The Abu Dhabi Innovation Index
Foreword

The Government of Abu Dhabi has set out the goal of attaining a knowledge-based economy. This comes as part of a prudent strategic vision that aspires to transform the Emirate from an economy that is oil-dependent to a more diversified economy that is capable of achieving sustainable development as well as regional leadership and competitiveness at the global level.

Given the important role of innovation with regard to achieving a knowledge-based economy, the Department of Economic Development-Abu Dhabi (DED), with the support and direction of the General Secretariat of the Executive Council-Abu Dhabi (GSEC), has collaborated with INSEAD to develop the Abu Dhabi Innovation Index and conduct the Abu Dhabi Innovation Survey. The latter was conducted in partnership with the Statistics Centre-Abu Dhabi (SCAD). These efforts come as a result of acknowledging that innovation is one of the most important drivers for building competitive capabilities in the light of the technological and knowledge revolutions that the world is witnessing at present. Developing, or even maintaining, competitive capabilities is now highly dependent on innovating and introducing new products at cost-competitive prices in addition to developing new techniques to generate these products. Countries that regard innovation as an important component of achieving high added-value are able to win the global competitiveness battle. They will do this through adopting a strategy that is rooted in product attractiveness, efficient resource utilisation and continuous development of production techniques.

This report is the first of its kind in the Emirate of Abu Dhabi. It provides a comprehensive assessment of Abu Dhabi’s innovation system including an examination of its strengths and weaknesses. In this report, we make a genuine effort to portray a clear picture of the Emirate’s innovation system as a first step before the DED develops a comprehensive strategy for a knowledge-based economy in Abu Dhabi.

Mohamed Omar Abdulla

Undersecretary, Department of Economic Development-Abu Dhabi
Executive Summary

This report provides a detailed assessment of the innovation capabilities of the Emirate of Abu Dhabi. Based on internationally benchmarked findings drawn from the Abu Dhabi Innovation Index and the Abu Dhabi Innovation Survey, the report highlights areas where the Emirate is globally competitive and where it needs to further develop the knowledge-driven sectors of its economy.

The Abu Dhabi Innovation Index shows that the Emirate is well set up by international standards to access knowledge required for innovation, and to anchor and retain this locally, and also to diffuse it across sectors of its economy. The Emirate’s success could be attributed to its ability to access skilled international talent and know-how, the results of investment in world-class telecommunications and transportation infrastructure, and strong leadership from its Government in the form of savvy procurement processes and other strategic investments in high-tech anchoring platforms such as Masdar, Strata, Advanced Technology Investment Company and the Cleveland Clinic Abu Dhabi. When compared to other natural resource-rich economies (NREs), Abu Dhabi emerged as highly efficient in adopting and diffusing new knowledge, technology, products and services across its economy.

The report also details the results of the Abu Dhabi Innovation Survey which was administered to a large sample of firms in the Emirate, and benchmarked against data from European countries on key parameters such as innovation activity, expenditure, co-operation, sources of information and barriers to innovation. The survey found that during the period 2008-2011, Abu Dhabi firms undertook more innovation in processes (59.4%) than products (38.5%). While 41% of the product innovations were new to the UAE markets and 16% were novel internationally, the survey reveals the prevalence of ‘innovation by adoption’ typified by the acquisition of new business units emerged as the most common mean of accessing new knowledge and technology. Unsurprisingly and in line with global trends, cost emerged as the most significant barrier facing innovative firms. The survey also found that the market dominance by large firms in some sectors presented a barrier to innovation for smaller domestic enterprises.

Collectively, the findings of both the Abu Dhabi Innovation Index and the Abu Dhabi Innovation Survey portray the Emirate of Abu Dhabi as a growing economy that is globally connected and highly active in adopting and diffusing knowledge and innovation. Whilst many other NREs appear to be standing still at a crossroad, Abu Dhabi has made great strides in moving toward becoming a more knowledge-based economy. However, while local firms may be doing well in adapting technology developed elsewhere, the Emirate must evolve and grow its capacity to create and develop new innovations if it is to build an economically significant and sustainable knowledge-driven economy. To that end, the report sets out key areas for improvement across multiple dimensions that underpin value creation and innovation-related activities. These include: facilitating access to specialist knowledge for SMEs and entrepreneurs, incentivising foreign companies to locate their regional headquarters in the Emirate, continuing to invest in the infrastructure needed to support knowledge creation, and becoming more strategically integrated into existing global research networks.
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<td>Venture Capital</td>
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<td>Yahsat</td>
<td>Al Yah Satellite Communications Company</td>
</tr>
</tbody>
</table>
Figure 23: Cross-sectoral breakdown of Abu Dhabi’s process innovation activities

Figure 24: Who developed Abu Dhabi’s process innovations?

Figure 25: Method of learning about new process innovations developed by other enterprises

Figure 26: Method of acquiring new process innovations developed by other enterprises

Figure 27: Share of firms that introduced at least one product, process innovation or both

Figure 28: Innovative Abu Dhabi firms – breakdown by firm size

Figure 29: Cross-sectoral share of firms that introduced one product, process innovation or both

Figure 30: Share of firms that introduced at least one process innovation

Figure 31: Cross-sectoral share of firms that introduced at least one process innovation

Figure 32: Share of R&D and other innovation expenditure on total innovation expenditure

Figure 33: Cross-sectoral share of R&D and other innovation expenditure on innovation expenditure

Figure 34: Share of firms that introduced at least one product, process innovation or both

Figure 35: Cross-sectoral share of firms that introduced at least one process innovation

Figure 36: Share of R&D and other innovation expenditure on total innovation expenditure

Figure 37: Cross-sectoral share of R&D and other innovation expenditure on innovation expenditure

Figure 38: Innovative Abu Dhabi firms – breakdown by firm size

Figure 39: Cross-sectoral share of firms that introduced one product, process innovation or both

Figure 40: Share of firms that introduced at least one process innovation

Figure 41: Cross-sectoral share of firms that introduced at least one process innovation

Figure 42: Share of R&D and other innovation expenditure on total innovation expenditure

Figure 43: Cross-sectoral share of R&D and other innovation expenditure on innovation expenditure

Figure 44: Share of firms that introduced at least one process innovation

Figure 45: Cross-sectoral share of firms that introduced at least one process innovation

Figure 46: Share of R&D and other innovation expenditure on total innovation expenditure

Figure 47: Cross-sectoral share of firms that introduced at least one process innovation

Figure 48: Cross-sectoral share of firms that introduced at least one process innovation

Figure 49: Cross-sectoral share of R&D and other innovation expenditure on innovation expenditure

Figure 50: Cross-sectoral share of R&D and other innovation expenditure on innovation expenditure
List of Tables

Table 1: Capacity and performance indicators for the Abu Dhabi Innovation Index ......................................................... 5
Table 2: Abu Dhabi’s aggregate innovation rankings .............................................................................................................. 6
Table 3: Capacity and performance indicators for accessing knowledge .................................................................................. 9
Table 4: Capacity and performance indicators for anchoring knowledge .................................................................................. 11
Table 5: Capacity and performance indicators for diffusing knowledge .................................................................................... 14
Table 6: Capacity and performance indicators for creating knowledge ..................................................................................... 16
Table 7: Capacity and performance indicators for exploiting knowledge .................................................................................... 19
Table 8: Abu Dhabi Innovation Index: Cross-economy analysis ................................................................................................. 23
Table 9: Cross-sectoral rankings of the most significant barriers to innovation in Abu Dhabi ............................................... 49
Table 10: Capacity indicators ....................................................................................................................................................... 131
Table 11: Performance indicators ............................................................................................................................................. 132
Table 12: Correlation coefficients between capacity and performance pillars ............................................................................. 133
Part 1: Introduction

1.1. The Policy Context of Innovation

Innovation policy is a government tool designed to accelerate the rate of innovation in an economy. The ultimate objective of innovation policy is to resolve diverse socio-economic problems, such as low productivity levels, economic regeneration matters, energy and environment, or health-related matters. In the Gulf Cooperation Council (GCC) countries, as in most other natural resource-driven economies, innovation policy has been at the core of the economic diversification policy agenda. In Abu Dhabi, the Economic Vision 2030 sets an ambitious plan to drive innovation and move towards a knowledge-driven economy. The plan includes strategic distinct sub-goals related to Information and Communication Technology (ICT), education, infrastructure and many other intermediate goals towards the ultimate objective of a full transition towards a sustainable knowledge-based economy. However, like elsewhere, there are obstacles, which unless addressed, will prevent Abu Dhabi from achieving these goals. These obstacles pertain primarily to the development of the capabilities necessary for the Emirate to achieve its goals. An economy that has been successfully built to manage and operate a lucrative hydrocarbon economy will require new and different sets of capabilities to function as a knowledge-based economy. Such capabilities are derived from a mixture of physical, social and human capitals.

Innovation policies are therefore geared towards solving two problems, firstly, broad socio-economic problems, such economic diversification, and secondly problems pertaining to innovation itself. Measurement and monitoring efforts therefor need to capture the two levels of policy interests - the innovation capacity and the performance.

An economy’s capacity for innovation is central to its ability to achieve competitiveness. Innovation here is about the ability to create value in an economy from new knowledge developed domestically or from technology developed elsewhere. But the corresponding performance of the economy is contingent upon its ability to deploy its capacity in the most optimal way. In this context, one of the main aims of innovation policy is to help countries develop dynamic capabilities whereby value is created through a variety of direct and indirect use of new knowledge.

Policymakers seeking to improve their country’s economic standing via innovation need to understand the features and characteristics of their capabilities, areas of comparative advantage and weaknesses, drivers of competitiveness and innovation - both in the context of their own particular economy and relative to what is taking place in the economies of their primary trading partners.

The purpose of this report is to investigate the various dimensions that underpin the innovation that creates and adds value in the Abu Dhabi economy. A new composite index of innovation, titled the ‘Abu Dhabi Innovation Index’, was developed in order to assess the various factors that contribute to innovation in the Emirate and to examine the results relative to how other natural resource-rich economies (NREs) are performing on the various dimensions. The technical basis for this index is detailed in the latter sections of Part 1 of the report. The comparative assessment of Abu Dhabi’s performance relative to other NREs is presented and discussed in Part 2. Based on a comparison of the results of the European Community Innovation Survey (CIS) with a local survey of innovation activity in a large sample of Abu Dhabi firms, Part 3 presents a benchmarking of the innovation performance of the Abu Dhabi business community relative to that of European countries. The policy implications of this comprehensive assessment of Abu Dhabi’s capabilities are drawn together in Part 4, and a snapshot summary of the results of the Abu Dhabi Innovation Index is presented in Part 5.

1.2. Introducing the Abu Dhabi Innovation Index

Innovation measurement tools have traditionally grouped indicators of innovation into two categories; input indicators (e.g. R&D investment) and output indicators (e.g. number of patents). Much less attention has been paid to the value created directly and indirectly through the learning process, which accompanies investments in a given economy. For example, an investment made by a company to acquire new computer software generates new learning in the firm that may allow it to create new value by, among other factors, enhancing its innovation capability. The decision to make such an investment is almost always justified on the basis of the value that may be created. The firm itself may not create the new software, but nevertheless uses it to create new value, for example by making the production process more efficient or to develop new products and services.

Likewise, new production systems and processes are often developed by specialised supplier firms for clients around the world, who adopt them to generate new value and enhance their capacity for innovation. A multitude of similar investment decisions are made every day by firms around
the world that support economies everywhere to innovate, and thereby create new value and grow. Yet such investments are often not recorded as ‘investments in innovation’ and therefore fail to be included in the data typically used to count the innovation capabilities of an economy, leading to discrepancies between the input and output statistics reported by countries. For example, countries such as Australia, Belgium, Canada, Norway and the United Kingdom (UK), make relatively small investments in traditional innovation inputs (including R&D activities) yet claim high value-added outputs on the basis of performance measures such as Gross Value Added.

The Abu Dhabi Innovation Index, on the other hand, employs existing input and output indicator data across a wide range of socio-economic activities undertaken in 188 economies, to focus on what is of greatest relevance to policymakers, namely the creation of new socio-economic value. In essence, this new index is designed to reflect the innovation that actually matters and may thus more usefully guide innovation policy. The index achieves this both by providing a more cogent interpretation of the data than previous measures, and by generating better comparisons between and within economies.

A core premise of the Abu Dhabi Innovation Index is thus that the innovation capabilities of an economy can be mapped and measured along five key functions that typically lead to value creation and which, individually or collectively, contribute to new value creation. The five functions are shown in Figure 1.

![Figure 1: Five functions of innovation capabilities](image)

The Abu Dhabi Innovation Index allows policymakers to benefit from a measurement tool that examines ‘problem-solving’ and ‘value-creation’ through the activities of learning, adoption and adaptation as its core framework of analysis and measurement, rather than the capacity to innovate per se. An innovation system can then be understood as one that delivers the five key functions that underlie problem-solving and value creation in an economy (i.e. accessing, anchoring, diffusing, creating and exploiting knowledge) and from which an innovation policy can be structured around these five functions in any particular innovation system.

The first innovation function of economies is ‘Knowledge Access’. This function is interpreted as the capabilities in an economy to connect and link to local and international networks of knowledge and innovation. More specifically, it represents the capability of firms, hospitals, universities and individuals to secure benefits through their access to networks or memberships in regional and international networks (Tether and Tajar, 2008). The benefits of which include privileged and rapid access to knowledge and information that allows local players to utilise external resources to secure local and/or international comparative advantage (Inkpen and Tsang, 2005).

The capability to access knowledge resources at comparatively preferential terms (e.g. cost and speed) also contributes to an economy’s overall international comparative advantage. For example, a local telecommunications firm that is the first to acquire 4G systems and introduce it into the local market may gain two quick advantages: firstly, in the short-term it may enjoy a monopoly over that market, and secondly, in the longer term, it may benefit from having superior experience and expertise over other competitors who later enter the market.

The second function is ‘Knowledge Anchoring’. This function is generated by the capabilities existing within an economy to domesticate external sources of knowledge. In essence, anchoring is manifested in the capacity of an economy to attract sources of knowledge such as international talent, foreign investment and foreign firms into relocating to its region. While the capacity to access international knowledge may gain crucial short-term advantage, in the longer term it is this capacity to domesticate sources of external knowledge that helps an economy to sustain any such competitive advantage.

For example, an international company that opens an industrial design centre in Abu Dhabi creates greater economic and knowledge spill-over impacts in the Emirate’s economy than that which might be achieved merely by collaborating with such a firm over distance. This act of re-locating into the locale, allows other local firms, universities and other local players to interact more easily with an international parent company and hence facilitate other new value creation activities locally. In a similar vein, collaborating with overseas talent is not the same as working together with their personnel locally and onsite. The convenience of co-location reduces the transaction costs that arise from physical distance, time difference and cultural variations.
The intensity and quality of the exchange with a local partner is typically much greater, as people can participate more frequently than when a partner is based overseas. The anchoring of international knowledge sources, however, is not an easy affair and competition between economies for the anchoring of international knowledge resources continues to be fierce (e.g. see Mahroum, 2005).

The third innovation function is ‘Knowledge Diffusion’. This is the collective capability of an economy to adopt, adapt and assimilate new innovations, practices and technologies. Knowledge diffusion is a critical capacity for innovation performance because it is a good indicator of the success of the first two capacities, i.e. accessing and anchoring. Identifying and attracting international resources of knowledge and expertise to the local economy will need to be matched by local absorptive capabilities that permit local firms and institutions to learn from their foreign counterparts and create value from the knowledge acquired. This includes not only formal learning, but also informal learning acquired through the use of new products and services. The OECD (1968), for example, suggests measuring two aspects of innovation performance: being the first to commercialise new products and processes (performance in originating innovations); and the level and rate of increase in the use of new products and processes (performance in diffusing innovations).

Finally, the two classical functions that have traditionally captured the attention of innovation policymakers, namely ‘Knowledge Creation’, which can be understood as the ability to generate and bring in new knowledge in the form of ideas, discoveries, designs and inventions to the world; and ‘Knowledge Exploitation’, which is the ability to utilise new knowledge for social and commercial purposes in order to create value from it. These two capabilities are similar, despite often being regarded as input and output factors (creation being input and exploitation being output) in the sense that they are both capabilities within an economy that allow it to derive additional benefit from existing knowledge. New knowledge creation does not stem from a vacuum but arises from the deepening and expanding of existing knowledge, while knowledge exploitation is the capacity to recognise potential opportunities arising from new knowledge and deploying the required resources to realise actual gains.

The previous discussion does not infer that economies draw on the five capabilities in equal measure. Indeed, not all countries, regions or cities draw on the same capabilities to innovate, nor do they necessarily require strength in all five capacities (Mahroum et al., 2008). While the Abu Dhabi Innovation Index gives equal weighting to the capabilities to create the index, the country-specific analyses re-contextualise the results to explain the significance of the results for each of the rankings of each of the five capabilities.

Unlike traditional approaches to innovation measurement, the Abu Dhabi Innovation Index shifts the focus of policymakers from innovation (i.e. as a linear process starting with knowledge creation and ending with knowledge exploitation) to value creation as a process consisting of knowledge absorption and knowledge development (see Figure 2) where the original source of knowledge becomes a secondary issue.

Additionally, it is argued that value creation is achieved through innovation-related activities and not necessarily through innovation per se. This represents a radical shift from the conventional view in which knowledge creation and exploitation capacities are regarded as the start and finish points for innovation, with knowledge being created in places such as universities or a company’s research departments and then applied by other different departments or firms.

Mainstream policymakers tend to assume that innovation must take place within a specific

![Figure 2: The innovation process is far from being a linear one](image)
geographic and political context to be successful, despite the fact that, in reality, knowledge creation and exploitation often happen in different places. What is often overlooked is that new value may be added by accessing knowledge overseas, attracting its bearers into the local economy or through the wider diffusion of such knowledge (e.g. the use of a PC) within an economy. This is evident on the micro-level where for any business entity or organisation, solutions are regularly sourced from external sources to complement or augment internal capacities (Cohen and Levinthal, 1990). Therefore, the innovation environment in which firms, universities, research centres, hospitals and other knowledge-based organisations operate has a huge impact on their ability to add value and generate new solutions (see Bosch et al., 1999). A firm that is part of an industrial cluster characterised by a strong absorptive capacity will be better positioned to benefit from high levels of spillover, learning and growth (see Giuliani, 2005). Therefore, one could argue that new value creation depends on abilities to acquire, assimilate, convert and exploit knowledge. In this context, absorptive capacity becomes the single most important factor for both knowledge creation and exploitation.

