacity	Strong TT and absorptive capacity, weaker on UIIs but increasing
Motivation and capabilty for entrepreneurship	Major issues: youth incentives and role of women	Important and growing
International standards	Emerging compliance: problems in IP and VC law	Compliant
Commercialisation processes		
Startup and growth	Elongated, unclear pathways but strong entrepreneurs	Clearly defined pathways characterised by business discipline
Internationalisation	Exception	Norm
Labour supply	Problem of rentier-employment preference	Some problems with technical labour
IP and legal issues	Remains a challenge	Clear and at international standards
Incubation governances	Academic not business	Mainly business (older remain academic)
SME governances	Technical product push	Market and finance pull
Financial resource assembly	Grant-based	Market led, international VC available and wide Business Angel networks
Entrepreneurial risk and	Fear of failure, difficult risk syndication	Some fear of failure, easier risk syndication
Knowledge flow/distribution	Recombination from international study of knowledge	Knowledge flows more endogenous
Commercialisation outputs	No clear measurement	Proven record, room to grow

Figure-8.2: Summary of cross-case analysis

CHAPTER-9 ANALYSIS AND THEORY DEVELOPMENT

9.1 Introduction

Here I reintegrate an analysis of my data with previous research literature, answering the three research questions set out in section 5.4 and indicating the theoretical contribution worthy of publication made in this research.

My research design uses Charmaz's (2006) constructed grounded theory, as part of which I presented a provisional analytical framework in figure-4.1, which I am now able to revise in the light of evidence gathered and interpreted. Themes from my initial framework structure this chapter, as they have my previous data presentation and in-case analysis chapters: institutions. I approach these themes using an out-to-in perspective, triangulating between (a) what previous research leads me to expect, (b) what I actually found empirically, and (c) the sense I make of what I have found and how it can contribute to the development of knowledge in the area of commercialisation in oil-rich developing economies.

The major narratives emerging from my research in relation to KSA's commercialisation appear in my initial framework and are made visible by my decision to contrast commercialisation process in KSA with those in the UK. To illustrate, institutional thickness is a major theme from the grounded data and figure-4.1 begins by highlighting its importance as a theme. The inter-relationship between state, universities and business (including Triple Helix) jumps out of my research as a major theme and is embedded in the figure 4.1 framework in terms of development state characteristics and knowledge-based economy, each of which is then disaggregated into commercialisation inputs and processes. Another major theme prominent in the research is support for entrepreneurs, including funding (and the associated questions of risk, exit, IP law and business governance law). This too features strongly in my figure-4.1 framework and under the heading of enablers and barriers too are disaggregated into sub-themes. In short, I am satisfied that my initial framework, derived from the literature review, has given useful

structure to my thinking and subsequently to data gathering (chapter-5), data presentations (chapters 6 and 7) and my cross-case analysis in chapter-8. Figure-9.1 details the structure of this chapter based as is shown on major and sub-themes derived from my literature review (chapters-2 and 3), initial framework (chapter-4), and in-case analysis (chapter-8) represented by figure-8.2.

9.1	Introduction, risk and structure
9.2	Policy, perceptions and practice on commercialisation in KSA
9.3	Theme-1: Institutions, culture and the developing economy
9.3.1	Meta institutions in Saudi Arabia
9.3.2	Islam inhibits innovation?
9.3.3	Saudi cultural traits inhibiting entrepreneurship
9.3.4	Perestroika without glasnost i.e. restructuring without openness
9.3.5	An Arabic development state model?
9.3.6	Summary theme-1: institutions, culture and the developing economy
9.4	Theme-2: The triple helix and systems of innovation
9.4.1	Operation of the Triple Helix
9.4.2	University-industry links
9.4.3	SSIs: active agency and knowledge spillovers
9.4.4	Knowledge and learning and the knowledge-based economy
9.4.5	Summary theme-2: triple helix and systems of innovation
9.5	Theme-3: Support for entrepreneurs
9.5.1	Barriers and incentives
9.5.2	Commercialisation inputs and enablers
9.5.3	Commercialisation processes
9.5.4	Resource assembly and commercialisation
9.5.5	Legitimacy and commercialisation
9.5.6	Governances and culture
9.5.7	Outcomes/outputs of commercialisation
9.5.8	Knowledge flows and the economy
9.5.9	Summary theme-3: support for entrepreneurs
9.6	Answers to research questions and theoretical contribution
9.6.1	Answer to research question-1
9.6.2	Answer to research question-2
9.6.3	Answer to research question-3
9.7	Framework revision and theoretical contribution

Figure-9.1: Structure of chapter showing major and sub-themes

My analysis chapter flows towards section 9.6 answering my research questions and section 9.7 pulling together my theoretical contribution; part of which is revising my initial framework into a final version. Overall, as figure 8.2 revealed, KSA faces long-term, deep institutional and cultural challenges if it is to successfully diversify from oil dependency. A good start has been made with *Vision 2030* receiving wide distribution and acceptance (as an idea if not always in practice) and substantial investment in the infrastructure network that includes university-based incubators, university research departments and enablement of non-oil business and research networking.

UK experience suggests that some areas of commercialisation are more prone to success than others. In Edinburgh Veterinary Science, Biotechnology Artificial Intelligence and Medicine (with to some extent Electrical Engineering) are successful; in Cambridge Biotechnology, Software (games and security), Engineering and Finance are prominent successful commercialisation sectors. In KSA, one could point to great success in oil and gas extraction, refining and logistics and to the important religious tourism sector. Two points follow. UK's successes are in areas involving formal knowledge cumulation, which builds upon years of basic and applied research – in short these sectors could only unfavourably compare with KSA commercialisations. Cross-sector comparisons are therefore difficult between countries. An added complication is the gap between policy announcements, particular in KSA and practical effort and achievement. I therefore begin this analysis chapter with a short section on the policy/practice gaps, focusing on the persistence of the gaps in KSA.

Risk and mitigations during analysis

There are main four dangers facing this analysis. Firstly, it is clear that 'culture' is an important explanation of actions within each country and of differences between commercialisation activities between KSA and the UK. Following Dretske (1981) and Douglas (1987), my concern is not to reify culture – ending as a non-explanation. Instead, each section seeks to identify the origin, continuity and change in cultural predispositions – in short what active agents can do to alter negative aspects of culture. Since the institutions I reference are nested, I continually switch between units of analysis, returning

always to the level of the firm. The second danger inherent in all cross-country comparisons (Browaeys and Price 2008), especially those between a developing and developed economy and society is *otherisation* (Jackson and Gozdecka 2011): stereotyping one is all good or bad. Grounding in evidence and literature helps avoid this danger, as does an honest approach (Bulmer 1969) to accepting differences in stage of development, morals and goals. A third danger is relativism: things are different, but it does not matter since there is no one-best-way and all solutions are equally valid. This is unlikely to be the judgement of international markets in goods, capital, labour and knowledge: *best* practice may be a chimera; nevertheless for KSA (and the UK) *better* practice at commercialisation is essential. I am a commercialisation practitioner in KSA and wish the best for my country. A fourth danger is loss of focus, which I address by structuring my analysis to answer the research questions posed seeking every lesson possible to support Saudi Arabia's future.

9.2 Policy, perceptions and practice on commercialisation in KSA

Only as institutions mature and a coherent and accepted vision of national destiny is communicated and accepted can the gap between policy and actual practice narrow. As a state in transition from oil-dependency, bridging the policy/practice gap takes time, since for example the urgency of national renewal experienced in Japan (1945) and China (1949). Instead, as 9.2 illustrates, KSA has in part become enculturated into a *rentier mentality*, enjoying soft incomes from oil: at national and local implementation levels the gaps between how selected policies are perceived in KSA and their delivery in practice. These policy/practice gaps are not selected to portray KSA negatively, rather to acknowledge that in practice gaps exist and need to be discussed and addressed in order to bridge the perceptions/reality gap.

9.3 Theme-1: Institutions, culture and the developing economy

Figure-9.3 summarises with reference to literature and data sections four of the main sub-themes arising in my research of how institution and culture in KSA are influencing commercialisation. Perhaps understandably, policy documents such as *Vision 2030* make no mention of such problematic areas. In this section I triangulate between these issues,

my data and my interpretation in order to paint a picture of the thematic interaction between institutions, culture and commercialisation in KSA.

Policy	Perceptions	Actual practice in KSA
<i>Vision 2030</i> : diversification via commercialisation to achieve modernisation without westernisation	<i>The National</i> (020617) survey suggests that 58% of Saudi Executives strongly support <i>Vision 2030</i> , another 34% agree, only 8% say outlook unchanged.	Unclear yet if the population as a whole buy into the strategy, especially young people and those comfortable with rentier incomes (Ulrichsen 2011)
<i>Saudisation</i> : to increase private sector employment eradicating <i>rentier mentality</i>	Bloomberg (2016) suggests oil-dependency culture remains strong	Still only 15% of the roles are occupied by Saudis: young people prefer Government or large foreign company jobs
<i>Vision 2030</i> targets a range of knowledge-based sectors	UK Government (2017) suggests KSA is targeting petrochemicals, auto-assembly and biotechnology	Incubators not yet focusing on innovative and exportable products (section A/23)
<i>Vision 2030</i> views KSA as knowledge and business portal for GCC economy	UN (2011) says KSA ICT infrastructure capable of GCC leadership	A/20 acknowledges GCC struggles to internationalise SMEs
The last ten five-year plans in KSA have promoted diversification from oil	View expressed by interviewees and promulgated in policy documents	Albassam (2015) and others conclude that little progress has been made in 40 years
<i>Vision 2030</i> emphasises vocational education and training	Major investment in education eg 110,000 Saudis studying abroad	Universities and young people remain averse to vocational education
Risk capital	KASCT (2014) and A/3 says risk capital available	A/5, A/6, A/7 A/20 say risk capital not available. banks
Successful TT and commercialisation	<i>Vision 2030</i> says TT and commercialisation a success	A/23 and others cannot point to any successful commercialisations

Figure-9.2: KSA policy perceptions and practice

Key sub-themes	Literature section	Example authors	Data section
Meta institutions – monarchy and Islam - conservative	1.1	Abu Hakima 1967 Abdullah (1995)	6 (introduction); 6.2.2.1
Islam inhibits innovation	1.6	Huntington 1996; Aury (1997; 2001)	6.2; 6.2.3.4
Saudi cultural traits inhibit entrepreneurship	1.2; 1.4 and 2.4	Al-Hegelan and Palmer (1985); Ulrichsen (2011)	6.2.3.4; 6.2.4; 6.3.1.2
Perestroika without glasnost - restructuring without openness	2.3	North (1990, 1999, 2009); Porter (2009)	6 (introduction) and 6.3

Figure 9.3: Main sub-themes from literature review on institutions and culture

9.3.1 Meta institutions in Saudi Arabia

The dominant discourse in the literature (section 2.3) suggests that transition from a *rentier* state (Beblawi 1990) follows North (2007) and Rosenberg and Birdzell's (1986) prescribed route, perhaps employing Bouckaert's (2007) *bureaupreneurship* model of property transfer. Other prominent western scholars similarly conclude that KSA cannot successfully transition, including Pappas (2003); Peters, Rice, and Sundararajan (2004); Volkmann (2004); Lalkaka (2006); and, Alshumaimri, Aldridge and Audretsch (2010).

The central point in *Vision 2030* is that KSA can modernise without westernising – use its oil wealth to import and commercialisation (largely US) technology, creating a successful knowledge-based economy by 2030 joining the top-15 (by GDP) economies, while retaining institutions such as an absolute monarchy and strict Islamic social morès. Technological diversification using oil revenue investment being the key strategy, KSA is now using King Abdul-Aziz City for Science and Technology (KACST) to promote 200 R&D units, 2,500 projects and network of incubators and case-based research applauds achievements in emerging technological sectors for example Al-Kibbi (2002); Al-Kurdi (2002); Ramady (2005), and Al-Thawwad (2008).

Is it possible that North is wrong? Japan, Korea and Taiwan using US technology transfer (TT) built successful economies with without democratic institutions. China's growth uses a Beijing-model at variance with the Washington consensus. Are authors such as Pack (2008) wrong to suggest that Arab economies are incompatible with knowledge-based growth achieved by commercialising transferred technologies? Alternatively, is Rodik (2011) correct arguing that of globalising economy, national sovereignty and democracy; only two out of three are possible?

Many people in KSA believe they can successfully modernise without adopting the western institutional framework, that democracy is unnecessary – these ideas link closely with debate on national systems and the development state in following sections. Here I explore three dimensions of this debate: does Islam inhibit innovation, does Saudi culture suppress entrepreneurship and can rapid economic development occur (as Rodik [2011] and others

suggest) without open democratic institutions? As figure-4.1 indicates since these issues significantly influence commercialisation, they are of great importance to my research.

9.3.2 Islam inhibits innovation?

A brief examination of the arguments shows the fallacy of suggesting that Islam necessarily inhibits innovation as Huntington (1996) argues since non-Arabic Muslim countries in the past (textiles in northern India and early-19th century Egypt) and currently (Turkey, Kazakhstan and Xinjiang in China) are innovative. One in 40 of the four million US Muslims run a business. Historically the Arab Muslim enlightenment in the twelfth and thirteenth centuries made important contributions to world culture as discussed classically by Robinson (1996) and more recently by Beckwith (2009), Lapidus (2012), Alkhateeb (2014) and Frankopan (2015).

KSA today has 17 companies on the Forbes-2000 global list (US\$567.8 billion in assets), compared to 56 India (50 times the size). No single interviewee, two-thirds of whom had studied abroad referred at any point to Islam constraining technological innovation; though I acknowledge with Lewis (2011) that invisible cultural influences are difficult to recognise and that a central precept of Islam is opposing innovation in religion, a cultural trait to which I now turn. I conclude that strategy documents, such as *Vision 2030* are correct to assume that there is no intrinsic inhibition in Islam to entrepreneurs and innovation a point twelve of the KSA interviewees endorse.

9.3.3 Saudi cultural traits inhibiting entrepreneurship

Figure 9.4 summarises some of the cultural traits potentially impacting on KSA innovation and entrepreneurship. There are of course positive traits in the Saudi culture supporting entrepreneurship, in particular traditional trading culture, commitment to family and family businesses, and friendship with non-Saudis are important. There are also important sub-cultures in KSA that may negatively effect innovation and entrepreneurship, including the following list.

- A privileged military (10.7% of GDP and 300,000 staff) often deploying advanced US equipment, though with no evidence of knowledge spillover.

- Shi'a minority (15% of population): religion/state identify clash; periodic clashes
- 4,000 Mutaween (religious police) resentment and periodic protest
- Travel or brain drain (10,000 emigrants per year)

Institutions and cultural traits	Possible effect on innovation and entrepreneurship
<ul style="list-style-type: none"> • Absolute monarchy: centralised and top-down control 	<ul style="list-style-type: none"> • Lack of experimentation and localised innovative • Few hybrid organisational forms
<ul style="list-style-type: none"> • Islamic religious dominance 	<ul style="list-style-type: none"> • Against innovation • Early Medina ideal –looking back not forward
<ul style="list-style-type: none"> • Resource-richness and largess 	<ul style="list-style-type: none"> • Welfare alternative to business startup • Import alternative to productivity rises (e.g. agriculture in Africa because there is no alternative)
<ul style="list-style-type: none"> • Guardianship of women 	<ul style="list-style-type: none"> • Low workforce participation • Low business startup rate
<ul style="list-style-type: none"> • US technology transfer 	<ul style="list-style-type: none"> • Suppresses indigenous innovation with limited spillover and adaptive commercialisation
<ul style="list-style-type: none"> • Youth lack of work ethic 	<ul style="list-style-type: none"> • Low young person business startup • Welfare dependency • Never-ending education • Quota of Saudi employees for existing businesses
<ul style="list-style-type: none"> • Formalistic education 	<ul style="list-style-type: none"> • Inactive pedagogy • Weak UIL and entrepreneurship education

Figure 9.4: KSA institutions and cultural traits possibly effecting entrepreneurship and innovation

9.3.4 Perestroika without glasnost i.e. restructuring without openness

North *et al* (2009) insists that without an open society (western democratic institutions) economies fail to modernise, despite the experience to the contrary in development states such as Japan, Korea, Taiwan and now China. Section 8.1 sets out the major institutional arrangements in KSA: it is an absolute monarchy, compacted with Islam (Madelung 1997; Alkhateeb 2014), with a low women's participation rate in employment and business start up and significant brain drain. These arrangements mean that commercialisation (and all other) initiatives are centrally and top-down directed, careful not to challenge these meta-institutions. Though historically a trading nation, since the advent of oil and US alliance (Anderson 1981; Grayson 1982) traditional gift-giving to maintain loyalty and legitimacy has is now pervasive adding to a reluctance to embrace industrialisation and modernisation.

KSA's culture disincentivises risk taking as a result of (a) ambitions being limited to Government sinecure jobs, unending education or simply welfare benefits; (b) disparagement of employment in SMEs relative to large companies; and (c) reluctance to

experiment with hybrid organisational forms and new ideas. The economy appears stuck in oil, finance and religious (and now health) tourism.

Economic historians such as Mokyr (1990) and Landes (1998) make the point that centralised politico-economic systems do badly because experimental are discouraged: there is no bottom-up pressure for change out of fear of offending the centre. Put another way, by Bowles and Edwards (1993) patterns of consumption and products must align: glasnost and perestroika are twins. Figure-4.1 captures this interaction by ‘nesting’ levels of institutions since as Bourdieu (1984) makes clear, most people inhabit several habituses and are likely therefore to hold conflicting values. Whilst RQ-2 invites conclusions identifying hegemonic values, the world of practice will always be more nuanced.

9.3.5 An Arabic development state model?

Here I argue that the state needs to play a central role in directing KSA’s move towards diversification into a more knowledge-based economy and cannot afford to leave development issues simply to market forces. Neither KSA nor the UK is a development state. My argument in section 2.4 is that envisioning itself as a DS may be the best strategic outlook for KSA, since its strategy of modernisation without westernisation disavows the Washington model, implicit in North’s insistence of adopting US-style democratic and social institutions and finds little and as my analysis shows the associated ideas of the TH and innovation systems remain a future project for KSA. Of course, KSA is highly unlikely to adapt the Beijing-consensus, in the form of single (communist) party leadership; other characteristics however (see figure-9.5) may prove important.

I note that despite numerous differences between interviewees (on policies such as incubator management, provision of risk capital and purchase of TT), there is no difference on the need for radical institutional change, whereas UK interviewees are more sanguine about current institutional arrangements.

Argument	Literature section	Example authors	Data section
Advantages of catch-up in expanding world economy	1.2 2.4	Gerschenkron (1962) Woo-Cummings (1991)	8.2.3.4

Value-adding not value-distributive state	1.6; 2.2; 2.4.1	Pempel (1999)	7.2.2.1 8.2.2.1
An expert bureaucracy?	2.4.1	Al-Hegelan and Palmer (1985) Schneider (1991)	6.2.2.3 8.2.2.2
A national vision?	2.10.3, appendix 2	Pempel (1999) Vogel (2011)	8.2.2.3
Stability and innovation incentives	2.3	Bellin (2004)	6.2.2.5; 7.2.2.5; 8.2.2.4 & 8.2.2.5
KSA can be a DS?	2.4.2	Gap in literature	

Figure 9.5: main issues from literature and data on KSA as a development state

Catch-up economies traditionally seek to slowly climb the international value tree, often beginning with labour-intensive manufacturing (textiles), migrating to advanced assembly (cars, chips, televisions, mobiles) and only then growing from small seeds incursions into emerging sectors; in KSA’s case, access to US TT and oil-wealth offer alternative growth paths (Brett 2009).

As section 8.2.2.1 notes, the UK sees itself as migrating from a value-distributing welfare state into a neo-liberal value-creating state; focusing state spending and tax concessions on wealth creation. Since its foundation, KSA has been a value-distributing state (first the *zakat* and later oil revenues); section 6.2.2.1 suggests value-distribution remains important in retaining legitimacy and social stability, whilst there is resentment at largess to the Saud family princes. Mazzucato’s (2013) point is that all successfully developed economies have benefited from state interventions, hence discussion on the development state strategy.

The point about a DS’s expert bureaucracy is that it places (contested) scarce resources at point that make a difference to strategy implementation. For example MITI decided on technology targets and then enforced business-to-business and university-to-business R&D joint projects, afterwards allowing competition in sales. Similarly, China’s TVEs, SEZs and SOEs became hybrid, semi-state (*bureaupreneurship*, Bouckaert 2007) organisations. Section 8.2.2.2 shows successful commercialisation in the UK guided by similar hybrid organisations, increasingly led by expert business people (as are most PPPs). In KSA (section 6.2.2.2) this is not the case: for example academics lead incubators (Respondent-

14 A/14/14) and he says, *dull economists lead economic policy-making*: centralised control inhibits governance hybridity and experimentation.

As section 8.2.2.3 notes, the UK has a self-confident vision of itself as a knowledge-based economy (see Respondent-35, 7.2.2.3). There are issues with this, for example the social exclusion of less educated people threatened by globalisation and the extent to which elite groups (such as university researchers) accept the vision when it requires change to their own practice. KSA too have a knowledge-based vision of the future, in its case under the umbrella of monarchy, Islam and rejection of western cultural values. If this vision is accepted by KSA citizens, who is to say its not a good vision. This is Respondent-16 (A/16/4) point. Without a shared (national) goal, it is unlikely that individuals and communities will sacrifice now, for future benefit.

Section 8.2.2.5 argues discerns fragility from exogenous shocks facing both the UK and KSA, further whilst at first sight KSA faces more internal instability (governance transitions, minorities, position of women) the UK too has uncertainties (Scottish independent, north-south divide, social exclusion). Change and stability oscillate everywhere. What is different (section 8.2.2.3), are incentives to innovation; later sections (8.2.3.2, 8.3.3 and 8.2.3.4) show many of these (law, tax policy) to be structural. The culture of entrepreneurship problem faces difficulties in both countries; the larger research base in the UK, however, produces more commercialisations.

One aspect (particularly of the Chinese) DS approach is evolution and context. Deng Xiaoping (Vogel 2011) famously implemented his modernising vision by metaphorically stepping on stones to cross a stream; in short by opportunistic experimentation. It may be that improving KSA's commercialisation activities (RQ-3) a degree of trial and error is necessary. Certainly, my framework (figure 4.1) should not be deterministically interpreted; rather drivers, inputs and processes should iteratively interact to settle on best ways (to commercialise) in the Saudi context.

9.3.6 Summary theme-1: institutions, culture and the developing economy

KSA's meta institutions, including Government structure, Islam, Saudi culture and its strategy of modernisation without westernisation (*Vision 2030*) are inhibiting the rapid commercialisation of knowledge-based technologies. In particular the Saudi gift-giving culture with associated clientism and favouring friends and family in appointments when coupled with vast flows of oil revenue have created a *rentier mentality* eschewing entrepreneurship. Simply opening up labour markets and company formation to market forces is likely to lead to regime instability and to spread to the existing successful KSA sectors (oil, gas, finance and tourism). My argument is that the state's role in institutional and cultural renewal is pivotal. An Arabic version of Chalmer's (1982) development state thesis to overcome the *burden of (institutional) backwardness* mobilised around a national destiny vision and with an expert bureaucracy leading economic development, may be an alternative. A major contribution of this research to theorisations of Arab economic development is therefore the idea of an Arab Development State as a vehicle to deliver modernisation without westernisation.

9.4 Theme-2: the triple helix and systems of innovation

Here I argue that that Triple Helix (TH) is not functioning in KSA (indeed it operates ineffectively in the UK) and because of KSA's 'thin' institutions. I show that despite frequent references to the TH idea in policy documents and by practitioners, shallow university-industry linkages, absence of basic research migrating into marketable commodities and low levels of academic entrepreneurship negate any suggestion of the TH operating in KSA. I also show that despite the idea the sector focus, deliberately creating ecosystems commercialising knowledge in software, logistics and life-sciences, these have yet to take root in KSA, which unlike the UK has been unable to create successful clusters around its leading research universities. Theoretically, I challenge the usefulness of TH theory, arguing that it is at best a metaphor. Unpacking the idea of knowledge-based development, I argue that KSA's knowledge conduits as presently constituted are incapable of building the endogenous knowledge base necessary to fulfil *Vision 2030* pointing to strategic and operational ways in which this could improve. Creating this national vision, trust in an expert bureaucracy and in doing so recapturing the Saudi work ethic from oil dependency, could only come from the King.

9.4.1 Operation of the triple helix

Drawing upon the literature discussion in sections 1.2 and 2.7, figure 9.6 highlights on-going important debates in relation to national systems of innovation (NSI) and the triple helix (TH).

Argument	Literature section	Example authors	Data sections
KSA NSI lacks institutional thickness and clustering	1.2	Porter (1990; 2009)	6.2.1.1
Is TH more than metaphor; can it be found anywhere?	2.7	Etzkowitz (1983; 2000) Saad (2004)	7.2.1.3 8.2.1.3

Figure 9.6: Main arguments from literature review on NSI and triple helix

Porter’s (2009) conclusion (section 6.2.1.1) that KSA’s NSI lacks institutional thickness and effective clustering is confirmed by my data. Respondent-18 (A/18) for example confirms this, pointing however to only ten years of policy initiatives in KSA trying to thicken institutions and create clusters and suggesting that in ten years time the picture may be different. However, the failure of TH theorists to develop a clear policy initiatives is reflected both in the difficulties both the UK and US face in embedding commercialisation into universities and the wide range of suggestions for institutional change analyses suggest for KSA.

Similar theoretical issues face triple helix theory (sections 2.7) of the literature review. Data sections 7.2.1.3 and 8.2.1.3 support Said’s (2004) argument (section 1.5) that the idea of a TH is simply inappropriate to economies/societies in the processes of institutional development to support commercialisation (see also 2.5 on universities). My argument that TH is best seen as a metaphor, rather than robust theory of policy-guide even in developed economies is supported Respondent-33 Bioquarter Director, (A/33/13) and Respondent-35 Policy expert and UK incubation manager (A/35/6). This develops the critique of TH mounted by Mowery and Sampat (2004). In both countries Government, business and universities working closer to support commercialisation is clearly desirable, beyond that it is not clear what TH theory adds, as Respondent-7 (A/16/1) suggests. Various quadruple helices have been suggested (section 2.7.1), no data from either country

suggests such theoretical innovations will overcome its lack of focus. My study joins those mentioned in section 2.7.2 finding insufficient evidence for the operation of a triple helix, especially as Balzat and Hanusch (2004) argue in developing economies.

Section 8.2.3.4 comparing SWOTs, shows the both the UK and KSA face external threats and opportunities, in particular the UK's role in international knowledge flows (inward R&D investment and university links) is an important opportunity. Although there is discontent in the UK about its national vision as a knowledge-based economy (from lower skilled groups threatened by globalisation and impoverished by negative wealth redistribution) the vision dominates policy. In KSA there is no clear dominant vision of what the country will be famous for in 25-years time. In terms of figure-4.1, there is a dissonance between economy and society in KSA: a point to which I return in my conclusions chapter.

9.4.2 Universities and university-industry links

The arguments and gaps in research I identified are shown in figure-9.7. Note, I discuss absorptive capacity below in section 9.15.

Problem-centred learning inculcates the skills and confidence to solve individual, social and business problems after graduation. As Roy (1992) and Kahn (2011) establish, university education in KSA does not use action-based pedagogy, rather the default is rote and passive learning (see section 6). Indeed, every KSA university student must attend Qu'ran by rote learning classes, as the *Chronicle for Education* (2011) notes, this pedagogy does not deliver marketable skills or capacity for innovation and entrepreneurship. UK universities, alternatively, aspire to using critical pedagogy and action learning, often based on problem-solving.

Argument	Literature section	Example authors	Data sections
Rote learning pedagogy	1.2; 2.1	Roy (1992) Kahn (2011)	6
Balancing direction with autonomy;	1.5 2.5.3	Giroux (2006)	8.2.1.2 8.2.2.2 and 8.2.4

Balancing applied with basic research	2.5.3 2.10.1	Wu (2007) Perkmann (2011)	8.2.4; 8.2.3.4
Providing human capital	1.6 2.5.3 3.9	Gaspar and Glaeser (1998); Kim (2000); Ramady (2010) and Jordan (2011)	8.2.3.4 8.2.4, 8.3.5 and 8.4.
Business engagement	2.5.3	Siegel (2006) Lecuyer (2006)	8.3.2; 8.3.3, 8.4.8, A/15/6 and A/10/18
Building absorptive capacity and research capability	1.6 2.1 2.5	Verspagen (1993); Kinder (2002); Etzkowitz (2000) and Cohen and Levinthal 1990	8.3.3

Figure 9.7: Arguments and data on university-industry links

Whilst authors such as Giroux (2006), as section 9.2.3 above notes, DSs marshal scarce R&D resources by directing university research fields, privileging applied research and insisting on partnerships with business. Clearly, there are balances here beyond research agendas, with universities often playing a critical-friend role in social disputes and defending free speech and supporting only applied research may not prove attractive to foreign researchers.

As the researchers in figure 9.5 emphasise providing high-level human capital is a critical contribution of universities in developing economies. Section 8.4.3 notes that labour supply is a major constraint in KSA but not in the UK. Not because UK universities are perfect but better. Also, UK firms expect to train and invest (especially online training).

Saudi students following medical, engineering and business courses in the US and UK are often surprised at the degree of business engagement such as speakers, live case studies, business-based projects, internships and general engagement with business; this can be especially so in medical, engineering and informatics schools.

Whilst UK UIL is imperfect, in KSA it is at early stages and a major constraint on commercialisation and (as I shall argue below) on university reform.

9.4.3 SSIs: active agency and knowledge spillovers

Effective SSI's feature beneficial knowledge flows and a leadership (however informal) able to align innovations with market potential exploiting untraded interdependencies

(section 2.6.2). In practical terms, these may include a supply or specialist labour, access to specialist professional services and most importantly knowledge spillovers stimulating innovation as a result of social interactions in an environment purposively seeking innovation. Whilst Respondent-15, a Science Park Manager mentions SSI activity in the oil industry (A/15/1) the only SSIs around commercialisation of university research in KSA is to be found in the 5-year Plan i.e. in intentions such as the Badir network of incubators and Tehran Valley. As section 8.2.1.2 reveals, far from untraded interdependencies, I found little evidence of cooperation between incubation centres or their staff. There is simply not sufficient throughput to create knowledge flows and spillovers. This is not so in the UK, where software is a recognisable SSI around Cambridge (A/34/9) and bio-medical in Edinburgh (7.2.1.2). KSA now has high quality infrastructure in which to locate clustered sectors, the challenge now is the human, social and knowledge flow dimensions of SSI-building. This will be helped by knowledge sharing between science parks and universities.