The Abu Dhabi Innovation Index suggests that the ‘Absorptive Capacity’ of developing countries is of the utmost importance to the success of any government policy interventions. For example, a government policy to increase foreign investment will yield long-term benefits only if there are knowledge spill-overs into the local economy. This is particularly important for developing countries where the ability to absorb and adapt foreign technologies that it is exposed to, has a follow-on impact on the ability to leverage global trade and investment. For example, the strength of local absorptive capacity in China has helped such investment drive knowledge-based development. Likewise, a report by the World Bank found that weak absorptive capacity in Indonesia and Mexico prevented them from taking advantage of growing foreign investment. This report concluded that “the bulk of technological progress in developing countries has been achieved through the absorption and adaptation of existing and new-to-the-market or new-to-the-firm technologies, rather than the invention of entirely new technologies” (World Bank, 2008).

### 1.3. Innovation Capacity vs. Performance

One of the key strengths of the Abu Dhabi Innovation Index is its ability to distinguish between the capacity of an economy to innovate from its actual innovation performance. A country might possess a potentially strong innovation capacity but, due to structural and other problems, fail to exploit that potential. For example, in 2009, according to the INSEAD Global Innovation Index, Iceland ranked first in the world in terms of its innovation capability, but the country has arguably failed to leverage that strong capability to build a knowledge-driven economy resilient enough to prevent the collapse of the economy in the wake of the global banking crisis.

This distinction represents a significant improvement over existing indicators. Splitting the overall structure of any given economy into its capacity and performance dimensions allows for a nuanced assessment of its underlying structure. For instance, economies might score low on the input scale but perform favourably on the output scale or conversely score high on input and low on output resulting in a benchmark that does consider the variation in the strengths or weaknesses of innovation performance among economies. Specifically, the Abu Dhabi Innovation Index provides three types of measurements:

i. Strengths and weaknesses along the five key value creation and innovation-related capacities. This is achieved through a dynamic comparison of the different innovation functions (Access, Anchor, Diffuse, Create and Exploit) along both capacity and performance dimensions. This is useful because policymakers can examine how their country is performing along each of the dimensions of innovation capabilities.

ii. The Abu Dhabi Innovation Index allows policymakers to gain a better perspective of their innovation efficacy, i.e. the gap between an economy’s existing innovation capacity and its ability to make efficient use of that capacity to innovate and create new value. This insight provides a new dimension to innovation policy; one that goes beyond input-output resource manipulation to wider aspects of the function of innovation eco-systems, particularly those relating to ‘bottlenecks’, market failures and technology lock-in issues.

iii. Finally, the Abu Dhabi Innovation Index paves the way for further research into the relationship between each of the five pillars of innovation capability and value creation. The latter may be measured using a variety of indicators and proxies of value creation, such as labour productivity, GVA (Gross Value Added), GDP (Gross Domestic Product), etc.

### 1.4. A Brief on the Index Construction Process

The full list of capacity and performance indicators is provided in Table 1, whilst their definitions
and sources are listed in Appendix A. The report draws primarily on internationally available data such as those collated and produced by the World Bank, the OECD, and the World Economic Forum among others. The process of selecting indicators of the five key dimensions of innovation capacity and performance was based on both extensive literature reviews and consultation with expert informants from the field. The methodology has been subjected to blind peer-review by a minimum of four anonymous reviewers prior to publication in Technovation (see Mahroum and Al-Saleh, 2013).

Total capacity and total performance give an aggregate score for the five dimensions. Within each capacity/performance pillar, the scoring is a non-weighted average with a possible maximum of seven. Total capacity and total performance are scored as a sum of individual pillars, giving a maximum possible score of 35 each for capacity and performance. Further technical details on the methodology adopted by the index are provided in Appendix A.

Table 1: Capacity and performance indicators for the Abu Dhabi Innovation Index

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<th>Performance Indicators</th>
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<td>ACCESS</td>
<td>Internet Users per 100 people</td>
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<tr>
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<td>Total Broadband per 100 people</td>
<td>Breadth of International Markets</td>
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<td>Extent of Business Internet Use</td>
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<td></td>
<td>Extent of Trade Barriers</td>
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<td></td>
<td>Quality of Infrastructure</td>
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<td>ANCHOR</td>
<td>Days for Starting a Business</td>
<td>Inward FDI Flow</td>
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<td></td>
<td>Number of Procedures</td>
<td>FDI and Technology Transfer</td>
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<td></td>
<td>Cost of Starting a Business</td>
<td>Foreign Born Immigrants</td>
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<td>Political Stability</td>
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<td></td>
<td>Protecting Investors</td>
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<td></td>
<td>Foreign Ownership Restrictions</td>
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<tr>
<td>DIFFUSION</td>
<td>Literacy Rates</td>
<td>Firm Level Technology Adoption</td>
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<tr>
<td></td>
<td>Quality of Education System</td>
<td>Buyer Sophistication</td>
</tr>
<tr>
<td></td>
<td>Availability of Scientists and Engineers</td>
<td>Production Process Sophistication</td>
</tr>
<tr>
<td></td>
<td>Extent of Staff Training</td>
<td>ICT Goods Imports</td>
</tr>
<tr>
<td></td>
<td>Local Availability of Specialised Research and Training Services</td>
<td>Gross Capital Formation</td>
</tr>
<tr>
<td>CREATION</td>
<td>Gross Domestic Expenditure on R&amp;D (GERD)</td>
<td>Scientific Publications per capita</td>
</tr>
<tr>
<td></td>
<td>Company Spend on R&amp;D</td>
<td>Patent Filings per capita</td>
</tr>
<tr>
<td></td>
<td>Intellectual Property Protection</td>
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<tr>
<td></td>
<td>Quality of Scientific Research Institutes</td>
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<tr>
<td>EXPLOITATION</td>
<td>Venture Capital Availability</td>
<td>Creative Goods</td>
</tr>
<tr>
<td></td>
<td>Local Equity Market Access</td>
<td>Industry Value Added</td>
</tr>
<tr>
<td></td>
<td>Government Procurement of Advanced Technology Products</td>
<td>Services Value Added</td>
</tr>
</tbody>
</table>
1.5. Where Does Abu Dhabi Stand on the Global Innovation Scene?

In line with standard practice commonly adopted in conventional composite indices, an effort is made here to assess where Abu Dhabi ranks in the global innovation league. Using the latest data available for the thirty-eight indicators that make up the Abu Dhabi Innovation Index, an aggregate score has been produced. In order to provide a more meaningful insight, however, the aggregation and global rankings have been made for the capacity and performance levels. Table 2 shows the global ranks of some NREs including Abu Dhabi. Given that not all data are readily available at the Emirate level, informed estimates have been sought from experts (currently working for the DED and the Emirates Competitiveness Council) for cases where Abu Dhabi data, as distinct from the UAE, is not available.

Table 2: Abu Dhabi’s aggregate innovation rankings

<table>
<thead>
<tr>
<th>Global Capacity Rank</th>
<th>Economy</th>
<th>Global Performance Rank</th>
<th>Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Finland</td>
<td>11</td>
<td>Canada</td>
</tr>
<tr>
<td>6</td>
<td>Qatar</td>
<td>14</td>
<td>Finland</td>
</tr>
<tr>
<td>9</td>
<td>Norway</td>
<td>21</td>
<td>Abu Dhabi</td>
</tr>
<tr>
<td>10</td>
<td>Canada</td>
<td>22</td>
<td>Australia</td>
</tr>
<tr>
<td>14</td>
<td>Australia</td>
<td>23</td>
<td>Norway</td>
</tr>
<tr>
<td>19</td>
<td>New Zealand</td>
<td>24</td>
<td>United Arab Emirates</td>
</tr>
<tr>
<td>22</td>
<td>Malaysia</td>
<td>25</td>
<td>Malaysia</td>
</tr>
<tr>
<td>24</td>
<td>Abu Dhabi</td>
<td>26</td>
<td>Saudi Arabia</td>
</tr>
<tr>
<td>26</td>
<td>United Arab Emirates</td>
<td>29</td>
<td>Qatar</td>
</tr>
<tr>
<td>27</td>
<td>Saudi Arabia</td>
<td>32</td>
<td>Brazil</td>
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<tr>
<td>29</td>
<td>Bahrain</td>
<td>35</td>
<td>New Zealand</td>
</tr>
<tr>
<td>30</td>
<td>Chile</td>
<td>37</td>
<td>Chile</td>
</tr>
<tr>
<td>32</td>
<td>Oman</td>
<td>39</td>
<td>South Africa</td>
</tr>
<tr>
<td>45</td>
<td>South Africa</td>
<td>48</td>
<td>Bahrain</td>
</tr>
<tr>
<td>57</td>
<td>Jordan</td>
<td>54</td>
<td>Russia</td>
</tr>
<tr>
<td>62</td>
<td>Kuwait</td>
<td>55</td>
<td>Jordan</td>
</tr>
<tr>
<td>67</td>
<td>Russia</td>
<td>61</td>
<td>Oman</td>
</tr>
<tr>
<td>70</td>
<td>Brazil</td>
<td>64</td>
<td>Argentina</td>
</tr>
<tr>
<td>77</td>
<td>Botswana</td>
<td>78</td>
<td>Nigeria</td>
</tr>
<tr>
<td>93</td>
<td>Nigeria</td>
<td>79</td>
<td>Kuwait</td>
</tr>
<tr>
<td>100</td>
<td>Argentina</td>
<td>106</td>
<td>Venezuela</td>
</tr>
<tr>
<td>132</td>
<td>Algeria</td>
<td>111</td>
<td>Botswana</td>
</tr>
<tr>
<td>140</td>
<td>Venezuela</td>
<td>115</td>
<td>Algeria</td>
</tr>
</tbody>
</table>
While Abu Dhabi’s capacity and performance ranks appear to be relatively high in the global innovation league (as shown in Table 2), this comparison suffers from two major limitations. Firstly, the innovation process is too complex to be captured with a single figure or rank. Secondly, a direct comparison of all countries of the world is at best misleading and at worst meaningless. Therefore, policymakers need to be cautious with findings emerging from such high-level aggregations as they can easily lead to overly-simplistic policy conclusions.

In order to provide a contextualised and relevant international assessment, it makes sense to compare Abu Dhabi’s innovation capabilities with those of other NREs that resemble in composition and structure. Therefore, this report provides a detailed assessment of Abu Dhabi’s innovation capabilities in comparison to other similar such economies. In addition, rather than constructing a single index based on a ‘super-composite’ of several composite indices, this report provides an international benchmark at three different levels: capacity, performance and efficacy. Furthermore, the assessment and benchmark is detailed at the level of the individual innovation pillar (for example, the capacity, performance and efficacy of innovation access, anchoring or diffusion). This innovative analytical approach, embedded in the Abu Dhabi Innovation Index work, has the potential to effectively inform evidence-based policymaking.
Part 2: Assessing Innovation Capabilities of Natural Resource-Rich Economies

2.1. Introduction

After decades of relying on natural resources to drive economic growth, NREs including those in the GCC region have begun adopting economic development strategies aimed at fostering a more sustainable growth path. This drive is based on the recognition that the traditional resource-based structure of the GCC economies needs to become increasingly diversified away from natural resources dependency and more so towards economies that are knowledge and innovation driven.

The Abu Dhabi Economic Vision 2030 is an example of a newly adopted strategy by GCC governments that is designed to fast-track their economies’ transition toward becoming more knowledge and innovation-driven. This strategic plan which was completed in 2008, based on the principles laid out in the Government’s Policy Agenda 2007-2008, is intended to set out the path that the Emirate will take towards the building of world-class knowledge infrastructure. The Policy Agenda has identified nine pillars that will form the architecture of the Emirate’s economic, social and political futures, namely: a sustainable knowledge-based economy; a large empowered private sector; an optimal and transparent regulatory environment; a continuation of strong and diverse international relationships; the optimisation of the Emirate’s resources; premium education, healthcare and infrastructure assets; complete international and domestic security; maintaining Abu Dhabi’s values, culture and heritage; a significant and ongoing contribution to the federation of the UAE. Subsequently, the 2030 Vision document has set seven distinct goals for Abu Dhabi to achieve over the next two decades (see Figure 3).

It is important to note that innovation activities in NREs tend to give rise to innovation systems that differ in many aspects from those of resource-poor knowledge-driven economies. For example, resource-intensive industries (such as energy industries) within NREs are often controlled by state-owned enterprises or by enterprises that until recently were state-owned. Innovation activities thus remain largely concentrated in a few sectors that are directly or indirectly linked to the natural resource sector. The inflated role of resource-intensive industries in such economies also has the effect of crowding out other economic activities that are not part of the hydrocarbon industrial eco-system. The effect of such an economic industry structure can be traced in the innovation performance of the Abu Dhabi business community, which will be discussed in detail in Part 3 of this report.

The innovation access, anchor, diffusion, creation and exploitation capabilities of these economies tend to be largely concentrated in large companies and state-owned enterprises. The challenge for these economies tends to be spreading or developing these capabilities in the wider economy, especially to SMEs and the private sector.

In this report, Abu Dhabi is examined in relation to a set of 22 NREs (namely Algeria, Argentina, Australia, Bahrain, Botswana, Brazil, Canada, Chile, Finland, Jordan, Kuwait, Malaysia, New Zealand, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, South Africa, United Arab Emirates and the Venezuela). Other NREs such as the United States of America (USA) and Sweden were not considered in this comparative assessment because they are seen as economies that have long grown out of natural resource dependency.

![Figure 3: Goals of the Abu Dhabi Economic Vision 2030](image-url)
2.2. Abu Dhabi’s Knowledge Accessing Capabilities

Abu Dhabi demonstrates a good ability in identifying and domesticating external knowledge sources.

Economies vary in their capacity to access their needs of knowledge, expertise and skills for the development of specific products and services upon which local value creation is dependent. This is not to be taken for granted. Such an access capacity requires significant private and public investments in connectivity infrastructure, organisational development, competencies and legal frameworks that facilitate knowledge transfer through trade and investment. It is expected that such inputs and investments result in an economic performance that benefits from strong cross-border activities and the integration in global value chain. Table 3 lists internationally available indicators that have been used to measure the ‘Access’ capacity and performance of economies.

Table 3: Capacity and performance indicators for accessing knowledge

<table>
<thead>
<tr>
<th>Access Capacity Indicators</th>
<th>Access Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Users per 100 people</td>
<td>Value Chain Presence</td>
</tr>
<tr>
<td>Total Broadband per 100 people</td>
<td>Breadth of International Markets</td>
</tr>
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<td>Extent of Business Internet Use</td>
<td></td>
</tr>
<tr>
<td>Extent of Trade Barriers</td>
<td></td>
</tr>
<tr>
<td>Quality of Infrastructure</td>
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</tbody>
</table>

BOX 1: Connectivity of Cities as a Measure of their Access Capacity

One important indicator of the strength of the access capacity of a particular city is the extent of its connectivity. The research programme ‘Globalization and World Cities (GaWC)’ at the Loughborough University measures the connectivity of cities on the basis of the presence of global specialised services providing firms and the level of office representation of such firms in different cities. These are typically professional business services firms, including auditing and management consultancies and legal services. According to GaWC’s classification for the year 2010, Abu Dhabi is classified under the category of ‘Beta-cities’. This designation puts Abu Dhabi in the same category of cities as Geneva, Detroit and Stuttgart. Abu Dhabi ranks third (after Dubai and Riyadh) in the hydrocarbon-rich GCC region.

Dubai currently leads the region’s cities in terms of global connectivity, particularly because many global service providers firms use the city as their regional headquarters.
Trade barriers and broadband penetration reflect the ability of an economy to ‘plug in’ and learn from the wider world. In Figure 4, the status of Abu Dhabi in relation to the other NREs (including the UAE) in the access dimension is considered. When it comes to access capacity, the Emirate’s strongest suit is seen to be Business Internet Use and Infrastructure. Specifically, the high ranking for infrastructure is a very heartening sign in the sense that a robust infrastructural base provides the necessary ‘platform’ to keep businesses based in Abu Dhabi well connected to the rest of the world. A crumbling infrastructure imposes an enormous cost to the economy by disallowing the efficient allocation of goods to pockets in the market where their demand is highest.

Additionally, Abu Dhabi performs favourably in the GCC region, along the ICT dimensions of internet use, both in terms of business and more generally (where it ranks second after Qatar). Connectivity, which has become the hallmark of the modern knowledge economy, seems to be relatively strong in Abu Dhabi. Nevertheless, Abu Dhabi displays a similar favourable outcome to other neighbouring economies when it comes to trade barriers. Abu Dhabi is ranked 6th among the NREs under consideration. Trade barriers represent a restriction not only on the flow of goods and services but also potentially on the flow of knowledge, cutting-edge management practices and new technology.

How well an economy make use of its access and connectivity capacities may be observed in attributes such as the presence of global advanced services providers and the size of a country’s foreign market. In this respect, compared to its neighbours, Abu Dhabi performs well along all the extant dimensions of this particular pillar.

Abu Dhabi leads the GCC region in terms of the breadth of its value chain, which is an important indicator of the extent of its economic diversification. A reduced value chain breadth implies that the economy specialises in narrow areas, and thus has narrower access capacity - while an expansive value chain implies that exporting companies are engaged in a broad spectrum of activities, from the rudimentary to the sophisticated, and engaging a larger set of networks.

In terms of international market size in the GCC region, Abu Dhabi lags behind only the national average of the UAE and Saudi Arabia. This hints to the relationship between value chain diversification and trade partners’ diversity. Abu Dhabi is thus positioned to leverage its diverse value chain to achieve even greater penetration in global markets.

Nonetheless, as shown in Figure 4, Abu Dhabi has performed exceptionally well on the access dimension as a whole, and even more so than its access capacity indicators would suggest.

Despite its currently good performance, Abu Dhabi would benefit both from attracting more global firms and broadening the range of its exports to accelerate its access to international knowledge sources.
2.3. Abu Dhabi’s Knowledge Anchoring Capabilities

Abu Dhabi demonstrates a good ability in identifying and domesticating external knowledge sources.

It is not sufficient for a country to be able to access needed knowledge, technology and skills from overseas. In the long run, it is essential that a country is able to attract and domesticate foreign knowledge because countries with a weak domestic knowledge base derive comparably little benefit from the influx of any foreign investment or talent (World Bank, 2008). Moreover, while all countries in principal may benefit from a strong ability to access international sources of knowledge, countries with strong domestic knowledge bases are better positioned to reap the benefits of international exchanges. This is particularly so in knowledge domains that are highly complex and capital intensive. Nevertheless, some of the countries that suffer from a weak ability to access internationally seek to compensate by using incentives to attract and maintain a constant flow of knowledge resources. The experience of Qatar and Saudi Arabia in substituting weak access by anchoring foreign agents of knowledge transfer can be in this context. Other countries, such as South Korea, Taiwan and China, have overcome the challenges of access by first sending their students to study overseas and, second, by establishing anchoring institutions and programmes back home (such as the Spring programme in China) that prepares the ground for bringing them back. More recently, Chile has been experimenting with a programme that supports foreign entrepreneurs moving to the country to start a business, in order to address its recognised weakness in accessing sources of high-tech entrepreneurship. The programme, titled ‘Start-up Chile’, provides the founders of promising young firms with the equivalent of USD 40,000 and a year’s visa to come and work on their ideas in Chile (The Economist, 2012).

Such incentives are called anchoring incentives and can vary from bureaucratic procedures facilitating business development to regulation and policy. More specifically, anchoring incentives include reduced time, procedures and cost of starting a business, political stability as well as the efficiency of government agencies in implementing policies that permit and promote private sector development and the strength of laws facilitating both investor protection and foreign ownership. These types of incentives are expected to translate into stronger performance in attracting and domesticating outside knowledge resources associated with foreign direct investment (FDI) and skilled migrant labour.

Table 4: Capacity and performance indicators for anchoring knowledge

<table>
<thead>
<tr>
<th>Anchor Capacity Indicators</th>
<th>Anchor Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days for Starting a Business</td>
<td>Inward FDI Flow</td>
</tr>
<tr>
<td>Number of Procedures</td>
<td>FDI and Technology Transfer</td>
</tr>
<tr>
<td>Cost of Starting a Business</td>
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<td></td>
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<tr>
<td>Foreign Ownership Restrictions</td>
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</table>
BOX 2: China and Singapore as Cases for Creating Value through Anchoring

Foreign Direct Investment (FDI), one of the adopted anchoring performance indicators, is a potentially powerful channel for creating value. According to the OECD (2010), China has maintained its position as one of the world’s top destinations for FDI. Whilst it has been suggested that the gains from FDI are largely ‘unilateral’ (benefiting primarily the foreign investor) with minimal investment in local capacity building, China offers a counter example of a country that has accrued significant local benefits from FDI. As noted by Fu (2008), the strength of local absorptive capacity in China ensured that FDI fuelled both regional innovation and knowledge-based development. However, China must continue to work to harness more effectively the potential for transferring the technology that resides in FDI as the country comes to rely increasingly on technology to sustain growth (Yousuf and Nabeshima, 2006).

Another telling performance indicator of knowledge anchoring capability is ease of starting a new business. According to recent data, co-published by the World Bank and the International Finance Corporation (2011), Singapore is ranked first in the world in terms of ease of doing business. For example, it is estimated that it takes only three days to start a business in Singapore, compared with a world-wide average of thirty five days. Bankruptcy proceedings are also straightforward to implement in a country known for its strict enforcement of laws (Lopez-Claros, 2011).

All of the abovementioned factors contribute to enhancing a country’s potential for competitiveness and value creation as they compete in attracting international talent and foreign firms to locate to their respective economies.

Figure 5 illustrates Abu Dhabi’s capacity and performance with regard to its capability in anchoring knowledge in relation to the 22 other NREs considered. The anchor capacity pillar quantifies the ability of an economy to attract talent, as measured in terms of the time and cost associated with starting a business, factors related to foreign ownership restrictions (which are decisive factors for entrepreneurs), as well as the potential for attracting financial capital (measured through the inclusion of indicators such as investor protection and ownership restrictions which play a critical role in both the attraction and retention of financial capital). When we look at Abu Dhabi’s knowledge anchoring capabilities in relation to other comparable economies, the Emirate’s performance along most of these dimensions appears fairly robust. Abu Dhabi does not take top spot along any of the attributes but manages to score relatively well on factors related to time needed to start a new business, political stability and foreign restrictions on ownership. On the other hand, compared to the other NREs, Abu Dhabi performs less well on indicators measuring licencing procedures to start a business and investor protection.

Abu Dhabi performs fairly well on the anchor performance indicators, such as Inward FDI. More specifically, on the critical dimension of ‘FDI and Technology Transfer’ – a measure of the technology influx due to foreign investment – Abu Dhabi is ranked relatively highly. This implies that Abu Dhabi is attracting high value added FDI, which is an important source for the processes that lead to domestication of foreign knowledge and expertise.

Despite the need for more efforts on the input side, Abu Dhabi performs rather well in anchoring sources of foreign knowledge and expertise.
In terms of anchoring foreign knowledge and expertise, Abu Dhabi has been developing platforms that help to attract and domesticate international technology and innovation actors. Over the past few years, it has set up a number of high-profile platforms in support of these goals including the following:

**The Masdar Initiative** has been established to spearhead the creation of a renewable energy industry in Abu Dhabi. The Masdar Institute, a part of this initiative, is the region’s first research-orientated university with an explicit focus on sustainable energy studies. The Institute which was established through close collaboration with the Massachusetts Institute of Technology (MIT), has to date been successful in recruiting over sixty world-class academics and top-tier researchers. By 2018, it aspires to host up to 800 graduate students, along with 200 academic staff.

**Strata** was established in 2009, as a Mubadala aerospace company, as part of the Abu Dhabi Government’s economic diversification efforts. Aerospace is one of the key sectors identified in the Abu Dhabi 2030 Vision as a strategic industry for creating a high-tech and knowledge-driven economy in Abu Dhabi. Plans are, therefore, in the works to make Al-Ain’s Nibras Aerospace Park a major regional aerospace manufacturing and service hub. Strata has recently formed partnerships with key aircraft manufacturers such as EADS/Airbus, FACC and Alenia Aeronautica. Strata has also created new career opportunities in the Emirate ranging from technical and other engineering, and managerial roles, expecting to have more than 1,000 employees by 2015.

**Cleveland Clinic Abu Dhabi** is a multi-specialty hospital, currently preparing to launch its operations in Abu Dhabi. It aims to provide a unique and unparalleled extension of the Cleveland Clinic’s model of care, offering a range of medical services that will bring the best medical expertise and highest international standards of healthcare to Abu Dhabi and the region.

**Advanced Technology Investment Company (ATIC)** is a wholly-owned subsidiary of Mubadala Development Company. ATIC has been focusing on building leading technology companies such as Global Foundries, with the ultimate aim of bringing expertise and know-how in the semiconductor industry to Abu Dhabi. GlobalFoundries is today one of the main players in the global semiconductor industry. ATIC supports the diversification of the Abu Dhabi’s economy by serving as a catalyst for anchoring high-tech expertise through making R&D investment for developing local talent.
2.4. Abu Dhabi’s Knowledge Diffusion Capabilities

Abu Dhabi performs well adapting and assimilating new innovations and spreading them across its economy.

Economies may be able to access and anchor knowledge, technology, skills and expertise from any external source but yet fail to spread these sufficiently widely across the economy for maximum benefit. Innovation-driven high value adding activities tend to cluster and concentrate both geographically and sector-wise. For example, apart from Germany, most technology-intensive industries in Europe tend to be found in small concentrated geographic pockets. Empirical evidence from the UK, and elsewhere, has shown that a minority of regions are often responsible for the majority of innovations. Such regions tend to specialise and this supports their ability to develop and diffuse their innovations (Mahroum et al., 2008). The challenge for any government is to reduce the gap between regions, sectors and firms rich and poor in knowledge. A number of factors can be instrumental in this regard and these are reflected in the list of indicators outlined in Table 5 below. These include literacy, quality and local availability of scientists and training centres for capacity, whilst for diffusion performance, several indicators are used including technical sophistication at the levels of individual, firm and production process.

Table 5: Capacity and performance indicators for diffusing knowledge

<table>
<thead>
<tr>
<th>Diffusion Capacity Indicators</th>
<th>Diffusion Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy Rates</td>
<td>Firm Level Technology Adoption</td>
</tr>
<tr>
<td>Quality of Education System</td>
<td>Buyer Sophistication</td>
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<tr>
<td>Availability of Scientists and Engineers</td>
<td>Production Process Sophistication</td>
</tr>
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<td>Extent of Staff Training</td>
<td>ICT Goods Imports</td>
</tr>
<tr>
<td>Local Availability of Specialised Research and Training Services</td>
<td>Gross Capital Formation</td>
</tr>
</tbody>
</table>

BOX 4: South Korea as an Example for Fostering Competitiveness through Diffusion

The successful diffusion of ICT applications in South Korea is widely reported in the innovation literature and media. Moreover, it is often suggested that high diffusion of broadband in South Korea has positively contributed not only to the competitiveness of the national economy but also to the growth of electronic commerce and e-government initiatives (e.g. see International Telecommunication Union, 2003; Kim et al., 2009). Other diffusion-related factors which have contributed to the competitiveness of South Korea include high literacy rates, availability of scientists and engineers as well as specialised research centres. As a result of major reforms that started in the 1960s, enrolment in elementary education in South Korea reached 100% by 1970, and the number of researchers with Ph.D. degrees increased over tenfold from 3,417 to 36,106 over the period 1980-1996 (Chung, 2001).

Other areas in which South Korea has excelled are the implementation of process reengineering, problem-solving and quality management practices such as 6 Sigma. Despite the widespread perception that 6 Sigma is difficult to implement even in private corporations, it is interesting to note that it has been implemented by the national rail road ‘KORAIL’ and the national postal service as well as the Prosecutor’s Office and the Korean Intellectual Property Office. These efforts were all undertaken to help realise the vision of the South Korean government to build an innovative nation ranked among the top ten countries for national competitiveness.
Due to massive recent investment in areas related to education, training and research, Abu Dhabi ranks highly in all of the dimensions included in the diffusion capacity pillar - both at the regional level as well as when compared to the other 22 NREs.

Abu Dhabi leads the GCC region on the dimensions of Firm-level Technology Adoption and Production Process Sophistication. Against other NREs, Abu Dhabi ranks second after Norway (in Firm-level Technology Adoption) and after Finland (in Production Process Sophistication). This observation is consistent with the results of the Abu Dhabi Innovation Survey (discussed in more detail in Part 3 of this report), which found that Abu Dhabi firms are primarily process innovators. Abu Dhabi hosts a high number of specialist professional and technical services consulting firms which play a significant role in knowledge transfer and diffusion. Where the Emirate is perhaps still lagging is in university to industry knowledge diffusion. This was also observed in the Abu Dhabi Innovation Survey, where collaboration with universities ranked low for innovative firms in Abu Dhabi.

A number of recent initiatives have already been undertaken in Abu Dhabi to address the university to industry diffusion gap. For example, the Centre of Excellence for Applied Research and Training (CERT) was established in 1996 as the commercial, research and training arm of the Higher Colleges of Technology (HCT). The main objective of CERT is to advance education, research and collaboration with international organisations that leads to technology transfer into the UAE. More recently in 2011, the Abu Dhabi Technology Development Committee (TDC) launched the ‘Takamul Programme’ to provide legal and financial support to scientists and academics working in the UAE universities who need to file international patents. Another initiative include launched by ATIC and ADEC (Abu Dhabi Education Council) is the ‘Al Nokhba Programme’, that aims to empower bright young Emirati students by providing international industrial experience of the type needed to lead a broad range of high-tech industries.

Abu Dhabi achieved fifth place in terms of Buyer Sophistication and tenth in Gross Capital Formation. However, the Emirate ranks in the middle of natural resource-rich GCC economies. These are important indicators because sophisticated buyers are key agents in diffusing knowledge due to their ability to identify the value inherent in new technology and other knowledge-based utilities. Gross Capital Formation is an indicator of ‘capital accumulation’ activities in firms, which is another indicator of the absorption of knowledge embedded in capital.

Abu Dhabi provides a strong environment for knowledge diffusion when compared to its neighbouring economies. However, in comparison to more advanced economies it still has room for improvement.

An indicator in which Abu Dhabi performs exceptionally well is ICT Goods Imports. Such imports give a sense of the level and intensity of diffusion activities in an economy. In recent years, ICT products and services have constituted an important component of most economies’ growth strategies. Indeed, ICT imports have come to play an important role in Abu Dhabi’s growth and economic diversification strategy. The ICT sector acts as an enabler of innovation in the rest of the economy. By allowing rapid and unfettered access to the rest of the world for both corporations and individuals, ICT allows for rapid dissemination of ideas and technologies.
### 2.5. Abu Dhabi’s Knowledge Creation Capabilities

Abu Dhabi has made great strides in boosting its abilities to generate new knowledge.

Most advanced economies invest anywhere between 1.8% and 5% of their GDP on R&D activities to grow their capacity to create new knowledge. Such investments are based on the expectation that there exists a strong relationship between knowledge creation and value creation. More specifically, it is expected that at least some of the newly-created knowledge will translate into commercial and/or social return to the economy and nation at large. In order to improve the chances of this happening, governments support knowledge creation activities with investment in education and training as well as knowledge translation activities, such as applied R&D. Furthermore, across the economies of most advanced OECD countries, intellectual property rights frameworks have been developed to protect and incentivise investments in knowledge creation activities. In order to capture these efforts at the level of an economy, a number of relevant indicators have been selected from among those available at an international level. These are presented in Table 6 below.

#### Table 6: Capacity and performance indicators for creating knowledge

<table>
<thead>
<tr>
<th>Creation Capacity Indicators</th>
<th>Creation Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Domestic Expenditure on R&amp;D (GERD)</td>
<td>Scientific Publications per capita</td>
</tr>
<tr>
<td>Company Spend on R&amp;D</td>
<td>Patent Filings per capita</td>
</tr>
<tr>
<td>Intellectual Property Protection</td>
<td></td>
</tr>
<tr>
<td>Quality of Scientific Research Institutions</td>
<td></td>
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</tbody>
</table>

Of all the pillars in the Abu Dhabi Innovation Index, the knowledge creation indicators bear closest resemblance to traditional measures of innovation such as expenditure on R&D and intellectual property protection. In this regard, Abu Dhabi ranks typically among the region but that ranks low by international standards. For example, whilst Abu Dhabi is ranked 14th in GERD (Gross Domestic Expenditure on R&D), 6th in Company Spend on R&D, 7th in Quality of Scientific Research Institutions and 10th in terms of intellectual property protection among the NREs under consideration, it is ranked 2nd in the GCC region, after Qatar, in the overall creation capacity score. The current nascent base of scientific work in the region as a whole means that it may be a while before scientific output can be expected to rise to international standards, in terms of quality and quantity. However, the strong emphasis of the Abu Dhabi Government on enhancing knowledge creation capacity is likely to accelerate the process of building knowledge absorption capacity in the Emirate. Examples of this include increased spending on R&D such as that recently been made by ADEC, Masdar and ATIC among others, to boost the development of a scientific research base in Abu Dhabi.
The outcomes of knowledge creation are reflected in a diversity of outputs including scientific publications and patent files. In this respect, Abu Dhabi’s rank is low, largely due to low recorded levels of scientific publications and patents. The situation is likely to improve in the near future, particularly because of the recent launch of the aforementioned Takamul Programme by the TDC. This programme has been active in providing support for both international patent filings and enhancing awareness with regard to intellectual property in the Emirate. The historical weakness in capacity for scientific research has been somewhat offset by its ability to access and anchor knowledge, wherein firms in Abu Dhabi draw on foreign sources of knowledge and expertise for the development of new products, processes and services.

The relative weakness of Abu Dhabi in knowledge creation in comparison to more advanced NREs, as apparent in Figure 7, is not surprising given the fact that knowledge creation is a long-term process and Abu Dhabi has only recently invested in the creation of a local knowledge production infrastructure, including the establishment of research centres and branches for several international universities. Thus it will take some time before the fruits of these investments come to bear, including in an increase in the number of scientific papers published internationally.

To stimulate knowledge creation, economies need to perform well on capacity indicators such as intellectual property protection and company spend on R&D.
BOX 5: Texas: Research and Industry Collaborations Drive Knowledge Creation and Exploitation

The economy of Texas used to be driven by agriculture and petroleum. Today, technology is considered to be its growth engine. Texas has a wide variety of high-tech industries ranging from advanced technologies, aerospace and defence, to ICT, life sciences, media and arts. Thanks to a very favourable business climate, Texas serves as headquarters of 58 of America’s Fortune 500 companies - more than any other state in the US.

In addition, the colleges and universities in Texas are crucial breeding grounds of innovation and are among the main drivers of innovation in the state. According to the US Patent and Trademark Office, more than 6,400 patents were generated from universities in Texas, ranking it second nationally (Keuhner-Herbert, 2011). The strong university system is also supplemented with technology parks such as Texas A&M’s Research Park, which allows private companies and other organisations to collaborate with the university.

A close knit and collaborative nexus between the strong university system and technology parks fulfil many vital functions in the Texan innovation system. There exist numerous networking opportunities to help diffuse knowledge emerging from the university system into the business community.

The state makes an extensive use of ‘networks’ to create the necessary connections between entrepreneurs and investors, where scientists and firms are more likely to collaborate and create new knowledge and innovations. For example, the Innovate Texas Foundation was set up to provide a unified mechanism to connect its technological resources with entrepreneurs and capital. While the Abu Dhabi Innovation Index emphasises the importance of accessing knowledge from international sources, it is important to note that there can be local impediments to accessing knowledge. For example, firms sometimes cannot access knowledge and innovations generated in the public sector, especially in areas such as defence where information is highly classified. Hence, the Innovate Texas Foundation helps firms within the state to gain access to such areas.

The Government of Texas supported innovation by breaking down traditional disciplinary silos in universities through providing opportunities for firms and research scientists to collaborate. Creating a collaborative mechanism between industry and researchers is thus vital for developing creative capacity and ensuring that it is exploited commercially.
2.6. Abu Dhabi’s Knowledge Exploitation Capabilities

Abu Dhabi performs exceptionally well in terms of mobilising and exploiting new knowledge for social and commercial purposes.