9.4.4 Knowledge and learning and the knowledge-based economy

I find much of the business literature on learning (Nonaka and Takeuchi 1995 is an example) frustratingly fails to differentiate the (often passive) management of knowledge from active learning of new knowledge. Here I adopt a synthesis of active learning and business development theory; figure-9.8 summarises my theoretical arguments and data on which I draw.

The important of active learning from a Vygotskian perspective (section 2.1) is that TT is never passive; technologies are always adapted to suit a new heritage, sense-making or challenges. Additionally, as section 1.5 notes, knowledge transfer always requires re-contextualisation – an opportunity for innovation.

Argument	Literature section	Example authors	Data section
Active learning not passive knowledge needed to transfer and adapt technologies	2.1	Vygotsky (1934) Engeström (1987)	6.2.4, 7.2.4 and 8.2.4

Knowledge acquisition in TT non-linear, cultural issues	1.5	Lewis (2007)	8.3.3
Active agency rather than artefacts transfer and distribute tacit know-how	2.1 2.6	Geels (2004) Ogle (2008) Archer (1996)	8.3.4 8.4.9
KBE shortens science-technology time gap for internationally competitive products	2.2	Pisano (1997 and 2006)	8.2.4 8.2.1.1
Meaning of KBE socially negotiated in context	2.2.1	Boyer (1988 1990; 1996)	8.1

Figure 9.8: arguments and data on knowledge and knowledge-based economy

Data sections 6.2.4 and 7.2.4 show Saudi and British incubating entrepreneurs using knowledge transferred from abroad (mostly tacit and recombinations) in their product development. Only the largest commercialisations (Respondent-28; Respondent-9) systematically use formal scientific knowledge transferred across international borders, which they adapt to constitute a new product. Saudi and UK policy should differentiate between supporting commercialisations capable of significant growth, compared to those with less potential (the former often embedding formal knowledge). Theoretically, conceptualising startup as a process of active learning importantly challenges more passive knowledge-management perspectives.

Section 1.5 makes the point that all technology transfers are non-linear: the outcomes are unforeseen in their impact on society or the innovation ecosystem (Chang 1995). As evidence in 8.3.3 shows, this is rarely as a result of entrepreneurs mining home university research, though for UK researchers and entrepreneurs outcomes may be the result of interactions with international company resources. Cultural differences can give products new meanings and uses, such as Respondent-8 CEO of a recycling company says idea of processing date palm oil from waste from Indonesian. Chesborough's (2011) work on open innovation and Kinder's (2004) critique of closed project management approaches underline the importance of non-linearity. The management of startups as a project is then a matter of balanced judgement: sufficient discipline to move the project forward coupled to the flexibility open innovation demands. This is a further policy reason for placing incubation resources under the management of experienced business people.

In a field of research such as innovation shaped by crossing cultures or systems (national or sectoral) there is always a danger of determinism: the view that other pathways could not have been followed (Rosenberg 1982). Hence sections 2.1 and 2.6 in the review of previous research contests theorisations that insufficiently allow for active agency; an example being Breschi and Malerba (1997), favouring instead) idea of agents and institutions mutually interacting and shaping and

The entrepreneurial journeys cited in chapters six and seven vindicate a non-deterministic view of TT in which agency is important (Archer 1996) and Ogle's (2008) notion of *ideas space*, illustrating with many examples entrepreneurs creating new products for their target context/market – Respondent-9 is a good example. Innovation and entrepreneurship are always social activities performed by individuals who learn; take risks, which is why figure 4.1 gives prominence to active agency.

Many innovation theorists, such as Saha *et al* (2004) conflate new economy or knowledge-based economy with the use of ICT. Leaving aside the point that PCs, Internet and databases are now mature rather than new technologies, section 2.2 argues that this view distracts attention from the main point – made by Pisano (1997) – that if there is a new wave of innovation, it is not limited to a particular technology, rather it is the result of a shortening timeframe between scientific discovery and technological exploitation as internationally competitive products. As section 8.2.4 illustrates, this can be the result of universities doing applied research (often with industrial partners), refocusing away from the next important basic research issue, towards applications. As 8.2.1.1 shows, shortening knowledge gaps is less likely in KSA where joint projects with foreign international companies are fewer and since research projects are more centrally determined. Theoretically and in policy-making clarity of terms and objectives is important: sadly too many development strategies loosely use terms, building houses on sand.

In section 2.2.1, I emphasise Boyer's (1988) point that in sustainable economies, consumption modes (including culture, human relations) must align with regime of

production. This point is reinforced by economic development consultant reports that invariably suggest adopting the same target technologies everywhere, regardless of heritage and capability. Boyer's point is that comparative advantage based on knowledge resources differentiates rather than homogenises. We see KSA variously committing to biomedical, software, green technology and biotechnology (7.2.1.2) and advanced manufacturing (A/16/4) and downstream oil, healthcare and financial services (section 6.4.8.3). Insufficient attention is paid in KSA to what its knowledge-based economy should look like: its strategic goals for 25-years hence. By contrast, the UK has no industrial strategy and Innovate UK (7.2.2.3) aims to amplify successful research in whatever field it occurs. This alignment between changing society and changing economy is a central point of this research – change is harmonious or conflictual. In the UK, many people whose jobs have disappeared or been restructured resent the change over the last 40 years, that has undoubtedly benefited the majority. For KSA, the next 25-years seeking to diversify its economy is likely to be equally problematic.

9.4.5 Summary theme-2: triple helix and systems of innovation

While agreeing with critics of Etzkowitz's (2000) TH theory as inapplicable to emerging economies without mature institutions (Saad 2004), my argument goes further suggesting that data from Edinburgh shows the limited reach of academic entrepreneurship even inside of mature innovation institutions; accepting that in parts of Edinburgh and Cambridge commercialisation works well.

Many commentators refer in general terms to KSA's knowledge base and its lack of vocational orientation (xx) and absence of business links (xx) and applied research (xx). My work digs deeper into these issues identifying a rote learning, rather than problem-centred pedagogy as problematic and absence of UILs throughout the university systems (teaching, projects, work-based learning and incubation centres) as a major weakness in KSA's university system.

I show in section 9.4.5 that while KSA universities spend considerably on TT (embodied technologies, patents and visiting researchers) there is little connection between the TT and

commercialisations, which tend to be based on informal learning from international study or travel. Investment in TT while helping build absorptive capacity, is not contributing directly to building sectoral systems of innovation. There is a disconnect between imported knowledge and target sectoral capabilities, reflecting the absence of UILs and in particular university research being guided by the needs of businesses in nascent sectors.

My data shows a clear gap between the UK and KSA in the use of active learning and problem-solving pedagogies, enhanced in the former case by joint-research and student work-based learning around projects. KSA policy documents, such as KACST (2010) point to considerable investment in TT; however, they fail to draw connections between the TT and sectoral capacity building in the form of commercialised products. Reviewing the business impact of TT in target sectors is likely to reveal the need for more focus on applied research and closer liaison between universities, incubators and the leaders of innovative sectors.

9.5 Theme-3: Support for entrepreneurs

Here I analyse support for entrepreneurs, including financial support, contrasting my findings in KSA with those in the UK and with previous research on KSA and KSA policy documents. Amongst the barriers to commercialisation I find that while the entrepreneurial mindset is yet to be embedded in UK universities, in KSA it is almost non-existent. Commercialisation enablers in the form of university-based incubators are far less connected into university research in KSA than in the UK; an illustration of ‘thin’ institutions. Commercialisation processes also differ in that UK incubators are more business disciplined i.e. market oriented and inter-connected with business via strong university-industry links. Given this, resources assembly and access to risk capital is more systematic in the UK whereas in KSA banks only infrequently offer facilities to startups, Angel funds are rare and incubatee companies rarely interact with potential funders. Legitimacy amongst KSA incubatees is perceived in terms of legal recognition, whereas UK incubatees discern it in terms of sales and trading. Importantly, incubation management in KSA remains in the hands of academics, whereas leading incubators in the UK business leaders manage incubation facilities. Though reliable outcome figures for

incubation value-for-money are unavailable in both countries, KSA outcomes are disappointing to policy-makers and Managers. Knowledge flows in KSA incubators are failing to exploit TT purchased by universities and are characterised by competition rather than cooperation between incubation centres. I conclude by identifying major blockages in KSA knowledge flows for commercialisation processes. While the physical infrastructure for KSA commercialisation and administrative support services matches that of the UK, support for entrepreneurs in KSA is only now emerging and reflects the low level of development in the indigenous knowledge-based private sector and a continued *rentier* mentality. There is a considerable gap between policy pronouncements on support for entrepreneurs in KSA and practice. Theoretically, this section demonstrates the inapplicability of much of the literature on support for entrepreneurs in the KSA culture and context, supporting the need for a new framework, such as the one I develop from this research.

9.5.1 Barriers and incentives

My literature review highlights several gaps to which this research brings new evidence, summarised in figure-9.10.

Methodological issues bedevil social science research: confusing ought and is and establishing causal links between social agent actions and results. Etzkowitz (1998) theory of the TH is criticised above (section 9.3) as metaphoric – more ought than is. Here I analyse the causality question: do universities as institutions incentivise academics towards commercialisation? In his first work, Etzkowitz spoke of universities as regional leaders citing Stanford and Silicon Valley. However important startups are in regional economies, evidence suggests that the impact of university activities on regional economies is limited, for example, section 8.3.1 shows this is the case in Cambridge and even more limited in Scotland (7.2.1.2).

Argument	Literature section	Example authors	Data section
Are these university entrepreneurial	3.2	Etzkowitz (1998)	8.2.3
Are academic researchers also entrepreneurs?	3.4	Gulbrandsen (2005), Mowery and Ziedonis (2002) and Shane (2004)	8.2.3.1

What incentivises academics to commercialise – money?	3.7.4	Siegel et al (2003); Schankerman (2003); Markman (2004)	7.3.3
Does institutional policy effect academic entrepreneurship?	3.6.3 3.7.7	Kenney and Goes (2004)	8.2.3.2 8.2.3.3

Figure 9.10: arguments and data on academic entrepreneurship incentives and barriers

Gulbrandsen (2005) noting the intention of universities to commercialise, pose the issue in terms of individual academic researchers spinning out companies, patenting or consulting. Mowery and Ziedonis (2002) find increased patenting by academic researchers, however, as Shane (2004) argues, the patent is an *input* and only a *potential output* to commercialisation, if the criterion is profitable trading exploiting research: entrepreneurs purposively take innovation risks to create profit. While Dasgupta and David's (1987) argue that academic and industrial researchers do the same things but for different reasons (papers not profit) and different audiences (peers not market) is appealing, evidence suggest otherwise: academic entrepreneurs pursue answers to social rather than *only* intellectual problems. Incubation managers in both KSA and the UK (section 8.2.1.3) complain that most academic researcher have no entrepreneurial mindset. There are academic entrepreneurs; section 8.2.3.1 gives examples however they are a minority.

Much of the research on academic entrepreneurship is based on US data, for example Ambos et al (2008) and Lam (2010) where IP ownership rests with the individual researchers; unlike the UK and KSA where it is owned by the institution. Incentives structures therefore differ, with the university as an institution driving formal-knowledge academic entrepreneurship, as in the Respondent-28 case. Most of the staff entrepreneurs interviewed draw on informal knowledge, over which the university has no legal rights. For student entrepreneurs, university incubation is mainly unrelated to university research. Shane (2004b) argues that the Bayh-Dole Act in the US, which ascribes IP to the institution, is an advantage. From a policy perspective, it is important that *both* the researcher and the institution are motivated to exploit research.

Researchers have suggested that monetary reward incentives staff academic entrepreneurship (Schankerman 2003), disincentivises academic entrepreneurship

(Markman et al (2004) or is only a part of the incentives (Siegel et al 2003). My research (section 8.3.5) suggests academic entrepreneurs are motivated by control, social contribution and the satisfaction operationalising research rather than monetary reward. For KSA, the point made in section 8.2.2.4 mitigates against this conclusion in that some (especially student) academic entrepreneurs appear motivated to extend their incubation period by receipt of welfare benefits. Otherwise academic entrepreneurs face the same barriers as other entrepreneurs: in KSA (section 8.4.8) these revolve around a culture demeaning SME employment and structures such as company law, IP law and difficulties marshalling resources, with resource marshalling being an important barrier also in the UK.

In summary, the picture I find of academic entrepreneurship is more nuanced than some researchers represent. In both countries commercialisation as a legitimate activity is yet to embed in the mindset and activities of most academic researchers. Little formal knowledge is commercialised in KSA resulting in low-growth companies, whereas in the UK, research are more likely to exploit formal knowledge. This point is missing from KSA policy documents such as KACST reports, which focus on TT as an input into universities rather than as an output into successful products and companies.

9.5.2 Commercialisation inputs and enablers

Three issues emerge from my literature review relating to enablement of academic entrepreneurship, which figure-9.11 summarise. Clark (1998) suggests that successful university commercialisation is enabled by the following inputs: strong leadership of commercialisation; strong UILs; diversified funding sources; strong research base and entrepreneurial culture amongst academic staff. From a university ‘push’ perspective Clark’s findings have stood the test of time.

Argument	Literature section	Example authors	Data section
Push not pull	3.5	Clark (1998)	8.3
Institutional context matters, linking services and TTO structures	3.6 3.7.6	Lam (2011)	8.2.3.4 8.2.3.3
Ideas originating in university	3.6.2	Dahlstrand (2000) Shane (2004)	8.2.3.1

Figure-9.11: arguments and data on commercialisation inputs and enablers

However, significantly they understate the importance of market and product ‘pull’ factors, this is important since evidence (section 8.3) shows that outward orientation towards markets matters (including supply chain, partners and customers). Comparison of SWOTs for entrepreneurship in the UK and KSA (section 8.2.3.4) emphasises that the ecosystem facing SMEs critically influences success: entrepreneurs convert ideas and knowledge into consumer solutions.

Referring back to figure 3.8, incubators may be generalist or specialised: Edinburgh’s BioQuarter is an example of the latter and LaunchEd of the former. As sections 6.3.1.4 and 7.3.1.4 entrepreneurs in both countries accessed a range of commodity (space, office support), specialist and professional services. Lam’s (2011) research shows that some academic disciplines (medicine, biotechnology, software) are more prone to commercialisation than others. This highlights the importance of specialist services being available, adding to points made in 8.2.3.1, that incubators managed by business people are more likely to succeed than those managed by academics, however the business people need specialist knowledge. I also note (section 3.7.6) that few universities offer all disciplines and those specialising in less commercialisable disciplines (theology) are less likely to incubate businesses.

Dahlstrand (2000) and others define a university spinout as taking ideas originated in parent organisation to market and Shane (2004) that the higher the quality of research an academic performs, the more likely s/he is to commercialise. My evidence only partly supports these findings. As section 8.4.3 illustrates, about half of the entrepreneurs I interviewed obtained significant (informal) knowledge from visits abroad, with the exception of Respondent-9 and Respondent-28 few commercialised formal university research. Blumenthal et al ’s (1996) argument that applied research funded by industry is most likely to result in commercialisation sounds intuitively true, however, my research generated no relevant evidence.

I conclude that researchers such as Clark (1998) understate the importance of market-pull and business discipline in considering commercialisation inputs, a conclusion I later include in my revised commercialisation framework. Secondly, that the source of knowledge for commercialisation ventures in KSA (and to an extent in the UK) is not university-generated knowledge, (often purchased TT knowledge in the KSA's case); instead it is more likely to be the transfer of business models or informal ideas gained by staff and students from international study or visits.

9.5.3 Commercialisation processes

This section explores commercialisation processes, leaving legitimacy and financial resource assembly for discussion in the following two sections. Here, as figure 9.12 illustrates, I focus on four problematic issues in the literature.

Argument	Literature section	Example authors	Data section
Stages models	3.6.1	Van de Ven et al (1999)	8.4
Exploitation models: licensing or new firm	3.6.1 and 2.6.2	Hill (1995) Dickson, Coles and Smith (1998)	
Hard work and emotional commitment	4.7.1	Kahneman (1973)	7.4.1 8.4.1
JVs influence research agenda and learning	3.7.4.3	Siegel <i>et al</i> (2003) Meyer-Krahmer et al (1998)	
KSA structures misalign with its technology strategy	2.2.2 3.3.8	Bell (1990)	8.4

Figure-9.12: arguments and data on commercialisation inputs and enablers

In disputing linear models of innovation, Van de Ven et al (1999) speaks of the chaotic journey of academic entrepreneurs (and all entrepreneurs) iterating between dimensions of their business plan and its implementation. Section 8.4 captures some of this seeming chaos confirms (as section 9.5 above does) the non-linearity of entrepreneurship processes.

Researchers have commented upon models of entrepreneurship, with Dickson, Coles and Smith (1998) suggesting that licensing (or sale of IP) allows academics to retain their research focus, point raised also by Radosevitch (1995). Licencing is a more typical route to commercialisation than new company formation (section 7.4.5.1) as Respondent-14, a KSA Science Park Manager (A/15/7) and Respondent-35 (A/35/4) attest. There are three

reasons for this: firstly many academics have neither capability nor inclination to cross-governances into business (PPL in 7.2.3 is an example. Secondly, (section 6.4.4.2 and 8.4.8) many VCs will only invest if business people are leading the venture. Thirdly, starting up a company is hard work and distracting from academic pursuits; Stephan et al (2007) find that commercialisation crowds-out research work and Respondent-28 evidences this (section 8.48).

As section 7.4.7 indicates, startup and growth require high emotional investment and hard work; Danny Kahneman (1973) emphasises the emotional element; as Geuna and Nesta (2006) put it: patent or publish. My research finds that for many academics commercialisation is just too distracting from their main goal (7.4.1 and 8.4.1) and as Smith and Parr (2003) suggest they avoid it and like Respondent-21 yearn to get back to authoring on bee-keeping (A/21/11).

When academic researchers do engage with business, perhaps not to commercialise, there is feedback into their research (section 3.7.4.3 and Siegel et al 2003): interestingly all of the academic staff incubating that I interviewed have continued their academic work in addition to launching businesses.

In summary, data from both KSA and the UK suggests academics that while more UK academics are prepared to facilitate the commercialisation of their research, motivation remains a problem. In KSA, the ethos of universities is yet to accept applied research and its commercialisation with only few exceptions indicating a gulf between *Vision 2030* statements and practice.

9.5.4 Resource assembly and commercialisation

This section addresses three gaps in research literature related to resource assembly as shown in figure-9.13; I also point to significant gaps between KSA policy statements and what I find occurs in practice.

Argument	Literature section	Example authors	Data section
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Research funding: ethics and closed innovation	3.7.4.5 3.7.6	Collinson and Gregson (2003) Wright et al (2004)	8.4.7
Research funding curse	3.7.6	Auty (1985), Sachs & Warner (2001)	1.2
Developing economy policy	2.10.3; Appendix 2	Chang (2005); Smith (2008); Brett (2009)	8.3

Figure-9.13: arguments and data on resource assembly and commercialisation

Section 3.7.6 on research funding shortages, notes with D’Este and Perkmann (2010) that where industry funds research an outcome commercialisation is likely: few businesses fund basic research (though as Pisano 2011 suggests, increasingly business philanthropy funds difficult-to-research diseases). Two issues arise that I have not seen in the literature. Firstly, section (8.2.1.2) raises the point from Collinson and Gregson’s (2003) work that some publicly funded IP in the UK is purchased for private profit by US VCs. A concomitant point is that where individual researchers exploit knowledge arising from publicly funded research there is an ethical issue of private gain at public cost. Secondly, section 3.7.6 discusses the issue of research funding, highlighting researchers such as Wright *et al* (2004) discussing the provenance of funding. My point is that whatever the provenance, many research grants come as closed-innovation: prescribed processes and outcomes (Kinder 2002) that may exclude commercialisation activity or following-up non-specified activities.

Section 1.2 mentions the curse of natural resources (Sachs and Warner 2001) as an explanation of why resource-rich economies can lack innovation. In my experience, many VCs are wary of free cashflow, suggesting it breeds indiscipline and lack of focus. Put bluntly how relevant to building a business is a background in an academic environment and access to free cashflow?

Assistance with business planning, financial structuring and accessing finance and business partners are an important part of the services KSA and UK incubators provide academic entrepreneurs. My own impression is that whilst Arabs freely speak about their personal finances (whereas Europeans are circumspect), in business Arabs are disinclined to focus on money, whereas in the UK it is a central topic.

Section 8.4.7 suggests that few banks in KSA and UK fund startups, however academic entrepreneurs in the UK more than in KSA are pitching to angel investors and using Kickstarter. Only a minority (such as Respondent-28) are of a size and growth potential to attract venture capital. In section 2.3, discussing the importance of institutional thickening Storper and Salais (1997) highlight finance. Here I note the important policy issue facing the KSA Government to promote HNWIs involvement in angel and crowd-funding initiatives.

Despite policy statements, such as KACST (2011) funding of applied research and proof-of-concept in KSA continue to be Government-led and are neither provided nor guided by business. This contrasts with the UK where private funding of applied research is normal and Angel funders (plus grants) fund early stage commercialization. While bank facilities can be difficult to obtain for early-stage companies in the UK, in KSA none are available. Resource assembly for spinout companies in KSA remains a major problem.

9.5.5 Legitimacy and commercialisation

This short section makes a single point. Following Scott (1995), legitimacy is now one of the core concepts in entrepreneurship theory (Venkataraman 1997), hence its incorporation as a building block in my (section 4.4) framework. Legitimacy is recognition as a viable agent in the eyes of the new venture's customers, suppliers, funders and partners (section 8.4.7). Only legitimate companies will attract external investors as section 6.4.5.2 notes. In the same section I note that no single KSA interviewee alludes to business metrics of legitimacy such as breakeven, profitability or margins – though some had achieved this legitimisation. Instead, several refer to legitimacy as formal or legal recognition, for example becoming registered as a company, illustrating naïvety. In discussing legitimacy, I expand Scott's (1995) idea to align with KSFs i.e. legitimacy in the eyes of the market and customers is paramount; legitimacy in the eyes of regulators is a qualified condition prior to market legitimacy.

9.5.6 Governances and culture

Cultures are socially-constructed: patterned behaviour that over time becomes an unconscious predisposition guiding thought and action (Lincoln and Kalleberg (1982 in governances; Bourdieu (1985). Incubator managers in KSA and the UK continually refer to lack of entrepreneurial culture amongst academics; though not articulated the cultural heritage of academic incubator managers and entrepreneurs is an important theme running throughout my evidence (for example figure 8.1; 8.45, 8.46) and a central aspect of my framework (figure 4.1). Researchers now pay significant attention to culture and governances in entrepreneurship (Porter 2009), yet often citing culture as a black box, meaning hidden and cannot be understood or altered. This section addresses some of these issues from literature (figure-9.14) analysing the changes in policy and practice likely to help change cultures and governances.

Business models evolve as entrepreneurs clarify their core value-adding activities (Zott and Amit 2007). Any business planning activity should return again and again to the business model. A simple example: Respondent-24 (7.4.1) changed from a text-charging to an app download subscription model as she gained understanding of her market. Other UK entrepreneurs too reiterated their business models (section 7.4.1). Only Hussein Al Alattar (A/10/11) of the Saudi entrepreneurs spent time thinking about his business model (section 6.3.1).

Argument	Literature section	Example authors	Data section
Business models evolve and can be innovative: are they culturally influenced	2.6.2	Zott and Amit (2007)	6.3.1; 6.4.7; 7.4.1
Incubating companies are typologised by organisational form	3.6.2	Pirnay et al (2002)	8.4.5 8.4.6
Mediating effects - motivators such as age or money	3.7.2; 3.7.3 3.7.4.6/7 3.7.4.8	Owen-Smith and Powell (2001) Audretsch (2000) Colyvas et al (2002)	
Incubator governances: academic hegemony	3.7.7	Franklin et al (2001) Siegel et al (2004) Tuunainen 2002	8.4.5 6.3.3/7.3.3 6.4.5.1/7.4.5.1
Entrepreneurs culture and context: commitment, control or social impact	3.7.1 3.7.4.10/11	Thematic to literature review Porter (2009) Bourdieu (1985) Lincoln and Kalleberg (1982)	8.4.6 entrepreneur governances

Figure-9.14: arguments and data on academic entrepreneurship - culture and governances

In part this difference illustrates the closer connection the UK entrepreneurs have with business people (from business and as incubator managers) and funders (via pitching). Perhaps also it illustrates a cultural trait: the Arab trader buys cheap, sells dear and creates a margin. Saudi people obsessively use the mobile Internet and social media; it is therefore odd that there is little interest in online business models, for example Anderson (2009). There is an inconsistency between Incubator Managers saying they prepare businesses for launch in KSA (section 6.4) and the practice of not discussing business models.

In section 3.6.2 I discuss various typologies of incubating companies. The focus of researchers (Pirnay et al 2002 is one example) is on the organisational relationship between parent originator and new-Co. From the viewpoint of new companies, their organisational relationship is less important than the processes by which they overcome the *liability of newness* by creating their own legitimacy in the eyes of partners and customers.

Section 9.8 above considered the degree to which financial reward motivates entrepreneurs, endorsing Franklin *et al* (2001) and Colyvas *et al*'s (2002) conclusion that control, social impact, and self-esteem are more powerful motivators for academic entrepreneurs. Audretsch (2000) studying biotechnology spinouts suggests that age has an important mediating effect (3.7.2): this may be true in a long-gestation field such as biotechnology and in particular in US universities where only older academics have tenure and less publication pressure. Another dimension to emerge from my research: in the UK students consider it 'cool' to start a business, this is less so in KSA. Addressing these cultural issues is a major policy question facing KSA.

Figure 8.1 contrasted incubator governances between the UK and KSA noting that business people now manage successful UK incubators whereas academics manage in KSA, though this may be changing.

In summary, section 8.4.6 suggest that my research evidence shows a greater market-orientation amongst UK academic entrepreneurs. Partly, business connected and discipline or business incubation managers (benefits; stay time). Researchers and Incubation Managers often refer to entrepreneurial culture, however, researchers rarely dig into issues such as motivation or issues concretising commercialisation such as business models. My research finds greater motivation to launch businesses amongst young people in the UK relative to KSA, assisted by a more practical business orientation in incubation centres.

9.5.7 Outcomes/outputs of commercialisation

There is a dearth of reliable quantitative data on the outcomes and outputs of university commercialisation. More research is required: quantitative studies of incubator cost-benefits and economic impact and qualitative studies with control groups not located within incubators. Figure-9.15 poses questions based on gaps in the literature that this section elucidates.

It is understandable as Bruneel *et al* (2012) argue that incubation-supported startup is more efficient than unsupported startup, resulting in higher survival rates as Sherman (1999) suggests. My experience in commercialisation suggests a failure rate (market or leadership rather than technology) of 50% within two-years (Manigart et al 2002 suggest a 56% failure rate and Gage 2012 75%).

Argument	Literature section	Example authors	Data section
What are the outcomes of university commercialisation activities?	2.7.10; 3.2; 3.3 & 3.7.8	Etzkowitz (1998)	6.5.1; 7.5.1; 8.5
What are the outputs of university commercialisation activities?	2.9.1	Bruneel <i>et al</i> (2012)	6.5.2; 7.5.2
How do university incubation graduate firms perform after launch?	3.7.9/10	Dahlstrand (1997)	6.5.1; 7.5.1
Is institutional change catalysed by success faster in developing economies?	2.3	Hodgson (1993, 2007) Di Maggio and Powell (1983) Archer (1988)	8.5

Figure-9.15: arguments and data on academic entrepreneurship outputs and outcomes

It is therefore difficult to recognise figures such as only 16% of French spinoffs failed over 6-years (Mustar 1997); only 32% of 3,376 US university spinoffs failed in a twenty-year period (AUTM 2012); only 13% of Swedish spinoffs failed over a 33-year period (Dahlstrand 1997), and a European network study finding a two-year failure rate of 9% (EBICN 2012). I am not challenging the veracity of this research, simply pointing out a significant variation from VC industry figures (EVCA 2013).

Figures in section 2.7.10 claim significant economic contribution to economic growth from university commercialisations. However, as my methods chapter notes, evaluating the economic benefits of projects over time, (given multipliers and assumed causalities), is problematic. For example, the AUTM in 2001 calculated that spin-offs from American academic institutions between 1980 and 1999 created US\$ 33.5 billion in economic value-added; this sounds impressive until calculating this is 0.25% (a quarter of 1%) of the year 2000 GDP. Section 7.5.1 gives figures from the Biggar (2012) for Scotland showing a similar amount of contribution; despite references in policy documents such as KACST (2014) to success, interviewees could name successful commercialised research in the KSA.

All incubators were asked for cost-benefit analysis or raw income-expenditure data: none were able or prepared to provide this data (6.5.2; 7.5.2). ERI alluded to internal and confidential financial assessments. Current evaluation frameworks focus on the quality of incubator services and the incubator as a property business, such as Erlewine (2007) which AUTM use. Further research is urgent necessary to produce generally acceptable and comparative data around cost-benefits of incubation units.

The structure and institutions of the UK economy are hardly recognisable compared with those of 50-years ago; still more so is the pace of change in KSA. As section 2.3 argues, citing Di Maggio and Powell (1983), North (1990) and Hodgson (2006); the pace of institutional change in a developing economy/society context is faster. This is because

mimetic, normative and coercive processes are all operating: thin institutions (like loose networks) can be an advantage in times of rapid change.

Successful commercialisation outcomes, as Biggar (2012) notes must include figures on sustained companies successfully trading, either profitably or with a pathway to profit. Despite the absence of cost-benefit figures in the UK, Managers were able to point to successes; this is not the case in KSA where there is an urgent need for auditable figures. Overall, there is a lack of empirical justification for the theoretical claims (eg Bruneel *et al* 2012) that incubated firms launch more efficiently and sustain longer than non-incubated firms.

9.5.8 Knowledge flows and the economy

KSA spends too little on R&D, gets too little in return and fails to attract international projects; a weak entrepreneurship culture is exacerbated by distortions resulting from resource-richness including high-return outlets for capital and high welfare payments and formal education disconnected from industry. Policy claims (*Vision 2030*) that TT and commercialisation are successful in KSA do not match with evidence from practice.

In 2010 KSA launched a decade of entrepreneurship accompanied by various initiatives such as the Fast Growth-100, National Entrepreneurship Centre, the Prince Salman Entrepreneurship Institute and the King Abdullah University of Science and Technology (KAUST). The King Abdul-Aziz City for Science and Technology (KACST) in Riyadh has 200 R&D units and 2,500 projects contributing to KSA's over 26,000 journal papers and 8,000 registered patents. Yet little of the activity is finding its way into new companies and products – the central question of this research (sections 1.2 and 2.10). More fundamentally, lack of commercialisation is not a policy priority. Global R&D is rising and international knowledge flows are increasingly US-EU-East Asia by-passing. Spend of 0.3% of GDP on R&D (UK is 1.8% and 6,000 researchers (UK 250,000), almost zero international R&D is a problem. My first point in figure-9.16 is that KSA policy-makers need to acknowledge the problem.