The capability to exploit new knowledge and learning is among the most critical and essential innovation capabilities. Economies that are not competitive in exploiting new knowledge and learning will benefit less from their investments in R&D and knowledge acquisition. Any new knowledge or innovation produced locally or internationally will generate socio-economic returns only if it is exploited adequately. A weak capacity to exploit innovation therefore leads to poor return on investment, wasting of talent and a significant gap between inputs and outputs in the innovation system. Therefore, new ideas, techniques and learning travel to those economies where the promise of greater return on investments lies. Such exploitation capacity may be enhanced by factors such as the availability of venture capital (VC), equity markets, and government procurement of advanced technology products. As shown in Figure 7, such factors are expected to increase the value added to the economy that eventually translates into better living standards.

Table 7: Capacity and performance indicators for exploiting knowledge

<table>
<thead>
<tr>
<th>Exploitation Capacity Indicators</th>
<th>Exploitation Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venture Capital Availability</td>
<td>Creative Goods</td>
</tr>
<tr>
<td>Local Equity Market Access</td>
<td>Industry Value Added</td>
</tr>
<tr>
<td>Government Procurement of Advanced Technology Products</td>
<td>Services Value Added</td>
</tr>
</tbody>
</table>

Figure 8 considers the comparative exploitation capacity of Abu Dhabi with respect to other NREs. Abu Dhabi has a regional advantage in relation to Government Procurement of Advanced Technology Products, which means that government plays an important role in demanding new services and products. This result was also observed in the Abu Dhabi Innovation Survey presented in Part 3 of this report, which found that public administration and public services topped the list of sources of demand for innovation. Where the Emirate still lags behind is access to a local equity market (ranked 10th) and availability of VC (ranked 7th). There are indications that this may change in the near future with the creation of the Global Marketplace Abu Dhabi that will act as a hub for financial services. Beyond providing finance for potentially risky start-ups (a category likely to be ignored by traditional financial intermediaries such as banks), VC firms also play a key role in vetting innovative ideas. This said, the dominance of family-run businesses in Abu Dhabi may be a mitigating factor, with money from family and friends partially offsetting the need for VC. This is particularly so in the light of the prevalent business ownership laws that stipulate the presence of a local Emirati partner in any venture, which in many cases acts as a channel for seeking capital.
The industrial and economic structures of Abu Dhabi also mitigate the absence of a strong VC base. Much of Abu Dhabi’s economy is dominated by a handful of prominent firms like Etisalat and Abu Dhabi National Oil Company (ADNOC) that do not require the financial and strategic assistance of VC firms. This finding was also confirmed in the Abu Dhabi Innovation Survey in Part 3 of this report, where it has emerged that the bulk of innovative activities occurs in these large enterprises. This lack of VC capacity may thus be a key reason for the dominance of the large enterprises among innovative firms in the Emirate. However, entities like the Khalifa Fund for Enterprise Development may augment access to VC through recent moves to begin offering financial support to Emirati nationals who want to start their own businesses.

With regard to exploitation performance, Abu Dhabi emerges as one of the NRE leaders in terms of Industry Value Added (ranked 2nd in the NREs under consideration). The latter comprises net output after adding up all outputs and subtracting immediate inputs in mining, manufacturing, construction, electricity, water and gas.

In spite of the dearth of venture capital, the Emirate does well when it comes to knowledge exploitation. This can be explained in part by the dominance in the economy of large companies with strong technical/financial resources.

Clearly, Abu Dhabi’s performance not only exceeds that of the other emirates in the UAE, but also other developed countries. On some indicators, such as the utilisation of skilled labour, this may also be the effects of regulations governing the residence of foreign skilled labour where permission to stay is linked to full employment capacity. This translates into higher levels of skilled labour deployment than is the case in more advanced economies where migration systems tend to permit skilled persons to stay even without employment. Furthermore, Abu Dhabi is considered to be a tax heaven for businesses (excluding oil companies and foreign banks) which in theory should improve its prospects for higher levels of investment funding and potentially higher profits.
2.7. Assessing Aggregate Innovation Capabilities

The Abu Dhabi Innovation Index confirms that the Emirate enjoys strong innovation capabilities based on its ability to access knowledge, and then to anchor and exploit it commercially.

Abu Dhabi enjoys a relatively strong capacity across each of the five capabilities. The small gap between its potential capacity and its actual performance indicates that Abu Dhabi is successfully realising its potential. Figure 9 succinctly characterises the overall innovation capacity and performance dimensions in the Abu Dhabi’s economy.

However, aggregate scores may smooth important variations among the composite indicators. In particular, attention should be paid to the pattern of variation across countries on the two dimensions of capacity and performance where it can be seen that some economies show higher innovation performance despite possessing lower innovation capacity, and vice versa. A more nuanced benchmarking should, therefore, take into consideration the level of efficiency and effectiveness (together interpreted as ‘efficacy’ in this report) of a given system of innovation. The next section does exactly this and provides a benchmark analysis derived from a comparison of the select NREs at the level of capacity and performance. The result is a ‘Typology of Innovation Capabilities’ that assesses the various economies along a quadrant categorising their innovation capabilities in terms of capacity, performance and efficacy.

2.8. Typology of Innovation Capabilities

Some countries invest substantially in developing and maintaining a strong innovation capacity but fail to see these investments translate into higher levels of industry or international competitiveness. This is often largely due to governments’ classical emphasis on investment in science, technology and education on economic growth, with scant attention to what happens in between those inputs and outputs such as the learning, adoption and adaptation of knowledge that take place within the actual processes of innovation. To illustrate this point, consider that South Korea has a much higher level of enrolment in tertiary education than Switzerland, but the latter scores considerably higher on traditional measures of economic development (such as GDP per capita). Another example is the so-called Swedish paradox of high R&D input and low innovation output. Sweden invests heavily in R&D but fails to translate this into commercial success, whilst another Nordic country like Norway does not invest as much but yet enjoys higher productivity, even when excluding its hydrocarbon industry (Andersson and Mahroum, 2008; Bitard et al., 2008).

Moving beyond conventional approaches that measure innovation inputs and outputs, the Abu Dhabi Innovation Index provides an innovative analytical perspective, namely the ‘Typology of Innovation Capabilities’. More specifically, it allocates the NREs included in this review into one of the following four categories, based on their overall innovation efficacy as discussed in the previous section:

- High Capacity/High Performance
- High Capacity/Low Performance
- Low Capacity/High Performance
- Low Capacity/Low Performance
**High Capacity/High Performance:** These economies invest continuously in the various factors supporting innovation performance and do well in exploiting these investments to achieve comparably high levels of performance. As shown in Table 8, the vast majority of the set of NREs fit this description. Note that in Table 8 the countries have been listed in alphabetical order rather than by their index rankings.

**High Capacity/Low Performance:** These economies invest strongly in the various factors supporting innovation performance, but for various reasons this does not translate into significant economic benefits.

**Low Capacity/High Performance:** Relative to the other NREs, these economies do not invest significantly in factors support innovation performance, yet perform well in generating innovation outputs. None of our sample of NREs fits this description entirely, but Brazil and Russia show characteristics of this.

**Low Capacity/Low Performance:** These economies do not invest substantially in factors that support innovation performance and do not display strong innovation performance. Saudi Arabia, Brazil, Russia and Egypt all fit this description among our sample of NRE countries.

Figure 10 locates the NREs on a typology of their respective innovation capabilities. Note that the XY line on the graph represents the theoretical point where innovation capacity inputs generate commensurately equivalent performance outputs. This is an important analytical distinction that is often overlooked in other innovation indices and benchmarking studies. As shown in Figure 10, Canada is the strongest performing NRE due to its top ranking on most of the indicators, and also because the country is very efficient in converting innovation capacity into performance. Russia and Venezuela are the only countries whose overall performance is greater than their capacity. It is interesting to note here that Venezuela, which while falling into the low-capacity/low-performance category, is efficacious in capitalising on its potential. Brazil lies on the XY line and hence could also be classified as being efficacious in turning its innovation capacity into performance due largely to its significant local market and integrated value chains.

Whilst Abu Dhabi does not appear to be exceptionally efficacious at the aggregate level, it has a remarkable degree of efficacy at the access and exploitation pillars (as shown previously in Figures 4 and 8). Figure 7 also shows that the biggest efficacy gap for Abu Dhabi exists at the creation pillar. This may be explained by the expected time lag between recent investments in knowledge creation and the realisation of that performance.
Table 8: Abu Dhabi Innovation Index: Cross-economy analysis

<table>
<thead>
<tr>
<th>High Capacity/High Performance</th>
<th>High Capacity/Low Performance</th>
<th>Low Capacity/High Performance</th>
<th>Low Capacity/Low Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abu Dhabi</td>
<td>Bahrain</td>
<td>None</td>
<td>Algeria</td>
</tr>
<tr>
<td>Australia</td>
<td>Chile</td>
<td>Argentina</td>
<td>Botswana</td>
</tr>
<tr>
<td>Brazil</td>
<td>Jordan</td>
<td>Nigeria</td>
<td>Russia</td>
</tr>
<tr>
<td>Canada</td>
<td>Kuwait</td>
<td>Oman</td>
<td>Venezuela</td>
</tr>
<tr>
<td>Finland</td>
<td>New Zealand</td>
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<tr>
<td>Malaysia</td>
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<td>Norway</td>
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<td>Qatar</td>
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<tr>
<td>Saudi Arabia</td>
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<td>UAE</td>
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Part 3: How do Abu Dhabi Firms Innovate?

3.1. Introduction

Part 3 explores innovation in the Abu Dhabi economy at the micro-level. Specifically, it offers insights into the characteristics that affect an Abu Dhabi company’s propensity to innovate, the types of firms that invest more in innovation, the types of innovation activities these firms are engaged in and finally how innovation in Abu Dhabi firms varies from that in other countries. To gauge these multiple dimensions of innovation, this section reports the findings of the 2012 Abu Dhabi Innovation Survey, covering the four-year period from 2008 to 2011. The survey was based on the European Community Innovation Survey (CIS) (see Box 6).

The survey covers issues such as terms of innovation activity, expenditure, co-operation and sources of information and market geography in addition to the most prevalent barriers to innovation in the Emirate of Abu Dhabi over the period 2008-2011. It was used to survey a total of 532 firms over the period June-August 2012. Given that these firms belong to a range of different sectors, it was important to analyse such various dimensions of innovation at the sectoral level. In order to highlight the innovation activities that take place in Abu Dhabi beyond hydrocarbons, six main sectors have been considered, namely: manufacturing; construction; transport and associated services; ICT; financial and insurance; and professional, scientific and technical activities. Part of this sectoral analysis is provided here, whilst the results of the full cross-sectoral analysis are presented in Appendix E.

The analysis presented in Part 3 includes a showcase of five innovative Abu Dhabi firms, in addition to a comparison of the innovation performance of enterprises in Abu Dhabi with those in a number of European countries. The international comparison is based on the most recent results of the European CIS 2010, covering the three-year period from 2008 to 2010. Results from the CIS 2010 for various European countries have been retrieved from Eurostat’s webpage (European Commission, 2013).

BOX 6: Abu Dhabi Innovation Survey Methodology

The 2012 Abu Dhabi Innovation Survey follows the approach adopted in the Community Innovation Survey (CIS), which is a standard measure of the innovation performance of countries. National surveys of this type derive their methodologies from the Oslo Manual published by the OECD in 1992 and subsequently revised in both 1997 and 2005. The Oslo Manual includes methodological guidelines for collecting and interpreting data on innovation. Innovation surveys take a sample that is representative of all business establishments in a country, by sector and size. Following the CIS tradition, no firm with fewer than ten employees was considered in the Abu Dhabi Innovation Survey. Additionally, a stratified random design with a systematic probability proportional to size was adopted. Through this sample design approach, the survey population was divided into non-overlapping stratum. A total of 580 firms were targeted to represent ten economic activities in the Emirate.

Further details about the sample size and response rate are provided in Appendix C, and the actual questionnaire is presented in Appendix D.

3.2. The Innovation Activities of Abu Dhabi Firms

‘Innovation activity’ was defined per the Oslo Manual as a situation where enterprises were engaged in any of the following activities:

- Product Innovation: introducing to the market a new or significantly improved product (good or service).
- Process Innovation: implementing a new or significantly improved production process, distribution method or support activity for goods or services. This excludes superficial changes to the organisational structure of the company.

Moreover, the new or improved product and process innovation must be new to the surveyed enterprise, but it does not have to be new to its sector or market. Additionally, it does not matter whether the innovation was originally developed by the enterprise itself or was sourced from elsewhere. In this respect, almost 65% of Abu Dhabi firms introduced either a product or process innovation over the period 2008-2011. More details of the findings of the Abu Dhabi Innovation Survey are provided in the following sections.
3.2.1 Product Innovation

According to the Abu Dhabi Innovation Survey, 38.5% of the firms had introduced a new or significantly improved product. 21% of firms had introduced new goods while 33% introduced new services. In total, 38.5% of Abu Dhabi firms could be classified as product innovators over the period 2008-2011.

When asked about whether their enterprises had introduced new or significantly improved products over the period 2008-2011, 21% of the surveyed companies in Abu Dhabi declared that they had introduced new goods whilst 33% had introduced new services. In total, 38.5% of Abu Dhabi firms could be classified as product innovators over the period 2008-2011.

When comparing these results with those reported in the 2009 Abu Dhabi Pilot Innovation Survey conducted by the General Secretariat of the Executive Council (GSEC, 2011), we observe a continuation of the trend where Abu Dhabi firms generate more innovation in the form of new/improved services than in goods. This is despite the fact that a large majority of firms active in innovation are found in the manufacturing sector. The 2009 pilot survey reported that 27% of firms they surveyed had introduced new goods and 28.5% had introduced new services. This small reduction in innovation activities over the time period considered in the two surveys can be explained in part by the global financial crisis that commenced in 2008. Whilst Abu Dhabi has maintained positive GDP growth over the period 2008-2011, the performance of some firms was marginally compromised by the global economic turmoil.

In comparison with firms in European countries, those in Abu Dhabi differ strikingly in terms of the proportion of new goods versus service innovations. The share of firms that have introduced physical products versus those that have introduced new services in all European countries is the reverse of those of Abu Dhabi. With the exception of Cyprus and Luxembourg—two countries with a large financial services industry—European firms introduced more new physical goods than services (see Figure 11). The reason for this difference lies in the sectoral composition of the Abu Dhabi economy, which has a large share of service industries supplying construction in addition to the oil and gas industries. As shown in Figure 12, the share of new/improved services exceeds products introduced in all of the major non-oil sectors in Abu Dhabi, including the manufacturing sector.

![Image: Figure 11: Share of firms that introduced at least one good or service, over the periods 2008-2010 (EU countries) and 2008-2011 (Abu Dhabi)]
16% of the product innovations introduced by Abu Dhabi firms were internationally novel, whereas 41% of the introduced products were new to the UAE markets, and the remaining 43% were novel only to the innovating companies that introduced them.

Product innovations can be further distinguished by their degree of novelty - i.e. if a good or service is new to the market, or just new to the innovating firm. Innovations new to the market often have greater economic relevance, since they afford the firm a temporary monopoly in a sector of the market. The survey results show that the bulk of the innovation in Abu Dhabi firms’ revolved around identifying innovations elsewhere and adopting them into the domestic market. Only 16% of the product innovations introduced by Abu Dhabi firms were genuinely novel at a global level. The remaining 84% products had already been introduced elsewhere. Figure 13 summarises the breakdown of the newness of innovative products introduced by the Abu Dhabi firms in the survey. In essence, these findings at the micro-data level are consistent with those at the macro-level that were discussed earlier in this report. For instance, accessing, anchoring and diffusing innovations from elsewhere are key important channels of value creation and novelty for firms in the Emirate of Abu Dhabi.
Compared to European countries, Abu Dhabi ranks very high in terms of the share of innovating firms that introduce new products to the market (see Figure 14). Part of this may be explained by the small size of the overall Abu Dhabi market insofar as there appears to be an emerging pattern, where small countries disproportionately lead the ranking. In small economies, domestic markets tend to be dominated by fewer firms in each sector and hence new products are more likely to be seen as novel compared to large countries. However, Abu Dhabi and the UAE in general, have very open and fast-growing economies that can draw a variety of international suppliers in any given sector. For example, 80% of America’s Fortune 500 companies have their regional headquarters (HQs) in the UAE (KPMG, 2008). This indicates that Abu Dhabi is indeed characterised by strong innovation adoption when compared to other countries.

Figure 15 provides further details with regard to the novelty breakdown of product innovations across the Abu Dhabi’s economic sectors. New-to-the-firm innovations seem to be frequently reported within sectors that are dominated by relatively small number of firms, e.g. construction, transport, banking and insurance sectors.
The prevalence of the ‘innovation by adoption’ trend among Abu Dhabi firms can also be observed in the breakdown of their innovation investment portfolios. The acquisition of other business enterprises and/or business units tops the methods of acquiring expertise or knowledge in this specific domain in the Emirate of Abu Dhabi (Figure 16).

Figure 17 shows that such acquisition was not limited to local firms but includes foreign enterprises as well. However, Figure 18 reveals that acquisition of foreign enterprises was absent in the transport sector and minimal in the construction sector. Both of these two sectors have witnessed significant developments in terms of technical and commercial expertise. Hence, mergers and acquisitions tend to take place locally.

Figure 16: Breakdown of Abu Dhabi’s innovation activities over the period 2008-2011

Figure 17: Nationality of business units acquired by Abu Dhabi firms
In addition to the acquisition of other business entities, investment in extramural (out-of-firm) R&D, the ‘Market Introduction of Innovations’ (includes market research and launch advertising) and the ‘Acquisition of Other External Knowledge’ are among the most common responses to questions about activities related to the introduction of a new good or service innovation. Figure 19 shows that the acquisition of new knowledge tends to be largely through ‘off-shelf purchases’ (65%), but significant licensing activities are taking place as well (27%). In both forms of acquisitions, knowledge transfer through training is often reported to occur.

A further look at the sectoral level reveals that ‘off-shelf purchases’ are the only reported method of acquiring new product innovations in the transport and financial sectors (Figure 20). On the other hand, licensing activities seem to figure highly in the ICT sector. This is largely due to the fact that ICT products tend to be readily licensable when compared to those belonging to other sectors.
To sum up, the overall pattern of innovation activities shows that Abu Dhabi firms are actively acquiring new product innovations from elsewhere and introducing them in the UAE market (as shown in Figure 16). This is a strong positive sign that shows an economy that is constantly upgrading its knowledge base for the benefit of increased welfare, utility and competitiveness.

*Suppliers and customers are the most important channels that Abu Dhabi firms have for identifying or learning about new product innovations.*

Suppliers, which are often foreign companies or subsidiaries of foreign companies, as well as customers, among whom government agencies and companies are important segment, represent important learning catalysts for innovation in Abu Dhabi (see Figure 21). Other important channels are trade exhibitions and exposure to international markets. The latter gives further support to the analysis at the macro-level in the Abu Dhabi Innovation Index, where the capability to access sources of new techniques and knowledge in Abu Dhabi was identified as being quite strong.
BOX 7: Neopharma

Based in Abu Dhabi, Neopharma is a pharmaceutical manufacturer that produces generic medical products as well as specialised Beta-lactam products that comprise a broad range of antibiotics including items such as penicillin derivatives. This enables the company to produce and patent non-infringing products that are in high demand, helping the UAE to reduce its reliance on imports. In doing so, Neopharma functions as a knowledge access, diffusion and anchor agent. At present, 940 drugs from the registered 6,868 are actually made in the UAE. To that end, Neopharma is among fourteen UAE medical manufacturers recently permitted to research new drugs and register patents. This formed a part of a resolution introduced by the UAE’s Ministry of Health in 2013. This means that Neopharma is also actively engaged in new knowledge creation. Interviews with the firm’s senior management have confirmed that the establishment of the R&D-intensive plant aims to contribute to the Emirate’s goal of attaining a knowledge-based economy.

The Neopharma plant was established in 2003 with an investment of USD 25 million and occupies an area of 100,000 square meters. Upon inauguration, the plant obtained quality certifications including the ‘EU GMP’ certificate from Belgium and the ‘Regulatory Collaboration Principles In GCC States (GCC-DR)’ certificate. By 2008, Neopharma was the first pharmaceutical company in the region to operate an integrated management system encompassing ISO 9001, ISO 14001 and OHSAS 18001. Within a relatively short period of time, Neopharma has emerged as a pioneering medical product manufacturer that aims to provide world-class quality medicines at affordable prices.

To ensure its global competitiveness, Neopharma has engaged in several cooperative efforts. For example, it embarked on a joint venture with Biocon to start one of the region’s first biotechnology companies – Neobiocon. In doing so, Neopharma strengthened its role as an access and anchor agent of knowledge within the Abu Dhabi’s innovation system. Neopharma has also entered into a joint venture with the University of Arkansas to enhance its nanotechnology products such as nano biosensors. Through collaboration with the UAE Genetic Diseases Association (UAE GDA), Neopharma has recently developed the formulation of Folic Acid and Vitamin B12 with the name Manal, which is an important component of the UAE GDA’s goal to prevent neural tube defects. Due to Neopharma’s established access to international and local expertise, it has managed to introduce – for the first time in the region – a sustained release version of a popular anti-diabetic product giving patients the convenience of dosage. Moreover, the company’s knowledge creation and diffusion capabilities have been enhanced with the establishment of a dedicated manufacturing centre for its innovative Beta-lactam products producing a wide range of antibiotics. In addition, the company has started to extend its global reach by signing a manufacturing contract for Lagap in Switzerland.

The company began exporting its products in 2004, starting with Switzerland and expanded in the wider region by exporting to Yemen, Libya and Iraq. By 2005, and upon obtaining GCC-DR certification, Neopharma made its debut in the region when it started exporting to other GCC countries. Bearing in mind the strategic location of the Emirate, several other countries were subsequently added to this list of countries it exports to including Afghanistan, Tajikistan, Turkmenistan and Kenya, which in turn distributes in wider East Africa.
3.2.2 Process Innovation

Some 59.4% of the surveyed companies in Abu Dhabi declared the implementation of a new or a significantly improved process innovation in the period 2008-2011. Half of these innovations were in the form of new or significantly improved maintenance, purchasing, accounting or computing systems (see Figure 22). Manufacturing and production processes came second, trailing by 10 percentage-points. The third type of process innovations were logistics related innovations. The results indicate that a substantial share of Abu Dhabi’s process innovations occur in the form of new ICT systems. This observation is again consistent with findings in the macro-level data in the Abu Dhabi Innovation Index.

As shown in Figure 23, the breakdown of the types of process innovation activities seems to follow a somewhat similar pattern across various sectors of the Abu Dhabi economy. An obvious exception is the transport sector, which has understandably reported a relatively frequent incidence of improved logistics, delivery or distribution methods.

Figure 22: Breakdown of Abu Dhabi’s process innovation activities over the period 2008-2011

Figure 23: Cross-sectoral breakdown of Abu Dhabi’s process innovation activities over the period 2008-2011
When asked where their process innovations were developed, the vast majority of the firms surveyed in Abu Dhabi declared that these were developed in-house (see above). Nevertheless, as presented in Figure 24, a significant share of process innovations (42%) was developed by or in collaboration with other parties. This trend is a healthy sign of the level of knowledge transfer and cooperation in the innovation system. The sources for these process innovations are similar to those identified for product innovations. Suppliers and customers are the two main channels of innovation learning for Abu Dhabi firms, followed by international exposure activities including exhibitions (see Figure 25).

As is the case with product innovations, Figure 26 shows that off-shelf purchasing and licensing activities remain the most common forms of acquiring new process innovations. This appears to be another trend that characterises much of the innovation activities in Abu Dhabi.
BOX 8: Al Yah Satellite Communications Company (Yahsat)

Headquartered in Abu Dhabi, Yahsat is a private joint-stock company that is fully owned by the Mubadala Development Company – an investment arm of the Abu Dhabi Government. Initially established in 2007 to supply secure telecommunication services for the Abu Dhabi Government, the company has now become the region’s first multi-purpose satellite system. Today, Yahsat provides customised satellite solutions for the government as well as for the commercial sector in the Middle East, Africa, Europe, Central and South West Asia.

With no satellite expertise available in the UAE, Yahsat has developed strategic relationships with internationally recognised satellite service providers and equipment manufacturers to design customised end-to-end satellite communication solutions. Yahsat, therefore, functions as a unique agent of knowledge access, anchor, diffusion and exploitation in the UAE’s telecommunication sector. Yahsat has channelled the expertise of USA-based suppliers to develop YahClick – the company’s flagship product and most innovative service offer. YahClick provides high speed, cost-effective Internet for a large variety of home and business users in 28 countries across the Middle East, Africa and South West Asia. The YahClick satellite broadband service uses commercial Ka multi-spot beam technology – essentially a ‘game changing’ satellite technology that provides multiple benefits for rural and underserviced areas. The technology has a much lower cost of bandwidth and greater bandwidth availability than other competitive technologies in Ku-band, C-band and L-band. In addition, it doesn’t require large infrastructure investment by service partners, as Yahsat provides all the hub management in four central gateways. Customers only need a small, easy to install satellite dish, and a modem to receive and transmit Internet traffic.

In addition to introducing the Ka multi-spot beam technology to the region, Yahsat has also promoted a new business model, and one which is unique in the satellite industry according to Yahsat’s leadership team. Yahsat focuses on providing local solutions that cater to individual business and customer needs by working with a network of service partners in each country. Unlike its competitors who have local operations (or just sell satellite capacity), Yahsat works in close partnership with local Service Partners (SPs). Trained by Yahsat, SPs interface with end customers and are responsible for sales, billing, user equipment installation and customer service. Meanwhile, Yahsat takes charge of satellite control and configuration, the network management centre, quality of service, monitoring, Web interface and ground segment infrastructure. This business model is tailored to meet individual market needs and allows products, services and processes to be constantly revisited based on the SPs’ feedback. Working with SPs is also considered to be a less costly approach than establishing local offices in each market.

To develop the capacity needed to deliver its services, Yahsat signed a USD 1.66bn turnkey contract with a leading European company – EADS/Thales Alenia Space – for the provision of two satellites (Y1A and Y1B) as well as for their related network management systems and ground segment operations (this includes all of the earth-based equipment/infrastructure required to operate a satellite).

In 2013, Yahsat had 30 YahClick SPs on the ground with more than 2,500 distribution points of sale in its coverage area, as well as four IP gateways in Abu Dhabi, Madrid, Luxemburg and Athens. Yahsat is also at the forefront of local knowledge transfer; by 2013, Yahsat had trained over twenty fresh Emirati graduates with technical background in satellite technology. These people currently occupy various technical positions within Yahsat, including those of satellite controllers.
3.3. Comparing Abu Dhabi Innovation Behaviour to Other Economies

Abu Dhabi has a high share of innovating firms, but also a much higher share of large firms than comparator European economies.

The proportion of innovating firms in the Abu Dhabi economy is higher than that what exists in any European country. Some 65% of all Abu Dhabi enterprises have introduced a product and/or a process innovation between 2008 and 2011 (see Figure 27). The closest European country in this respect is Germany with 64.3%. The result for Abu Dhabi might be explained by the dominance of large enterprises in the Abu Dhabi’s economy, resulting in a survey sample with a considerably high number of firms with more than 250 employees. The share of large enterprises in the Abu Dhabi sample was 37.3%, compared with an average of 4% in the EU CIS. This is a remarkable difference. Small firms of up to 49 employees account on average for 79% of the CIS firms in European countries, but only 24% in the Abu Dhabi sample. Larger firms have a higher propensity to innovate, a fact that should be kept in mind when comparing Abu Dhabi and EU CIS results. Figure 28 shows a breakdown of innovative Abu Dhabi firms in terms of size.

The high proportion of larger firms in Abu Dhabi also means that it has a higher propensity to introduce innovations of all types than their counterparts in Europe.

Another striking feature of the Abu Dhabi economy is the prevalence of process innovation over product innovation. Figure 27 shows that almost all innovative firms in Abu Dhabi have introduced at least one process innovation. This finding may be explained by the large number of process industries such as mining and oil processing, etc. Countries which are regarded as technological leaders, such as Germany, Sweden, Finland or Norway have a higher share of firms that are product rather than process innovators.

Figure 27: Share of firms that introduced at least one product, process innovation or both, over the periods 2008-2010 (EU countries) and 2008-2011 (Abu Dhabi)
Abu Dhabi companies seem to focus more on process innovations than product innovations when compared to European enterprises. As shown in Figure 29, this trend seems to be sector-neutral. In general, this can be interpreted to be a sign of the on-going transition of many large Abu Dhabi firms from labour-intensive to capital-intensive processes in an effort to improve their competitiveness.

Evidently, among Abu Dhabi firms there is a greater focus on process innovation to optimise supporting activities, rather than on manufacturing technologies or improved logistics (see Figures 30 and 31). In this respect, Abu Dhabi enterprises are not much different from firms in most European countries. European firms in countries like Turkey, Estonia and France, with considerably lower propensities for process innovation, show a preference for process innovation to improve production processes compared to functions that support an enterprise or logistics. Moreover, Abu Dhabi firms show a much higher propensity to introduce any of the three types of process innovations than any other country (except Cyprus for logistics innovations). While such a behavioural pattern is unlikely to change due to the longer period of observation in Abu Dhabi (four years versus three years), it can be explained by the on-going process to upgrade and optimise technology that has been documented elsewhere in this report.
Figure 30: Share of firms that introduced at least one process innovation, over the periods 2008-2010 (EU countries) and 2008-2011 (Abu Dhabi)

Figure 31: Cross-sectoral share of firms that introduced at least one process innovation, over the period 2008-2011, in Abu Dhabi
3.4. Innovation Expenditures of Firms

A majority of firms do not allocate any funds for innovation per se, and a very small proportion of firms have received any public funds for innovation.

Among the sample of firms surveyed in Abu Dhabi, 60% indicated that they had not allocated any funds to directly support innovation-related activities. Additionally, only 2.6% of the survey population received public financial support for innovation activities over the period 2008-2011.

Abu Dhabi firms that spend money on innovation, tend to spend a high amount relative to turnover - at a level that ranks comparably with Nordic countries.

Innovation activities of firms can be reflected in the amount of money that firms spend on innovation, and the distribution of these funds can vary across classes of innovation activities. On average, Abu Dhabi is clearly among the economies with the highest innovation expenditure as a percentage of turnover (see Figure 32). Innovation expenditure amounts to 3.2% of turnover if non-innovative firms are excluded. This is about the level achieved in Nordic countries like Denmark, Finland, and Sweden, and it puts Abu Dhabi ahead of most European countries, including Austria, Belgium, France or Germany\(^1\).

![Figure 32: Share of R&D and other innovation expenditure on total innovation expenditure, over the periods 2008-2010 (EU countries) and 2008-2011 (Abu Dhabi)](image)

Figure 32 provides a further examination of innovation expenditure at the sectoral level. It has become apparent that innovating Abu Dhabi firms, belonging to the main non-hydrocarbon sectors, allocate higher innovation expenditures than that assigned by an average Abu Dhabi firm (i.e. 3.2%). Allocating relatively high innovation expenditures in such sectors can serve as a positive sign for a NRE that is keen on diversifying its economic activities.

![Figure 33: Cross-sectoral share of R&D and other innovation expenditure on total innovation expenditure, over the period 2008-2011, in Abu Dhabi](image)

Figure 33

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1 Germany is not included in Figure 32, because the breakdown into R&D and non-R&D expenditure is not available for this country. Total innovation expenditure of German firms amount to 2.1% of turnover in 2010.
It should be recalled here that the nature of innovation activity in Abu Dhabi and the target of related expenditure differs from that seen in European countries such as Finland and Sweden by being largely process-orientated and novel to domestic market only. Moreover, a large proportion of such expenditure by Abu Dhabi firms is made in relation to innovation acquisition. Figure 34 shows a breakdown of the innovation-related expenditure for firms that have actually allocated funds for innovation activities. Clearly, the biggest shares of innovation funds were allocated to the acquisition of machinery, equipment and software over the period 2008-2011. This figure does not include expenditure made for the acquisition of other companies or business units, which was ranked number one in terms of type of innovation activity by the firms surveyed (as shown in Figure 16).

![Figure 34: Breakdown of Abu Dhabi’s innovation related expenditure over the period 2008-2011](image)

A closer inspection of the international CIS data reveals an important difference between Abu Dhabi and the Nordic countries. *Firms in the Nordic countries spend the bulk of their innovation expenditure on R&D, while Abu Dhabi firms devote the majority of their innovation expenditure on other innovation activities, mostly the acquisition of machinery, equipment and software.*

The relationship between various components of innovation expenditure is depicted in more detail in Figure 35. The figure reveals that innovation activity in Abu Dhabi firms depends mostly on the diffusion of acquired technology. *Expenditures on the acquisition of machinery, equipment and other external knowledge, account for almost 70% of total innovation expenditure of Abu Dhabi firms.* This groups Abu Dhabi at the lower end of the R&D-related ranking of Figure 35 with countries like the Czech Republic, Malta, Romania and Slovakia.
Figure 36 shows that the breakdown of innovation expenditure in Abu Dhabi is almost sector-neutral. The slight exception is the transport sector, which seems to invest relatively more on machinery acquisition and less on R&D activities. An innovation strategy based on acquired technology is not necessarily a disadvantage. Such a strategy is frequently found among developing economies seeking to catch-up by benefitting from the global pool of technology and knowledge. However, as countries approach the technology frontier, they may find it more and more difficult to compete with countries where innovation is predominantly based on own R&D efforts.
**BOX 9: AccuVis Bio**

Funded by the Khalifa Fund for Enterprise Development with initial support from the Arab Science and Technology Foundation, AccuVis Bio is a R&D-intensive biotechnology company that is based in the Emirate of Abu Dhabi. Standing for “Accurate Vision Biotechnology”, the company is incubated by Abu Dhabi University, and is committed to providing innovative products and services to the biotechnology and pharmaceutical industry. These two sectors have been identified by the 2030 Vision as potential engines of economic growth and diversification in the Emirate. AccuVis Bio’s agreement with Abu Dhabi University allows it to diffuse knowledge and exploit research for commercial purposes, and to transform inventions and patents into marketable products.

AccuVis Bio’s main activities include manufacturing test kits and providing export/import as well as genetic analytical services. Current products include sample preparation, preservation and analysis kits for DNA, RNA and protein isolation, as well as molecular diagnostic kits for all types of pathogens. Genetic analysis services include human disease diagnosis to predict the risk of various diseases like cancer, diabetes, genetic abnormalities and predictive genetic disorders. They also help individuals with paternity testing, ancestral origin identification, and gene-by-gene sequence analysis. The R&D unit in AccuVis Bio gives support to researchers and students for their projects, as well as training and consultancy services. The company has also developed a proprietary biotechnology-derived technology platform that has multiple applications such as live cell rapid detection, diagnostics, monitoring and therapeutic applications. Moreover, AccuVis Bio is the exclusive partner in the Middle East for Norgen Biotek – which is one of the top ten Canadian biotechnology firms – that provide innovative sampling solutions. This collaboration has enabled AccuVis Bio to access high-level expertise and develop new innovative products such as HIV molecular diagnostic kits for use in resource-limited areas.

Being headquartered in Abu Dhabi, the company enjoys ample advantages from local economic and geographical conditions such as easy access to diverse human resources, a favourable tax environment, political stability and integration with international markets.

### 3.5. Collaboration Activities around Innovation

Some 35.6% of innovating firms surveyed in Abu Dhabi have co-operated with other parties to introduce new products or processes.

A well-functioning system of innovation depends on the intensity of exchange between firms, universities, governmental research organisations, non-profit organisations, customers, etc. Hence, achieving effective co-operation among the various innovation actors has become a main goal of innovation policies around the world. A special focus of policy lies in the relationships between firms and universities.

By international standards, Abu Dhabi firms co-operate frequently during the process of innovation. Co-operating firms, over the period 2008-2011, constitute 21.4% of all firms in the sample or 35.6% of all innovating firms (see Figure 37). Such figures (which exclude pure consulting or contracting out, i.e. without active cooperation) put Abu Dhabi ahead of several European countries that are often ranked highly for innovation, including the Netherlands, Norway and Germany. While this may reflect frequent sourcing of external knowledge sources by Abu Dhabi firms, it may also be a sign that knowledge exchange is taking place in Abu Dhabi’s innovation system.
Figure 37: Share of firms with innovation co-operations on all firms and all innovative firms, over the periods 2008-2010 (EU countries) and 2008-2011 (Abu Dhabi).