Argument	Literature section	Example authors	Data section
“Houston, we have a problem” - problematising lack of commercialisation and international R&D	1.2 2.10	Ramady 2005	8.2.4
The knowledge-based economy and knowledge base society misalignment	2.2 2.4	North (1990, 2009); Stehr and Ericson 1992; Boyer (1996); and Castells (1997)	6.2.2.4 and 7.2.2
How different is catch-up in a knowledge-based era of economic development?	1.5; 2.3; 2.4; 3.2 and 3.3	Gerschenkron (1966); Perez and Soete (1988); Krugman (1993); Davison 2000 and Al-Kurdi 2002	2.5.3; 9.4
Is the KSA university system fit for purpose and aligned with Government strategy?	2.1; 2.5; 2.6; 3.7.4.2 and 3.7.4.3	Gibbons <i>et al</i> (1994); Jacob <i>et al</i> (2003)	
Why are knowledge flows interrupted?	2.1	Michelle 2003	6.4.8; 7.4.8 and 8.4.9

Figure-9.16: arguments and data on academic entrepreneurship impact and knowledge flows

Knowledge-based economy and knowledge base society misalignment are observable in both KSA and Scotland. North’s (1990, 2009) point that only Washington-consensus (open democratic) institutions create modern economies is criticised (section 9.15) as ethnocentric. However, as Castells (1997) argues, a knowledge economy does need a knowledge society, freely clashing and developing ideas. Krugman (1993) refers to the development trap: moving from middle to higher income requires an educated workforce creating new competitive products: the challenge facing India, China and Singapore. This is one of Stehr and Ericson’s (1992) reasons for suggesting that privileging economic over societal development cannot work: in effect, Boyer’s (1996) argument that mode of production and regime of accumulation must align. For KSA there appears to be a misalignment between strategic goal and social development.

How different is catch-up in a knowledge-based era of economic development? Gerschenkron’s (1966) argument, which is now integrated into the development state thesis, is that the state can enable rapid catch-up by targeting the importation of advanced technologies even (Davison 2000) leapfrogging market leaders – as many Japanese manufacturers did. Importing knowledge embedded in plant and equipment is entirely different from importing knowledge for knowledge-based products and services since this requires sufficient capacity to understand and adapt the exogenous knowledge not simply

to operate equipment (section 1.5). KSA does not allow branches of international universities to establish in the Kingdom, but has recruited some 1,000 international lecturers and a glance at [higheredjobs](#) (2015) reveals hundreds of vacancies. My point is that despite the importation of foreign knowledge, commercialisation rates remain low. Theoretically, catch-up in the era of more knowledge-based products is more difficult, unless people are imported for applied research on company projects – which as noted above, KSA is failing to do.

Section 9.2 and 9.6 above criticise the weak UILs in KSA's universities, here a more fundamental question is asked. Is the KSA university system fit for purpose and aligned with Government strategy of building a knowledge-based, diversified economy? The data suggests that it is not, (a) it employs an out-dated pedagogy; (b) is not vocational; (c) too much research is not applied, and (d) too disparate. Little seems to have altered since Roy's (1993) critique of Saudi education's formality.

Whereas UK universities increasingly employ problem-centred (action) learning and a pedagogy that encourages critical thinking Kahn (2011) found KSA universities still using talk-and-chalk, lecturer-centric pedagogy. Indeed, even in the incubators, students must follow a programme of courses, distracting focus from their business project. If new ideas and recombinations of knowledge (Gibbons *et al* 1994) are to flourish, Saudi universities need to fundamentally alter their pedagogy.

Jacob *et al* (2003) note that few KSA students and courses are vocationally-oriented. This is in sharp contrast with the UK. In section 6.2.3.4 Respondent-18 and I favourably contrasted the IIT (B) where student dissertations are new products and business plans. Indeed, since Nehru India has carefully deployed IIS and IIM.⁵ Students in Edinburgh on medical, engineering, music or veterinary courses expect modules on business and commercialisation. KSA too should embed vocational orientation and entrepreneurship on all courses and (section 9.6) achieve this by much closer links with businesses.

⁵ Indian Institute for Information Technology; Indian Institute for Science and Indian Institute for Management see Lall 1987; Judd 2004 and Kinder and Rau Das (2015)

Section 8.4.9 suggests that with honourable exceptions such as Respondent-9, few Saudi researchers do applied research, focusing on solving problems, which may result in new products. As section 3.7.4.2 notes, applied research can result in high-level intellectual challenges and (section 3.7.4.3) interactions with businesses identify such challenges. This links with point (d) above and Gibbons et al 's (1994) argument that academic disciplines can either reflect what is comfortable for academics or the needs of society. KSA universities follow a traditional disciplinary structure; they would better follow interdisciplinary paths. What famous for?

In summary, KSA universities need a radical reform of pedagogy, UILs, vocational courses, commercialisation and applied research. Without suggesting that the UK is an ideal type, a comparison reveals four blockages in KSA significantly greater than in the UK: connection to global knowledge flows; manner of distributing knowledge (pedagogy); inability to flow (both ways) between business and university; governances and weak network (between incubators and businesses). These are the barriers a policy agenda seeking KBE must address.

9.5.9 Support for entrepreneurs - theme summary

The major narratives I have found in terms of support for entrepreneurs is the academic entrepreneurship (particular commercialising formal knowledge) is more deeply embedded in UK universities and difficult to find in KSA universities, which have few industry links (in applied research or work-based learning) and poor networking between business and their incubators. By offering generous grants and little business discipline, KSA incubators can become shelters for students rather than engines of innovation. Availability of risk capital is general in the UK and largely absent in KSA, where legitimacy is interpreted judicially rather than in market terms such as sales and partnerships: the *rentier mentality* appears still strong in KSA. While business people now manage UK university incubators in KSA they remain managed by academics. Neither country gathers robust value-for-money data on its incubators, however it is clear that the expensive infrastructure in KSA produces few successes, unlike those in the UK. KSA incubators exploit informal

knowledge gathered on international visits by staff and students rather than the expensively purchased TT, whereas formal knowledge flows in the UK result in some basic and applied research being commercialised. Overall, the UK can point to some success in its commercialisation strategy whereas in KSA there are major gulfs between policy pronouncements and practice.

Theories of academic entrepreneurship such as Shane (2004) find little verification in a developing, resource endowed economy such as KSA, where institutional arrangements and culture act as barriers to innovation and are unlikely to drive catch-up. I find that Clark's (1998) 'push' factors (leadership, UILs) remain a valid explanation of UK relative success and KSA's current lack of commercialisation. Absence of UIL Siegel *et al* (2003) and membership of international research networks adversely effect KSA's ability to commercialise advanced technologies, harmed also by the lack of risk capital (Chang (2005) and discourse about business models. Gerschenkron's (1966) idea of catch-up, is dated, synthesising it with Castells' (1998) idea of knowledge flows is useful, however, KSA is unable to exploit commercially its purchased knowledge flows, because of institutional constraints.

9.6 Answers to research questions and theoretical contribution

In developing economies, transferred technologies often fail when infrastructure, human capital or culture prove inadequate (Chang 1995). More optimistically, appendix-2 gives examples from China and India of successful TTs. KSA is a rich country with an advanced infrastructure, education system and Government deeply committed to acquiring and exploiting advanced technologies. Yet, as sections 9.14, (drawing from 6.5.1; 7.5.1 and 8.5) show, the record of successful commercialisation of university knowledge in KSA is poor. Why is this the case, what can be done about it and are our theoretical models adequate to explaining why KSA performs badly? Having spent 20-years working in Saudi commercialisation, my PhD research set out to answer these questions, which I now do.

Having selected and justified three research questions (1.4 above) their theoretical (1.6) and practical significance (1.6), section 1.7 illustrated the intellectual flow of my research:

critically reviewing literature to identify gaps and arguments (chapters 2 and 3) referencing the UK as a comparator, suggesting an analytical framework to structure the research (chapter-5) and then justifying a method of assembling and analysing data (chapter-6). In chapters 7 and 8, I assembled original data from original interviews, public reports and previous empirical research, which I subjected to in-case and cross-case analysis, and in chapter-9 have reintegrated these results with previous research. The purpose of this section is to bring my intellectual journey to a conclusion; setting out what I have discovered. In answering my research questions I assemble evidence justifying (and challenging) my answer, then highlight the theoretical and policy implications of my answers. To assist the reader (and myself) each of the following three sub-sections begins with a summary table.

9.6.1 Answer to research question-1

My answer to RQ-1 recognises that only in the last two Five Year Plans, has the diversification vision and commercialisation strategy been articulated (figure-9.17).

Institutional change model

North (1990; 2009) adds significantly to our view of institutions and institutional change in particular ideas of explaining stability change using institutional analysis featuring active agency, though Archer (1998; 2007) improves on his agent-structure formulation.

Research Question-1	What is the contribution of state owned science parks and business incubators in Saudi Arabia towards commercial innovation and entrepreneurship?	
Summary answer	Saudi university-based incubators have been established as an important part of a strategy to diversify the economy as oil revenues decline. They are not yet delivering significant new products and businesses facing institutional barriers, cultural barriers, governance clashes, and interrupted knowledge flows. Significant areas of economic development and commercialisation theory fail to guide KSA policy-making and implementation. Marshalling resources behind a clearer national vision of the future will assist KSA's diversification strategy. Comparison with the UK shows that some of these issues also arise.	
	Evidence	Section(s)
Supporting evidence	• OK on inputs, so far: universities, R&D, incubators	9.2.1
	• Low R&D spend	9.15
	• Inputs but outputs papers and patents	9.15
	• Problematising lack of commercialisation	9.11
	• TH myth: statist version, cross-cultures, state hegemony	9.4
	• Non-entrepreneurial universities and academics	9.8
	• Governances	9.13

	• Mediating effects	9.13
	• Outcomes and outputs	9.14
	• International knowledge flows	9.15
Counter-evidence	• Oil and gas and international oil companies; health tourism	9.13
	• 100k students study abroad	9.13
	Author/theory	
Theory contribution	• North (2009) wrongly dismisses alternative models	9.15
	• Gerschenkron's (1966) theory dated in era knowledge economies	9.15
	• The development state thesis may prove a model for KSA	9.15
	• Etzkowitz's (1983) triple helix lacks empirical support as significant in either a developing or developed economy	9.3, 9.5 and 9.8
	• Governances clashes challenges academic entrepreneurship theory application to developing and developed economy	9.13
	• Outcomes and outputs – need for systematic quantitative research	9.14
Policy agenda	• University system needs radical change: UILs, pedagogy and vocational courses – reinforcing curse of resource richness	9.15
	• Need for CBA evaluation of incubators in both countries, also access policies and business leadership	9.10
	• Cultural and governances issues in both countries	9.13

Figure-9.17: Summary of RQ-1 answer, noting my theoretical contributions

As I argue in section 9.15 North's insistence that economy modernisation is necessarily accompanied by adoption of open democratic government (i.e. accepting pluralism and alternative centre of power) contradicts Japanese, Korean, Taiwanese and now Chinese experience (Chang and Grabel 2004); arguable the openness and tiering of India's public administration is a barrier to modernisation (Smith 2008). My contribution goes further than disputing North in three ways.

The cultural and governances changes required from universities are at an early stage (9.2.1). That said problematising commercialisation, especially culture, governances and structures is essential if commercialisation is to be more. Whilst these are matters of degree, compared to the UK, KSA has less entrepreneurial universities and academics. Outside of my research footprint and outside the incubators, there may be counter evidence showing that in oil and gas large companies and family firms are commercialising. KSA universities (section 9.15) are not focused on commercialisation; they are rarely partners in significant international knowledge flows.

Placing incubators (especially specialists such as biotechnology) proximate to universities has many advantages, though there is little formal knowledge flow between the incubators

and the universities. As interviewees in the UK and KSA suggest, expecting research academics to cross governances and effectively manage incubators is unrealistic: the incubators need to be managed by business people and may be better (some at least) located on business premises. These arguments have implications for my framework, which I return to below.

Catch-up in the era of knowledge economies

Gerschenkron's (1966) argument that state-supported technological leapfrogging can enable technological catch-up is now dated, since comparative advantage rests in knowledge stores and their exploitation rather than the possession of product and process artefacts. This argument reinforces the importance of institutions with absorptive capacity and the ability to generate and exploit knowledge; it also underscores the changing ('softer') role of the state in development without at North does, insisting on open Government.

The development state thesis may prove a model for KSA

Development state theory, suggesting that mobilisation around a national vision, led by an expert bureaucracy, which is now integrated into the development state thesis, is that the state can enable rapid catch-up by targeting the importation of advanced technologies even (Davison 2000) leapfrogging market leaders, with a determined policy agenda privileging economic over socio-political advances has worked successfully as an Asian model. My suggestion is that for a country such as KSA, seeking modernisation without westernisation, this may be a model to follow.

Production and consumption alignment

Thirdly, choosing to follow this model sets the challenge (Boyer 1996) of aligning production mode with regime of accumulation: in particular knowledge-based creativity (in the case of KSA) with its inherited Arabic and Muslim culture. Imposition of a western consensus on KSA would be (in Weber's terms) an iron cage, not a light cloak. KSA has to evolve its own institutional arrangements, which as Brett (2009) argues are likely to differ from those of developed economies because market entry is contested. KSA has a

unique Islamic/Arabic heritage an *organic solidarity* (Durkheim) that will influence and in turn be influenced by the exigencies of operating in global markets.

Finally, in agreeing with critics who challenge the applicability of TH to developing contexts, I argue additionally that TH theory is also inapplicable to the UK context as a policy – its use is best confined to a laudable metaphor not a policy guide.

The triple-helix is not a policy guide

Section 9.3 presents research evidence (Said 2004) and empirical evidence (data sections 7.2.1.3 and 8.2.1.3) that for developing countries, lacking institutional thickness TH theory (Etzkowitz 1983) is an inappropriate guide to action for developing countries. I further agreed with Mowery and Sampat (2004), citing evidence in section 9.5 and 9.8, that there is scant evidence supporting theory in the UK. My conclusion in 9.8 is that TH theory is best seen as a metaphor or ideal type and not a guide to action in developing countries.

Governances in developed and developing economies

That institutions matter is beyond dispute, following North (1990) section 2.3 argues that useful institutional analysis explains both stability and change: institutions are the (stability) end point of active agents pushing against or combining habituses to create a new world more suiting their aspirations. In short, path dependency or direction-of-travel are not pre-determined; outcomes alter with agents' aspirations and their ability to negotiate and act upon new governances including (Sender 2001) an entrepreneurial habitus. My point in section 2.3 is that developing countries lack untraded interdependencies (Storper 1997) and institutional thickness (Amin 1994) in the same way that less developed regions within developed countries are disadvantage. The difference of course is that institutional isomorphism is easier when the best practice example is proximate, in a similar cultural setting and is part of the same meta-institutions: this is the situation facing universities in the UK's deprived regions. I argued in section 9.4 above, that the challenges of catch-up (Gerschenkron (1962) grow more complex for a developing economy in a global economy privileging knowledge products. To draw from global strategy literature, KSA commercialisation faces a wide psychic distance (Johansson and

Vahlne 1977) from best practice and elongated network building processes to overcome the liability of newness (Mathews (2002a and 2002b) by learning, linkages and leverage. There is an important lesson from Japanese success here. The machine that changed the world did not diffuse lean production technology by trading with indigenous firms, rather as Womack et al (1990; 1996) and Oliver and Wilkinson (1982) show, their processes and culture became an exemplar via knowledge spillovers. Seeking knowledge spillovers from international R&D sources seems therefore an important way for developing economies to address the deficits alluded to in section 9.4 and challenges Storper, Amin and global strategy theorists pose. Attracting international R&D and amplifying spillover effects (culture, ways-of-working and commercialisation processes) appears from theory important to KSA leap-frogging into the governance successful R&D commercialisation requires.

Policy: academic priorities

Two important policy recommendations arise from this part of my research. Firstly, in both countries a much higher proportion of academic researchers need to prioritise commercialisation above papers and patenting (9.15): this will only occur if appointment and promotion policies reflect this re-balancing (9.13 mediating effects). R&D spend at 0.3% of GDP is low; in difficult budgetary times, it may be that cumulated resources can be deployed into a (Norwegian-style) development fund. TH is not a model for KSA (or other developing states), who need to recognise a greater degree of state leadership coupled with devolved power and resources and encouragement to experimentation (especially in hybrid organisations such as joint incubator-HNWI angel networks and corporate venturing).

Policy university reform

Section 9.15 concludes that the KSA and UK university systems need reform. In the UK's case this means going further along the existing direction of travel by encouraging a culture of UIL and commercialisation, strengthening internationalisation and cross-cultural learning environments, improving action learning where it is weak and making creative use of online learning, using contact time for critical discourse rather than information

transmission. KSA's university is not fit-for-purpose, if the purpose is supporting a knowledge-based economy and commercialisation; debate around this purpose will undoubtedly be conflictual (Islamic scholars and academics) and will require strong leadership. Reform should include the following four points.

- Most fundamentally KSA universities need a more active learning pedagogy, centred on problem-solving based on applied and joint with business faculty research and encouraging critical thinking by students: this should reflect in curricula design, teaching methods and assessments.
- To strengthen UILs, KSA universities should benchmark with successful models (such as IIMB, IITB); encourage businesses to work with university in knowledge transfer partnerships and work with business bodies to introduce more vocational courses. Regular transfer of staff between industry and university should be encouraged. Structures and resources should fund more applied research pulled by suggestions from business (including international businesses and research centres).
- Inter-disciplinary structures, research centres and courses should be encouraged, taking advantage of online opportunities to merge knowledge repositories and student interaction (Christensen et al 2011). Such courses should be offered internationally.
- Universities should evolve into international learning environments encouraging staff and students from abroad

University reform is a major policy question facing KSA and the UK that should reflect cultural heritage and values; for this reason I do not agree with the one-best-way package of reforms Christensen and Dyring (2011) propose, which amount to diffusing the US model.

9.6.2 Answer to research question-2

My answer to RQ-2, (see figure-9.18 summary), revolves around culture and structures. Compared with the UK and other countries more successfully commercialising university research, KSA has important structural deficits including: unclear IP law; inadequate company law; inefficient capital and exit markets; and disincentivising capital gains

taxation (SWOTs; section 9.19). Unlike the UK where for young people owning a business is ‘cool’ (9.12 cultural preferences in KSA favour Government or large company employment (9.2.4). Whereas UK universities increasingly expose young people to business (9.6) and vocational course (9.15) this is not the case in KSA, where also academics are disincentivised from commercialisation (9.8) by governances favouring publishing or patenting. KSA incubation is a pushed rather than pulled by markets, having too little connection to existing businesses ((9.9).

In the UK incubators and SSIs business people increasingly managed, whereas in KSA they are overly influenced by academics and under central government control (9.7). Unlike the UK, KSA is excluded from important global knowledge flows not attracting international R&D or participation in joint-university research projects (figure-9.18). UK incubators encourage pitching and exposure to VC, Angel and crowd-funding sources – KSA lacks sufficient risk capital sources (9.11).

Research Question-2	How do financial, social, cultural and human capital blend in KSA’s innovation and entrepreneurship processes and how might their impact be improved?	
Summary answer	Relative to both the UK and its own contextualised needs, KSA has important structural deficits inhibiting innovation including the incentivisation of researchers, ability to attract international R&D and the management of its incubation centres. These couple with issues in company and IP law, capital markets and tax law along with the governances and pedagogy in its university system. Existing theory neglects the challenges facing the KSA: a resource-rich country, with Arabic and Muslim traditions. Clear national leadership, including a preparedness to devolve and experiment can mitigate these barriers.	
	Evidence	Sections
Supporting evidence	• IP, risk capital, company law; tax, exit markets	9.19; 8.2.3.4
	• Human capital: motivation/capability to commercialise	9.6
	• Cultural disincentives	9.2.4
	• Legitimacy ‘cool’	9.12
	• Little vocational orientation	9.15
	• UILs	9.6
	• Agency in SSIs, focus, centralisation	9.7
	• Pull and push	9.9
	• Disincentives to academics	9.8
	• Resource assembly	9.11
	• Interrupted flows	9.15
Counter-	• Sub-cultures	9.2.3

evidence	• Family businesses	
	• Academic entrepreneurs in both countries	9.6
	Author/theory	
Theory contribution	• Insufficient active agency in KSA NSI and to allow devolved leadership, risk-taking, business leadership and experimentation	9.5
	• Little evidence of academic entrepreneurs in UK or KSA	9.6
	• Innovation in incubators pushed not pulled: lack of market and business discipline in KSA incubation	9.9
	• Resource-richness theory (Auty 1985) and <i>rentier mentality</i> (Beblawi (1987): links to culture	9.11
	• Transition routes from rentier state – issues for KSA	9.4
	• Knowledge flows mainly informal and recombinations not formal	9.9
Policy agenda	• IP, risk capital, company law; tax, exit markets	9.5
	• Motivating academic entrepreneurship	9.6

Figure-9.18: Summary of RQ-2 answer and contribution to theory

Active agency in NSI, SSI and clusters

Throughout this research I have emphasised the need for active agency in leading SSIs and generally in institution-building (9.5). I now see this formulation whilst correct is inadequate since the agency needs also to be capable of providing business development leadership (which many academics can not) and to be nested in wider institutional arrangements allowing experimentation with cross-governance projects having devolved authority and resources from the centre.

Evidence of academic entrepreneurs in UK or KSA

Only two of the entrepreneurs interviewed (Dr Saud and Respondent-28) conform to the idea of academic entrepreneurs commercialising formal knowledge from their university research. This is scant evidence for academic entrepreneurship, in particular, the claim that it amounts to a new innovation paradigm discussed in chapter-3. Indeed, in both the UK and KSA incubation managers point to low commitment by academic researchers to commercialisation. I am not suggesting that academics in KSA and UK are not entrepreneurial, rather that their activities are not mainly in the direction of starting and building new businesses based on their research. The business entrepreneur has a business purpose towards which s/he creates an innovation, marshals resources, seeks business legitimacy: all of which require risk-taking. As US research, and the Dr Saud/ Respondent-28 examples illustrate, there are academics who can straddle business and university governances, however these are a minority. One of my theoretical contributions is

therefore to question the generalisability of academic entrepreneurship and to suggest that much more quantitative research on its outputs is necessary before the theory can be regarded as general applicable. Research, such as Massa and Testa suggests misalignment of goals between entrepreneurs, academics and policy-makers.

Pulled not pushed incubators

University commercialisation aims to create linkages between new knowledge, solutions to problems that can be profitably exploited (technology) and the resources (including capital and leadership) capable of starting and building a business. As section 10.1.2 below makes clear, the old debate between pull and push in innovation studies ended with agreement that both are necessary; hence my criticism in section 9.9 of Clark (1998) for being mainly concerned with knowledge-push. For generalist incubators (such as Edinburgh students and KAUST) the pull is resolved by proof of concept and market testing; linking with existing businesses and funders. Experience suggests these businesses rely on informal knowledge, recombinations of practice and whilst viable are not likely to prove high-growth. Specialist incubators (medical devices, software, biotechnology) face different pull issues; in their case identifying exploitable knowledge and pulling the knowledge and/ the academic entrepreneur into incubation. My contribution here is to highlight the proactive nature of incubation in specialist fields and therefore the need to facilitate regular knowledge audits by business people of researcher's work, seeking exploitable knowledge.

Resource richness and innovation

In a rentier state, the ruling elite uses their unearned wealth to buy loyalty and internal peace (Field 1984d; Auty 1985, 1999, 2001, 2001a, 2002, 2004). Much of the rentier state literature focuses on national level settlements and the effect on institutional development and relationships with the ruling family/elite (Bulte et al 2005; Losman 2010) relationships not effort are rewarded with Government contracts and sinecure employment. Instead I want to focus on two less researched aspects of the oil rentier state: firstly, its impact on the broad populace and secondly, likely transition routes from an unsustainable model.

Research such as Sachs and Warner (1995, 1999); Auty (1997, 2001), and Sachs (2001) allude to resource-richness disincentivising innovation and entrepreneurship since focus is on consumption over investment or (for example Collier 2008) that it promotes instability from inter-elite battles for control. My research (9.11) suggests that Government welfare payments (including subsidising incubation tenure and extended periods of study) act as disincentives to entrepreneurship and additionally, HNWIs faced with risky startup investment or assured 10% returns on property investment, take the latter choice. These predilections are mix with an Arab culture to invest in things (gold, property) and the Muslim aversion to usury. My research reveals a rich problem for future research.

Beblawi (1987; 1990) uses the term *rentier mentality* to describe how Saudis view themselves as dependants on the ruling elite; what Moore (1998) graphically terms subjects rather than citizens, with accompanying expectations of state benefits. These benefits in KSA emerged under King Faisal's state building in the 1950s and 1960s emerging as Hertog (2007) shows as a model of expatriate labour working (in advanced and menial jobs), whilst Saudis benefited from Government sinecures or generous benefits. This is what I have termed the value-distributing state. What value is created apart from rentier income derives from vibrant markets in property and stocks. Launching the 8th Five-year Plan outlining the commercialisation strategy to diversify also proposed an indigenisation of the labour force. Whilst numbers of expatriate labour seem to have declined, the *rentier mentality* remains strong and is a major cultural obstacle to company startup and innovation, since Saudis continue to expect a high living standard without effort: my contribution to debate on KSA development.

Transition routes from rentier state – issues for KSA

As I have shown, institutional theorists such as North (1990) point to only one transition route for KSA – to adopt western open institutions (see also Kolstad and Wiig 2009 and Collier and Hoeffler 2009); I suggest other transition routes, including the development state model, which includes a value-adding state. Rentier state theorists tend to adopt North's position. Chaudhry (1994) suggests as a transition route, adopting neo-liberal market institutions; the impact of which in KSA would be significant destabilisation, a

position with which Losman (2010) agrees, though he presents no alternative. Hertog (2007) believes that another period of state modernisation in KSA will shift towards the value-adding model, however Ulrichsen (2011) argues such a strategy will bring conflict into the settlement between the house of Saud and Islam. My view is that the policy of indigenisation is the correct approach: bottom up incentivisation of Saudis to take employment, including startups.

Knowledge flows mainly informal and recombinations not formal

Section 9.9 reveals that most of knowledge used by KSA and UK entrepreneurs was informal not university research, often obtained from foreign travel or recombining existing knowledge to new purposes. Gibbons (1994) suggests that universities organising research themes (or to be even more focused jointly with companies, organised for a business project purpose) are more likely to be interdisciplinary. Respondent-28 is a good example, drawing in software and computing disciplines following the initial geology discovery. Section 2.1 argued that active learning rather than passive KM better conceptualises the processes of understanding and using new knowledge, some of which is likely to be tacit learning - not necessarily associated with codification cycles as Nonaka and Takeuchi (1990) suggest. Knowledge distribution is especially important in multidisciplinary teams, since negotiating meaning (definitions and causalities) is a well of innovation. To return to Gibbons, purposiveness is important to commercialisable research, which as section 2.2 argues means reducing the distance between science (discovery) and technology (product and sales). Incubation managers in KSA and the UK are unhappy at the siloed organisation of research in their respective universities.

Policy: IP, law, tax, risk capital, exit markets

The UK has evolved structures supporting startup and commercialisation over a 35-year period; areas in which KSA is beginning to innovate. Perhaps a ten-year timescale for change could be agreed and an experienced agency (such as the European Venture Capital Association) appointed to guide a structural change process.

Policy: Motivating academic entrepreneurship

UK and KSA reward structures privilege journal publication above teaching excellence, administration contribution or commercialisation. This is understandable given the importance of research in international university indices such as the Financial Times, Economist, AMBA and AACSB rankings. It is notable that UK universities rank highly because they focus on journal output rather than commercialisation – a major challenge for incubation managers that needs attention. Benefactions to UK universities (for example the Saudi billionaire Wafic Saïd’s funding of Oxford’s business school) and many other corporate donors are international companies. Improving research output, teaching and commercialisation at the same time is challenging and will require game-changing injections of resources and their management by capable people.

9.6.3 Answer to research question-3

Conventional wisdom is that KSA must die in order to enter heaven: it must reject its heritage and identity and westernise in order to modernise. Whilst rejecting this argument, the leadership of KSA has not articulated an alternative: my research points to a way of doing this; figure-9.19 summarises my answer to and issues arising from RQ-3.

Research Question-3	Why do innovation and entrepreneurship processes in KSA appear less effective than those in the UK?	
Summary answer	Whilst structural issues inhibiting commercialisation may be addressed, deeper institutional and cultural issues explain KSA’s poor 303 relative to the UK. Theoretical approaches such as TH, NSI and SSI that simply record these differences are of little use in promoting change. Dominant models of development (North; Porter) dismiss the possibility of modernisation without westernisation. KSA may benefit from exploring alternative models, such as an Arabic version of the development state model; though alignment between social and economic/ technological change poses change challenges. KSA’s university system needs fundamental reform including new approaches to pedagogy, organisation of disciplines and engagement with industry.	
	Evidence	Section(s)
Supporting evidence	• Meta-institutions think, centralised, top-down: low experimentation;	9.2.1 and figure 9.2
	• Social/economic misalignment; sinecures, big government jobs	9.2.4
	• Supports Porter on NSI but NSI no policy agenda	9.3
	• UK attracts international R&D; global knowledge distribution	8.2.3.4; 9.15
	• UK better KBE vision	9.4
	• Less formal knowledge commercialised	9.15
	• Value-distributing state	9.4
	• Hybrid organisations	9.4
	• Women’s contribution to entrepreneurship and innovation in KSA	9.2.4; 9.4
	• Welfare payment and the rentier state	9.11
	• Exogenous shocks	9.4

	• Crossing governances	9.13
	• Interrupted knowledge flows	9.15
	• Radical university reform	9.16.1
Counter-evidence	• Development successful: universities, R&D, incubators	9.2.1
	• TH faulty in both countries	9.3
	• UK (like KSA) elements not buying into vision	9.3
	• Both exogenous shock fragile	9.4
	• Both alienated underclass	9.4
	• Balance of basic and applied R&D	9.6
Theory	Author/theory	
contribution	• Bowles and Edwards (1993) aligning production and consumption	9.2.4
	• State experimenting – stepping on stones	9.4; 9.16.2
	• Huntington wrong: Islam can be innovative	9.2.2.
	• Contribution of women to entrepreneurship and innovation	9.2.4; 9.4
Policy	• Culture matters: UK and KSA (reinforced by <i>rentier mentality</i>)	9.11
agenda	• No bottom up push for change – how to do it changing governances	9.2.4, 9.13

Figure-9.19: Summary of RQ-3 answer and contribution to theory

Saudi meta-institutions (9.2.1), principally Islam and the Monarchy retain the support of the Saudi population. That is not to say these meta-institutions are not criticised, for example for being overly centralised and top-down, which inhibits experimentation. Other criticisms include waste of resources on vanity projects, the limited contribution of women to entrepreneurship and a university system failing to deliver effective teaching, research or commercialisation.