Figure 38: Cross-sectoral share of firms with innovation co-operations on all firms and all innovative firms, over the period 2008-2011, in Abu Dhabi.
The total number of co-operating firms can be further split according to their co-operation partner. Around 50% of all co-operating enterprises in Abu Dhabi have reported internal co-operation (i.e. partnership with another business entity within the same enterprise group). Figures 39 and 40 compare the types of external partners at the economy and sectoral levels, respectively. All of the Abu Dhabi’s results are evidently consistent with the abovementioned finding that suppliers are a frequent means by which new product and process innovations come to attention (as presented in Figures 21 and 25). The international comparison confirms that suppliers are the most important co-operation partners in all countries except Germany. Abu Dhabi has an above-average share of co-operation with suppliers when compared to the EU average. This fits with observation made in the previous section that the dominant innovation investment strategy in Abu Dhabi is to acquire machinery and equipment. On the other hand, the share of Abu Dhabi firms that co-operate with universities is much lower and below the average of the European Union. The same is also true for co-operation with public research and government organisations.
Established in 2008, Geographic Planning Collaborative – Global Information Solutions LLC (GPC-GIS) specialises in location-adapted GIS consulting and technology solutions in the MENA region. GIS technology provides an information infrastructure platform that is used to collate, manage, accurately verify, analyse, share and transform geographical data into visual representations. Such platforms can help inform decision-making processes across government and private sector businesses on multiple levels.

GPC-GIS, a member of the GPC Group, leverages the experience of its US founder and President, Mark Sorensen. With more than thirty years of international experience in the application of GIS and related technologies in the fields of urban and regional planning, utilities, resource science, policy and management, the GPC Group has become a globally renowned name in the field of GIS technology.

Over the past 10 years, GPC-GIS has become a successful ‘diffusion agent’ that has implemented several projects in the MENA region, most notably in Oman, Lebanon, Bahrain, Libya, Yemen, Afghanistan, Iraq and the UAE. The ‘anchor project’ for the GPC-GIS headquarter set-up in Abu Dhabi, the Abu Dhabi Spatial Data Infrastructure (AD-SDI), has been one of the largest and most innovative GIS programmes in the world. Initiated in July 2007 as part of the Abu Dhabi Government Services Modernisation Programme, the AD-SDI was designed to facilitate geospatial data sharing between government entities and other relevant entities, provide coordinated access to up-to-date high quality geographical information and advise the Abu Dhabi Government’s customers on spatially-enabled e-Government services. ‘Abu Dhabi’s leadership is striving for technological innovation, and is keen to invest in world-class research and resources. Not only are they a supportive government, but sourcing talent among the large number of locals and multi-nationals makes it easy to access the appropriate skills, particularly with UAE universities providing highly commendable GIS programs. This complements GPC’s international multi-disciplinary network of GIS Professionals that can be called on for specific expertise’ said Sorensen.

In recognition of its achievements, the AD-SDI programme – under the aegis of Abu Dhabi Systems and Information Centre (ADSIC) and with the support of GPC-GIS as a strategic partner – has received several international awards, including in 2010 the ‘Making the Difference Award’ from GIS technology leader ESRI; and in 2012, the World e-Governments Organisation of Cities and Local Governments’ ‘Outstanding e-Government Prize’ award in the ‘Open City’ Category.

3.6. Firms’ Sources of Information

Government departments and agencies represent only a minor share of partners reported by Abu Dhabi firms as co-operating with them around innovation, or who they described as sources of information. Market sources were instead the most commonly reported source of knowledge for Abu Dhabi firms. Further details in this respect are provided in Figures 41 and 42.
Figure 42: Cross-sectoral breakdown of sources of information and co-operation for innovation activities in Abu Dhabi over the period 2008-2011

Figure 43 provides more details regarding the breakdown of the above sources of knowledge and partnerships. Apparently, the most frequently used sources of knowledge are suppliers and clients. This is in addition to private specialists based in Abu Dhabi.

Figure 43: Sources of information and co-operation for innovation activities in Abu Dhabi
3.7. Clients for Firms’ Innovation

While government departments and agencies do not feature high as important partners for innovation, they rank very high as stimulators of innovation in their capacity as innovation customers.

The results of the Abu Dhabi Innovation Survey show that public organisations have been the main driver of demand for innovation in the Emirate. The same applies for the construction sector, which although is classified here as a private-sector market, government demand remains significant. Figure 44 shows that the construction sector is an important driver of innovation activities in the Emirate despite being internationally classified as a low-tech sector (e.g. as per the OECD’s Frascati Manual).

Construction, oil and gas, public services and government procurement are key drivers of Abu Dhabi’s innovation on the demand-side. Sectors such as tourism, health services and multimedia that have been identified by the Government of Abu Dhabi as strategic sectors for future growth, currently remain modest in their level of impact. This is also reflected in the type of firms that have been introducing innovations which tend to be concentrated around Business-to-Business (B2B) industries.

The vast majority of innovating firms in Abu Dhabi are in B2B industries.

The vast majority of the surveyed firms are classified as B2B enterprises (64% of total firms) as opposed to customer-orientated (36%). An exception is the financial and insurance sector that seems to be involved more in making business with customers.

Additionally, the average percentage of the share of exported output is estimated to be 10.2% of total output. Figure 45, however, shows that the bulk of the market activities of the surveyed firms is concentrated within the Middle East region and the UAE in particular.
**BOX 11: Emircom**

Founded in 1984 as part of a larger group with just five employees, Emircom is now one of the major ICT companies in the GCC region with over four hundred employees. Emircom has achieved this success by leveraging Abu Dhabi’s strengths in knowledge access, anchoring and diffusion. Through a series of strategic partnerships with major ICT companies such as Cisco, EMC and Microsoft, the company gained access to latest developments in the industry and acted as a point of knowledge anchor and diffusion in the local economy. For example, in 2010, Emircom joined hands with the Abu Dhabi Education Council (ADEC) to use Cisco technology in order to connect all the schools in the UAE. In just a few years, this Abu Dhabi firm has continued to build partnerships with major international ICT companies and act as a channel for knowledge and technology diffusion across the major industries in the region including the public, banking and insurance sectors.

Emircom considers its beginnings and continued presence in Abu Dhabi have been crucial to its success. This reflects several factors, chief among them being the savviness of the domestic UAE market, which has a particularly high level of early technology adoption. “The UAE’s ‘technologically literate’ business community has motivated Emircom to provide modern and high-quality technological solutions,” said Mr. Mohamad Abou-Zaki, COO of Emircom. Additionally, being able to establish long lasting partnerships with major public and private institutions in the region has also provided ample opportunities for the company to invest in keeping up to date with state-of-the-art technologies. For example, Emircom has been actively collaborating with Etisalat for thirty years and with the Abu Dhabi Police for almost fifteen years to date.

Today, Emircom is Cisco’s largest partner in terms of sales volumes in the UAE. It is also a business partner with some of the country’s major firms including Etihad Airways and Aldar Properties. The company’s performance over the years has gained its widespread recognition within the industry, and has seen the French giant Schneider Electric’s coveted prize for ‘Outstanding Performance for the year 2012’.
3.8. Barriers to Innovation

The Abu Dhabi Innovation Survey reveals that over the four years from 2008 to 2011, some 12% of the enterprises that were surveyed reported abandoning some of their innovation activities or projects at the conceptual stage, with another 15% reporting that they experienced serious delays, while another 9% had abandoned innovation activities at a later stage of development.

The respondents were presented a list of internal and external factors that stood behind as barriers to their innovation activities and were asked to rank them (high-somewhat-low) in terms of importance. The two most frequently cited barriers in this list were ‘high cost of innovation’ and ‘market domination by established enterprises’ (Figure 47). Interestingly, relatively few enterprises felt constrained by a lack of information on markets, which is consistent with the finding in the index that Abu Dhabi enjoys a strong access to knowledge capability.

A close look at the sectoral level further confirms that the ‘high cost of innovation’ and ‘market domination by established enterprises’ are perceived as the most significant barriers to innovation in Abu Dhabi. Additionally, the hampering factor relating to ‘uncertain demand for innovation goods and services’ ranks highly within some sectors, namely manufacturing; construction; financial and insurance; and professional, scientific and technical activities (see Table 9). On the other hand, the transport sector seems to enjoy the most certain demand for innovation goods and services in the Emirate.

Figure 47: Relative importance of factors hampering innovation in Abu Dhabi over the period 2008-2011
Table 9: Cross-sectoral rankings of the most significant barriers to innovation in Abu Dhabi over the period 2008-2011

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Manufacturing</th>
<th>Construction</th>
<th>Transport and Associated Services</th>
<th>Information and Technology</th>
<th>Financial and Insurance Activities</th>
<th>Professional, Scientific and Technical Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation costs too high</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Uncertain demand for innovation goods and services</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Market dominated by established enterprises</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Local/regional market does not necessitate modification or change</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Lack of funds within enterprise or group</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Lack of finance from sources outside the enterprise</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Lack of nearby resources of expertise</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Difficulty in finding cooperation partners of innovation</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Lack of qualified personnel</td>
<td>9</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Lack of Information on markets</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

Across countries, there appears to be remarkable uniformity in barriers to innovation. Barriers related to the costs of innovation projects are regarded most important by the enterprises in all countries surveyed in the CIS (see Figure 48). Lack of funds, from both internal and external sources, is therefore understandably ranked high in importance by the firms that want to innovate. Abu Dhabi firms also ranked barriers associated with cost as being a major barrier to innovation.

Compared to firms in other economies, those in Abu Dhabi described market domination by established enterprises as a much more important market-place barrier to their innovation activities. This is perhaps not surprising given the composition of the Abu Dhabi economy and hence the survey sample with a considerably large proportion of large firms - as distinct from personalised services and small retail sectors (which were not included in the sample).

The relative market concentration that prevails across many industries of the Abu Dhabi economy poses a major barrier to innovation for smaller domestic firms.
In addition to barriers to innovation pertaining to demand-side factors such as market concentration and weak competition, supply-side constraints include finding the right partnerships and people with the right sets of skills.

They survey found that the market power of established firms in Abu Dhabi was a pronounced barrier to innovation for smaller domestic firms. Even more so than uncertainty or lack of demand for innovations, which were more commonly cited barriers to innovation among European firms in the CIS (Figure 49).
Figure 50, which considers hampering factors related to knowledge, shows that the Abu Dhabi firms in the survey most frequently complained about difficulties in finding co-operation partners for their innovation projects. The next most significant supply side issue was the lack of qualified personnel, which appears to be a challenge despite Abu Dhabi’s comparative strength in accessing skilled international workforce. In most European countries represented in the CIS, such a lack of qualified personnel is reported to be a more severe barrier to innovation than difficulties in finding the right partners with which to cooperate. This is expected given the high level of integration in the European innovation system in comparison with the situation in Abu Dhabi, which is a part of a less integrated region of emerging economies.

To conclude Part 3, Box 12 highlights some of the key cross-sectoral variations, whilst the results of the full cross-sectoral analysis are presented in Appendix E.
BOX 12: Cross-sectoral Snapshot Analysis of Abu Dhabi’s Non-Oil Sectors

**Manufacturing Sector** is a key engine of both growth and economic diversification in Abu Dhabi. With the support of the Abu Dhabi Government and a continuous flow of investment, the Emirate has witnessed the development of several industrial zones, manufacturing belts and mega infrastructural projects such as the Khalifa Industrial Zone Abu Dhabi (Kizad). The Abu Dhabi Innovation Survey has revealed that manufacturing firms in Abu Dhabi are actively engaged in product (goods and services) and process innovation activities. The latter go beyond implementing new methods of producing products and also include the introduction of new or significantly improved support facilities for processes such as maintenance systems. Additionally, more than those belonging to any other sector in Abu Dhabi, manufacturing firms seem to allocate a sizeable proportion (i.e. around 40%) of their total innovation expenditure to support internal and external R&D activities.

**Construction Sector** has been considered by the 2030 Vision as a key enabling sector relevant to the Emirate’s economic strength. Driven by an increased demand – mostly through government procurement – construction activity has recently witnessed a robust growth in the Emirate. Unlike manufacturing, however, construction is a sector that is dominated by a relatively small number of large firms. Given the existence of well-developed construction expertise and talent in the UAE, mergers and acquisitions tend to take place in this sector with local firms. Moreover, whilst the vast majority of new construction-related product innovations seem to be acquired through off-the-shelf purchases, most of the process innovations tend to be developed within own enterprise group.

**Transport and Associated Services** constitutes a ‘focus sector’ in the 2030 Vision. Over the past forty years, Abu Dhabi has developed road networks, port infrastructure and airports that are world-class and efficient in order to both meet the demand of its residents and businesses, and maintain its connectivity with trading partners in the region and beyond. As is this case with construction, the transport sector is dominated by a relatively small number of established enterprises. Hence, difficulties in finding innovation partners have emerged as a major barrier in this sector. Additionally whenever mergers or acquisitions happen, they usually take place locally. Off-the-shelf purchases were also reported as the only method opted for by firms belonging to this sector of acquiring new product innovations developed by other enterprises. Therefore, the vast majority of innovation-related expenditures by transport firms is devoted to acquiring new machinery and equipment as opposed to carrying out R&D activities.

**ICT Sector** has received a special attention from the Abu Dhabi Government in order to transform the Emirate into a telecommunications centre for the region. Given that telecoms is a high-tech, rapidly growing and capital intensive sector, the 2030 Vision has recognised that in order to maintain Abu Dhabi’s place as a regional ICT leader, there is a need for continuous investment and innovation to ensure that the infrastructure is up-to-date. Whilst ICT firms in Abu Dhabi agree that they operate in a dynamic market that necessitates on-going technological change, they perceive ‘market dominance by established enterprises’ as the most hampering factor to innovation in this sector. Furthermore, most of the innovation taking place within this sector is concentrated on service and process innovations. For instance, the amount of ICT firms that have introduced a new service is estimated to be around four times those that introduced a new good over the period 2008-2011.

**Financial and Insurance Sector** is another important engine of growth and value creation in Abu Dhabi. Accompanying the growth of the local economy, there is a growing demand for increasingly sophisticated financial services. Additionally, the financial sector provides an opportunity to diversify economic activities into areas that are not based on natural resources. Unlike many of the large Abu Dhabi firms that are mostly engaged on B2B business, most of the firms in the financial and insurance sector tend to provide their services to individual customers. They are also actively engaged in acquiring new innovations from elsewhere, through off-the-shelf purchases, and introducing them to the UAE market. Adaptation and learning constitute a major part of the innovation activities taking place in this sector.
Professional, Scientific and Technical Activities are considered a key support industry to achieve sustained economic growth and diversification in the Emirate. Barriers identified here are somewhat similar to those experienced in the manufacturing sector. More specifically, the three most significant barriers to innovation reported for this sector are ‘high cost of innovation’, ‘uncertain demand for innovation goods and services’ and ‘market domination by established enterprises’. In line with the trend prevailing across the various economic sectors, Abu Dhabi firms co-operate frequently during the process of innovation. Moreover, suppliers are the most frequent innovation partners and method of learning about new innovation. However, a relatively high share of the innovation expenditures, set by the firms within this sector, is allocated for training staff on innovation-related matters.
Part 4: Imperatives for the Abu Dhabi Innovation Policy

The findings of the Abu Dhabi Innovation Index and the Abu Dhabi Innovation Survey portray an innovation system that is globally connected and highly active in the adoption and diffusion of innovations.

The Abu Dhabi innovation system displays a high degree of capability in accessing, anchoring and diffusing new knowledge. This is achieved through the strong access businesses in the Emirate have to skilled international workforce, recent large-scale government investments in knowledge-intensive activities and enterprises, and the presence of firms with global operations and outreach. Relative to comparator economies, Abu Dhabi is particularly efficient in adopting and introducing new products, processes and services. Nevertheless, there remains room for improvement across all pillars of innovation capabilities, especially in the capability to create new knowledge. As Abu Dhabi Government’s investment in innovation-enabling activities increase, the risk for growing inefficiencies between capacity and performance will increase. Therefore, private sector partnership in innovation projects will be necessary to mitigate against such risks. Private sector involvement will help steer innovation investments towards market needs and make more efficient use of combined public-private resources.

For Abu Dhabi to achieve a high-capacity/high-performing economy, policymakers need to differentiate between capacity problems and performance problems.

ACCESS: Abu Dhabi ranks 8th for its Capacity and 5th for Performance.
Facilitating access to specialist knowledge will help SMEs in Abu Dhabi to improve their ability to productively innovate and grow.

Abu Dhabi is a regional leader in terms of Internet connectivity, global trade and world-class infrastructure, but this study identifies a lack of access to advanced service providers that could help local SMEs find solutions to their innovation problems. This includes a range of areas from technical and legal advice through to market research. The Abu Dhabi Innovation Survey shows that large local firms are making the most of their diverse range of suppliers as a key source of innovation knowledge, along with their participation in local and overseas conferences and trade exhibitions. Indeed, the strength of Abu Dhabi’s ranking on this pillar of innovation capability can be attributed to the innovation performance of these larger companies. Smaller firms have, however, underperformed in this respect because they are not adequately resourced to travel overseas and participate in international exhibitions and the like, nor do they have as wide ranging supplier networks to reach out to for information to aide their efforts to innovate. Abu Dhabi’s overall capability in accessing innovation related knowledge could be significantly boosted by facilitating a higher presence of advanced service providers, particularly those equipped to assist SMEs.

While the ability of firms in Abu Dhabi to access knowledge is likely to receive a boost from the soon-to-open Global Marketplace Abu Dhabi on Al Maryah Island, the Abu Dhabi Government could more comprehensively address the issue by creating innovation relay programmes similar to those adopted in Europe (see Box 13). These programmes actively identify the problems hindering innovation in local SMEs and match them to appropriate solution providers from around the world. A similar such programme in Abu Dhabi would help to solve the challenges currently holding back SMEs with regard to identifying sources of solutions for their innovation projects, as well as in financing access to such solutions. This is not trivial because the Abu Dhabi Innovation Survey has clearly identified that the difficulty in finding innovation partners is hampering the innovation capability of many Abu Dhabi firms.
BOX 13: Innovation Relay Centres

Innovation Relay Centres (IRC) are a network of trans-national technology cooperation agencies that help small firms, research institutions and large companies with expertise and other forms of support. An IRC acts as a hub that facilitates innovation by providing access to other entrepreneurs and ideas that can help SMEs to overcome problems in commercialising their innovation projects. This initiative was established by the European Commission in 1995. By 2002, there were 260 offices spread across 33 countries assisting thousands of SMEs and promoting knowledge transfer by matching European partners with a marketing contact through brokerage events, networking opportunities and SME missions (Times Higher Education, 2002). IRCs have also helped point SMEs in the direction of sources of financing and assisting with the negotiation of contracts (Dantas, 2013).

ANCHOR: Abu Dhabi ranks 15th for its Capacity and 7th for Performance.

Abu Dhabi needs to simplify bureaucratic procedures for foreign companies setting up businesses, and also create unique incentives to (re)locate their regional corporate headquarters in the Emirate.

Abu Dhabi performs well in terms of both political stability and technology transfer. Underpinned by the Economic Vision 2030, positive developments are now well underway aimed at strengthening the Emirate’s capacity to anchor knowledge. Recent examples include the establishment of the Abu Dhabi Business Center and the Cleveland Clinic Abu Dhabi. Moreover, the government’s investment policy is geared towards attracting foreign leading companies to set up a presence in the Emirate.

The current legal stipulation that firms maintain an office in the Emirate in order to operate a local business, but this may not be sufficient to attract international firms to set up HQs in the Emirate. Abu Dhabi needs to leverage its strong ‘anchoring’ attributes relating to costs, convenience and calibre, to attract more knowledge-intensive companies and investments.

In this regard, the Abu Dhabi Government has over the last few years created what may be called ‘anchoring zones’ in renewables, defence, aerospace, semiconductors and other high-tech industries. These have taken different forms including generic industrial zones such as ZonesCorp and Kizad, in addition to sector specific ones such as the Masdar City and the Nibras Aerospace Park.

On the academic side, Abu Dhabi now hosts major flagship academic institutions, including INSEAD, New York University and the Sorbonne, and investment is underway to start building a base for science research in the region. These have an important role to play in training and educating the workforce and thus enhancing further the anchoring capacity of the Emirate. Seen together, these various initiatives are beginning to form the necessary components of a fully-fledged innovation system.

Notwithstanding what has been achieved, more effort remains needed to put and keep Abu Dhabi ahead of its comparator group. In addition to improving the ease of doing business, foreign-ownership laws will have to be regularly monitored to ensure that they are competitive enough in relation to other comparator economies. In this context, it is important to distinguish between regulations and laws that organise and facilitate investment and those that retain investment. The latter is particularly important amid today’s increased global economic and political turbulence. This is an area where Abu Dhabi can leverage on by enhancing investor’s protection laws and other related regulatory frameworks. For example, in the beginning of the 2000s, amid a global scepticism about the ethical use of stem-cell research, countries that have adopted liberal regulations, such as Australia, Brazil and the UK, have managed to attract research activities in this domain from other countries, especially from the US.
Abu Dhabi’s knowledge diffusion capability is among its strongest systemic attributes. Its high levels of technology adoption, ICT imports, buyer sophistication, skilled workforce and education make Abu Dhabi an excellent place for the diffusion of new technologies and practices. The Abu Dhabi Innovation Survey has shown that Abu Dhabi firms are intensive adopters of new information management and operation systems. These are also enablers of knowledge diffusion within firms and across the economy.

Going forward, the Abu Dhabi Government should continue enhancing education and training standards at all levels and also introduce mobility schemes that facilitate opportunities for students and researchers to move between the academic/educational system and industry. Industrial apprenticeships should be increased as well as sponsorship of schemes that create a path for talent and new innovations in knowledge to transit from academia to industry. In this regard, the Abu Dhabi Government may consider introducing an industrial-postgraduate grant scheme in which Ph.D. researchers can be hosted by industry to work on specific problems while under supervision from their university (see Box 14). But firms can also benefit from a variety of well-established models of learning transfer such as the Canadian Industrial Research Assistance Program (IRAP). Managed by the Canadian National Research Council, IRAP has been active in helping Canadian firms to develop technologies and successfully commercialise them in a global marketplace. This has been achieved through providing a range of services which include offering technical, business and strategic advisory services, in addition to networking and linkage opportunities with potential partners and investors (NRC, 2013).

**BOX 14: Industrial CASE**

‘Industrial CASE’ is a programme offered by Research Councils in the UK. This programme provides a mechanism for funding doctoral studentships that are relevant to industry, and which are jointly supervised by academic and industrial partners. Interested companies receive an industrial CASE studentship allocation and then take the lead in proposing a suitable engineering or natural sciences project, with an academic partner of their choice. Whilst the Research Council provides funding for the scholarships directly to the academic institution, the industrial partner also provides the academic institution with a cash top-up equivalent to at least a third of the Research Council’s funding. During a typical 3½ year award, the student is expected to spend a minimum of three months on the premises of the industry partner, thus benefitting from access to training, facilities and expertise not traditionally available in their host academic setting. Any travel and accommodation costs incurred by the students during these placement periods are covered by the industry partner. Industrial CASE studentships ultimately encourage productive collaboration between academia and industry. The latter additionally benefit from having a motivated, high-quality doctoral student undertaking cutting-edge research on topics of their interest (EPSRC, 2013).

This innovation capability pillar is Abu Dhabi’s weakest link. Abu Dhabi has a modest output in terms of scientific publications and patent filings. Moreover, intellectual property rights are not sufficiently protected by law when compared to advanced economies, which is an important consideration for firms wanting to protect hard-won proprietary knowledge. Abu Dhabi’s performance on this pillar is perhaps not surprising, given that the Emirate has largely prioritised spending on learning, adopting and adapting new knowledge rather than creating new knowledge. Abu Dhabi’s investment in a strong knowledge creation capability is, however, part of a long-term strategy that will take some time before it makes a visible impact. Thus, continuing such investment cannot be over emphasised.
The Abu Dhabi innovation system would benefit from programmes supporting international researcher mobility and the participation in international research networks. So far, activities of this type have been undertaken on an ad hoc basis largely as an offshoot of industrial projects in partnership with foreign companies or governments. The Abu Dhabi innovation system would benefit from broad international science and technological partnerships that would link and integrate the local research community with the global one. This could include, for example, a closer integration into the European Framework Programmes for Research and Technological Development.

Abu Dhabi can also leverage off its significant trading relationships with countries like the US, Japan and South Korea that have strong research communities and academia-industry partnerships. Additionally, rather than assuming the role of being the sole investor in innovation activities, the Abu Dhabi Government should incentivise the private sector to invest, e.g. through subsidies or procurement. Indeed, there is a potentially strong role that could be played by the big companies, such as ADNOC, Etihad Airways and Etisalat. In some targeted areas, foreign investors may also be asked to establish R&D centres in the Emirate.

Abu Dhabi Government should continue investing in the development of basic infrastructure required for a strong knowledge creation, including research institutions that can attract world-class scientists and train future researchers.

EXPLOITATION: Abu Dhabi ranks 4th for its Capacity and 1st for Performance. Abu Dhabi will achieve higher levels of innovation and growth if barriers to innovation for its SMEs are removed.

The close alignment between type of innovation and economic activity makes Abu Dhabi occupy the best place among its comparator economies in terms of exploiting its total innovation capabilities. From the efficient use of foreign skilled labour to the wide use and spread of ICT process innovations led by a strong and savvy government procurement drive, Abu Dhabi manages to perform very well in terms of extracting value from its available capabilities.

Nevertheless, this study has identified that much of the strength of the Abu Dhabi’s ability to exploit knowledge can be attributed to the activities of a limited number of large players in a limited set of industries. The fact that most innovations stem from, and through, customer-supplier relationships indicates that the channels for innovation in Abu Dhabi tend to be vertical in structure and hence silo-based. There is, therefore, lots of room for improvement in terms of efficiency and scale if collaborative activities expand in new directions and more horizontally across the economy.

In particular, more attention needs be given to SMEs and potential entrepreneurs to tap into new sources of knowledge in order to expand their innovation activity horizontally and enter new markets. Moreover, there are important issues to be addressed in the light of the findings of the Abu Dhabi Innovation Survey. The survey identifies the high cost of innovation as a major challenge, particularly for SMEs trying to innovate in a domestic market dominated by large firms. These are structural issues that require government intervention to change the framework conditions under which SMEs operate.

Khalifa Fund for Enterprise Development offers a range of funding programmes that aim to create a new generation of Emirati entrepreneurs. In order to further support the development of innovation-orientated SMEs and start-ups, attention needs be given to the availability of seed capital and VC, as well as to commercialisation activities, for example through technology transfer and relay activities or foreign trade support. Some countries have created dedicated public entities that provide all of these services through a single agency (e.g. Innovation Norway) while others use a mix of agency partners dedicated to assist specific types of companies (e.g. Alberta Innovates; see Box 15).
BOX 15: Alberta: Working with Small Businesses to Create and Exploit Knowledge

Alberta is the oil capital of Canada. Like most other NREs, economic diversification is high on the government agenda. The Alberta economy is driven by SMEs; 58.8% of Alberta’s firms employ between 1-4 people while less than 2% of the firms employ more than 100 people (Industry Canada, 2011). Thus, without government support, the large majority of businesses in Alberta could not engage in intensive innovation activities. The government, therefore, plays a crucial role in providing commercialisation support through regional business-to-business networks and product commercialisation centres.

Many of these initiatives are spearheaded by the Alberta Innovates - Technology Futures (AITF) that was formed by combining 10 government research organisations from within Alberta. This agency provides human capital support to ensure SMEs have access to the talent that they require (AITF, 2010). The network and collaborative initiatives provided by AITF enable SME’s to access and diffuse knowledge. This was done to make it easier for researchers and firms to work together more closely. In particular, to create and exploit new knowledge in areas such as climate change and health care which is multidisciplinary, and having a central innovation agency has proved crucial for generating results. Furthermore, by consolidating the ten research agencies, Alberta is better able to steer innovation in a direction that more closely aligns with the state’s strengths in agriculture, energy and health.
Part 5: Economy Profiles

(A snapshot summary of results of the Abu Dhabi Innovation Index)
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| **Anchoring Capacity** |                   |
| Days for Starting a Business | 6.41 | 12 |
| Number of Procedures | 2.88 | 17 |
| Cost of Starting a Business | 6.03 | 17 |
| Political Stability | 6.08 | 7 |
| Protecting Investors | 2.62 | 20 |
| Foreign Ownership Restriction | 4.72 | 13 |
| Averaged Anchoring Capacity | 4.79 | 15 |

| **Diffusion Capacity** |                   |
| Literacy Rate | 5.91 | 12 |
| Quality of Education System | 5.83 | 5 |
| Availability of Scientists and Engineers | 4.90 | 6 |
| Extent of Staff Training | 5.54 | 7 |
| Local Availability of Specialised Research and Training Services | 5.50 | 6 |
| Averaged Diffusion Capacity | 5.54 | 6 |

| **Creation Capacity** |                   |
| GERD | 1.57 | 14 |
| Company Spend on R&D | 4.41 | 6 |
| Intellectual Property Protection | 5.36 | 10 |
| Quality of Scientific Research Institutions | 5.16 | 7 |
| Averaged Creation Capacity | 4.12 | 8 |

| **Exploitation Capacity** |                   |
| Venture Capital Availability | 4.67 | 7 |
| Local Equity Market Access | 5.94 | 10 |
| Government Procurement of Advanced Technology Products | 5.24 | 2 |
| Averaged Exploitation Capacity | 5.29 | 4 |
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Algeria Performance Capacity

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Australia

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Australia
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| **Anchoring Capacity** |
| Days for Starting a Business | 6.96 | 2 |
| Number of Procedures | 6.63 | 3 |
| Cost of Starting a Business | 6.96 | 4 |
| Political Stability | 6.02 | 9 |
| Protecting Investors | 3.76 | 10 |
| Foreign Ownership Restriction | 6.59 | 3 |
| Averaged Anchoring Capacity | 6.15 | 3 |

| **Diffusion Capacity** |
| Literacy Rate | 6.84 | 4 |
| Quality of Education System | 5.67 | 6 |
| Availability of Scientists and Engineers | 3.40 | 13 |
| Extent of Staff Training | 5.70 | 5 |
| Local Availability of Specialised Research and Training Services | 6.54 | 3 |
| Averaged Diffusion Capacity | 5.63 | 5 |

| **Creation Capacity** |
| GERD | 4.65 | 2 |
| Company Spend on R&D | 4.08 | 9 |
| Intellectual Property Protection | 5.77 | 6 |
| Quality of Scientific Research Institutions | 6.45 | 3 |
| Averaged Creation Capacity | 5.24 | 3 |

| **Exploitation Capacity** |
| Venture Capital Availability | 3.74 | 11 |
| Local Equity Market Access | 6.25 | 7 |
| Government Procurement of Advanced Technology Products | 3.37 | 12 |
| Averaged Exploitation Capacity | 4.45 | 11 |
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Bahrain Performance

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**Capacity**

- Access
- Exploitation
- Anchor
- Creation
- Diffusion
### Capacity

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#### Accessing Capacity

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#### Anchoring Capacity

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Exploitation

Anchor

Creation

Diffusion
## Capacity

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Oman
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### Exploitation Capacity

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| Local Equity Market Access | 5.88 | 11 |
| Government Procurement of Advanced Technology Products | 4.32 | 7 |
| Averaged Exploitation Capacity | 4.87 | 9 |
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| **Anchoring Capacity**            |
| Days for Starting a Business      | 6.66  | 8 |
| Number of Procedures              | 4.38  | 12 |
| Cost of Starting a Business       | 6.54  | 14 |
| Political Stability               | 6.52  | 4 |
| Protecting Investors              | 3.19  | 16 |
| Foreign Ownership Restriction      | 4.93  | 12 |
| Averaged Anchoring Capacity       | 5.37  | 10 |

| **Diffusion Capacity**            |
| Literacy Rate                     | 6.42  | 8 |
| Quality of Education System       | 6.50  | 2 |
| Availability of Scientists and Engineers | 5.80  | 3 |
| Extent of Staff Training          | 5.17  | 8 |
| Local Availability of Specialised Research and Training Services | 3.54  | 16 |
| Averaged Diffusion Capacity       | 5.49  | 7 |

| **Creation Capacity**             |
| GERD                              | 1.46  | 16 |
| Company Spend on R&D              | 4.73  | 4 |
| Intellectual Property Protection  | 6.05  | 4 |
| Quality of Scientific Research Institutions | 7.00  | 1 |
| Averaged Creation Capacity        | 4.81  | 5 |

| **Exploitation Capacity**         |
| Venture Capital Availability      | 7.00  | 1 |
| Local Equity Market Access        | 7.00  | 1 |
| Government Procurement of Advanced Technology Products | 7.00  | 1 |
| Averaged Exploitation Capacity    | 7.00  | 1 |
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Saudi Arabia

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Saudi Arabia
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South Africa

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Venezuela
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|                                |                  |                  |
| **Anchoring Capacity**         |                  |                  |
| Days for Starting a Business   | 1.00             | 23               |
| Number of Procedures           | 1.00             | 23               |
| Cost of Starting a Business    | 4.26             | 22               |
| Political Stability            | 2.26             | 22               |
| Protecting Investors           | 1.00             | 23               |
| Foreign Ownership Restriction  | 2.45             | 20               |
| Averaged Anchoring Capacity    | 2.00             | 23               |

|                                |                  |                  |
| **Diffusion Capacity**         |                  |                  |
| Literacy Rate                  | 5.91             | 12               |
| Quality of Education System    | 1.83             | 21               |
| Availability of Scientists and Engineers | 2.40 | 20 |
| Extent of Staff Training       | 2.30             | 20               |
| Local Availability of Specialised Research and Training Services | 1.23 | 22 |
| Averaged Diffusion Capacity    | 2.74             | 21               |

|                                |                  |                  |
| **Creation Capacity**          |                  |                  |
| GERD                           | 1.30             | 17               |
| Company Spend on R&D           | 1.81             | 22               |
| Intellectual Property Protection| 1.00             | 23               |
| Quality of Scientific Research Institutions | 1.55 | 22 |
| Averaged Creation Capacity     | 1.41             | 22               |

|                                |                  |                  |
| **Exploitation Capacity**      |                  |                  |
| Venture Capital Availability   | 1.34             | 21               |
| Local Equity Market Access     | 1.00             | 23               |
| Government Procurement of Advanced Technology Products | 1.00 | 22 |
| Averaged Exploitation Capacity | 1.11             | 23               |
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References


Appendix A: Abu Dhabi Innovation Index Methodology

1. Benefits and Limitations of a Composite Index

The primary benefit of a composite index such as the Abu Dhabi Innovation Index is that it distils a wide variety of information i.e. it takes complex information as represented by indicators across a wide variety of dimensions, and synthesises this in a way that is easily understood at a glance. Additionally, this succinctness in presentation makes it more accessible to a wider range of stakeholders, including those with non-technical backgrounds.

This boon in terms of conciseness and ease of access also warrants a note of caution in that there is a corresponding danger that such composite indices can sometimes be overly generalised. This is particularly the case where subjective judgements have been made by experts weighing up only a few of the potentially numerous variables in an analysis. Taking a somewhat elusive concept like innovation and pinning a number to it reduces the breadth of what it might otherwise represent. The total list of variables affecting innovation is immense and it was a practical necessity to concentrate attention on a smaller subset. Naturally, doing so means that some idiosyncrasies of innovation dynamics for particular country’s will be lost, in the way that interesting information about the ‘woods’ is overlooked when we focus on particular ‘trees’. Thus, a single index measure cannot be expected to tell the whole story. Additionally, the manner in which indices are constructed and different data are standardised for purposes of comparison (for instance, the present index relies on min-max normalisation) means that unusual results for a particular country may swing the overall performance of the index because only a broad cross-section of countries is considered at any one given point in time.

It is also worth noting that a high or low score on a given indicator/pillar is not good or bad per se, but rather it signifies the level of alignment between performances in an aspect of the economy with policy objectives, and as such can be used to monitor achievement of policy targets. Accordingly, a high score on an area of policy interest is a positive indicator, while a low score in a non-priority area is a neutral indicator. Therefore, the Abu Dhabi Innovation Index may be a useful tool that helps policymakers to assess drivers of innovation performance in the economy of the Emirate relative to other economies or against their own policy objectives.