Theory aligning production and consumption: vision and stepping on stones

Although meta-histories differ in emphasis between state (Mokyr 1990; Mazzucato 2013) and market (Landes 1998) as influences all agree that a combination of decentralised experimentation (vertical) and (horizontal) economy/society alignment is necessary for long-term growth. Bowles and Edwards (1993) using regulation theory as an explanatory framework for US technological history show that as modes of production alter, so too must regimes of accumulation. Post-war UK history demonstrates a shift from manufacturing to services and with it more knowledge-workers and knowledge-related employment.

As I noted, this creates a problem for social groups disconnected from globalisation and with low knowledge capabilities. Since 1932, the Saudi economy has been dominated by oil, religious tourism and later financial services. Having established a knowledge-

economy vision the Kingdom now faces the challenge of migrating mode of production (including university commercialisations) and consumption regime (education of staff, lifestyles promoting creativity). These are big, meta-historical issues. Such changes cannot be legislated since they stem from cultural practices that evolve over time, discarding outmoded habituses in favour of the new. A clear vision of the (knowledge economy) destination is crucial to change. Technological paradigm shift do not occur evenly, quickly or without failure of some experiments. Deng and Nehru are characterised by their vision (wealth, strength and independence and for Nehru science, independence and social progress). KSA needs an overarching vision that agents support and work to achieve. For example, company-sponsored and private universities could be an experiment, from which some positive lessons are learned and other experiences rejected. For example, Hewlett-Packard has an international network of company-run incubators and may be persuaded to establish one in KSA. In section 9.4, I used Deng's metaphor of stepping on stones to cross a stream – one step at a time, experimenting, giving up central control, negotiating consensus around a vision of the future. Bold leadership will be needed.

Islam can be innovative

Section 9.2.2 above rebuts Huntington's (1996) argument that Islam somehow retards innovation referencing economic performance in Turkey, Kazakhstan and Xinjiang and Muslim entrepreneurs in the US and UK and the success of large Saudi companies. Since 1978 Muslims have been awarded 11 Nobel prizes including one for physics and two for chemistry.

Women's contribution in KSA

Women make an important contribution to the UK economy having a 68% labour market participation rate: it is 5% in KSA. Half of the self-employed in the UK are women and women lead one-in-five businesses (<http://www.prowess.org.uk/facts>). In developing countries women-led businesses (often small-scale manufacturing or services) are important for economic growth (Mead and Liedholm 1998; Langowitz and Minniti 2007), reducing poverty (Pralhad and Hammond 2002) and as Eddleston and Powell (2008)

argue, women's' self-fulfilment. In many countries, developing and developed, the different nature of women's social capital (Rankin (2001), in particular raising capital, is a major inhibitor. Research in other Muslim countries, shows that whilst issues around balancing work and home can inhibit women starting businesses, startup has the advantage (see Jamali's 2009 research in Lebanon) in overcoming discriminatory labour markets. Pointing out that the Qu'ran raises no objections to women working outside the home, Roomi and Parrot's (2008) argue that in Pakistan demonstrates that all Islamic societies underestimate the business contribution of women. In China it is said that women hold up half of the sky: in KSA's economy they do not. Legitimizing startup and outside the home working in KSA will contribute significantly to innovation rates and non-oil GDP growth; it may also reduce emigration.

Policy: Culture matters: UK and KSA

Culture is a social construction, embedded ways of thinking and doing arise from patterned behaviour (mimetic) but also from manipulation (normative and coercive): this is after all why strategies are set – to shape cultural change in a privileged direction. Deterministic uses of culture, such as Pack's (2008) argument around Asian flexibility versus Arab intractability are unhelpful, since active agents are left with no possibility of making changes. Rothaermel et al (2007) argument on structural changes to motivate academics appears more useful in the UK context, where basic institutions to create knowledge are in place. KSA faces the deeper challenge of legitimising commercialisation in the mindset of businesses and academics within a wider cultural context distorted by resource-richness and its accompanying demotivation of innovation and risk. Managed cultural change is the result of hundreds of small actions that add up to quantitative movement: this is the agenda KSA's leaders need to instigate.

Policy: No bottom up push for change – new governances

My point above on aligning the new knowledge-based strategy with social morès, consumption patterns and evolving social structures, using decentralisation to allow

experimentation translates in policy terms to using *reflection-in-action* (Schön (1983) to allow new governances to emerge. These new governances, as Kooiman and Jentoft (2009) note may be messy and hybrid, (for example public-private partnerships, social enterprises, user-led cooperatives). Only by after top-down risks (one thinks of King Abdullah and the launch of KAUST) will pressure from bottom-up grow to alter for the better KSA's governance structures.

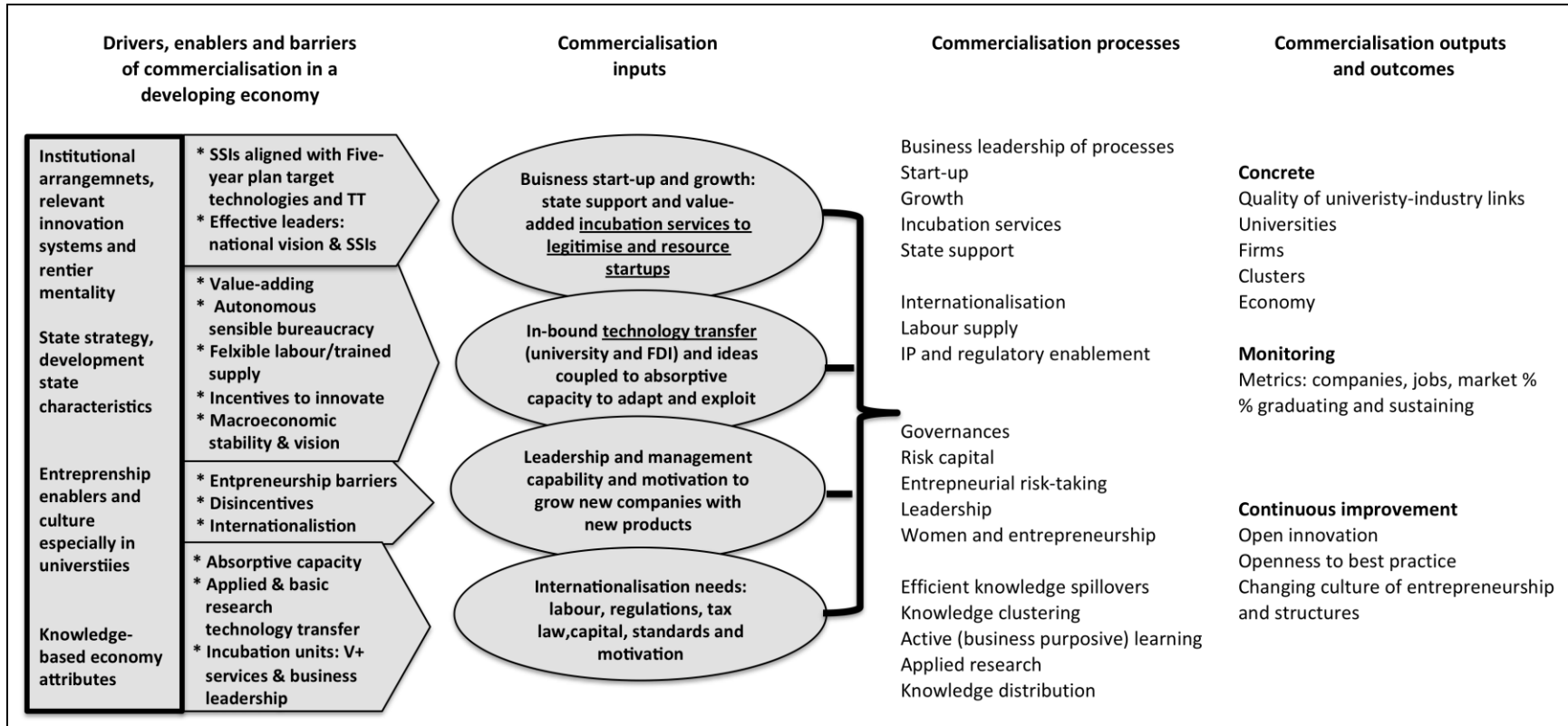
9.6.4 Framework revision and theoretical contribution

Following Charmaz (2007) having presented and used in data gathering, presentation and analysis an initial framework (figure-4.1) as a result of my research I now (figure-9.20) amend the framework as a contribution to theory of commercialisation in resource-endowed, developing economies as part of my contribution to theory.

Under drivers and enablers the framework now includes a specific reference to rentier mentality given its importance as a disincentive to entrepreneurship, and to entrepreneurship enablers is added *especially universities* given importance of shift from rote-learning to active learning, problem-solving and embedding university-industry links into teaching and applied research. I have added the reference to (TT) technology transfers to the SSI arrow, given the importance of seeking to transfer technologies the universities will commercialise and in the same arrow the importance of national leadership and vision (development state ideas) behind which to enrol people and resources – a major problem currently in KSA where the gulf between policy and practice is apparent. To emphasise the point, I have also added *vision* to macro-economic stability, since the vision must deliver degrees of both stability and change. Against flexible labour, I have added *trained* highlighting the necessity of young people to accept that vocational education is relevant. *Applied* is added to basic research given the finding of researchers lack of preference to work on joint project with businesses. Finally, in the left side of the framework, I have added *business leadership* to the section on incubators given its importance. The commercialisation inputs column is unaltered except for the inclusion of capital in the lowest circle. I now head the column on commercialisation process with *Business leadership of processes* a major finding from my research and in the final column include

Quality of UILs as a major output (and input in subsequent cycles) of commercialisation.
This final framework will appear in my research publications and further research.

Figure=9.20: Revised conceptual framework



	Introduction: main themes arising from research
10.1	Research question answers and contribution to knowledge
10.1.1	Institutions, culture and the developing economy
10.1.2	The Triple Helix and systems of innovation
10.1.3	Support for entrepreneurs and academic entrepreneurship
10.1.4	Revised conceptual framework of commercialisation in developing countries
10.2	Validity and generalisation
10.3	Policy implications
10.4	Empirical contribution
10.5	Management practice recommendations
10.6	Publications plan
10.7	Further research
10.8	Dissemination and impact

Figure-10.1: Structure of Chapter-10

10.1 Research questions answers and contribution to knowledge

Whilst cultural, institutional and structural differences explain the better performance of the UK in commercialisation than in KSA, weaknesses in culture, institutional governances (not structures) are evident in both countries. Despite significant investment, there is a low level of successful commercialisation (company) outputs and (economic and social) outcomes in KSA: my answer to research question-1.

Structures are the legal, fiscal and market enablers or barriers to commercialisation in particular and to entrepreneurship and innovation in general. Specifically, KSA has inadequate structures relative to the UK for IP law, company establishment and ownership

changing, raising risk capital and exit markets. These structural deficits also feature significantly in my answer to research question-2, however cultural and institutional issues predominantly explain why the linkages in my framework are stronger in the UK than KSA. In particular, KSA is weaker than the UK in university governances (applied research and UILs); the passive non-problem based pedagogy; shortage of human capital for startups and SMEs (exacerbated by the low women's participation rates) and preparedness of central government to devolve resources and encourage experimentation. Commercialisation processes in KSA are also weaker than in the UK, where the processes remain imperfect and unsystematic: my answer to research question-3. For both countries, the challenge of improving commercialisation processes is one of adjusting institutional governances and the culture predisposing relationships between academic researchers and incubators on the one hand, and business leaders and funders on the other hand.

I discuss structural policy and management issues below in section 10.7 and 10.5. Here I note that the KSA has these important structural deficits, which contribute towards 'thinner' institutions and a negative culture - acting as important barriers to the commercialisation of transferred or indigenously generated knowledge. Section 10.4 below summarises my contribution to the body of empirical findings.

My answers to these research questions as been informed by theory: what does previous research and theoretical frameworks lead us to expect to find, and how does this align with what we actually empirically discover: what does my research add to this body of knowledge? Figure 10.1 classifies the theoretical contributions highlighted in chapter-9 under three headings, which I now discuss: these are commercialisation in developing countries, KSA's commercialisation strategy and academic entrepreneurship.

10.1.1 The Triple Helix and commercialisation in developing countries

Since Veblen (1965) and Sleznick (1949) we have understood the importance of institutions to economic success, social well-being and innovation. Di Maggio and Powell's (1983) work highlights the importance of isomorphic change in shaping institutions to mirror models with proven success, not least of which as figure 4.1 captures

is the cultural glue influencing relationships between agents in different institutions and reshaping institutions (section 2.3). Comparing the UK and KSA meta-institution reveals as expected important differences (figure 9.1 and section 9.2) encapsulated from the viewpoint of commercialisation in SWOTs (section 8.2.3.4): both have a strategy of creating a (more) knowledge-based economy, however, the UK cumulated knowledge capabilities and position in global knowledge chains gives it advantages.

Gerschenkron's (1966) argument is that led by the state, prioritising advanced technologies and leap-frogging (Davison 2000), perhaps using mimetic, normative and coercive isomorphic processes gaps can be narrowed. However, I argue in section 9.15 that as knowledge rather than natural resources or technology access becomes the source of national competitive advantage, Gerschenkron's (1966) theory needs updating to focusing on the challenge of joining global knowledge chains such as attracting international R&D, universities participating in international R&D projects and creating the absorptive capacity to appreciate and adapt exogenous knowledge into new competitive products and services. Updating Gerschenkron's (1966) theory has important policy implications for Saudi universities and UILs, which I return to below.

In both the KSA and UK Etzkowitz's (1983; 2000) TH theory is oft-cited. Yet not only has Said (2004) challenged its applicability to developing economies with 'thinner' institutions, as section 9.3 argues, policy-implementers in both countries question is usefulness citing governances clashes between academic and business institutions and the lack of entrepreneurial culture amongst academics. Whilst Mowery and Sampat (2004) too challenge the generalisability of TH theory international, my argument is that its applicability in both developed and developing countries is as a metaphor or ideal type – it is not a theory grounded in any verifying empirical evidence: as the famous statistician W Edwards Deming said, "without data you are just another person with an opinion."

Commercialisation	• Gerschenkron's (1966) theory dated in era of knowledge economies
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in developing economies	<ul style="list-style-type: none"> • Etzkowitz's (1983) triple helix lacks empirical support as significant in either a developing or developed economy
	<ul style="list-style-type: none"> • North (2009) wrongly dismisses alternative models
	<ul style="list-style-type: none"> • Bowles and Edwards (1993) aligning production and consumption: vision of future
KSA's commercialisation	<ul style="list-style-type: none"> • Resource-richness theory (Auty 1985) and <i>rentier mentality</i> (Beblawi (1987): links to culture
Strategy and its	<ul style="list-style-type: none"> • Transition routes from rentier state – issues for KSA
Implementation	<ul style="list-style-type: none"> • The development state thesis may prove a model for KSA
	<ul style="list-style-type: none"> • Insufficient active agency in KSA NSI and to allow devolved leadership, risk-taking, business leadership and experimentation
	<ul style="list-style-type: none"> • Innovation in incubators pushed not pulled: lack of market and business discipline in KSA incubation
	<ul style="list-style-type: none"> • State experimenting – stepping on stones
	<ul style="list-style-type: none"> • Huntington wrong: Islam can be innovative
Academic	<ul style="list-style-type: none"> • Little evidence of academic entrepreneurs in UK or KSA
Entrepreneurship	<ul style="list-style-type: none"> • Outcomes and outputs – need for systematic quantitative research
	<ul style="list-style-type: none"> • Knowledge flows mainly informal and recombinations not formal

Figure 10.1: Summary of my theoretical contribution ordered by importance

Institutions and culture supporting entrepreneurship and innovation do not exist in isolation from other socioeconomic and political influences. Porter (2009) and North (1990) point to open society (meaning western democratic) institutions are necessary for knowledge-based economic growth. This is an especially important point in KSA where the ruling elite (and much of society) rejects such as strategy favouring instead *modernisation without westernisation* and citing development state models, such as China, that have successfully taken different routes. In section 9.2.1 I argue that North's (1990; 2007) view ethnocentrically privileges a one-best-way solution to institutional change and that (a) *modernisation without westernisation* seems possible (Asian examples); (b) an Arabic version of the development state thesis may be possible and (c) part of the challenge in such a solution (Boyer 1996; Bowles and Edwards (1993) will be a realignment between a future (knowledge-based) regime of accumulation in KSA and a (changed) mode of regulation. Many of the latter points (women in the labour market, criticality in universities, structures supporting startup and growth) are discussed below under policy implications. North's (1990) predicts KSA's *modernisation without westernisation* strategy will fail; I am challenging the generalisability of his theory outside western economies and in drawing attention to the possibility of an Arabic development state model

highlighting the fact that such a model involves not only re-theorising Arabic economic and innovation strategies, it reaches deeply into other social relationships.

Referring back to figure 10.1, this section has identified four areas of theory relating to commercialisation in developing economies to which my research adds.

10.1.2 KSA's commercialisation strategy – theory development

Motivating entrepreneurship amongst academic researchers is a serious barrier to commercialisation in both the UK and KSA rooted in the perverse incentives in university governances where publications and basic research are rewarded not applied research, commercialisation or teaching. Amongst students and nascent entrepreneurs in general the UK and KSA differ in cultural attitudes towards startups. Owning a business is 'cool' in the UK whereas in KSA people prefer to work for large companies or (46% of employees) for the Government. Cultures are socially constructed; section 9.2 argues with Auty (1985) and Sachs (2001) that resource-richness can be a brake on innovation and entrepreneurship, making two contributions to this theme. Firstly, I argue that the brake arises not simply from financial disincentivisation (welfare payments, sinecure jobs, generous education grants), there is what Beblawi (1987; 1990) terms a *rentier mentality*: a culture that a high living standard exists as a right, rather than something to be worked for. This encourages HNWIs to invest in property rather than take the risk of startups failing and pervades young Saudi attitudes towards becoming entrepreneurs. A second contribution to thinking about the rentier state is around its transition. After all, the motive Saudi Government's has for commercialisation is the impending depletion of oil stocks and revenues after 2035. Most theorists adopt North's position that westernisation is the only option. In sections 6.2.2, 7.2.2 and 8.2.2 I develop the idea of the value-adding state, arguing that the UK is moving away from a value-distributing model and similar trends are beginning in KSA as oil revenues fall and levels of largess and 46% of all employment being in the public sector become unsustainable. This is new territory for the KSA elite hoping that the indigenisation policy will also contribute to creating a new sustainable model.

Cultural and motivation changes are important parts of identity construction. Faced with the mantra of *modernisation without westernisation* and inability to create the institutions that support western NSIs, SSI and THs, many Saudis now look to the Asian development state as a model (section 2.4). Plainly, KSA does not have some of the characteristics of the DS (vision and shared goals, expert and autonomous bureaucracy, mercantilism (figure 3.4), I suggest (section 6.2.2; 8.2.2; 9.4) that one way of negotiating a vision for post-oil KSA success is to paint on the development state canvas, seeking to place positive aspects of the Asian experience into an Arab/Islamic model of the future. I intend in further research to return to this point and explore the barriers and benefits to an Arabic development state.

One aspect of both the development state and the western market model is the preparedness of central elites to devolve sufficient power and resources to allow experimentation. I suggest that in KSA's case this may involve special economic zones, allowing experimental new governances (private universities, company-led universities) and experimental sources of risk capital. Throughout this research, I have emphasised the importance of active agency: people taking decisions and risks, from which new patterns emerge, new cultures and eventually new institutions. Deng Xiaoping famously used the metaphor of stepping one stones: trying-out, experimenting, improvising. KSA's next decades are a *high-velocity environment* (Eisenhardt 1989); in absence of North's road-map improvisation will learning in action (Weick's (1993) *simultaneity*) in which universities are likely to play a major part.

Knowledge-based economies reduce the time gap between science and technology; between the invention of knowledge via research and its embodiment in products and services for sale (Pisano 2011). The incubator is therefore a bridge addressing this gap: a managed risk-reducing route commercialising knowledge. As section 2.9.1 shows, research typologises incubators by ownership (private/university); generalist or specialist (figure 3.8) and services (figure 3.8) examples being Becker and Gassmann (2006) and Von Zedtwitz (2003). My research suggests additional important variable to previous typologies of university-related incubators: management, pull-push coupling and UILs.

My research shows a clear trend in the UK towards place incubation management in the hands of experience business-people, not academics. The second important new variable between incubators arising from my research is balance between pull and push, which I considered in 7.2.1.1 and formed part of my criticisms of Clark (1998) in section 9.9 and 9.16.2. Relationships between pull and push in innovation theory are viewed as ‘coupled’ (Nelson and Rosenberg 1993) i.e. both pressures are needed. As Pavitt (1991) shows in some fields for highly formal knowledge or long gestation periods ‘push’ predominates: pharmaceuticals, biotechnology and satellite research are examples. In other fields ‘pull’ predominates – the IIT(B) students’ apps are an example or simple medical testing devices. Where pull predominates knowledge-trawling is an important function of the incubator, for pulled ideas market-testing and analysis become paramount. A third variable incubators revealed by my research is the depth of services (similar to that of clusters in figure 2.7), shown in figure 3.8. In particular the depth of UILs and ability to joint-venture with existing firms, access mentoring and network linkages and ability to pitch for risk capital are important. These characteristics of incubators are more prevalent in the UK than KSA. My contribution is to suggest that future comparative research on incubators add to the criterion currently used deepening understanding of why some incubators are more effective than others.

In section 9.2.2 I argue that evidence from Islamic countries, the US, KSA’s 17 Forbes-2000 list, and history disputes Huntington’s (1996) thesis that Islamic economies are doomed to low rates of innovation because the faith discourages enquiring minds. Of course Islam is far from homogeneous. Is it the case that ‘cultural Muslims’ (a self-description in Kazakhstan) are more or less innovative or as Nasr (2007) claims that Shi’a are more innovative. My point is that in rejecting Huntington’s otherisation of Islam researchers should not fall into the same trap; there is a clear case for further cross-cultural research between Muslim countries.

Referring back to figure 10.1, this section has identified seven areas of theory relating to KSA’s commercialisation strategy and its implementation to which my research adds.

10.1.3 Academic Entrepreneurship

My research focused on university-related incubators. Entrepreneurship theory (chapter-3) suggests that academic entrepreneurship is emerging as particularly important for knowledge-based economies (Henrekson and Rosenberg 2001). As I note in section 9.16.2 only Respondent-28 and Respondent-9 fit the classic model of academic entrepreneurship: university-based research, formally codified and embedded into new products and commercialised. The other entrepreneurs use informal knowledge, gathered outside of universities and then generic university incubators to develop their product. Respondent-28 left the university incubator to enter a private one (7.4.5.1) and Respondent-9 (left the incubator in which he worked (6.3.1.4). My research gathered no evidence supporting academic entrepreneurship theory's validity. Instead academic researchers were shown uninterested in commercialisation (7.3.2) and unable to cross governances between research and business (8.2.1.3; figure 8.1). Acknowledging the contrary evidence from the US (3.7.9), I can only conclude that suggestions of a new paradigm emerging by Nerkar and Shane (2003) exaggerate the contribution of academic entrepreneurship and that much more quantitative research is necessary to test the theory.

As I explained in the methods chapter my initial intention was to prepare a cost-benefit analysis framework as part of my research, however at piloting it became clear this would not be possible since incubators either did not have or would not publicly release the data. AUTM data is generic and insufficiently detailed for CBA purposes. Indeed, as I suggest in section 9.15 the data from the US on the success rate and longevity of university spinouts seems exceptional. As in the entire field of academic entrepreneurship there is a need for cross-country research, drawing on robust CBA data and indisputable figures of incubation graduation and subsequent trading. Edinburgh's ERI benchmarks against Cambridge University incubation units, regarded as benchmarking against the best (7.2.1.1). For KSA the gulf with the US in research base, institutional arrangements and culture makes benchmarking against them problematic. This research suggests that models in IIMB and IITB in India and the incubation centre at Zhejiang University in Hangzhou (as developing economies) may prove more beneficial.

Apart from Respondent-9 and Respondent-28 who exploit formal knowledge resulting from university research, the entrepreneurs I interviewed look different from the linear models of Etzkowitz (1983) and Shane (2004) and closer to Gibbons et al (1994) recombinations of knowledge, often using informal learning gained outside of universities. Had I limited my dataset to (for example) biotechnology or software, or a post-incubation sample of (say) turnover at US\$ 5 million or specialist incubators, these findings may have been different. Nonetheless, for my dataset the linear model of university-based formal knowledge migrating into businesses is not visible. From the viewpoint of incubation-relating knowledge flows in developing economies, this evidence shows that high-growth companies are more likely to arise from specialist incubators and from spillover from global knowledge chains. Since KSA is outside of global knowledge chains attracting international R&D centres (as China and India successfully do) and enhancing UIIs become important. In summary, the knowledge flows I find are not those predicted in academic entrepreneurs or TH theory, re-theorising the nature of knowledge flows in incubators may assist KSA in refining its strategy. This point links strongly with section 10.3 below, in which I consider policy implications for KSA, in particular the need for reform of the universities.

Referring back to figure 10.1, this section identifies three areas of theory relating to academic entrepreneurship to which my research adds.

In summary, fourteen areas of theory development summarised in figure 10.1 under three sub-headings add to the fields of knowledge covered in this research and as section 10.6 below indicates, form the basis for publications.

10.2.4 Use of framework and cross-cultural comparison

Embarking on this research, I realised that existing frameworks were inadequate: insufficient active agency, not nested, too ethnocentric and unsuitable for comparative research or insufficiently interdisciplinary. Having reviewed literature on innovation and entrepreneurship (chapter 2 and 3) I constructed a new theoretical framework in chapter-4, citing Charmaz's (2007) constructed grounded theory approach; i.e. a framework with which to structure data gathering and analysis and then to revise in the light of grounded theorisations.

The figure-4.1 framework has internal validity in that its use has guided my research without identifying concepts or causal relationships omitted or redundant. In particular, the framework allowed easy movement between nested levels of institutions and enabled reference to active agency and at times lack of it. In section 9.17 I suggested revisions to the framework increasing the prominence given to culture (especially entrepreneurial culture) and digging deeper into institutions (for example centralised control and the contribution of women in entrepreneurship and innovation).

Figure-9.20 illustrates my revised framework. Its external validity will I hope be established if accepted in guiding KSA policy-making (10.3), feature in my publication plan (10.6), and used in dissemination activities (10.8).

10.2 Validity, generalisability and limitations

Validity

Since my ontological stance is post-positivist - I draw upon the subjective interpretations of incubation managers and entrepreneurs = there is no truth out-there awaiting discovery; rather respondents and researcher socially construct validity (Gilbert and Mulkay 1984). The task of the research is to dig sufficiently deeply into social construction to create an explanation the meaningfulness of which is not from referencing external ethnographic factors, rather meanings for the person in context (Gill 2000). As Biber and Leavy (2010) argue, as social researchers, we construct a reality and then triangulate with previous

empirical research and theory, Scapens (1990) and Humphrey and Scapens (1996) test the logic and validity of our social construction.

Validity is therefore the quality of what Rorty (1989:73) calls *knowing and doing in praxis* and Yanow (2000) *meaning making*. Validity derives not from the cumulation of facts, rather from analytical rigour (see Hawkesworth 1988) of well-chosen cases and context using an empathic perspective (Yanow 2003). As Schwartz-Shea and Yanow (2003) point out, whilst appropriate positivist evidence-based decision-making may be appropriate for practice adaptation, in emergent and dynamic social fields critical research methods can be more revealing. Validity and trustworthiness in ethnographic research rests on honestly gathered data, honestly interpreted, respecting alternative interpretations (Angen 2000) to which I aspire. The validity of this abductive research, which is exploratory, rests upon the groundedness and the representativeness of data and triangulating with earlier research. This qualitative research aspires to internal (logical, conceptual robustness) validity, providing the scaffolding for further research testing these concepts as hypotheses in a wider array of cases for external validity using cross-sectional analysis. I recognise, therefore, that my empirical material allows only limited generalisation, a point Burns and Grove (1999:296) make, other than concept validation since the sample is small and may not be representative. As Galasinski (2000) notes, the validity of the novel is not verifiable truth-hood or falsehood, rather the integrity (believability) of the narrative, the absence of exaggeration, evasion and manipulative inaccuracy that derives from honest and repeatable assembly of facts as perceived by social agents.

Generalisability

As Yin (2003) notes, casework may be designed to generalise from sample to population, however, my research design more follows William's (2000) notion of comparison and generalisation to other contexts being normative and tentative. I note also Kinder's (2002) insistence that since context is so important in social research that before conclusions can be generalised careful re-contextualisation is necessary. This is especially so given the idiosyncratic culture and context of KSA compared to other developing economies interesting in learning from it's commercialisation experiences and because of my

conclusion that whilst structures are important, institutional arrangements and culture crucially effect processes and outcomes.

Limitations

My original idea was to contrast incubation in four countries (the others being the US as a developed economy and China as a non-Arab/Islamic developing country). Time and resources did not permit the four-country data gathering. Access to a wide range of published research on the subject was useful for triangulation; however, some of the data is very context-specific. For example, the data on US incubation graduation and longevity rates, which as I suggest above is a field requiring much more cross-country quantitative comparison research. One of my research aims was to synthesise learning theory with innovation and entrepreneurship theory; I am aware that since learning is subject to cultural and contextual factors that my comments on this too may be limited in their applicability to other cultures.

10.3 Policy implications of answers to research question answers

My research identifies six policy areas arising from my research for policy-makers in KSA to consider, I also refer to UK relevance, where appropriate: three are classified as mainly structural and three are ‘wicked’ culture and governances issues.

KSA is in the early stages of implementing its commercialisation strategy to diversify its economy. Should a globally competitive technology arise in KSA, structures would inhibit its exploitation as section 9.5 and 9.8 note. This is not the case in China where lithium-ion batteries flourish or India’s offshore value-added services or for UK Internet financial services. Figure 10.3 summarises the structural issues KSA needs to address to enhance commercialisation.

KSA is not alone in not having a standard cost-benefit analysis (CBA) regime for its incubators; neither do AUTM in the US and the UK Association of Science Parks. Perhaps working with international bodies, KSA could set up a project with this goal. The aim

would be a robust CBA as part of a holistic evaluation of incubators (including their leadership, processes and impact). In effect, this fills the gaps in the last column of my figure 9.4 framework giving policy-makers an evidence base for policy making.

	Important policy suggestions	Section
Structural policy issues	<ul style="list-style-type: none"> Structural reforms: IP and company law, risk capital, tax, exit markets – structural changes in KSA 	9.5, 9.8 and 9.14
	<ul style="list-style-type: none"> Need for CBA evaluation of incubators in both countries, also evaluation of policies and business leadership 	9.10
	<ul style="list-style-type: none"> Motivating and re-modelling academic entrepreneurship 	9.6
Policy relating to culture and governances	<ul style="list-style-type: none"> KSA’s university system needs radical change: UILs, pedagogy, applied research and vocational courses – reinforcing curse of resource richness 	9.15
	<ul style="list-style-type: none"> Contribution of women to entrepreneurship and innovation 	9.16.3
	<ul style="list-style-type: none"> Culture and governances matter: they can be reconstructed by encouraging bottom-up experimentation and change drivers in KSA 	9.13 and 9.2.4

Figure 10.2: Summary of policy issues for KSA arising from my research

In both the UK and KSA academics are institutionally disincentivised from commercialisation by reward systems that privilege publication. Perhaps this explains the predominance of informal, non-university knowledge entrepreneurs’ use in university-associated incubators. Individual reward systems that reflect institutional goals (commercialisation) are likely to better incentivise achieving the goals.

I now turn to culture and governance policy issues arising from my research, each of which is problem and likely to be highly controversial. Section 9.15 argues that the KSA university needs fundamental reform, citing inactive pedagogy, lack of vocational courses, poor UILs, low levels of applied research, and absence of international research partnerships (particular with company R&D centres). Invariably reflect their society’s needs and as these change so too must KSA’s universities. The challenge is not a simple benchmarking but rather asking what will KSA’s society and economy look like in 25-years time and how do we create the universities then needed? This is a major policy area for Saudi Government and society not only for its academics.

It is not possible to overestimate the sensitivity to the social roles of women in a deeply Islamic and Arabic society such as KSA. Section 9.16.3 notes that diversified economies

greatly benefit from women’s participation in business and labour markets. Like other ‘big’ issues facing KSA, such as transition from a rentier state, this issue too needs to be negotiated carefully over time.

IP law	IP law in KSA is unclear yet a clear legal framework is essential if knowledge-based companies are to trade international and attract external investors.
Company law	Whilst startup legal processes have been streamlined, VCs need limited partnership legal platforms and easier ownership transfer. Many VCs only invest in consolidated cumulative preference redeemable ordinary shares, which do not currently feature in KSA law. A benchmarking exercise (for example with EVCA) will help change processes.
Capital markets	Shortage of risk capital can be a problem in every country (UK included). KSA lacks a VC network, networks of Angel investors and an Arabic crowd-funding site.
Banks	Examples such as the UK Small Loan Guarantee Scheme and Export Guarantee Fund will help increase bank support for startups and SME growth. Trading equity or friends and family capital is a poor model for high-growth startups.
Taxation	External investors look for tax exemption on capital gains from high risk startup investments and write-off of historic R&D costs; Saudi fiscal policy needs amending.
Exit markets	KSA for no formal Alternative Investment Market (AIM) allowing efficient initial public offerings (IPOs) – a major policy gap.

Figure 10.3: Summary of desirable structural reforms identified in this research to enhance commercialisation

My final policy implication relates to the last point: culture and governances. There are no blueprints for complex socio-economic change – that is why stepping on stones guided by a vision of the future – is a useful approach. Sections 9.13 and 9.2.4 make the case for devolved resources encouraging experimentation in organisational forms and processes.

10.4 Research question answers and empirical contribution

As I noted in my introductory chapter, KSA entrepreneurship and innovation is under-researched: much more is written about veiling and monarchy than Saudi companies and technology. I note Al Thawwad and Rashed’s (2009) work on regional policy and though dated, Al-Ghailani and Moor’s (1995) contribution on technology transfer. My main reference point empirically is the work of Al-Mubarak and his colleagues (2010a; 2010b; 2012; 2013a; 2013b; 2013c; and 2014); however, his studies are at an incubator unit of analysis rather than moving between agents, organisations and institutions, as my work does. Al-Mubarak does some comparative work though his substantive work is with other developing countries, not with a developed country as in my case and his primary expertise is Kuwait, where he is based.

Detailed quantitative research in KSA is notoriously difficult: Arab culture favours friendliness without openness. I was able to use a network built over twenty-years working at KACST to interview important figures in Saudi commercialisation: Respondent-23 a national level commercialisation policy maker is the father figure; Respondent-17 Manager of an incubation network, Respondent-18 and Respondent-20 lead the primary network for Saudi commercialisation at KACST. My dataset therefore containing elite interviews is unique.

In Edinburgh, using university contacts I was able to assemble data from extensive interviews with leading figures in commercialisation heading ERI: Respondent-35, Respondents 33 and 32. In addition, Dr Abdul at Cambridge gave me extensive access and introductions to companies.

In summary, as figure-1 in the appendix illustrates, I have assemble an extensive and unique dataset exceeding all others in relation to KSA commercialisation: this is my empirical contribution, which I anticipate will support the publications planned in section 10.6.

10.5 Management practice

My research focuses on institutions, culture and processes, here I make ten recommendations to agents active in KSA's commercialisation and incubation processes, summarised in figure-10.4.

(1) Leaders of incubation networks in both countries acknowledge that leadership of incubation centres demand competences and capabilities from business rather than (only) academic experience. This reflects an outward-looking, demand-pull and ability to cross governances that few academics possess. Boards of Incubation Units should appoint Unit Management with experience in launching relevant new businesses in the context (Scotland or KSA) in which the unit operates. Further, all incubation unit staff should have a business mentor and spend time learning business mechanics. Crossing governances is a major

challenge in commercialisation – the best way to achieve it is to bring experienced business people into the Incubation Units.

Management practice recommendations		Affected agents
1	Business leadership	Incubator management
2	Management of UIL network	Incubator Managers and members of their business network
3	Embed entrepreneurship in universities	University lecturers and students (and perhaps standards authorities)
4	Active learning pedagogy	University staff
5	Incubator recruitment (near market, winners), discipline, courses etc	Entrants, Managers and business mentors
6	Incubator processes and business links	Managers, incubators and business partners
7	Build wider university-industry linkages	University Management, applied researchers and business network connections
8	Pre-post launch mentors (business growth support)	Incubator Managers, entrepreneurs, business support staff
9	Internships and secondments (vs MSc)	Incubator Managers, Careers Service, Large company partners
10	Local/alumni Angel funds (ex-pat) cf IIIT(B)	

Figure-10.4: Summary of management practice recommendations

(2) Managers such as Respondent-20 at KAUST or Respondents-35 and 32 are not simply incubation centre Managers, rather they are managing a network of actors operating in a system purposively created to commercialise. Network management entails mobilising people not under command-and-control (business leaders, researchers, funders) towards the system goals (commercialisation in its many forms) and referencing the specific culture and context in which the commercialisation system operates. These networks, which are currently loosely-coupled as advisory or supportive, should be reconstituted as more closely-coupled systems. Firms and individuals in the system can then agree goals and targets and take responsibility for offering services such as business mentoring, short capability-enhancing internships and assisting entrepreneurs in creating their own business legitimacy in the eyes of potential partners by agreeing to introduce entrepreneurs to other businesses providing services or contracts relevant to the building of the commercialised business.

(3) Saudi universities are too far removed from the world of business and should encourage more applied research, where possible jointly with growth-potential local business. Bridging university-industry governances will also be helped by nudging universities to join international research projects. Incubation units should systematically trawl university research seeking potentially commercialisable technologies and/or opportunities for joint-working with local businesses or international business located in KSA and their supply chains. Working with local economic agencies, Incubation Units should systematically scan the needs of local businesses (for example their imports or supply blockages) and seek the support of University departments to conduct applied research relevant to meeting business needs. Every single university programme should include some element of entrepreneurship learning, ideally a course during which students experience a short secondment into a business and prepare project work associated their major with business development.

(4) Universities continue to use a rote learning, teacher-centred pedagogy and should move towards problem-centred and active learning i.e. relating technical learning to potential problem-solving innovative solutions and doing so in a manner that develops the skills and confidence including trans-disciplinary teams, in short preparation for the world of work.

(5) KSA incubation units appear insufficiently clear on selection and entry. Incubation Unit managers should set criteria such as entry only for businesses within one year of market launch or for only six-months to prepare a proof of concept. Two points follow: firstly, improving entry quality will improve the launch and success rate and secondly, Unit Managers and staff will dedicate time and resources towards better quality projects. For example, KSA finds it difficult to establish mentoring and links with existing businesses for projects incubating projects. Perhaps in part this is because the projects are so far from market? Promising projects rarely find it difficult to find mentors and partners. Where these are not available locally, Incubation Units should identify international partners, perhaps using links from international companies operating with KSA. The Indian Institute of Information Technology, Bangalore (IIIT-B) is a good model.

(6) Incubatees should periodically present to a panel of business representatives, should always have a business mentor, should spend time on short secondments into business rather than courses in the Incubation Centre and should in general adopt a market-oriented perspective and discipline. Incubators should more rigorously reject entrants simply sheltering under an umbrella of generous state payments.

(7) Incubators can lead the deepening of wider university-industry linkages by adopting the CONNECT model including (a) legal/risk-finance presentations to potential academic entrepreneurs; (b) technical presentation on applied research and its potential commercialisation to potential investors, startup lawyers etc and (c) periodic celebrations of successful commercialisation (both from KSA and abroad) to the wider audience interested in commercialisation.

(8) The incubators make insufficient use of business mentors for academic entrepreneurs. All entrepreneurs should have pre- and post-launch mentors. Where these cannot be found amongst local businesses in the target sectors, then mentors can be sought from foreign international companies in other sectors such as oil, health and logistics. All business plans should include an international section and mentors should support post-launch exploration of internationalisation. Where particular launched companies should internationalisation potential the Incubator Centre should procure and attach a business growth support mentor for the entrepreneur.

(9) Universities should encourage graduates seeking international MSc qualifications to choose programmes offering internships or work-based-learning and/or offer scholarships for pre-programme internships (perhaps associated with improving language skills. Working with large business partners, the University might arrange internships at international branches of companies active in KSA. Internships should be viewed as a normal route to active learning about successful business cultures.

(10) KSA lacks sources of readily available risk capital. University should launch Angel Networks inviting alumni and ex-pats to enrol, alongside locally high-net-worth-individuals. Perhaps universities might offer administrative services to the networks and procure grants for Investment Managers. The IIIT-B is a good model.

Not all of these suggestions to improve management practice in Incubators will be relevant to all, however, selected adoption – based on my research findings – will strengthen KSA Incubator management.

10.6 Publication plan

I plan four journal publications arising from this thesis as summarised in figure 10.5, in each case I hope that my supervisors will co-author.

Target journal	Argument/contribution	Time frame
International Journal of Technology Management	Various papers in IJTM explore the NSI or commercialisation arrangements in different countries; I propose an empirical addition to this theme of the journal	I have begun preparation of this paper, aiming for a draft by July 2017
The Journal of Technology Transfer	My work links with policy debates on technology transfer and commercialisation in JTT; I propose a policy contribution.	Mapped out, draft by end of September
Research Policy	RP has covered a range of theoretical subjects connecting with my research over the year. I propose to link with these from the perspective of commercialisation in an Arab/Islamic country, setting out the critique of North (1990), Etzkowitz (1983) and selected KM theories, introducing the idea of an Arabic development state.	Draft by February 2018
Venture Capital: An International Journal of Entrepreneurial Finance	Journal thread of risk capital sources and structures in developing countries since the provision of risk capital in developing economies occurs midst ‘thin’ institutions it is often informal (Bell 1997). In KSA as a rich country there appear to be unique opportunities (and difficulties). These are threads of debate in CIJEF, which I will pick up, drawing conclusions from KSA data.	Draft by June 2018

Figure 10.5: Publication plan

I intend to publish a version of my thesis as a textbook/training course aimed at entrepreneurship education and policy development in resource-endowed economies. My idea is following a scene-setting into, to threat my research findings in a ten-session course for incubation managers, policy-makers and funders. Tentative discussions in KSA suggest that the Government may fund this project and that universities are interested in

offering the course. I see the course as appropriate not only to oil-rich Arab countries, but also others seeking to diversify from oil dependency in Central Asia and Africa.

10.7 Further research

Throughout my analysis, I have referred to areas requiring further research, the most important of which are listed in figure 10.6: we only have one lifetime!

Area of further research
Quantitative study of outputs, outcomes including cost-benefit analysis of incubation activities across countries and in particular how leap-frogging can occur in the age of knowledge based economies.
The impact of commercialisation on universities, employment and creation of competitive technologies in developing countries; comparing (a) China, India and KSA, and (b) in a separate study, other Muslim countries/regions such as Turkey, Egypt, Kazakhstan and Xinjiang.
Sharps (1964) study of how technological innovation and society interact (steel axes for stone-age people in Australia) always fascinated me. Ethnographic study of technology and social change in KSA may help inform debate on the interaction between Arab and Islamic cultures in KSA and the evolving roles of women.

Figure 10.6: Areas of further research arising from my research

It may be a future Centre for Commercialisation in KSA will recruit staff with expertise and interest to support my own further research work

10.8 Dissemination and impact

I am already disseminating this work and it is having some impact, as recent top-level seminar in KSA illustrates. Over the next year or two I propose the following dissemination and impact activities.

- Publish the papers and textbook mentioned above and the associated management training course.
- Introduce ideas from my research at the annual Saudi Arabia Innovation conference in Jeddah (June 2018).
- To raise with KACST and Ministries the idea of a research Centre for Commercialisation in KSA to carry on this work, including dedicated PhD studentships.

BIBLIOGRAPHY

- Abdullah A, 1995, The ulama and the throne: the duality of authority in Saudi Arabia, Dar al-Rafid, London.
- Abreu M, Grinevich V, Hughes A and Kitson M., 2009, Knowledge Exchange between Academics and the Business, Public and Third Sectors, Centre for Business Research and UK-IRC, University of Cambridge, Cambridge, <http://www.cbr.cam.ac.uk/pdf/AcademicSurveyReport.pdf> (last accessed 10/8/2012).
- Abu Hakima, 1967, The brilliance of the meteor in the life of Muhammad ibn, Abd al-Wahhab Beirut.

- Acworth EB, 2008, *University-industry engagement: The formation of the Knowledge Integration Community (KIC) model at the Cambridge-MIT Institute*, Research Policy, 37, 1241-1254.
- Aghion and Howitt (2007), *Capital, innovation, and growth accounting*. Oxford Review of Economic Policy, 23:1, 2007, pp.79–93, Accessible at:
http://www.econ.brown.edu/fac/Peter_Howitt/publication/Solow%20volume.pdf.
- Aghion P and Howitt P, 1998, Endogenous Growth Theory, MIT Press, Cambridge MA.
- Aglietta M, 1979, A Theory of Capitalism Regulation, Verso, London.
- Agrawal A and Henderson R, 2002, *Putting Patents in Context: Exploring Knowledge Transfer from MIT*, Management Science, 8:1, 44-60.
- Ahmed Q, 2008, In the land of invisible women, Sourcebooks, Illinois.
- Al Fahad AH, *Raiders and traders: a poets lament on the end of the Bedouin Heroic age*, in Haykel B, Hegghammer T and Lacroix S, 2015, Saudi Arabia in Transition, CUP, Cambridge, chapter 12.
- Al Thawwad and Rashed M, 2009, *Technology Transfer and Sustainability-Adapting Factors: Culture, Physical Environment, and Geographical Location*, Journal of Communication and Computer, 6:7, 57-68.
- Al-Ghailani H and Moor W, 1995, *Technology Transfer to Developing Countries*, International Journal of Technology Management, 10 (7/8), 587–703.
- Al-Hegelan A and Palmer M, 1985, *Bureaucracy and development in Saudi Arabia*, The Middle East Journal, 39:1, 48-62.
- Al-Mubarak H and Busler M, 2012, *Incubation Landscapes in United States and Brazil: A comparison study*, World Journal of Social Sciences, 2:4, 249-255.
- Al-Mubarak H, Busler M and Al-Ajmei R, 2013, *Incubators as Tools for Economic Growth and Technology Transfer in Developed Countries*, European Journal of Business and Management, 5:16, 113-119.
- Al-Mubarak HM and Busler M, 2010b, *Business incubators: findings from a worldwide survey and guidance for the GCC states*, Global Business Review, 11:1, 1-20.
- Al-Mubarak HM and Busler M, 2013, *Business Incubation as an Economic Development Strategy: A Literature Review*, International Journal of Management, 30.
- Al-Mubarak HM and Busler M, 2013a, *The Effect of Business Incubation in Developing Countries*, European Journal of Business and Innovation Research, 2:1, 19-25.
- Al-Mubarak HM and Busler M, 2014, *Incubator successes: Lessons learned from successful incubators towards the 21st century*, World Journal of Science, Technology and Sustainable Development, 11.1.
- Al-Mubarak HM, Al-Karaghoul W and Busler M, 2010a, *The creation of business incubators in supporting economic developments*, European, Mediterranean and Middle East Conference on Information Systems, April Abu Dhabi.
- Al-Mubarak HM, Busler M and Al-Ajmei R, 2013c *Incubators as tools for economic growth and technology transfer in developed countries*, European Journal of Business and Management, 5:16, 113-121.
- Al-Thawwad RM, 2008, *Technology transfer and sustainability – adapting factors: culture, physical environment and geographical location*, Proceedings of The 2008 IAJC-IJME International Conference Paper 152, ISBN 978-1-60643-379-9.
- Albassam BA, 2015, *Economic diversification in Saudi Arabia: Myth or reality?* Resources Policy, 44, 112-117.
- Alkhateeb F, 2014, Lost Islamic History – reclaiming Muslim Civilisation from the past, Hurst and Co, London.
- Alkhateeb F, 2014, Lost Islamic History, Hurst, London.
- Allen TJ, 1995, Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R&D Organization, 2' edition, MIT Press.
- Allen TJ, 1997, Distinguishing Science from Technology: The Human Side of Managing Technological Innovation, Oxford University Press. New York.
- Allen, TJ, Tushman, M. and Lee, D. (1979) *Technology Transfer as a Function of Position on Research, Development and Service Continuum*, Academy of Management Journal, Vol. 22, pp. 694-708.
- Almeida M, Terra B and Hernandez MDPMP, *The incubator movement: a comparative analysis of Brazil and Mexico*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 10.
- Alshamsi MJ, 2011, Islam and pol reform in Saudi Arabia, Routledge, London.

- Alshumaimri A, Aldridge T, and Audretsch DB, 2010, *The university technology transfer revolution in Saudi Arabia*, The Journal of Technology Transfer, 35:6, 585-596.
- Altorki S, 2000, *The concept and practice of citizenship in Saudi Arabia*, Gender and Citizenship in the Middle East, 215-236.
- Alvesson M, 2002, Understanding organisational culture, Sage, London.
- Amin A. (1994). *Post-Fordism: models, fantasies and phantoms of transition*. In A.Amin (Ed.), Post-Fordism: a Reader. Blackwell, Oxford.
- Amsden, Alice H., and Wan-Wen Chu. Upscaling: recasting old theories to suit late industrializers. *Taiwan in the Global Economy: From an Agrarian Economy to an Exporter of High-Tech Products*, Westport, CN: Praeger (2002): 23-38.
- Andersen B, Brinkley I and Hutton W, 2011, Big Innovation Centre, work Foundation, Lancaster
- Andersen E and Teubal M, 1999, High-Tech Cluster Creation and Cluster Re-configuration – a systems and policy perspective, DRUID Conference Papers.
- Angen MJ, 2000, *Evaluating interpretive inquiry: Reviewing the validity debate and opening the dialogue*, Qualitative health research, 10:3 378-395.
- Archer M, 1988, Culture and Agency: The Place of Culture in Social Theory, Cambridge University Press, Cambridge.
- Archer M, 2000, Being human: the problem of agency, CUP, Cambridge.
- Archer M, 2007, *Making our Way Through the World*, Cambridge University Press, Cambridge.
- Argyris C, 1977, *Double Loop Learning in Organisations*, Harvard Business Review, September-October.
- Arnkil R, Jarvensivu A, Koski P and Piirainen, 2010, *Exploring the quadruple helix*, Final Report on Quadruple Helix Research for the CLIQ project, Tampere University, Working Paper.
- Aslan R, 2011, No God but God – the origins, evolution and future of Islam, Arrow Books, NY.
- Association of University Technology Managers (2001) The AUTM Licensing Surveys; University Start-up Data. AUTM Inc., Norwalk, Connecticut.
- Audretsch DB and Stephan PE, 1999, “Knowledge spillovers in biotechnology: sources and incentives,” in Journal of Evolutionary Economics, No. 9, pg. 97 – 107.
- Audretsch DB, 1998, *Agglomeration and the location of innovative activity*, Oxford Review of Economic Policy, 14:2, 18 – 29.
- Audretsch, David (2000) Is University Entrepreneurship Different? Working Paper, mimeo, Indiana University.
- Audretsch, David B., and Erik E. Lehmann. Does the knowledge spillover theory of entrepreneurship hold for regions? *Research Policy* 34.8 (2005): 1191-1202.
- Audretsch, DB, 1995, Innovation and industry evolution, MIT Press, Cambridge, and Dasgupta P and David PA, 1994, Towards a new economics of science, in Research Policy, No. 23 (5), pg. 487 – 521.
- Autio E and Laamanen T, 1995, *Measurement and Evaluation of Technology Transfer: Review of Technology Transfer Mechanisms and Indicators*, International Journal of Technology Management, 10 (7/8), 643–664.
- Auty RM (Ed.), 2001, Resource abundance and economic development, OUP, Oxford.
- Auty RM and Gelb AH, 2000, *Political Economy of resource-abundant states*, Annual Bank Conference on Developmental Economics, WB, Paris.
- Auty RM, 1985, *Materials intensity of GDP: Research issues on the measurement and explanation of change*, Resources Policy, 11:4, 275-283. Auty RM, 1997, *Natural resource endowment, the state and development strategy*, Journal of International Development, 9:4, 651-663.
- Auty RM, 1997, *Natural resources, the state and development strategy*, Journal of International Development, 9: 651-63.
- Auty RM, 1999, *The transition from rent-driven growth to skill-driven growth: Recent experience of five mineral economies*, Development Policies in Natural Resource Economies, 55-77.
- Auty RM, 2001, *The political economy of resource-driven growth*, European economic review, 45:4, 839-846.
- Auty RM, 2001, *Transition reform in the mineral-rich Caspian region countries*, Resources Policy, 27:1, 25-32.
- Auty RM, 2001a, Resource abundance and economic development, OUP, Oxford.
- Auty RM, 2002, Sustaining development in mineral economies: the resource curse thesis, Routledge, London.
- Auty RM, 2004, *Natural resources and civil strife: a two-stage process*, Geopolitics, 9:1, 29-49.

- Axelrod P, 2002, Values in Conflict: The University, the Marketplace, and the Trials of Liberal Education, Montreal, Quebec: McGill University Press.
- Backer TE, David SL and Soucy G, 1995, Introduction, in Backer TE, David SL and Soucy G, (Eds.), Reviewing the behavioural science knowledge base on technology transfer, Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, 1- 10.
- Baldwin WL and Scott JT, 1987, Market structure and technological change, Harwood Academic Publishers, NY.
- Balzer H and Askonas J, 2016, *The Triple Helix after communism: Russia and China compared*, Triple Helix, 3-31.
- Bank of Boston (1997) The Impact of Innovation, Boston, Mass. Economics Department, MIT.
- Barnes, Tina, Ian Pashby, and Anne Gibbons. Effective University–Industry Interaction: A Multi-case Evaluation of Collaborative R&D Projects. *European Management Journal* 20.3 (2002): 272-285.
- Bartels FL, Korla R and Vitali E, 2016, *Barriers to innovation: the case of Ghana and implications for developing countries*, Triple Helix, 3:12, 2-30.
- Bartels FL, Korla R and Vitali E, 2016, *Barriers to innovation: the case of Ghana and implications for developing countries*, Triple Helix, 3:12, 2-30.
- Basant, R. (2008). Bagalore Cluster: Evolution, Growth, and Challenges. In S. Yusuf, K. Nabeshima & S. Yamashita (Eds.), *Growing Industrial Clusters in Asia: Serendipity and Science* (pp. 147-193). Washington D.C.: The World Bank.
- Bauman Z, 1988, Freedom, Open University Press, Milton Keynes.
- Baumol WJ, Litan RE and Schramm CJ, 2007, Good capitalism, bad capitalism, and the economics of growth and prosperity, Yale University Press, London.
- Bearse P, 1998, *A question of evaluation: NBIA's impact assessment of business incubators*, Economic Development Quarterly, 12:4, 322-333
- Beblawi H, 1987, *The rentier state in the Arab world*, Arab Studies Quarterly, 383-398.
- Beblawi, H, 1990, *The rentier state in the Arab world*, in The Arab State, Chapter 4.
- Becker B and Gassmann O, 2006, *Corporate incubators: industrial R&D and what universities can learn from them*, Journal of Technology Transfer, 31, 469-483.
- Beckwith CI, 2009, Empires of the Silk Road, Princeton University Press, Oxford.
- Beer S, 1979, The Heart of Enterprise, Wiley, Chichester).
- Beeson M, 2009, *Developmental states in East Asia*, Asian Perspective, 33:2, 5-39.
- Beeson MK and Younger J, 2007, *DELETE-Regionalism and globalization in East Asia: politics, security, and economic development*. Palgrave Mcmillan.
- Beh LS, *Developmental state and Chinese capitalism: competition and collaboration* in Yeoh EKK and Loh JHL (Eds.), 2008, China in the World, University of Malaya, Kuala Lumpur, Cpt 11.
- Bekkers R, Bodas Freitas IM, 2008, *Analysing knowledge transfer channels between universities and industry: to what degree do sectors also matter?* Research Policy, 37, 1837–1853.
- Bell CG, 1991, High-tech Ventures, Addison-Wesley, New York.
- Bell D, 1973, The Coming of post-industrial Society: A Venture in Social Forecasting, Basic Books, NY.
- Bell D, 1979, *The social framework of the information society* in M. L. Dertouzos and J. Moses (Eds.), The computer age: a twenty-year view, Cambridge, MA: MIT Press.
- Bell M, 1997, *Technology transfer to transition countries: are there lessons from the experience of the post-war industrializing countries*, in Dyer DA (Ed.). 1997, The technology of transition: Science and technology policies for transition countries, Central European University Press, Budapest
- Bellgardt F, Gohlke J, Hasse H, Parzonka R and Schickentanz J, 2014, *Triple helix and residential development in a science park: the role of intermediaries*, Triple Helix, 2:14, 1-10.
- Bellin E, 2004, *The robustness of authoritarianism in the Middle East: exceptionalism in comparative perspective*, Comparative Politics, 36:2, 139-157.
- Bernstein, B. (1990). *Class, codes and control Vol 4: the structuring of pedagogic discourse*. London: Routledge.
- BERR (2007), 'UK Science and Innovation at the Heart of the Global Knowledge Economy', available at <http://www.berr.gov.uk/files/file40397.pdf> [accessed 10 December 2014].
- Bhaskar R, 1977, A Realist Theory of Science, Harvester, Hemel Hempstead.
- Biber SN and Leavy, P, 2010, The practice of qualitative research, Sage, London.

- Biggar, 2012, Economic Impact of the University of Edinburgh's Commercialisation Activity available at <http://www.research-innovation.ed.ac.uk/Portals/0/Documents/Economic-impact-study-commercialisation-final-report-2012.pdf> accessed 20 December 2015
- Bijker WE, 1987, *Of bicycles, bakelites, and bulbs: Toward a theory of sociotechnical change*, MIT press, Mass.
- BioEnt, 2014, available at <http://www.nature.com/bioent/2004/041101/full/bioent835.html> (accessed 24 May 2014)
- Birbili M, 2000, Translating from one language to another, *Social Research Update*, 31,
- Birley, S. (2003) Universities, Academics and Spinout Companies: Lessons from Imperial, *International Journal of Entrepreneurship Education*, Vol. 1, No. 1, pp. 1-21.
- BIS (2014), UK Innovation Survey: Highly Innovative Firms and Growth
- Black M, 1979, *More about metaphor*, in Ortony A (Ed.), *Metaphor and Thought*, CUP, Cambridge.
- Bloomberg, 2016, *Decades-Old Oil Reliance May Stymie Saudi Prince's Vision*, available at <https://www.bloomberg.com/news/articles/2016-04-24/decades-old-oil-dependency-may-stymie-saudi-prince-s-vision> (accessed 300517)
- Blumenthal, D, Campbell, C, Causino, N. and Louis, K. (1996) Participation of Life-Science Faculty in Research Relationships with Industry, *New England Journal of Medicine*, Vol. 335, No. 23, pp. 1734-39.
- Blumenthal, Susan J., and Elise Schlissel. Health Diplomacy: A Prescription for Peace. *Huffingtonpost.com* (2007).
- Boardman PC and Corley EA, 2008, *University research centres and the composition of research collaborations*, *Research Policy*, 37, 900–913.
- Bok D. (2003) *Universities in the Marketplace: The Commercialisation of Higher Education*, Viinceton
- Bonaccorsi A., Piccaluga, A., 1994. *A theoretical framework for the evaluation of university–industry relationships*, *R&D Management*, 24, 229–247.
- Bourauoui N, Bouhamed A, Chaabouni J and Saad M, *Inter-organisational learning through south-south cooperation*, in Saad M and Zawdie G (Eds.), 2011, *Theory and practice of the triple helix system in developing countries – issues and challenges*, Routledge, London, Cpt 4.
- Bourdieu P and Passeron J-C, 1979, *Reproduction in Education, Society and Culture*, Sage, London.
- Bourdieu P, 1977, *Outline of a Theory of Practice*, CUP, Cambridge.
- Bourdieu P, 1984, *Distinction: A Social Critique of the Judgement of Taste*, Cambridge, Massachusetts.
- Bourdieu P, 1990, *The Logic of Practice*, Polity Press, Cambridge.
- Bowles S and Edwards R, 1993, *Understanding Capitalism*, Harper Collins, New York.
- Boyer R and Drache D (Eds.), 1996, *States Against Markets - The limits of globalisation*, Routledge, London.
- Boyer R, 1988, Technical Change and the theory of regulation, in Dosi G, Freeman C, Nelson R, Silverberg G and Soete L (Eds.), 1988, *Technical Change and Economic Theory*, Pinter, London, pg. 67 - 94.
- Boyer R, 1990, *Regulation Theory*, Macmillan, London.
- Brautigam D, 2009, *The dragon's gift: the real story of China in Africa*, Oxford University Press, Oxford.
- Breschi S, Lissoni F, and Montobbio F, 2005, The Scientific Productivity of Academic Inventors: New Evidence From Italian Data, *CESPRI Working Papers* 168, Centre for Research on Innovation and Internationalisation, Universita' Bocconi, Milano, Italy.
- Brett EA, 2009, *Reconstructing Development Theory*, Macmillan, London.
- Breznitz D, 2007, *Innovation and the state: political choice and strategies for growth in Israel, Taiwan and Ireland*, Yale University Press, London.
- Bridge G, 2001, *Bourdieu, rational action and the time-space strategy of gentrification*, *Transactions of the Institute of British Geographers*, No. 26, pg. 205 – 216.
- Brimble, P., & Doner, R. (2007). *University-Industry Linkages and Economic Development: The Case of Thailand*. *World Development*, 35(6), 1021-1036.
- Broadfoot P and Osborn M, 1993, *Perceptions of Teaching: Primary School Teachers in England and France*, Cassell, London.
- Brockhaus RH, 1980, *Risk taking propensity of entrepreneurs*, *Academy of management Journal*, 23:3, 509-520.
- Brouthers KD, Brouther LE and Werner S, 1996, 'Dunning's eclectic theory and the smaller firm: the impact of ownership and locational advantages on the choice of entry-modes in the computer software industry,' *International Business Review*, Vol. 5, No. 4, pg. 377 – 394.
- Browaeys M-J and Price R, 2008, *Understanding Cross-cultural Management*, Pearson, Harlow.

- Brown JAC, 2014, Misquoting Muhammad: The Challenge and Choices of Interpreting the Prophet's Legacy, One world Publications, London.
- Bruneel J, Ratinho T, Clarysse B and Groen A, 2012, *The evolution of business incubators: comparing demand and supply of business incubation services across different incubator generations*, Technovation, 31, 110-121,
- Brush CG and Brush CG, 2006, Growth-oriented women entrepreneurs and their businesses: A global research perspective, Edward Elgar Publishing, London.
- Buenstorf G, 2005, *Commercialising basic science as a competitor or complement of academic accomplishment: the case of Max Planck Directors*, Max Planck Institute, Germany.
- Bulte EH, Damania R and Deacon RT, 2005, *Resource intensity, institutions, and development*, World development, 33:7, 1029-1044.
- Burgos-Mascarell A, Ribeiro-Soriano D and Martinez-Lopez M, 2016, *Dystopia deconstructed: apply the triple helix model to a failed utopia*, Journal of Business Research, 69, 1845-1850.
- Burns N and Grove SK, 1999, *Understanding research*, CUP, Cambridge.
- Burrell G, and Morgan G. 1994, Sociological paradigms and organisational analysis, Ashgate, London.
- Busenitz LW, 1999, *Entrepreneurial risk and strategic decision making it's a matter of perspective*, The Journal of Applied Behavioral Science, 35:3, 325-340.
- Callon, M. (1994) *Is Science a Public Good? Science, Technology and Human Values*, Vol. 19, 395-424- Chiesa, V. and Piccaluga, A. (2000) *Exploitation and Diffusion of Public Research: The*
- Callon, M. 1986. *Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieu Bay in J. Law (ed.), Power, Action and Belief: A New Sociology of Knowledge?* London: Routledge and Kegan Paul, pp. 196-233.
- Calvert J. 2006, *What's Special about Basic Research?* Science, Technology & Human Values, 31:2, 199-220
- Carayol N, 2005, *Academic incentives, research organization and patenting in a large French University*, Universite Louis Pasteur working paper.
- Carayol, Nicolas, and Mireille Matt. *Does research organization influence academic production?: Laboratory level evidence from a large European university*. Research Policy 33.8 (2004): 1081-1102.
- Carton M, 2001. *The rise of the knowledge management fashion: a consequence of the decline of the development ideology?* Norrag News. July, 12-13, Retrieved August 28, 2003, pp. 90, from <http://www.norrag.org/pdf/nn28.pdf>
- Castells M and Hall P, 1994, Technopoles of the World, Routledge, London.
- Castells M and Himanen P, 2002, The Information Society and the Welfare State – the Finnish Model, OUP, Oxford.
- Castells M, 1997, The Information Age: The Rise of the Network Society, Vol. One, Blackwell, Oxford.
- Cefis E and Ciccarelli M, 2005, *Profit differentials and innovation*, in Economics of innovation and new technologies, Cpt. 14, Routledge, London.
- Cefis E and Orsenigo L, 2001, *The persistence of innovative activities: A cross-countries and cross-sectors comparative analysis*, Research Policy.
- Chan KF and Lau T, 2005, *Assessing technology incubator systems in the science park: the good, the bad and the ugly*, Technovation, 25, 1215-1228.
- Chang H-J and Grabel I, 2004, Reclaiming Development, Zed Books, London.
- Chang H-J and Rowthorn B (Eds.), 1995, The Role of the State in Economic Change, Clarendon, Oxford, Introduction.
- Chang H-J, 2003, *Kicking away the ladder: development strategy in historical perspective*, Wimbledon Publishing, London.
- Chang H-J, *The Economic theory of the developmental state*, in Woo-Cumings M (Ed.), 1999, The developmental state, Cornell University Press, London, Chinese. 6.
- Chang H, 1994, The Political Economy of Industrial Policy, Macmillan, London.
- Charmaz K, 2006, Constructing grounded theory, Sage, London.
- Chaudhry KA, 1994, *Economic liberalism and the lineages of the rentier state*, Comparative Politics, 27:1, 1-25.
- CHE, 2011, <http://chronicle.com/article/Saudi-Arabias-Education/124771/> The Chronicle of Higher Education, 3 October 2010; retrieved 16 Jan. 2014 <http://chronicle.com/article/Saudi-Arabias-Education/124771/>

- Chen, K., & Kenny, M. (2005). The Role of University/ Research Institute-Industry Linkages in the Technological Development of Beijing and Shenzhen. *Working paper 168*.
- Chesbrough H, 2011, Open services innovation, Wiley, San Francisco, CA.
- Chisholm, L. (1999). The transition to a knowledge society and its implications for the European social model. Discussion paper, XVII European Symposium on Science and Culture, Bruges, 30 September-1st October.
- Chossudovsky M, 1997, The Globalisation of Poverty: Impacts of IMF and World Bank Reforms, Zed Books, London.
- Christensen CM and Dyring HJ, 2011, The innovative university: changing the DNA of higher education from the inside out, Jossey-Bass, San Francisco.
- Chugh, H. (2004) New Academic Venture Development: Exploring the Influence of The Technology Transfer Office on University Spinouts. Working paper, Tanaka Business School, Imperial College London.
- Clark N, *Revisiting agricultural science for development: from Mode 1 to Mode 2* Cpt 6
- Clark, H.C. (2004). Growth and Governance of Canadian Universities: An Insider's View. Vancouver, BC: UBC Press.
- Clarke BR, 1998, Creating Entrepreneurial Universities: Organisational Pathways of Transformation, New York: IAU Press.
- Coase R and Wang N, 2012, How China became capitalist, Macmillan, Basingstoke.
- Cohen W and Florida R and Randazzese L and Walsh J, 1998, *Industry and the Academic: uneasy partners in the cause of technological advance* in Noll R (Ed.), Challenges to the Research University, Brookings Institute, NY>
- Cohen WM and Levinthal DA, 1990, Absorptive Capacity: A New Perspective on Learning and Innovation, in Administrative Science Quarterly, No. 35, pg. 128 – 152.
- Cohen WM, Nelson RR and Walsh J.P, 2002, *Links and impacts: the influence of public research on industrial R&D*, Management Science, 48, 1–23.
- Colapinto C and Porlessa C, 2010, *Innovation in creative industries: from the quadruple helix model to systems theory*, Journal of Knowledge Economics, 3, 343-353.
- Collier P and Hoeffler A, 2009, *Testing the neocon agenda: democracy in resource-rich societies*, European Economic Review, 53:3, 293-308.
- Collier P, 2008, *The bottom billion*, OUP, Oxford.
- Collinson S and Gregson G, 2003, *Knowledge networks for new technology-based firms: an international comparison of local entrepreneurship promotion*, R and D Management, 33:2, 189-208.
- Colombo MG and Delmastro M, 2002, *How effective are technology incubators? Evidence from Italy*, Research Policy, 31, 1103-1122.
- Commins D, *From Wahhabi to Salafi* in Haykel B, Hegghammer T and Lacroix S, 2015, Saudi Arabia in Transition, CUP, Cambridge, chapter 8.
- Cooke P, 1990, Back to the future, Unwin Hyman, London.
- Cooper AC, 1985, *The role of incubator organisations in the founding of growth-oriented firms*, Journal of Business Venturing, 1, 75-86.
- Corden M and Neary JP, 1982, *Booming sector and Dutch disease economics: a survey*, Economic Journal, 92, 826-844.
- Cordesman A and Obaid N, 2005, Saudi Militants in Iraq, www.csis.org
- Cordesman A, 1984, The Gulf and the Search for Strategic Stability, Boulder, Westview.
- Cordesman A, 1997, Saudi Arabia: Guarding the Desert Kingdom, Boulder, Westview.
- Cottrill CA, Rogers EM and Mills T, 1989, *Co-citation analysis of the scientific literature of innovation research traditions*, Knowledge: Creation, Diffusion, Utilization, 11:2, 181-208.
- Cova B and Salle R, 2008, *Marketing solution in accordance with the S-D logic: co-creating value with customer network actors*, Industrial Marketing Management, 37:3, 270-277.
- Csikszentmihalyi M, 1996, *Creativity: Flow and the psychology of discovery and invention*, Harper Collins, New York.
- Czarniawska-Joerges B, 1992, Exploring Complex Organisations, Sage, London.
- D'Costa, A. (2006). *Exports, university-industry linkages and innovation challenges in Bangalore, India*. Paper presented at the World Bank Policy
- D'Este, P., Patel, P., 2007, *University-industry linkages in the UK: what are the factors underlying the variety of interactions with industry?* Research Policy, 36, 1295–1313.

- D'Este, P., Perkmann, M., 2011. *Why do academics engage with industry? The entrepreneurial university and individual motivations*, The Journal of Technology Transfer, 36, 316–339
- Dahlstrand, A. (1997) Growth and Inventiveness in Technology-Based Spin Offs Firms, *Research Policy*, Vol. 26, No. 3.
- Daniels H and Warmington P, 2007, *Analysing third generation activity systems: labour power, subject position and personal transformation*, Journal of Workplace Learning, 19:6, 377-391.
- Daniels, G. and Hofer, C. (1993) Characteristics of Successful and Unsuccessful Entrepreneurial Faculty and their Innovative Research Team, in N. Churchill, S. Birley, W. Bygrave, J. Doutriaux, E. Gatewood, E Hoy and W Wetzel (Eds) *Frontiers of Entrepreneurship Research*, pp. 598-609.
- Datta S and Saad M, *Innovation in a developing country context: developing an integrated framework through India's experience*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 12.
- Davison R, 2000, Technology Leapfrogging in Developing Countries-An Inevitable Luxury? The Electronic Journal of Information Systems in Developing Countries.
- Davison, R., D. Vogel, et al. (2000). Technology Leapfrogging in Developing Countries – An Inevitable Luxury? The Electronic Journal on Information Systems in Developing Countries 1(5): 1-10.
- Dawes, Sharon S., and Ophelia Eglene. New models of collaboration for delivering government services: A dynamic model drawn from multi-national research. *Proceedings of the 2004 annual national conference on Digital government research*. Digital Government Society of North America, 2004.
- DBIS, 2014, Innovation Report, HMG, London www.gov.uk/bis
- Deakin M, 2014, *Smart cities: the state-of-the-art and governance challenge*, Triple Helix, 1:7, 1-16.
- Deans P, The People's Republic of China: the post-socialist developmental state, in Low L (Ed.), 2004, Developmental States: relevancy, redundancy or reconfiguration Nova Science, NY, Cpt 4.
- Dedehayi O and Makinen SJ, 2011, *Determining reverse salient types and evolutionary dynamics of technology systems with performance disparities*, Technology Analysis and Strategic Management, 23:10, 1095-1114.
- Department of Business Innovation and Skills (2014), *Insights from international benchmarking of the UK science and innovation system*. Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/277090/bis-14-544-insights
- Detalle R (Ed.), 2000, Tensions in Arabia, Nomos, Baben-Baden.
- Dezhina IG, 2014, *Technology platforms in Russia: a catalyst for connecting government, science, and business?* Triple Helix, 1:1: 1-10.
- Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others? *Research Policy*, 32(2), 209-227.
- Dore R, 1986, Flexible Rigidities: industrial policy and structural adjustment in the Japanese Economy 1970-1980, Stanford University Press, Stanford.
- Dosi G, Freeman C, Nelson R, Silverberg G, and Soete L, 1988, Technical Change and Economic Theory, Pinter, London.
- Douglas M, 1987, How Institutions Think, Routledge and Kegan Paul, London.
- Doumato EA, 1999, *Women and work in Saudi Arabia: how flexible are Islamic margins?* The Middle East Journal, 568-583.
- Doumato EA, 2000, Getting God's ear: Women, Islam, and healing in Saudi Arabia and the Gulf, Columbia University Press, NY.
- Doutriaux J, 1987, Growth Patterns of Academic Entrepreneurial Firm *Journal of Business Venturing*, Vol. 2, pp. 285-97.
- Dretske FI, 1981, Knowledge and the Flow of Information, Blackwell, Oxford.
- Drucker P, 1959. Landmarks of tomorrow: a report on the new 'post-modern' world. London: Heinemann.
- Drucker P, 1993, Post capitalist society. New York: Harper Business.
- Drucker PF, 1985, Innovation and Entrepreneurship, Pan, London.
- Dugger WA, 1995, *Veblenian institutionism: the changing concepts of inquiry*, Journal of Economic Issues, XXIX:4, 1013-1027.
- Dunning JH, 1977, 'Trade, location of economic activity and the MNE: A search for an eclectic approach,' in Ohlin B, Hesselborn PO and Wijkman PM (Eds.), The International Allocation of Economic Activity, Macmillan, London, pg. 395 – 418.

- Dunning JH, 1988, Explaining international production, Macmillan, London; Dunning JH, 1988a, 'The eclectic paradigm of international production: a restatement and some possible extensions,' Journal of International Business Studies, Vol. 19, No. 1, pg. 1 – 32.
- Dunning JH, 1995, 'Reappraising the eclectic paradigm in the age of alliance capitalism,' Journal of International Business Studies, Vol. 26, No. 3, pg. 461 – 491.
- Dunning JH, 2000, 'The eclectic paradigm as an envelope for economic and business theories of MNE activity,' International Business Review, Vol. 9, No. 1, pg. 163 – 190.
- Dzisah J, *Mobilising for development: putting the triple helix into action in Ghana*, Cpt 8
- EBICN, 2012, European Business and Innovation Centre Network (EBN). (2012), 'BIC Observatory Facts and Figures'. Available online:
http://www.ebnsoftlanding.org/upload/file/BIC_Observatory_Report_2012.pdf
- Economic Offset Office, 2001, The Al-Yamamah Economic Offset Program, Jeddah.
- Economist 081215, <https://espresso.economist.com/45cb92deaa28dec873e1747caba3bf46>
- Eddleston K and Powell G, 2008, *The role of gender identity in explaining sex differences in business owners career satisfier preferences*, Journal of Business Venturing, 23, 244-56.
- El-Hadidy R, 1983, Is the 'Micro-electronics' an Appropriate Technology for Developing Countries, in Flessner P (Ed.), System Approaches to Appropriate Technology Transfer, Pergamon, NY, 125–127.
- Elster J, 1979, Ulysses and the Sirens, CUP, Cambridge.
- Engeström Y, 1987, Learning by expanding – an activity-theoretical approach to development research, Orienta-Konsultit, Helsinki.
- Eoyang E, 1989, Chaos Misread: or There's a Wonton in My Soup!, in *Comparative Literature Studies*, 26:3, 271 – 284.
- Ercikan K, 1998, Translation Effects in International Assessments, *International Journal of Educational Research*, 29, 543-553.
- Erlewine M, 2007, Measuring your Business Incubators Impact, National Business Incubation Association, available from <http://www.nbia.org/impact/index.php>
- Etzkowitz H and Chunyan Zhou, 2006, *Triple Helix twins: innovation and sustainability*, Science and Public Policy, 33:1, 77-83.
- Etzkowitz H and Leydesdorff L, 2000, *The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations*, Research policy, 29:2,109-123.
- Etzkowitz H, 1983, *Entrepreneurial scientists and entrepreneurial universities in American academic science*, Minerva, 21:2, 198-233.
- Etzkowitz H, 2003, *Innovation in innovation: the triple helix of university-industry-government relations*, Social Science Information, 42, 293-337.
- Etzkowitz, H. (1998) *The Norms of Entrepreneurial Science: Cognitive Effects of the New University-Industry Linkages*, Research Policy, Vol. 27, pp. 823-33.
- Etzkowitz, H. (2000) The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm, *Research Policy*, Vol. 29, pp. 313-
- Etzkowitz, H. (2002) *MIT and the Rise of Entrepreneurial Science*, Routledge. Florida, R. and Kenney, M. (1988) *Venture Capital Financed Innovation and Technological Change in the United States*, Vol. 17, pp. 119-37.
- Etzkowitz, H. (2002). Incubation of incubations: innovations as a triple helix of university0industry-government networks. *Science and Public Policy*, 29(2), 115-128.
- Etzkowitz, H. (2003), Innovation in Innovation: The Triple Helix of University-Industry-Government Relations. *Social Science Information*, 42(3), 293-337.
- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from national systems and 'mode2' to a Triple Helix of university-industry-government relations. *Research Policy*, 29(2), 109-123.
- Etzkowitz, Henry, and Jose Manoel Carvalho De Mello. The rise of a triple helix culture. *International Journal of Technology Management & Sustainable Development* 2.3 (2003).
- Europe—the case of Sweden and Ireland. Small Business Economics, 14, 299.
- Evans P, 1995, Embedded Autonomy: states and industrial transformation, Princeton University Press, Princeton.
- Farinha L, Ferreira J and Gouveia B, 2016, *Networks of innovation and competitiveness: a triple helix approach*, Journal of Knowledge Economics, 7, 259-275.
- Farmer JD and Lafond F, 2016, *How Predictable is Technological progress?* *Research Policy*, 45, 647-665.

- Farnell B, 2000, Getting out of the Habitus: an alternative model of dynamically embodied social action, in Journal of the Royal Anthropological Institute, Vol. 6, pg. 397 – 418.
- Field M, 1984, The Merchants: The Big Business Families of Saudi Arabia and the Gulf, Overlook Press, NY.
- Fine B, Fine, B., 2001, Social Capital versus Social Theory: Political Economy and Social Science at the Flamm K, 1988, Creating the Computer, The Brookings Institution, Washington DC.
- Fleisher BM, *Higher education in China: a growth paradox?* in Kwan YK and Yu ESH (Eds), 2005, Critical issues in China's growth and development, Ashgate, Burlington, Cpt 1.
- Florida R and Kenney M, Japanese Automotive Transplants and the Transfer of the Japanese Production System, in Deyo FC (Ed.), 1996, Social Reconstructions of the World Automobile Industry, Macmillan, London, pg. 51 - 87.
- Foucault, M. (1991). Remarks on Marx: conversations with Duccio Trombadori (R. J.
- Franklin, S., Wright, M. and Lockett, A. (2001) Academic and Surrogate Entrepreneurs in University Spin-Out Companies, *Jowriw/ of Technology Transfer*, Vol. 26, No. 1/2, pp. 127-41.
- Frankopan P, 2015, The Silk Roads, Bloomsbury, London.
- Freeman C and Soete L (Eds.), 1987, Technical Change and Full Employment, Blackwell, Oxford.
- Fuchs RF, 1963, *Academic Freedom. Its Basic Philosophy, Function, and History*, Law and Contemporary Problems, 28:3, 431-446
- Gage D, 2012, The venture capital secret: 3 out of 4 start-ups fail." *Wall Street Journal*, pg. 20.
- Galasinski D, 2000, The Language of Deception, Sage, London.
- Galbraith JK, 1979, The Nature of Mass Poverty, Penguin, London.
- Gallagher, K. S. (2006). *Limits to leapfrogging in energy technologies? Evidence from the Chinese automobile industry*, Energy Policy, 34:4, 383-394.
- Garfield E, 1986, *The metaphor-science connection*, Information Scientist, 9, (October), 316-323.
- Gaspar, J., & Glaeser, E. L. (1998). Information technology and the future of cities. Journal of Urban Economics, 43, 136-156.
- Gebhardt C, 2015, *The spatial dimension of the triple helix: the city revisited – towards a mode 3 model of innovation systems*, Triple Helix, 2:11, 2-4.
- Geijerstam J, 2004, Landscapes of Technology Transfer Swedish Ironmakers in India 1860–1864. Jernkontorets bergshistoriska skriftserie, 42 ISBN 91-974131-5-1.
- Geisler, R.L. (1993) Research and Relevant Knowledge: American Research Universities since World War II, Oxford: Oxford University Press.
- GEM, 2012, <http://www.doingbusiness.org/rankings> accessed on March 11, 2012
- Gerschenkron A, 1966, Economic backwardness in historical perspective, Harvard University Press, MA.
- Geuna, Aldo, 1998, *The internationalisation of European universities: a return to medieval roots*, Minerva, 36:3, 253-270.
- Gibbons M, Limoges C, Nowotny H, Schwartzman, Scott P and Trow M, 1994, The New Production of Knowledge, Sage, London.
- Gibson, D and Smilor, R. (1991) The Role of the Research University in Creating and Sustaining the US Technopolis, in A. Brett, D. Gibson and V. Smilor (Eds) *University Spin-off Companies*, Savage, MD: Rowan and Littlefield.
- Giddens A, 1982, *Commentary on the Debate (Marxism, Functionalism, and Game Theory)*, Theory and Society, 11, 527 - 539.
- Giddens A, 1994, Beyond Left and Right, Polity Press, Cambridge.
- Gilbert GN and Mulkay MJ, 1984, Opening Pandora's box: A sociological analysis of scientists' discourse, CUP Archive, Cambridge.
- Giroux, H.A. (2006). Higher education under siege: Implications for public intellectuals, *The NEA Higher Education Journal*, Thought & Action; Special Focus – The Academy at Work, 63-78.
- Global Innovation Index (2013). Available at <http://www.globalinnovationindex.org/content.aspx?page=gii-full-report-2013#pdfopener> (accessed December 14, 2015)
- Goldemberg J, 1998, *Leapfrog energy technologies*, Energy Policy, 26:10, 729-741
- Goldfarb, B. and Henrekson, M. (2003) *Bottom-Up vs Top-Down Policies: Towards the Commercialization of University Intellectual Property*, Research Policy, Vol. 32, No. 4,
- Goldratt, E.M. and Cox, J. (1993) *The Goal*, Gower, Aldershot.
- Goldstein & J. Cascaito, (Trans.). New York: Semiotext.

- Golub, E. (2003) *Generating Spin-off from University Based Research: The Potential of Technology Transfer*. PhD Dissertation, Columbia University.
- Gourman, J. (1997) *The Gourman Report*, National Education Standards, Northridge, CA.
- Grabher G, Rediscovering the social in the economics of interfirm relations, in Grabher G, 1993, *The Embedded firm*, Routledge, London, Cpt. 1.
- Grayson B, 1982, *Saudi-American Relations*, University Press of America, Washington.
- Griliches Z, 1979, Issues in assessing the contribution of R&D to productivity growth, in *Bell Journal of Economics*, Vol. 10, No. 10, pg. 92 – 116.
- Grimaldi R and Grandi A, 2005, *Business incubators and new venture creation: An assessment of incubating models*, *Technovation*, 25:2, 111-121.
- Gummesson V, 1991, *Qualitative Methods in Management Research*, Sage, London.
- Gylfason T, 2001, *Natural resources, education, and economic development*, *European economic review*, 45:4, 847-859.
- Habermas J, 1984, *The Theory of Communicative Action*, Vol. 1, Reason and the Rationalisation of Society, Beacon Press, Boston
- Hague, D. and Oakley, K. (2000) *Spin-offs and Start-Ups in UK Universities*. Committee of Vice-Chancellors and Principals (CVCP) Report.
- Häkansson H, 1989, *Corporate Technological Behaviour - Co-operation and Networks*, Routledge, London.
- Hakim C, 2011, *Honey money: The power of erotic capital*, Penguin UK.
- Hall P and Markusen A (Eds.), 1985, *Silicon Landscapes*, Allen and Unwin
- Hall P, 1990, 'The Generation of innovative milieu: an essay in theoretical synthesis,' *Institute of Urban and Regional Development Working Paper 505*, University of California, Berkeley.
- Hall P, Breheny, McQuaid R and Hart D, 1987, *Western Sunrise*, Allen & Unwin, London.
- Hall, S. (1988). *The hard road to renewal: Thatcherism and the crisis of the Left*. London; New York: Verso.
- Harris B, 2004, *The origins of the British welfare state: social welfare in England and Wales, 1800-1945*, Palgrave, London.
- Harrison B, 1994, *Lean and Mean - The Changing Landscape of Corporate Power in the Age of Flexibility*, Basic Books, New York.
- Hartley J and Allison M, 2000, *The modernization and improvement of government and public services: The role of leadership in the modernization and improvement of public services*, *Public Money & Management*, 20:2, 35–40.
- Harvey D, 1982, *The limits to capital*, Chicago University Press, Chicago.
- Harvey D, 1985, *The urbanisation of capital: studies in the history and theory of capitalist urbanisation*, Blackwell, Oxford.
- Harvey D, Flexible Accumulation through Urbanisation, in Amin A (Ed.), 1994, *Post-Fordism*, Blackwell, Oxford, Ch. 12.
- Harvey DL and Reed M, 1997, Social science as the study of complex systems, in Kiel LD and Elliot E (Eds.), 1997, *Chaos Theory in the Social Sciences: Foundations and Applications*, Ann Arbor, Michigan.
- Harvey, D. (2005). *A Brief History of Neoliberalism*. Oxford, UK: Oxford University Press.
- Hausmann R and Rodrik D, 2003, *Economic development as self-discovery*, *Journal of development Economics*, 72:2, 603-633.
- Hausmann, R., & Gavin, M. (1996). *Securing stability and growth in a shock prone region*. The policy challenge for Latin America. Inter-American Development Bank.
- Hawkesworth ME, 1988, *Theoretical issues in policy analysis*, SUNY Press, NY.
- Hayek F, 1991, *The Trend of Economic Thinking*, (Ed.) Bartley and Kresge, Routledge, London.
- Haykel B, Hegghammer T and Lacroix S, 2015, *Saudi Arabia in Transition*, CUP, Cambridge.
- HEFCE, 2009, *Evaluation of the Effectiveness and Role of HEFCE/OSI Third Stream Funding*, HEFCE, Edinburgh.
- Henderson J, 2002, *Globalisation of high technology production*, Routledge, London.
- Henderson R, Jaffe A and Traitenberg M, 1998, *Universities as a source of commercial technology*, *The Review of Economics and Statistics*, 80:1, 119-27.
- Henrekson, M., Rosenberg, N., 2001. *Designing efficient institutions for science based entrepreneurship: lesson from the US and Sweden*, *The Journal of Technology Transfer*, 26, 207–231.
- Hertog S, 2007, *Shaping the Saudi state: Human agency's shifting role in rentier-state formation*, *International Journal of Middle East Studies*, 39:4, 539-563.

- Higheredjobs, 2015, <https://www.higheredjobs.com/international/search.cfm?CountryCode=186>
- Hirschman AO, 1968, *The political economy of import substitution industrialisation in Latin America*, Quarterly Journal of Economics, 82: 1 – 32.
- Hirschman AO, 1981, *Essays in trespassing: Economics to politics and beyond*, CUP, Cambridge.
- Hobday M, 2000, *The project-based organisation: an ideal form for managing complex products and systems?* Research policy, 29:7 871-893.
- HoC, 2013, Bridging the valley of death, (Eight Report, HC 348)
- Hodgson GM, 1993, *The Economics of Institutions*, Elgar, Aldershot.
- Hodgson GM, 2007, *Meanings of Methodological Individualism*, Journal of Economic Methodology, 14:2, 211-26.
- Homma, H., Ikeda, N., & Attalage, R. A. (2008). Strengthening University-Industry Linkage in Developing Countries through International Cooperation: Case of Sri Lanka Through Cooperation of Toyohashi University of Technology, Japan. *Innovative Techniques in Instruction Technology, E-learning, E-assessment, and Education*, 432–436.
- Hoover Institution. (2002). Milton Friedman. Retrieved June 17, 2003, pp. 2, from <http://www-hoover.stanford.edu/BIOS/friedman.html>
- Horkheimer, M., & Adorno, T. W. (1972). *Dialectic of enlightenment*. (J. Cumming, Trans.). New York: Herder and Herder.
- <http://clients.digipage.co.uk/?userpath=00000000/00007479/00025542/>
- http://www.nesta.org.uk/assets/Uploads/pdf/Policy-Briefing/universities_policy_briefing_NESTA.pdf
- <http://www.scotland.gov.uk/Resource/Doc/89713/0021562.pdf>
- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221567/ukecon_mon_policy_framework.pdf
- Hu, Albert G. Z., and Gary H. Jefferson. 2004. Science and Technology in China. Paper presented at Conference 2—China’s Economic Transition: Origins, Mechanisms, and Consequences, Pittsburgh, PA, November 5–7.
- Hughes TP, 1987, *The evolution of large technological systems*, in *The social construction of technological systems: New directions in the sociology and history of technology*, 51-82.
- Humphrey C and Scapens RW, 1996. *Methodological themes: theories and case studies of organizational accounting practices: limitation or liberation?* Accounting, Auditing & Accountability Journal, 9, 86-106.
- Hungington SP, 1996, *The Clash of Civilizations and the Remaking of World Order*, Simon & Schuster, NY.
- Huraib, F. S., S. M. Hasnain, and S. H. Alawaji. Lessons learned from solar energy projects in Saudi Arabia. *Renewable energy* 9.1 (1996): 1144-1147.
- Illeris K, 2004, *Learning in Working Life*, Learning Lab Denmark, Roskilde University Press.
- Independent (2017) available at <http://www.independent.co.uk/news/world/middle-east/5-things-weve-learned-from-the-saudi-arabia-wikileaks-documents-10334914.html> (accessed 300517)
- Innovate UK, 2015, <https://www.gov.uk/government/organisations/innovate-uk>
- Inzelt A, 2015, *Re-aligning the Triple Helix in post-Soviet Armenia*, Triple Helix, 2:15, 2-17.
- Irawati D, *Bridging the gaps in the triple helix: a case study based on the challenge of the Indonesian Experience*, in Saad M and Zawdie G (Eds.), 2011, *Theory and practice of the triple helix system in developing countries – issues and challenges*, Routledge, London, Cpt 9.
- Isaksson OHD, Simeth M and Seifert RW, 2016, *Knowledge spillovers in the supply chain: evidence from the high tech sectors*, Research Policy, 45, 699-706.
- Itami H, 1987, *Mobilising Invisible Assets*, Harvard University Press, MA.
- Jackson AR and Gozdecka DA, 2011, *Caught between Different Legal Pluralisms: Women Who Wear Islamic Dress as the Religious ‘Other’ in European Rights Discourses*, The Journal of Legal Pluralism and Unofficial Law, 43:64, 91-120.
- Jacob, M., Lundqvist, M., & Hellsmark, H. (2003). Entrepreneurial transformations in the Swedish university system: The case of Chalmers University of Technology. *Research Policy*, 32(9), 1555-1568.
- Jamali D, 2009, *Constraints and opportunities facing women entrepreneurs in developing countries*, Gender in Management: an international journal, 24:4, 232-251.
- Jameson. *Condition postmodern*. English. Manchester: Manchester University Press.
- Jerome LW, *Triple helix knowledge clusters*, in Saad M and Zawdie G (Eds.), 2011, *Theory and practice of the triple helix system in developing countries – issues and challenges*, Routledge, London, Cpt 1.

- Jessop B, 1991, Thatcherism and flexibility: the white heat of a post-Fordist revolution, in Jessop B, Kastendiek H, Nielson K, and Pedersen O (Eds.), The Politics of Flexibility, op cit.
- Jessop B, 1992, Fordism and post-Fordism: critique and reformulation, in Scott JA and Storper MJ (Eds.), Pathways to Regionalism and Industrial Development, Routledge, London, pg. 43 - 65.
- Jessop B, 1992, Post-Fordism and flexible specialisation: incommensurable, contradictory, complementary, or just plain different perspectives?, in Ernste H and Meier V (Eds.), Pathways to Industrialisation and Regional Development, Belhaven, London.
- Jessop B, 1997, Survey article: the Regulation Approach, in The Journal of Political Philosophy, Vol. 5, pg. 287 – 326.
- Jessop B, 2001, Institutional (re) turns and the strategic – relational approach, in Environment and Planning A, 33, 1213 – 1235.
- Jessop B, The transition to post-Fordism and the Schumpeterian Welfare state, in Burrows R and Loader B, 1994, Towards a Post-Fordist Welfare State, Routledge, London, pg. 13 - 37.
- Jessop B. 1994, *The transition to post-Fordism and the Schumpeterian welfare state*, in R Burrows and B. Loader (Eds.), Towards a Post-Fordist Welfare State?, Routledge, London.
- Johnson C, 1982, MITI and the Japanese Miracle, Stanford University Press, Stanford.
- Johnson C, 1987, *Political institutions and economic performance: the Government-business relationship in Japan, South Korea and Taiwan*, in Deyo FE (Ed.), The Political Economy of the New Asian Industrialism, Cornell University Press, Ithaca.
- Johnson, B. & Lundvall, B. A. (2001). Why all this fuss about codified and tacit knowledge? Retrieved June 14, 2003, pp. 20, from <http://www.druid.dk/conferences/winter2001/paperinter/Paper/johnson%20&%20lundvall.pdf>
- Johnson, Björn, Edward Lorenz, and Bengt-Åke Lundvall. Why all this fuss about codified and tacit knowledge? *Industrial and corporate change* 11.2 (2002): 245-262.
- Jones TC, *The dogma of development* in Haykel B, Hegghammer T and Lacroix S, 2015, Saudi Arabia in Transition, CUP, Cambridge, chapter 3.
- Jones-Evans, D, Klofsten, M., Andersson, E. and Pandaya, D (1999) Creating a Bridge between University and Industry in Small European Countries: The Role of the Industrial
- Jordan AT, 2011, The making of a modern kingdom: globalization and change in Saudi Arabia, Waverland Press, London.
- Kahneman D and Tversky A, 1979, *Prospect theory: An analysis of decision under risk*, Econometrica: Journal of the Econometric Society, 263-291.
- Kayal AA, 2008, *National innovation systems a proposed framework for developing countries*, International Journal of Entrepreneurship and Innovation Management, 8:1, 74:86.
- Kedia B and Bhagat R, 1988, *Cultural Constraint on Transfer of Technology Across Nationals: Implication for Research in International and Comparative Management*, Academy of Management Review, 13:4, 559–571.
- Kemp T, 1978, Historical Patterns of Industrialisation, Longman, London.
- Kenney, M. (2000) *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region*, Stanford University Press.
- Kenney, M. and Goe, R.W (2004) The Role of Social Embeddedness in Professorial Entrepreneurship: A Comparison of Electrical Engineering and Computer Science at UC Berkeley and Stanford, *Research Policy*, Vol. 33, pp. 691-707.
- Kessler EH and Chakrabarti AK, 1996, *Innovation speed: a conceptual model of context, antecedents and outcomes*, The Academy of Management Review, 21:4, 1143-1191.
- Khan IA, 2011, *Learning difficulties in English: Diagnosis and pedagogy in Saudi Arabia*, Educational Research, 2:7, 1248-1257.
- Kim S, 2000, *Urban Development in the United States, 1690-1990*, Southern Economic Journal, 66:4), 855-880.
- Kinder and Burgoyne T, 2013, *Information processing and the challenges facing lean healthcare*, Financial Accountability & Management, 29:3, 271-290.
- Kinder T, 2002, *Good practice in best practice*, Science and Public Policy, 29:3, 1–14.
- Kinder T, 2003, *Go with the flow—a conceptual framework for supply relations in the era of the extended enterprise*, Research Policy, 32:3, 503-523.
- Kinder T, 2010, *e-Government service innovation in the Scottish criminal justice information system*, Financial Accountability & Management, 26:1, 21-41.

- Kirkland J and Stackhouse J, *Guarding the gatekeeper: university research managers in a triple helix environment*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 5.
- Klees S, 1999, *Privatization and neo-liberalism: ideology and evidence in rhetoric reforms*, Retrieved June 28, 2003, pp. 7, from <http://www.tc.columbia.edu/cice/articles/sjk212.pdf>
- Klofsten, M., Jones-Evans, D., 2000. Comparing academic entrepreneurship in *commercialization of university intellectual property*, Research Policy, 32:4, 639-658.
- Knack S, 2006, *Measuring corruption in Eastern Europe and Central Asia*, World Bank Policy Research Working Paper 3968, WB, Washington.
- Kodama F and Suzuki J, 2007, *How Japanese companies have used scientific advances to restructure their businesses: the receiver-active National System of Innovation*, World Development, 35.6, 976-990.
- Kolstad I and Wiig AR, 2009, *Is transparency the key to reducing corruption in resource-rich countries?* World Development, 37:3, 521-532.
- Kövecses Z, 2002, Metaphor: A practical introduction, OUP, Oxford.
- Krugman P, 1987, *The narrow band, the Dutch disease and the competitive consequences of Mrs Thatcher*, Journal of Development Economics, 17, 41-55.
- Krugman P, 1991, Geography and trade, MIT Press, Cambridge.
- Krugman P, 1999, The Return of Depression Economics, Penguin Books, London.
- Krugman P, 2013, End this depression now!, Princeton University Press, MA.
- KSA Government (2017) available at <https://www.saudi.gov.sa/wps/portal/saudi/governmentServices/serviceGroups?groupId=2&categoryName=categories&groupId2=1&categoryName2=beneficiaries> (accessed 300517)
- Kuhn TS, 1962, The Structure of Scientific Revolutions, International Encyclopaedia of Unified Science, University of Chicago, London.
- Kumar BN, 1995, *Partner-selection-criteria and Success of Technology Transfer: A Model Based on Learning Theory Applied to Case of Indo-German Technical Collaborations*, Management International Review, (Special Issue, 65– 78).
- Kunio Y 1986, Japanese Economic Development, OUP, Oxford.
- Kuratko DF and LaFollette WR, 1987, *Small Business Incubators for Local Economic Development*. Economic Development Review, 5:2, 49–55.
- Lakoff G and Johnson M, 1980, Metaphors We Live By, University of Chicago Press, Chicago.
- Lalkaka R, 2002, *Technology business incubators to help build an innovation-based economy*, Journal of Change Management, 3:2, 167-176.
- Lambert T, 2003, Lambert Review of Business-University Collaboration, HMSO, London.
- Landes D, 1998, The Wealth and Poverty of Nations, Little, Brown and Co, London.
- Langlois RN and Robertson PL, 1996, *Stop Crying over Spilt Knowledge: A Critical Look at the Theory of Spillovers and Technical Change*, Paper presented to MERIT conference on Innovation, Evolution and Technology, Maastricht, 1996.
- Langlois RN, 1997, *Scale, Scope and the Reuse of Knowledge*, Paper for the conference in honour of Brian J Loasby, Stirling, Scotland.
- Langlois, R.N. (1997) *Scale, Scope and the Reuse of Knowledge*, Paper for the conference in honour of Brian J Loasby, Stirling, Scotland.
- Langowitz N and Minniti M, 2007, *The entrepreneurial propensity of women*, Entrepreneurship Theory & Practice, 31:3, 341-64.
- Lapidus IM, 2012, Islamic Societies to the nineteenth century, CUP, Cambridge.
- Lapsley, I., & Miller, P. (2004). Foreword – Transforming universities: The uncertain, erratic path. Financial Accountability & Management, 20(2), 103-106.
- Latouche, S, 2007, In the wake of the affluent society: An exploration of post-development, Zed Books, London.
- Latour, B. 1987. *Science in Action*, Milton Keynes, England: Open University Press.
- Latour, B. 1988. *The Prince for machines as well as for machinations* in B. Elliot (ed.), *Technology and Social Process*, Edinburgh: University of Edinburgh Press, pp.20-43.
- Latour, B., Mauguin, P. and Teil, G. 1992. A note on socio-technical graphs, *Social Studies of Science*, 22: 33-57.
- Lau C-C, 2003, *China Changing Industrial System: challenges and prospects* in Cheng YS (Ed.), China's challenges in the Twenty-first century, City University of Hong Kong Press, HK, pg. 409-444.

- Laursen, Keld, and Ammon Salter. Searching high and low: what types of firms use universities as a source of innovation? *Research policy* 33.8 (2004): 1201-1215.
- Lave J and Wenger E, 1991, Situated Learning: legitimate peripheral participation, CUP, Cambridge.
- Law J & Bijker WE, Postscript, in Bijker WE & Law J (Eds.), 1992, Shaping Technology/Building Society, MIT, London, pg. 290 - 308.
- Law, J. and Callon, M. 1992. The life and death of an aircraft: a network analysis of technical change' in W. Bijker and J. Law (Eds), *Shaping Technology/Building Society: Studies in Sociotechnical Change*, Camb. Mass.: The MIT Press.
- Layton C, 1972, Ten Innovations. An International Study on Technological Development and the Use of Qualified Scientists and Engineers in Ten Industries, Originating Research Organisation, London.
- Le Renard, *Engendering consumerism in the Saudi Capital*, in Haykel B, Hegghammer T and Lacroix S, 2015, Saudi Arabia in Transition, CUP, Cambridge, chapter 15.
- Leadbeater, C. (2000). The weightless society: living in the new economy bubble. New York: Texere.
- Leatherdale C, 1983, Britain and Saudi Arabia, Frank Cass, London.
- Lee A, Wei-Ming W, Tsai-Ying, 2010, *An evaluation framework for technology transfer of new equipment in high technology industry*, Technological Forecasting & Social Change, 77, 135–150
- Lee N, 2011, *Free to Grow?*, NESTA Working Paper 11/01, Table 3.
- Lee N, Sameen H and Martin L, 2013, *Credit and the crisis: Access to finance for innovation small firms since the recession*, Big Innovation Centre, London.
- Lee, K. and C. Lim (2001). *Technological regimes, catching-up and leapfrogging: findings from the Korean industries*, Research Policy, 30(459-483).
- Lenman B, 1977, An Economic History of Modern Scotland 1600-1976, Batsford, London.
- Leonard M, 2008, What does China think? Harper-Collins, London.
- Levin IP, Schneider SL and Gaeth GJ, 1998, *All frames are not created equal: a typology and critical analysis of framing effects*, Organisational Behaviour and human decision processes, 76:2, 149-188.
- Lewis RD, 2007 The cultural imperative – Asianisation versus US corporate dominance, Intercultural Press, London.
- Leydersdoff L and van den Basselaar P, 1998, *Technology development and factor substitution in a non-linear model*, Journal of Social and Evolutionary Systems, 21, 173-192.
- Leydesdorff, L., & Meyer, M. (2003). The Triple Helix of university-industry-government relations. *Scientometrics*, 58(2), 191-203.
- Leydesdorff, Loet, and Michael Fritsch. Measuring the knowledge base of regional innovation systems in Germany in terms of a Triple Helix dynamics. *Research Policy* 35.10 (2006): 1538-1553.
- Leys, C. (2001). *Market-driven Politics: Neoliberal Democracy and the Public Interest*. London: Verso.
- Liaison Office, *R&D Management, Vol. 29*, pp. 7-56.
- Liao K, *The basic form, actual form and potential form of neo-Confucianism: considering the historical function and practical significance of neo-Confucianism* in Cao TY, Zhong X and Liao K (Eds.), 2010, Culture and social transformation in reform era China, Leiden, Boston, 45-64.
- Lincoln JR and Kalleberg AL, 1982, Culture, Control And Commitment, CUP, Cambridge.
- Lindberg M, Lindgren M and Packendorff J, 2010, *Quadruple Helix as a way to bridge the gender gap in entrepreneurship*, Journal of Knowledge Economy, 5, 94-113.
- Lindqvist S, 1984, Technology on trial: the introduction of steam power technology into Sweden, Almqvist and Wiksell, Stockholm.
- Link, Albert N., John T. Scott, and Donald S. Siegel. 2003. The Economics of Intellectual Property at Universities: An Overview of the Special Issue. *International Journal of Industrial Organization* 21 (9): 1217–25.
- Link, Albert N., John T. Scott, and Donald S. Siegel. 2003. The Economics of Intellectual Property at Universities: An Overview of the Special Issue. *International Journal of Industrial Organization* 21 (9): 1217–25.
- Lipietz A, 1992, Towards a New Economic Order, Polity Press, Cambridge.
- LiPuma E, 1993, Culture and the concept of culture in a theory of practice, in Calhoun C, LiPuma E and Postone M (Eds.), 1993, Bourdieu: critical perspectives, Policy, Cambridge.
- Llewellyn Smith, C.H. (2006), 'What's the Use of Basic Science?', available at the CERN website <http://public.web.cern.ch/public/Content/Chapters/AboutCERN/WhatIsCERN/BasicScience/BasicScience1/BasicScience1-en.html> [accessed 14 May 2014].

- Llewellyn-Jones L, 2003, Aphrodite's tortoise: the veiled woman of ancient Greece, Classical Press of Wales, Cardiff.
- Llewelyn S, 2002, *What counts as theory in qualitative management and accounting research?* Accounting, Auditing & Accountability Journal, 16:4, 662-708.
- Lockett, A. and Wright, M. (2004) Resources, Capabilities, Risk Capital and the Creation of University Spin-Out Companies: Technology Transfer and Universities' Spin-out Strategies, paper presented at the Technology Transfer Society Meetings, Albany, NY, 30 September 2004.
- Lockett, Andy, and Wright M, 2005, *Resources, capabilities, risk capital and the creation of university spinout companies*, Research Policy, 34.7, 1043-1057.
- London Stock Exchange, 2014, available at (accessed December 2015) <http://www.londonstockexchange.com/companies-and-advisors/aim/aim/aim.htm>
- Lööf et al, 2012, *R&D Strategy and Firm Performance: What is the Long-Run Impact of Persistent R&D? in Innovation & Growth. From R&D Strategies of Innovating Firms to Economy-Wide Technological Change*, OUP, Oxford.
- Losman D, 2010, *The rentier state and national oil companies: An economic and political perspective*, The Middle East Journal, 64:3 427-445.
- Louis, K.S., Blumenthal, D, Gluck, M.E. and Stoto, M.A. (1989) Entrepreneurs in Academe: An Exploration of Behaviors among Life Scientists, *Administrative Science Quarterly*. Vol. 34, No. i, pp. 110-31.
- Low L, Introduction and Overview, in Low L (Ed.), 2004, Developmental States: relevancy, redundancy or reconfiguration Nova Science, NY, Cpt 1.
- Luciani G, Allocation versus Production States, in Luciani G (Ed.), 1990, The Arab State, University of California Press, Berkeley.
- Lumpkin JR and Ireland RD, 1988, *Screening Practices of New Business Incubators: Critical Success Factors*, American Journal of Small Business, 12:4, 59–81.
- Liotard, J. (1989). The postmodern condition: a report on knowledge; translation from the French by Geoff Bennington and Brian Massumi; foreword by Fredric
- Lythe SGE and Butt F, 1975, An Economic History of Scotland 1100-1939, Blackie, Glasgow.
- Ma, Wanghua. 2004. From Berkeley to Beida and Tsinghua: The Development and Governance of Public Research Universities in the U.S. and China. Beijing: Educational Science Press.
- MacGarvie, Megan, and Jeffrey Furman. 2005. Early Academic Science and the Birth of Industrial Research Laboratories in the U.S. Pharmaceutical Industry. NBER Working Paper 11470, National Bureau of Economic Development, Cambridge, MA.
- MacGregor SP, Marques-Gou P and Simon-Villar A, 2010, *Gauging readiness for the quadruple helix: a study of 16 European Organisations*, Journal of Knowledge Economics, 1, 173-190.
- Machlup, F. (1962). The production and distribution of knowledge in the United States. Princeton (N.J.): Princeton University Press.
- MacKenzie D and Wajcman J, 1985, The Social Shaping of Technology, OU Press, Milton Keynes.
- MacLeod G and Jones M, 1999, *Re-regulating a regional rustbelt: institutional fixes, entrepreneurial discourse and the 'political of representation*, in Environment and Planning D: Society and Space, 17, 575 – 605.
- MaCulan A-M and De Mello JMC, *A new regulatory framework for the relationship between university and industry: the Brazilian experience*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 3.
- Madelung W, 2004, The Succession to Mohammed, CUP, Cambridge.
- Madu CN, 1992. Strategic Planning in Technology Transfer to Less Developed Countries. Quorum Books, NY.
- Magalhães, A. M. & Stoer, S. R. (2003). Performance, citizenship and the knowledge society: a new mandate for European education policy. *Globalisation, Societies and Education*. 1 (1), pp. 41-66.
- Malairaja C and Zawdie M, *Science parks and university-industry collaboration in Malaysia*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 13.
- Manigart S, Baeyens K and Hyfte, WV, 2002, *The survival of venture capital backed companies*, Venture Capital: An International Journal of Entrepreneurial Finance, 4:2, 103-124.
- Mansfield, E. and Lee, Y. (1996) The Modern University: Contributor to Industrial Innovation and Recipient of Industrial R&D Support, *Research Policy*, Vol. 25, and pp. 1027-58.

- Markiewicz K and DiMinin, 2005, *Commercialising the laboratory*, UC Berkeley, working paper.
- Markman, G., Siegel, D., Wright, M., 2008. Research and technology commercialization. Journal of Management Studies 45, 1401–1423.
- Markman, Gideon D., et al. Innovation speed: Transferring university technology to market. *Research Policy* 34.7 (2005): 1058-1075.
- Marshall M, 1987, Long Waves of Regional Development, Macmillan, London.
- Marx K, 1970, Capital Volume One, Lawrence and Wishart, London.
- Massa S and Testa S, 2008, *Innovation and SMEs: misaligned perspectives and goals amongst entrepreneurs, academics and policy makers*, Technovation, 28, 393-407.
- Massey D, Quintas P and Wield D, 1992, High-Tech Fantasies, Routledge, London.
- Mathews, J. A., & Hu, M.-C. (2007). Enhancing the Role of Universities in Building National Innovative Capacity in Asia: The Case of Taiwan. *World Development*, 35(6), 1005-1020.
- Mazzucato M, 2013, The Entrepreneurial State: debunking public vs private sector myths, Anthem Press, London.
- McAdam, M. and McAdam, R. (2008), High Tech Start-ups in University Science Park. Incubators: The
- McIntyre J and Papp D, 1986, The Political Economy of International Technology Transfer. Quorum Books. Westport, CT.
- McMeekin S, 2015, The Ottoman Endgame, Penguin, NY.
- McMillan, G.S., Narin, F and Deds, D.L. (2000) An Analysis of the Critical Role of Public Science in Innovation: The Case of Biotechnology, *Research Policy*, Vol. 29, No. i, pp. 1-8.
- Mead DC and Liedholm C, 1998, *The dynamic of micro and small enterprises in developing countries*, World Development, 26:1, 61-74.
- Merrifield DB, 1987, *New Business Incubators*, Journal of Business Venturing, 2, 277–284.
- Mian SA, 1997, *Assessing and managing the university technology business incubator: an integrative framework*, Journal of Business Venturing, 12, 251-285.
- Miner AS, Dale T, Eesley, MD and Rura-Polley T, 2001, *The magic beanstalk vision: Commercializing university inventions and research*, introduction to The Entrepreneurial Dynamic, Stanford University Press, Stanford.
- Mistral J, 1982, La diffusion internationale de l'accumulation intensive et sa crise, in Reiffers J-L, Économie et finance internationales, Dunod/Bordas, Paris, pg. 205 - 237.
- Mody A and Sherman R, 1990, *Leapfrogging in switching systems*, Technological Forecasting and Social Change, 37:1: 77-83.
- Mokyr J, 1990, The Lever of Riches, Oxford University Press, Oxford.
- Molas-Gallart, J., et al. (2002). Measuring Third Stream Activities: Final report of the Russell Group of Universities: SPRU Science and Technology Policy Research unit, University of Sussex.
- Molina A and Kinder T, 2000, *National systems of innovation, industrial clusters and constituency-building in Scotland's electronics industry*, in Lopez-Martinez R and Piccaluga A, 2000, Knowledge Flows in National Information Systems, Edward Elgar, Cheltenham, 15 - 55.
- Molina A and Kinder T, 2001, *National Systems of Innovations, Industrial Clusters and Constituency-Building in Scotland's Electronics Industry*, International Journal of Entrepreneurship and Innovation Management, 1:2, 241 – 275.
- Molina AH, 1999, *Understanding the role of the technical in the build-up of sociotechnical constituencies*, Technovation, 19, 1-29.
- Moore M, 1998, *Death without taxes: democracy, state capacity and aide dependence in the fourth world*, in Robinson M and White G (Eds.), The Democratic Developmental State: Politics and Institutional Design, OUP, Oxford.
- Moser S, Swain M and Alkhabbaz MH, 2015, *King Abdullah Economic City: Engineering Saudi Arabia's post-oil future*, Cities, 45, 71-80.
- Moss LS (Ed.), 1976, The Economics of Ludwig von Mises, Sheed and Ward, Kansas.
- Moulaert F and Swyngedouw E, 1989, A regulation approach to the geography of flexible production systems, in Environment and Planning D, Vol. 7, pg. 327 - 245.
- Moulaert F and Swyngedouw E, Accumulation and organisation in computer and communications industries: a regulationist approach, in Cooke P, Moulaert F, Swyngedouw E, Weinstein O, Wells P (Eds.), 1992, Towards Global Localisation, UCL Press, London, Ch. 3.
- Mowery D and Rosenberg N, 1979, *The Influence of Market Demand on Innovation*, Research Policy, 8, 102-153.

- Mowery D and Rosenberg N, 1998, Paths of Innovation: Technological Change in 20th-Century America, Cambridge University Press, New York.
- Mowery, D., & Sampat, B. (2004). Universities in National Innovation Systems. In., D. Fagerberg, C. Mowery & R. R. Nelson (Eds.), *Oxford Handbook of Innovation*. Oxford, UK: Oxford University Press.
- Mowery, D.C., Sampat BN, 2005. *The Bayh–Dole Act of 1980 and university–industry technology transfer: a model for other OECD governments?* Journal of Technology Transfer, 30, 115–127.
- Murray F and Stern S, 2005, *Do formal intellectual property rights hinder the free flow of scientific knowledge*, National Bureau of Economic Research, Paper 11,465.
- Mustar, P. (1997) Spin-Off Enterprises: How French Academics Create Hi-Tech Companies: The Conditions for Success or Failure, *Science and Public Policy*, Vol. 24, No. 1, pp. 17-4.V
- Nardi BA (Ed.), 1996, Context and consciousness, MIT, Mass.
- Nash R, 1999, Bourdieu, ‘Habitue,’ and Educational Research: is it all worth the candle? in British Journal of Sociology of Education, Vol. 20, No. 2, pg. 175 – 187.
- Nasr V, 2007, The Shi’a revival: how conflicts within Islam will shape the future, Norton and Company, London.
- Ndonzuau, F.N., Pirnay, F. and Surlemont, B. (2002) A Stage Model of Academic Spinoff Creation, *Technovation*, Vol. 22, No. 5, pp. 281-9.
- Neely A (Ed.), 2007, Business Performance Management, CUP, Cambridge,
- Nelson, R. (2001) Observations of the Post-Bayh-Dole Rise of Patenting at American Universities, *Journal of Technology Transfer*, Vol. 26, pp. 13—19.
- Nerkar, A. and Shane, S. (2003) When Do Startups that Exploit Academic Knowledge Survive? *International Journal of Industrial Organization*, Vol. 21, No. 9, pp. 1391-410.
- Newman JH, 1852, Discourses on the scope and nature of university education, available as e-text at http://www.ajdrake.com/etexts/texts/Newman/Works/disc_1852.pdf (accessed 281210)
- Newman, J.H. (1854) *The Idea of a University: Defined and Illustrated in Nine Discourses Delivered to the Catholics of Dublin in Occasional Lectures and Essays Addressed* (Notre Dame Series in the Great Books) by John Henry Newman, Martin J. Svaglic Notre Dame series in the great books Notre Dame, Ind.: University of Notre Dame Press, 1982.
- NHS, 2014, <http://www.stevenagecatalyst.com/>
- Nicolaou, N. and Birley, S. (2003) Academic Networks in a Trichotomous Categorisation of University Spin-Outs, *Journal of Business Venturing*, 5:3, 333-59. OECD (1998) *Fostering Entrepreneurship*, Paris.
- Noble CH, 1999, The Eclectic Roots of Strategy Implementation Research,’ in Journal of Business Research, Vol. 45, pg. 119 – 134.
- Nonaka I and Takeuchi H, 1995, The Knowledge-Creating Company, OUP, Oxford
- North DC, 1990, Institutions, institutional change and economic performance, CUP, Cambridge.
- North DC, 1999). *Institutions, Institutional Changes and Economic Performance*. Publication of Plan and Budget Organization.
- North DC, Wallis JJ and Weingast BR, 2009, Violence and Social Orders, CUP, NY.
- O’Shea, R. P. (2005). Entrepreneurial orientation, technology transfer and spinoff performance of U.S. Universities. *Research Policy*, 34(7), 994-1009.
- OECD Frascati Manual. 2002, 6th Edition.
- OECD, 2013, Main Science and Technology Indicators, (2), Paris.
- OECD. (1996). *Employment and growth in the knowledge-based economy*. Paris: OECD Documents.
- Ogle R, 2007, Smart world: Breakthrough creativity and the new science of ideas, Harvard Business Press, MA.
- Oh D-S, 2014, Business Incubation Strategy of High-Tech Venture Firms in a Science Park, *Technopolis*. 145-167.
- Oh I, *Not yet a triple helix 111? Japanese MOT policies and the problem of technology exploitation*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 15.
- Oil 2014, available at http://inflationdata.com/Inflation/Inflation_Rate/Historical_Oil_Prices_Table.asp accessed 20 December 2015
- Oliver N and Wilkinson B, 1992, The Japanisation of British Industry, Blackwell, Oxford.
- ONS (2013), *Gross Expenditure on Research and Development, 2011*. Compound annual growth rate. Deflator inferred from ONS tables.

- Organisation of Economic Co-operation and Development (2013), *OECD Science, Technology and Industry Scoreboard 2013*, Accessed at: http://dx.doi.org/10.1787/sti_scoreboard-2013-en
- Organisation of Economic Co-operation and Development (2013), *Science, Technology and Industry Scoreboard 2013* http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2013_sti_scoreboard-2013-en.
- Örtenblad, A, 2007 Senge's many faces: problem or opportunity?. *Learning Organization*, 14.2, 108-122.
- Ortony A, 1993, *Metaphor and theory change: what is a metaphor a metaphor for*, in Ortony A (Ed.), *Metaphor and Thought*, CUP, Cambridge.
- Oshikoya T, 1994, Macroeconomic Determinants of Domestic Private Investment in Africa: An Empirical Analysis. *Economic Development and Cultural Change*, 42(3).
- OTA-I SC-173, 1984, *Technology Transfer to the Middle East*, Washington, US Congress, Office of Technology Assessment, (September).
- Owen-Smith, Jason, Massimo Riccaboni, Fabio Pammolli, and Walter W. Powell. 2002. A Comparison of U.S. and European University-Industry Relations in the Life Sciences. *Management Science* 48 (1): 24–43.
- Pack H, 2008, *Asian Successes vs. Middle Eastern Failures: The Role of Technology Transfer in Economic Development*, *Issues in Science and Technology*, 24:3 (Spring).
- Pappas P, 2003, *The university's role in economic development: From research to outreach*, Jossey-Bass San Francisco.
- Papyrakis E and Gerlagh R, 2007, *Resource abundance and economic growth in the United States*, *European Economic Review*, 51:4, 1011-1039.
- Parker S, Tritt G and Woo WT, *Some lessons learning from the comparison of transitions in Asia and Eastern Europe*, in Woo WT, Parker S and Sachs JD (Eds.), 1997, *Economies in transition: comparing Asia and Eastern Europe*, MIT Press, MA, Cpt 1.
- Pavitt K. 1991. *What makes basic research economically useful?* *Research Policy*. 20, 109-119.
- Pedler M (Ed.), 1983, *Action Learning in Practice*, Gower, Aldershot.
- Pempel TJ, *The developmental regime in a changing world economy* in Woo-Cumings M (Ed.), 1999, *The developmental state*, Cornell University Press, London, Chinese. 5.
- Penfield J and Duru M, 1988, *Metaphors That Teach*, *Anthropological Quarterly*, 61:3, 119-128.
- Perez, C. and L. Soete (1988). Catching up in technology: entry barriers and windows of opportunity. *Technical Change and Economic Theory*. G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete. New York, Pinter: 458–479.
- Perkmann M, King Z, Pavelin S, 2011 *Engaging excellence? Effects of faculty quality on university engagement with industry*. *Research Policy* 40, 539–552.
- Perkmann M, Walsh K, 2008. *Engaging the scholar: three forms of academic consulting and their impact on universities and industry*, *Research Policy*, 37,1884–1891.
- Peters, M. (1999). (Posts-) Modernism and structuralism: affinities and theoretical innovation. *Sociological Research Online*, 4 (3), pp. 1-9. Retrieved January 3, 2003, from <http://www.socresonline.org.uk/socresonline/4/3/peters.html>
- Peters, M. (2000). Education policy research and the global knowledge economy. Access: *Critical Perspectives on Cultural and Policy Studies in Education*. 19 (2), pp. 90-101.
- Peters, M. (2001a). Poststructuralism, Marxism, and neoliberalism: between theory and politics. Lanham, MD: Rowman & Littlefield Publishers.
- Peters, M. (2001b). Lecture 3: Globalisation and the knowledge economy: implications for education policy in Aotearoa'. In 'Education and culture in postmodernity: the challenges for Aotearoa/New Zealand', a series of three public lectures at the Maidment Theatre, the UoA, 18-20 April. The Macmillan Brown Lecture Series (Awarded by the University of Canterbury, New Zealand), 43. Available at: <http://www.knowledgewave.org.nz/> under Catching the Knowledge Wave Website, 'Featured Articles and Papers'. 376
- Peters, M. (2001c). National education policy constructions of the 'knowledge economy': towards a critique. *Journal of Educational Enquiry*, 2 (1). Retrieved February 26, 2003, pp. 22, from <http://www.education.unisa.edu.au/JEE/Papers/JEEVol2No1/paper1.pdf>
- Peters, M. (2002a). Education policy in the age of knowledge capitalism. Retrieved June 25, 2003, pp. 21, from http://www.hku.hk/cerc/Beijing_Forum/Keynote/Michael_Peters_paper.doc
- Peters, M. (2002b). University, globalisation and the knowledge economy: an essay in the new political economy of knowledge. *Policy Futures in Education*. Online Journal. Retrieved February 18, 2003, pp.

- 19, from www.triangle.co.nz
- Peters, M. (2002c). Universities, globalisation and the knowledge economy. *Southern Review*.35 (2), pp. 16-36.
- Peters, M. (2002d). Cultural studies and the future of 'culture'. *New Zealand Journal of Sociology* 16 (2), pp. 1-10.
- Peters, M. (2003). Globalisation, education and the knowledge economy. Access: *Critical Perspectives on Cultural and Policy Studies in Education*, 21 (2), pp.33-
- Petersen AM, Rotolo D and Leydesdorff, 2016, *A triple helix model of medical innovation: supply, demand and technological capabilities in terms of medical subject headings*, *Research Policy*, 45, 666-681.
- Pfister HR and Böhm G, 2008, The multiplicity of emotions: A framework of emotional functions in decision making. *Judgment and decision making*, 3:1, 5-17.
- Phan, PH, Siegel, DS, 2006, *The effectiveness of university technology transfer: lessons learned from qualitative and quantitative research in the US and UK*, *Foundations and Trends in Entrepreneurship*, 2, 66-144.
- Piergiovanni, R., & Santarelli, E. (2001). Patents and the geographic localization of R&D spillovers in French manufacturing. *Regional studies: journal of the Regional Studies Association; the international forum for regional development policy and research*, 35(8), 697-702.
- Piore MJ and Sabel CF, 1984, *The Second Industrial Divide*, Basic Books, NY.
- Pisano GP, 1997, *The Development Factory*, Harvard University Press, Boston.
- Pisano, GP, 2006, *Science Business*, Harvard Business School Press, MA.
- Polanyi M, 1958, *Personal Knowledge*, Routledge & Kegan Paul, London.
- Polanyi M, 1958, *The Study of Man*, Routledge and Kegan Paul, London.
- Polanyi, M. (1967). *The tacit dimension*. London: Routledge & Kegan Paul.
- Porter M, 1990, *The Competitive Advantage of Nations*, Macmillan, London.
- Porter M, 2009, *Competitiveness and the state of entrepreneurship in Saudi Arabia*, Harvard Business School, available at http://www.hbs.edu/faculty/Publication%20Files/20090127_Saudi_Arabia_Competitiveness_and_Entrepreneurship_5bb2a687-c951-48c9-bc05-cb4ba3340c3e.pdf
- Porter ME, 1990, *The Competitive Advantage of Nations*, Macmillan, London.
- Potter G, 2000, For Bourdieu, Against Alexander: Reality and Reduction, in *Journal for the Theory of Social Behaviour*, Vol. 30, No. 2, pg. 229 - 246.
- Powers, J. and McDougall, P (2005) University Start-Up Formation and Technology Licensing with Firms that Go Public: A Resource Based View of Academic Entrepreneurship, *Journal of Business Venturing*, VoL 20, No. 3, pp. 291—311.
- Poyago-Theotoky, Joanna, John Beath, and Donald S. Siegel. 2002. Universities and Fundamental Research: Reflections on the Growth of University-Industry Partnerships. *Oxford Review of Economic Policy* 18 (1): 10–21.
- Poyago-Theotoky, Joanna, John Beath, and Donald S. Siegel. 2002. Universities and Fundamental Research: Reflections on the Growth of University-Industry Partnerships. *Oxford Review of Economic Policy* 18 (1): 10–21.
- Prahalad CK and Hammond A, 2002, *Serving the World's Poor, profitably*, *Harvard Business Review*, (September)
- PraxisUnico, 2012, Spin-Outs from Research to Market” (PraxisUnico/Young Company Finance.
- Priem RL, 2007, *A consumer perspective on value creation*, *Academy of Management Review*, 32:1, 219-235.
- Pyke F and Sengenberger W (Eds.), 1992, *Industrial Districts and local economic regeneration*, International Institute for Labour Studies, Geneva.
- Radwan I and Al-Kibbi J, 2002, *Small and medium enterprise development: A version for action in Saudi Arabia*, presented at the Small and Medium Enterprises Session at the Future at the Future Vision of the Saudi Economy Symposium held by Kingdom of Saudi Arabia Ministry of Planning. Riyadh.
- Raelin JA, 2008, *Work-based learning*, Jossey-Bass, San Francisco.
- Ramady MA, 2005, Components of technology transfer: a comparative analysis of offset and non-offset companies in Saudi Arabia, *World Review of Science, Technology and Sustainable Development*, 2:1, 72-91.
- Ramady MA, 2010, *The Saudi Arabian economy: Policies, achievements, and challenges*. Springer Science & Business Media, Berlin.

- Ranga M and Etzkowitz H, *Creative reconstruction: a triple helix-based innovation strategy in Central and Eastern Europe Countries*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 14.
- Rankin KR, 2001, *Governing development: neoliberalism, microcredit and rational economic woman*, Economy and Society, 30:1, 18-37.
- Razak AA and Saad M, *The challenges arising in the evolution of the triple helix institutional system: the case of Malaysia*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 11.
- Reich-Graefe R, 2016, *Intermediation in intermediation: triple helix innovation and intermediary legal organisation*, Triple Helix, 3:10, 2-45.
- Relationship between the Start-Up's Lifecycle Progression and use of the Incubator's Resources, Technovation, 28 (5): p. 277–90.
- Ricoeur P, 1977, The Rule of Metaphor: Multi-Disciplinary Studies in the Creation of Meaning in Language, University of Toronto Press. Toronto.
- Rifkin, J. (1998). Civil education for the twenty-first century: preparing students for a three-sector society. National Civic Review. Summer, 87 (2), pp. 177-181.
- Riley R and Robinson C, 2011, *UK Economic Performance: How Far do Intangibles Count?*, Innodrive working paper No. 14, DBIS, London.
- Robels AC, 1994 French Theories of Regulation and Conceptions of the International Division of Labour, Macmillan, London.
- Roberts, E. (1991) *Entrepreneurs in High Technology: Lessons from MIT and Beyond*, Oxford: Oxford University Press.
- Roberts, E. and Malone, D.E. (1996) Policies and Structures for Spinning Off New Companies from Research and Development Organizations, *R&D Management*, Vol. 26, pp. 17-48.
- Robinson F (Ed), 1996, The Cambridge Illustrated History of the Islamic World, CUP, Cambridge.
- Robinson J, 1962, Economic Philosophy, Penguin, Middlesex.
- Rodrik (2011)
- Rodrik D, 2015, The globalisation paradox: why global markets, states and democracy can't coexist, OUP, Oxford.
- Rodrik DR, 2011, The globalization paradox: democracy and the future of the world economy, Basic, New York.
- Rogers, E.M. (1986) The Role of the Research University in the Spinoff of High Technology Companies, (Vol. 4, pp. 169-81.
- Roomi MA and Parrott G, 2008, *Barriers to development and progression of women entrepreneurs in Pakistan*, Journal of Entrepreneurship, 17:1, 59-72.
- Roper S et al, 2006 *The Scottish Innovation System: Actors, Roles and Actions*, available at
- Rorty R, 1989, Contingency, irony, and solidarity, Cambridge University Press, Cambridge.
- Roseira C, 2014, *Understanding Incubator Value – A Network Approach to University Incubators*, Working Paper 532, Universidade do Porto, Faculdade de Economia do Porto.
- Rosenberg N & Birdzell LE, 1986, How the West Grew Rich - The Economic Transformation of the Industrial World, Tauris & Co., London.
- Rosenberg N, 1970, *Economic development and the transfer of technology: Some historical perspectives*, Technology and Culture, 11:4), 550-575
- Rosenberg N, 1982, Inside the Black Box - Technology and Economics, CUP, New York.
- Rosenberg N, 1990, *Why do Firms do Basic Research (with Their Own Money)?* Research Policy. 19, 165-174.
- Rothaermel FT, Agung S and Jiang L, 2007, *University entrepreneurship: a taxonomy of the literature*, Industrial and Corporate Change, 16, 691–791.
- Rutherford M, 1995, *The old and the new institutionalism: can bridges be built?* Journal of Economic Issues, XXIX:2, 443-451.
- Sachs JD and Andrew M. Warner AM, 2001, *The curse of natural resources*, European economic review, 45:4, 827-838.
- Sachs JD and Andrew M. Warner MA, 2001, *The curse of natural resources*, European Economic Review 45:4, 827-838.
- Sachs JD and Warner AM, 1995, *Economic convergence and economic policy*, NBER working paper 5039, Cambridge, MA.

- Sachs JD and Warner AM, 1999, *Natural resource intensity and economic growth in* Meyer J, Chambers B and Farooq A (Eds.), Development Policies in Natural Resource Economies, Elgar, Cheltenham, 13-38.
- Sadi MA and Al-Ghazali MB, 2010, *Doing business with impudence: a focus on women entrepreneurship in Saudi Arabia*, African Journal of Business Management, 4:1, 1-26.
- Alshemari N (2005). "23,000 Businesswomen, 213,000 Educational Women Jobs and 2.3 Million Female Students in Saudi Arabia". Aleqtisadiyah Newspaper, 9 August.
- Saha, R., K. Satyanarayana, and C. A. Gardner. Building a 'Cottage Industry' for Health (and Wealth): The New Framework for IP Management in India. *IP Strategy Today* 10 (2004): 26-60.
- Salem MI, 2014, *The role of business incubators in the economic development of Saudi Arabia*, International Business and Economics Research Journal, 13:14, 853-860.
- Salter A.J. and Martin BR. 2000, *The economic benefits of publicly funded basic research: a critical review*, Research Policy. xxxx
- Sankar, U. (2007). *The Economics of India's Space Programme—An Exploratory Analysis*, OUP, New Delhi.
- Saudi Arabian Monetary Agency, 48th Annual report, available at http://www.sama.gov.sa/sites/samaen/ReportsStatistics/ReportsStatisticsLib/5600_R_Annual_En_48_2013_02_19.pdf
- Saudi e-Government National Portal, 2010, n.d. National Plans and Initiatives: Ninth Development Plan. Chapter-5: Knowledge Based Economy. Available at <http://www.mep.gov.sa/themes/GoldenCarpet/index.jsp;jsessionid=024E62861EE532B3E9E68DE84221403F.alfa>.
- Saxenian A, The Genesis of Silicon Valley, in Hall P and Markusen A (Eds.), 1985, Silicon Landscapes, Allen and Unwin, London, Cpt. 2.
- Saxenian, A. (1994) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Cambridge, MA: Harvard University Press.
- Scapens RW, 1990, *Researching management accounting practice: the role of case study methods*, The British Accounting Review, 22, 259-281.
- Schneider BR, 1991, Politics within the state: elite bureaucrats and industrial policy in authoritarian Brazil, University of Pittsburgh Press, Pittsburgh.
- Schön DA, 1983, The Reflective Practitioner, Basic Books, NY.
- Schwartz M, 2013, A control group study of incubators' impact to promote firm survival, The Journal of Technology Transfer, 38:3, 302-331.
- Schwartz-Shea P and Yanow D, 2009, Reading and writing as method: In search of trustworthy texts, Organizational ethnography: Studying the complexities of everyday life, OUP, Oxford.
- Schwarz G, 1988, *Metaphor and Cognition: Beneath the Basics*, The English Journal, 77:8, 32-33.
- Science and Technology Policy Research, 1991, The relationship between publicly funded basic research and economic performance. [online]. (accessed 19 February 2010). <http://www.hm-treasury.gov.uk/d/156.pdf>
- Scott W, 1995, Institutions and organizations, Sage, London.
- Scottish Government (2004), 'The Competitiveness of Higher Education in Scotland, Phase 3: Summary', available at <http://www.scotland.gov.uk/Resource/Doc/47171/0028787.pdf> [accessed 14 August 2014].
- SE, 2012, Scottish Enterprise Proof of Concept Programme, available at <http://www.scottish-enterprise.com/proofofconcept> [accessed 17 August 2007].
- Segal, N.S. (1986) Universities and Technological Entrepreneurship in Britain: Some Implications of the Cambridge Phenomenon, *Technovation*, 4:3, 189-205.
- Şehitoğlu Y and Özdemir OC, 2013, *The Impact of Business Incubation on Firm Performance during Post Graduation Period-Turkey Example*, British Journal of Arts & Social Sciences, 12.1.
- Sender K, 2001, Gay Readers, Consumers, and a Dominant Gay Habitus: 25 Years of the Advocate Magazine, in Journal of Communication, Vol. 51, No. 1, pg. 73 – 99.
- Senge PM, 1990, The Fifth Discipline, Random House, London.
- Shane S, 2004a, Academic Entrepreneurship: University Spinoffs and Wealth Creation, Cheltenham, UK, Edward Elgar.
- Shane SA, 2004, Academic Entrepreneurship: University Spinoffs and Wealth Creation,
- Shane, S. (2001) Technology Regimes and New Firm Formation, *Management Science*, Vol. 47, No. 9, pp. 117.1-90.
- Shane, S. (2004b) Encouraging University Entrepreneurship: The Effect of the Bayh-Dole Act on University Patenting in the United States, *Journal of Business Venturing*, Vol. 19, No. 1, pp. 127-51.

- Shane, S. and Stuart, T. (2002) Organizational Endowments and the Performance of University Start-Ups, *Management Science*, Vol. 48, No. i, pp. 154-71.
- Shapiro MA, *The triple helix paradigm in Korea and Taiwan: a test for new forms of capital*, in Saad M and Zawdie G (Eds.), 2011, Theory and practice of the triple helix system in developing countries – issues and challenges, Routledge, London, Cpt 7.
- Sharp L, 1964, Technological innovation and culture change: an Australian case, in Sharp L, 1964, *Cultural and Social Anthropology: Selected Readings*, Macmillan, NY.
- Shepard JM, 2013, *Small Business Incubators in the United States: A Historical Review and Preliminary Research Findings*, *Journal of Knowledge-based Innovation in China*, 5.3.
- Sherbiny NA and Hatem OM, 2015, State and Entrepreneurs in Egypt: Economic Development since 1805, Palgrave Macmillan, London.
- Sherman HF, 1999, *Assessing the intervention effectiveness of business incubation programmes on new business start-ups*, *Journal of Developmental Entrepreneurship*, 4, 117-133.
- Shinn, Terry. The triple helix and new production of knowledge prepackaged thinking on science and technology. *Social studies of science* 32.4 (2002): 599-614.
- Shuklian S, 1995, *Marx, Dewey and the instrumentalist approach to political economy*, *Journal of Economic Issues*, XXIX:3, 781-805.
- Siegel, D. S. (Ed.). (2006). *Technology Entrepreneurship: Institutions and Agents Involved in University Technology Transfer*. London: Edgar Elgar.
- Siegel, D., Waldman, D, Atwater, L. and Link, A. (2004) Toward a Model of the Effective Transfer of Scientific Knowledge from Academicians to Practitioners: Qualitative Evidence from the Commercialization of University Technologies, *Journal of Engineering and Technology Management*, Vol. 21, pp. 115-42.
- Siegel, D.S., Waldman, D., Link, A., 2003, *Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study*, *Research Policy*, 32, 27–48.
- Simmons MR, 2006, Twilight in the desert: the coming Saudi oil shock and the world economy, John Wiley & Sons, London.
- Smilor, R.W, Gibson, D.V. and Dietrich, G.B. (1990) University Spinout Companies: Technology Start-Ups from UT-Austin, *Journal of Business Venturing*, 5, 63-76.
- Smith D, 2008, The Dragon and the Elephant, Profile, London.
- Smith, J. (2000). The origins of postmodernity. (Book Review). *Journal of Sociology*, August 2000, 36(2). p. 252.
- Snow DA and Benford R&D, 1988, *Ideology, frame resonance and participant obligation*, *International Social and Motivational Research*, 1:197-218.
- Soete, L. (1985). International diffusion of technology, industrial development and technological leapfrogging. *World Development*, 13(3): 409-422.
- Solow R, 1990, The Labour Market as a Social Institution, Blackwell, London.
- Solow RM, 1956, *A Contribution to the Theory of Economic Growth*, *Quarterly Journal of Economics* 70:1, 65–94.
- Solow RM, 1987, *We'd Better Watch Out*, *New York Times Book Review*, July 12, p. 36.
- Sorenson, O. and Stuart, TE. (2001) Syndication Networks and the Spatial Distribution of Venture Capital Financing, *Journal of Business Venturing*, Vol. 16, pp. 1546-88.
- Spinouts UK, 2012, <http://www.spinoutsuk.co.uk> (accessed May 17 2014).
- Sridhar M, 2013, *An Overview on Technology Nurturing and Incubation from a Life Science Perspective*, *Emerging Dimensions of Technology Management*, 63-71.
- Steck, H. (2003). Corporatization of the university: Seeking conceptual clarity. *ANNALS, AAPSS*, 585, 66-83.
- Stehr N, 2001, The fragility of modern societies: knowledge and risk in the information age, London: SAGE
- Stehr, N. and Ericson, R. V. (1992). *The culture and power: inquiries into contemporary societies*. Berlin; New York: W. de Gruyter.
- Steinmueller WE, 2001. *ICTs and the possibilities for leapfrogging by developing countries*. *International Labour Review*, 140:2, 193-210
- Sternberg R, 1991, *Reasons for the genesis of high-tech regions – theoretical explanation and empirical evidence*, *Geoforum*, 27:2, 205 – 223.

- Stevens C, 1990, *Technoglobalism vs. Technonationalism: the Corporation Dilemma*, Columbia Journal of World Business, 25:3, 42-9.
- Stiroh, K. J. (2000). Is there a new economy? Retrieved June 9, 2003, pp. 15, from http://www.ny.frb.org/rmaghome/economist/stiroh/ks_newec.pdf
- Storper M and Salais R, 1997, *Worlds of Production*, Harvard University Press, Cambridge, Mass.
- Streeck W, 1992, *Social Institutions and Economic Performance*, Sage, London.
- Stromquist, N.P., & Monkman, K. (Eds.). (2000). *Globalization and Education: Integration and Contestation Across Cultures*. Lanham, MA: Rowman & Littlefield Publishers, Inc.
- Swan J and Scarborough H, 2001, *Knowledge management*, Routledge, London.
- Szogs A, 2010, *Technology transfer and technological capability building in informal firms in Tanzania*, Centre for Innovation, Research and Competence in the Learning Economy, Department of Design Sciences Lund University ISBN: 978-91-977285-3-9.
- Takayuki Hayashi, 2003, *Effects of R&D programmes on the formation of university-industry-government networks: comparative analysis of Japanese R&D programmes*, Research Policy, 32, 1421-1442.
- Tambuyann T, 2009, *Women entrepreneurship in Asian developing countries: their development and main constraints*, Journal of Development and Agricultural Economics, 1:2, 27-40.
- Tang M, 2013, *Technology Business Incubators in China and India: A Comparative Analysis*, Journal of Global Information Technology Management, 16.2.
- Targeting Innovation Ltd. (TIL), 2008, *Scottish University Spin-out Study*.
- Targeting Innovation, 2009, *The UK Commercialisation Ecosystem*, available at www.targetinginnovation.com
- Teitelbaum J, 1998, *Sharyf Husayn ibn Ali and the Hashemite vision of the post-Ottoman order*, Middle Eastern Studies, 34, 103-22.
- Terry E, 2002, *How Asia Got Rich*, East Gate Books, NY.
- The Economist*, December 12, 2002
- The National (020617) available at <http://www.thenational.ae/business/economy/poll-saudi-business-executives-show-a-positive-take-on-vision-2030>
- Thursby, J. and Kemp, S. (2002) *Growth and Productive Efficiency of University Intellectual Property Licensing*, Research Policy, Vol. 31, pp. T 09-24.
- Todeva E and Etzkowitz H, 2013, *The Triple Helix as a highly charged intellectual enterprise*, Helice 2:3, 8-12.
- Tornatzky, G. (1996) *The Art and Craft of Technology Business Incubation: Best Practices, Strategies, and Tools from more than so Programs*. Research Triangle Park, NC: Southern Technology Council; Athens, Ohio: National Business Incubation Association.
- Touraine A, 1971, *The Post-Industrial Society. Tomorrow's Social History: Classes, Conflicts and Culture in the Programmed Society*, Random House, New York.
- Tsang EW, 1997, *Choice of International Technology Transfer Mode: A Resource-based View*, Management International Review, 37, 151-168.
- Tsebelis G, 1990, *Nested Games: rational choice in comparative politics*, University of California Press, Berkeley.
- Turn of the Millennium*, London: Routledge.
- Turpin, T., Sullivan, N., & Deville, A. (1993). *Crossing Innovation Boundaries: The Formation and Maintenance of Research Links between Industry and Universities in Australia*. Canberra: AGPS.
- Turtelboom, B. (1991). *Interest Rate Liberalization: Some Lessons from Africa*. *IMF Working Paper*, 121.
- Tversky A and Kahneman D, 1973, *Availability: A heuristic for judging frequency and probability*, Cognitive psychology, 5:2, 207-232.
- Tversky A and Kahneman D, 1981, *The framing of decisions and the psychology of choice*, Science.
- Tversky A and Kahneman D, 1982, *Variants of uncertainty*, Cognition 11:2, 143-157.
- UK Design Council, 2015, <http://www.designcouncil.org.uk>
- UK Government Expenditure, 2015, available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446716/50600_PESA_2015_PRINT.pdf
- UK Trade and Investment Report (2014) [https://www.gov.uk/government/publications/ukti-inward-investment-report-2013-2014--2](https://www.gov.uk/government/publications/ukti-inward-investment-report-2013-2014/ukti-inward-investment-report-2013-2014--2)
- Ulrichsen KC, *Saudi Arabia*, in Davidson C (Ed), 2011, *Power and politics in the Persian Gulf Monarchies*, Hurst & Co, London.

- UN (2011) available at <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan046473.pdf> (accessed 300517)
- UNIDO, 2005, Industrial Development Report, UN, NY.
- Unruh, G. C. and J. Carrillo-Hermosilla (2006). Globalizing carbon lock-in. *Energy Policy* 34(10): 1185-1197.
- Vaivode I, 2015, *Triple Helix Model of university-industry-government cooperation in the context of uncertainties*, Procedia: Social and Behavioural Sciences, 213, 1063-1067.
- Valentine SR, 2015, *Force and Fanaticism: Wahhabism in Saudi Arabia and Beyond*, Hurt & Co, London.
- Vandenberg P, 2002, *North's institutionalism and the prospect of combining theoretical approaches*, Cambridge Journal of Economics, 26, 217-235.
- Varga A and Acs ZJ, 2000, *Geographical spillovers and university research: a spatial econometric perspective*, Growth and Change, 31, 501-515.
- Vargas MIR, *Innovation systems interaction and technology transfer and assimilation for industrial development: the cases of South Korea and Mexico*, Saad M and Zawdie G, Cpt 2
- Vargo SL and Lusch RF, 2007, *Service-dominant logic: continuing the evolution*, Journal of Academic Marketing, 36, 1-10.
- Vassiliev A, 1998, *The history of Saudi Arabia*, Saqi Books, London.
- Veblen T, 1965, *The higher learning in America*, Kelley, NY.
- Venkataraman S, 1997, The distinctive domain of entrepreneurship research, *Advances in entrepreneurship, firm emergence and growth*, 3:1, 119-138.
- Verspagen B, 1993, *Uneven growth between interdependent economies: an evolutionary view on technology gaps*, Avebury, Aldershot.
- Virasa, T. (2011). University Technology Transfer and Commercialization: The Case of Mahidol University, Thailand. In P. K. Wong (Ed.), *Academic Entrepreneurship in Asia: The Role and Impact of Universities in National Innovation Systems* (pp. 310-335): New Horizons in Entrepreneurship. Cheltenham, U.K. and Northampton, Mass.: Elgar.
- Vogel EF, 2011, *Deng Xiaoping and the Transformation of China*, Harvard University, Press, Cambridge, Massachusetts.
- Vohora A, Wright M and Lockett A, (2004), *Critical junctures in the development of university high-tech spinout companies*, Research Policy, 33, 147-175.
- Vohora, A., Wright, M. and Lockett, A. (2004) Critical Junctures in the Development of University High-Tech Spin-Out Companies, *Research Policy*, Vol. 33, pp. 147-75.
- Volkman C, 2004, *Entrepreneurship studies - An ascending academic discipline in the twenty-first century*, Higher Education in Europe, 29:2, 177-185.
- von Krogh G and Roos J, 1995, *Organisational Epistemology*, Macmillan, London.
- Von Zedtwitz M, 2003, *Classification and management of incubators: aligning strategic objectives and competitive scope for new business facilitation*, Journal of Entrepreneurship and Innovation Management, 3 (1/2), 176-196.
- Walcott, S, 2003. *Chinese Science and Technology Industrial Parks*. Burlington, VT: Ashgate.
- Wallmark, J.T. (1997) Inventions and Patents at Universities: The Case of Chalmers University of Technology, *Technovation*, Vol. 17, No. 3, pp. 127-39.
- Walsh V, et al, 1992, *Winning by design: technology, product design and international competitiveness*, Blackwell, Oxford.
- WB, 2014, https://en.wikipedia.org/wiki/Entrepreneurship_Policies_in_Saudi_Arabia
- WB. (1999). World development report 1998/99: knowledge for development. New York: Oxford University Press.
- Weick K, 1979, *The Social Psychology of Organisations*, Random House, New York.
- Wertsch JV, 1985, *Vygotsky and the social formation of mind*, HUP, Mass.
- Wever, E., & Stam, E. (1999). *Clusters of high technology SMEs: The Dutch case*.
- Williams M, 2000, *Interpretivism and Generalization*. Sociology, 34:2, 209-24.
- Wilson (2012), *A review of Business-University Collaboration*, (accessed 25 May 2014) available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32383/12-610-wilson-review-business-university-collaboration.pdf
- Witty Review (2013), *Encouraging a British invention revolution: Sir Andrew Witty's review of universities and growth*, Accessible at:

- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249720/bis-13-1241-encouraging-a-british-invention-revolution-andrew-witty-review-R1.pdf
- Wolf A, 2002, *Does education matter – myths about education and economic growth*, Penguin, London.
- Wolf A, 2002, *Does education matter? Myths about education and economic growth*, *Perspectives*, 6:4, 115-118.
- Wolf A, 2002, *Does education matter? Myths about education and economic growth*, *Perspectives*, 6:4, 115-118.
- Wolf MJ, 1984, *The Japanese Conspiracy*, New English Library, London.
- Womack J, Jones D and Roos D, 1990, *The Machine that Changed the World*, Macmillan, New York.
- Womack, J. and Jones, D. (1996) *Lean thinking*, Simon and Schuster, NY.
- Woo-Cumings M (Ed.), 1999, *The developmental state*, Cornell University Press, London.
- Woo-Cumings M, 1991, *Race to the Swift: state and finance in Korean Industrialisation*, Columbia University Press, NY.
- World Economic Forum (2003) *Global competitiveness Report*, Chapter 1.
- Wright M, Vohora A, and Lockett A, 2004, *The Formation of High-Tech University Spinouts: The Role of Joint Ventures and Venture Capital Investors*, *Journal of Technology Transfer*, 29:3/4, 287-310.
- Wright M., Lockett A, Clarysse B and Binks M, 2006, *University spinout companies and venture capital*. *Research Policy*, 35, 481-501.
- Yamada J, 2000, *Neo-Techno-Nationalism: How and Why It Grows*, accessed 20 December 2011; available at <http://www.ciaonet.org/isa/yaa01/>
- Yamani M, 2000, *Changed identities: The challenge of the new generation in Saudi Arabia*, Royal Institute of International Affairs, London.
- Yanow D, 2003, *Interpretive empirical political science: What makes this not a subfield of qualitative methods*, *Qualitative Methods*, 1:2, 9-13.
- Zaini RM, Lyan DE and Rebentisch E, 2015, *Startup research universities, high aspiration in a complex reality: a Russian startup university case analysis using stakeholder value analysis and systems dynamic modelling*, *Triple Helix*, 2:4, 2-31.
- Zucker, L.G., Darby, M.R. and Armstrong, J. (1998) Geographically Localized Knowledge:
- Zuhair T. Bakhsh, MS, PhD, Ameerah Y. Mansour, MS, PhD, Edward K. Mensah, MS, PhD, Kevin G. Croke, PhD, James L. Drummond, DDS, PhD, Anne Koerber, DDS, PhD, 2012, *Factors affecting the internal brain drain of Saudi healthcare professionals*, *Saudi Medical Journal*, 33:12, 1285-1289.
- Zuker LF, Darby MR and Armstrong J, 1994, *Intellectual Capital and the Firm: The Technology of Geographically Localised Knowledge Spillovers*, *National Bureau of Economic Research*, Working Paper 4946, Cambridge, MA.