2. Normalisation of Data

In order to compare rankings obtained from different datasets it was necessary to mathematically normalise the data used in the Abu Dhabi Innovation Index using a ‘min-max’ normalisation method. This approach scales the data for each indicator over a common range [in this case, 1 to 7], which is obtained by subtracting from each raw indicator value the minimum range value and then dividing that by the total range of values. A shortcoming of this method is that it is susceptible to distortion from atypical extreme outlier values in the dataset. The advantage of min-max normalisation is that for comparison purposes it widens the range of indicators with a small interval, increasing the effect on the composite indicator more so than a z-score transformation. Data were thus normalised so that all indicators were recalibrated to fall within a range of 1 to 7, with 1 being lowest and 7 being highest.

Normalisation formula for positive series (where high is best, such as GDP per capita):

$$6 \cdot \frac{\alpha - \min}{\max - \min} + 1$$

Normalisation formula for negative series (where low is best, such as time to start a business):

$$-6 \cdot \frac{\alpha - \min}{\max - \min} + 7$$

The pillar-level score is the average of each data group and total scores for capacity and performance are calculated as the sum of averages for each indicator group.

$$T_i = \sum \bar{x}_i$$

Where $$T_i$$ is the total score for capacity or performance and $$\bar{x}_i$$ is the average for each indicator group.

3. Capacity and Performance Indicators

The Abu Dhabi Innovation Index is a conceptually-driven selection of key indicators that tracks both an economy’s capacity for innovation and its actual ability to exploit that capacity. The full
list of indicators, their definitions and sources are detailed overleaf. This is followed by the results of statistical testing (based on correlation coefficients) that verify the selection of variables in each pillar. This was initially determined based on the results of both an extensive literature review and consultation with expert informants from the field.

An initial pool of indicators was drawn from existing reputable indices of innovation and benchmarking studies. A preliminary model was tested and the results compared to a priori expectations suggested by the literature. Items that were markedly counter-intuitive or inconsistent with these expectations were reassessed. Whilst inconsistencies may point to a poor choice of variables, sometimes this pointed out valuable and interesting differences that deserve to be highlighted.

Moreover, whilst every effort has been made to utilise data from empirical sources, the reader should bear in mind that some of the data was based on qualitative measures that rely on expert judgement. For instance, the World Economic Forum’s Executive Opinion Survey is the source of several qualitative variables used in this report. An example of potential self-reporting and/or perception bias can be seen in the item that asked respondents to gauge the presence of the value chain in their countries, Qatari respondents ranked themselves 27th in the world, ahead of countries like Canada (41st) and India (42nd). This finding is inconsistent with a priori expectations. The inclusion of this variable thus skews the results and causes a false-positive result for Qatar in access performance. However, by including other quantitative measures which paint a different picture for the economies under consideration, this skew can be tempered. The full set of variables, their definitions and sources are provided in Tables 10 and 11. It is worth noting here that given the sparseness of up-to-date data for some of the economies under consideration, some data was obtained from sources other than the following.

Table 10: Capacity indicators

<table>
<thead>
<tr>
<th>Pillar</th>
<th>Indicator</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Internet Users per 100 people</td>
<td>Broadband users per 100 inhabitants</td>
<td>International Telecommunications Union</td>
</tr>
<tr>
<td></td>
<td>Total Broadband per 100 people</td>
<td>Broadband available per 100 inhabitants</td>
<td>International Telecommunications Union</td>
</tr>
<tr>
<td></td>
<td>Extent of Internet Business Use</td>
<td>Extent of business internet use</td>
<td>World Bank</td>
</tr>
<tr>
<td></td>
<td>Extent of Trade Barriers</td>
<td>Average tariff rates</td>
<td>International Trade Centre</td>
</tr>
<tr>
<td></td>
<td>Quality of Infrastructure</td>
<td>Quality of overall infrastructure</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td>Anchor</td>
<td>Days for Starting a Business</td>
<td>Time (in days) to start a business</td>
<td>World Bank, Ease of Doing Business</td>
</tr>
<tr>
<td></td>
<td>Number of Procedures</td>
<td>Number of procedures to start a business</td>
<td>World Bank, Ease of Doing Business</td>
</tr>
<tr>
<td></td>
<td>Cost of Starting a Business</td>
<td>Cost of starting a business (% of income per capita)</td>
<td>World Bank, Ease of Doing Business</td>
</tr>
<tr>
<td></td>
<td>Political Stability</td>
<td>Political stability and absence of violence/terrorism</td>
<td>World Bank Governance Indicators</td>
</tr>
<tr>
<td></td>
<td>Protecting Investors</td>
<td>Strength of investor protection</td>
<td>World Bank, Ease of Doing Business</td>
</tr>
<tr>
<td></td>
<td>Foreign Ownership Restrictions</td>
<td>Prevalence of foreign ownership</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td>Diffusion</td>
<td>Literacy Rate</td>
<td>Adult literacy rates</td>
<td>UNESCO</td>
</tr>
<tr>
<td></td>
<td>Quality of Education System</td>
<td>Quality of education system</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td></td>
<td>Availability of Scientists and Engi-</td>
<td>Availability of scientists and engineers</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td>Performance</td>
<td>Variable</td>
<td>Definition</td>
<td>Source</td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Access</td>
<td>Value Chain Presence</td>
<td>Breadth of value chain</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td></td>
<td>Breadth of International Markets</td>
<td>Foreign market size index: value of exports of foreign goods and services</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td>Anchor</td>
<td>Inward FDI Flow</td>
<td>Foreign investment inflows</td>
<td>UNCTAD</td>
</tr>
<tr>
<td></td>
<td>FDI and Tech Transfer</td>
<td>Extent of FDI bringing new technology into country</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td></td>
<td>Foreign Born Immigrants</td>
<td>Percentage of foreign born immigrants in total populations</td>
<td>United Nations Department of Economic and Social Affairs</td>
</tr>
<tr>
<td>Diffusion</td>
<td>Firm Level Technology Adoption</td>
<td>Firm-level technology absorption</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td></td>
<td>Buyer Sophistication</td>
<td>Buyer sophistication which reflects technology awareness</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
<tr>
<td></td>
<td>Production Process Sophistication</td>
<td>Production process sophistication</td>
<td>World Economic Forum, Executive Opinion Survey</td>
</tr>
</tbody>
</table>
4. Validating the Indicators Selection

This section reports the result of a test of the inter-item correlations of the various indicators chosen for the Abu Dhabi Innovation Index. Table 12 provides a correlation matrix of the capacity and performance pillars for the 188 economies included. The first column represents the five capacity pillars of Access, Anchor, Diffusion, Creation and Exploitation. The first row represents the corresponding performance pillars. Evidently, all correlation coefficients are fairly high. This provides an illustration of the degree of co-movement between the innovation capacity and performance capabilities, as modelled in the Abu Dhabi Innovation Index.

<table>
<thead>
<tr>
<th>Access</th>
<th>Anchor</th>
<th>Diffusion</th>
<th>Creation</th>
<th>Exploitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>0.720</td>
<td>0.295</td>
<td>0.596</td>
<td>0.650</td>
</tr>
<tr>
<td>Anchor</td>
<td>0.278</td>
<td>0.418</td>
<td>0.203</td>
<td>0.249</td>
</tr>
<tr>
<td>Diffusion</td>
<td>0.734</td>
<td>0.167</td>
<td>0.765</td>
<td>0.437</td>
</tr>
<tr>
<td>Creation</td>
<td>0.776</td>
<td>0.616</td>
<td>0.817</td>
<td>0.756</td>
</tr>
<tr>
<td>Exploitation</td>
<td>0.662</td>
<td>0.610</td>
<td>0.744</td>
<td>0.431</td>
</tr>
</tbody>
</table>

As shown in the following scatter diagrams, the results for the five innovation functions are consistently positive. This provides empirical evidence that supports the relevance of the indicators selected in the Abu Dhabi Innovation Index as a gauge of an economy’s capacity for innovation as well as its actual exploitation of that capacity. More specifically, the ‘green dots’ represent individual countries and the ‘dotted line’ represents a linear upward trend in the dataset for a particular innovation function.
The positive correlation suggests that those countries which score highly in their capacity to innovate along the five dimensions manage to translate that into noticeable performance gains. The positive trend is relatively weaker in the case of exploitation capability, given the challenges and the long-time usually taken to translate exploitation inputs into desired outcomes such as mobilising new knowledge for social and commercial purposes.
Appendix B: Complete Index Benchmarking Results

Access Capacity

Access Performance
Appendix C: CIS Analysis Methodology

1. Abu Dhabi Innovation Survey

The 2012 Abu Dhabi Innovation Survey follows the approach adopted in the Community Innovation Survey (CIS), which has become an established instrument for measuring the innovation performance of countries. National surveys of this type are methodologically based on the Oslo Manual published by the OECD in 1992 and subsequently revised in both 1997 and 2005. These surveys take a representative sample of business establishments in a country, according to sector and size. Following the CIS tradition, no firm with fewer than ten employees was considered in the Abu Dhabi Innovation Survey. Additionally, a stratified random sampling design with a systemic probability proportional to size was adopted. Through this sample design, the survey population was divided and grouped into non-overlapping ‘strata’. A total of 580 firms were chosen to represent ten economic activities in the Emirate. A cross-sectoral breakdown by firm size is shown below.

As shown in Figure C1, three classes of sample size have been adopted as follows:

- Small Firm: 10–49 employees
- Medium Firm: 50–249 employees
- Large Firm: 250 or more employees

To compensate for the highly labour-intensive nature of the construction sector, the following classification was adopted for this sector only:

- Small Firm: 10–199 employees
- Medium Firm: 200–2,399
- Large Firm: 2,400 or more

A total of 532 surveys were completed over the period June-August 2012; yielding a response rate of 92%. However, a number of the surveyed firms were deemed to be inappropriate for the study and were excluded from the analysis. Examples include personalised services such as bakeries and tailors and in addition, small enterprises which were found to actually employ fewer than ten staff. If these 32 firms are excluded from the original sample population, the sample-size will then drop to 500 and the response rate will become 91%. This is an exceptional response rate and can be attributed to two main factors. Firstly, data collection was performed by a governmental entity, namely Statistics Centre – Abu Dhabi (SCAD) where firms believed that they were supporting an official undertaking as opposed to an academic exercise. Secondly, the surveys were conducted in person, unlike innovation surveys in other parts of the world which are often carried out through a voluntary postal survey.

![Figure C1: Survey sample - breakdown by firm size](image)
2. International CIS Comparisons

Part 3 of this report compared the innovation performance of enterprises in Abu Dhabi with those in a number of European countries. The international comparison is based on the most recent results of the European CIS 2010, covering the three-year period from 2008 to 2010. Results from the CIS 2010 for various European countries were obtained from Eurostat’s webpage (European Commission, 2013). The CIS 2010 and the 2012 Abu Dhabi Innovation Survey share a high degree of comparability, since both surveys follow the methodology and definitions of the Oslo Manual by the OECD. However, the Abu Dhabi Innovation Survey covers the years 2008-2011, while the EU CIS only covers the years 2008-2010. The likelihood that a firm introduces an innovation in a four-year period is higher than in a three-year period. Whilst this may include some upward bias in the frequency of innovation activities, this difference is unlikely to matter for the qualitative comparison between innovation patterns in different countries, such as types of innovations introduced, sources of information and types of clients.
Confidentiality of Data, is Guaranteed by Law. Data is used only for Statistical Studies

Appendix D: Abu Dhabi Innovation Survey

2012 Abu Dhabi Community Innovation Survey Questionnaire

This survey collects Information about product, process and organizational innovation

June 2012
Contact Person in case of queries regarding the form:

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td></td>
</tr>
<tr>
<td>Job title</td>
<td></td>
</tr>
<tr>
<td>Years within the organization</td>
<td></td>
</tr>
<tr>
<td>Office Phone</td>
<td></td>
</tr>
<tr>
<td>Mobile Phone</td>
<td></td>
</tr>
<tr>
<td>Fax</td>
<td></td>
</tr>
<tr>
<td>E-mail</td>
<td></td>
</tr>
</tbody>
</table>
## General information about the enterprise:

<table>
<thead>
<tr>
<th>Name of Enterprise:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>P.O Box:</td>
<td></td>
</tr>
<tr>
<td>Serial Number:</td>
<td></td>
</tr>
<tr>
<td>No of establishment in the frame</td>
<td></td>
</tr>
</tbody>
</table>

### Please check your main economic activity

- [ ] 1. Mining and Quarrying
- [ ] 2. Manufacturing
- [ ] 3. Electricity, Gas and Water Supply
- [ ] 4. Construction
- [ ] 5. Transport and associated support services
- [ ] 6. Information and communication
- [ ] 7. Financial and insurance activities
- [ ] 8. Professional, Scientific and Technical Activities
- [ ] 9. Administrative and Support service activities
- [ ] 10. Arts, entertainment and recreation.

### If your enterprise main economic activity is not listed in the options above, please specify:

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
</table>

### Please provide a brief description of your enterprise (Size & Production):

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
</table>

### Is your enterprise part of an enterprise group?

(A group consists of two or more legally defined enterprises under common ownership. Each enterprise in the group may serve different markets, as with national or regional subsidiaries, or serve different product markets. The head office is also part of an enterprise group.) If your enterprise is part of an enterprise group, please answer all further questions only for your enterprise in the Abu Dhabi emirate. Do not include results for subsidiaries or parent enterprises outside of Abu Dhabi.

- [ ] Yes  In which country is the head office of your group located
- [ ] No
### Section One: Innovation activities and expenditures

1. **Does your enterprise have any of the following?**
   - [ ] 1. R&D Unit
   - [ ] 2. Testing Center
   - [ ] 3. Design Center
   - [ ] 4. Other innovation related unit
   - [ ] 5. Not Available

2. **During the Four years 2008 to 2011 did your enterprise engage in the following innovation activities:**
   - **2.1 Intramural R&D (in-house):**
     - [ ] 1. Yes
     - [ ] 2. No (If No go to Q. 2.2)
     
     Creative work undertaken by your enterprise to increase the stock of R&D knowledge and its use to devise new and improved products and processes (including software development).

     2.1.1 did your firm performs R&D during 2008 to 2011:
     - [ ] Continuously?
     - [ ] Occasionally?

   - **2.2 Extramural R&D (outside your enterprise):**
     - [ ] 1. Yes
     - [ ] 2. No
     
     Same activities as above, but performed by other companies (including other enterprises in your group) or by public or private research organizations and purchased by your enterprise

3. **During the Four years 2008 to 2011, did your enterprise engage in the following innovation adoption activities:**
   - **3.1 Acquisition of advanced machinery, equipment and Software**
     - [ ] 1. Yes
     - [ ] 2. No
     
     Acquisition of advanced machinery, equipment and computer hardware or machinery, equipment software to produce new or significantly improved products and processes

   - **3.2 Acquisition of other external knowledge**
     - [ ] 1. Yes
     - [ ] 2. No
     
     Purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises such as training specifically related to the development and/or introduction of new or significantly improved products and processes.

   - **3.3 Acquisition of other business entities.**
     - [ ] 1. Yes
     - [ ] 2. No (If No go to Q. 4)

     3.4 The acquisition of another enterprise or business unit for the purpose of accessing and acquiring their expertise or knowledge in a specific domain. If yes, was the acquisition
     - [ ] Local
     - [ ] Foreign
     - [ ] both
4. **During the Four years 2008 to 2011, did your enterprise engage in the following innovation diffusion activities?**

<table>
<thead>
<tr>
<th>4.1 Market introduction of innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 1. Yes</td>
</tr>
<tr>
<td>Activities for the market introduction of your new or significantly improved goods and services, including market research and launch advertising</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.2 Other preparations/adaptations</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 1. Yes</td>
</tr>
<tr>
<td>Training on new procedures and/or technical preparations to implement or introduce new or significantly improved products and/or processes</td>
</tr>
</tbody>
</table>

5. **What percentage of total business expenditure goes to innovation related activities?**

   (If the answer is 0% go to Q. 7)

6. **Considering your answer in 5, please estimate the percentage of your innovation related expenditure on each of the following activities in 2008-2011**

<table>
<thead>
<tr>
<th>6.1 Intramural (in-house) R&amp;D (Include capital expenditures on buildings and equipment specifically for R&amp;D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] %</td>
</tr>
</tbody>
</table>

   | 6.2 Extramural R&D : [ ] % |

<table>
<thead>
<tr>
<th>6.3 Acquisition of machinery, equipment and software (Exclude expenditures on equipment for R&amp;D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] %</td>
</tr>
</tbody>
</table>

   | 6.4 Acquisition of other external knowledge: [ ] % |

   | 6.5 Market introduction of innovations (New to UAE Market/ New to International Market/ New to the Company): [ ] % |

   | 6.6 Training for the implementation or introduction of new products or processes: [ ] % |
Section One: Innovation activities and expenditures

During the Four years 2008 to 2011, did your enterprise engage in the following innovation diffusion activities?

4.1 Market introduction of innovations
- 1. Yes
- 2. No
Activities for the market introduction of your new or significantly improved goods and services, including market research and launch advertising

4.2 Other preparations/adaptations
- 1. Yes
- 2. No
Training on new procedures and/or technical preparations to implement or introduce new or significantly improved products and/or processes.

What percentage of total business expenditure goes to innovation related activities?
(If the answer is 0% go to Q. 7)

Considering your answer in 5, please estimate the percentage of your innovation related expenditure on each of the following activities in 2008-2011

6.1 Intramural (in-house) R&D: (Include capital expenditures on buildings and equipment specifically for R&D):

6.2 Extramural R&D:

6.3 Acquisition of machinery, equipment and software (Exclude expenditures on equipment for R&D):

6.4 Acquisition of other external knowledge:

6.6 Training for the implementation or introduction of new products or processes:

7. During the Four years 2008 to 2011, did your enterprise receive any public financial support for innovation activities?
- 1. Yes
- 2. No

8 Sources of information and co-operation for innovation activities

During the Four years 2008 to 2011, which of the following information sources were the THREE most important access points for knowledge feeding into your innovation activities?

8.1 Market Sources:
- 8.1.1 Suppliers of equipment, materials, components, or software
- 8.1.2 Clients or customers
- 8.1.3 Competitors or other enterprises in your sector
- 8.1.4 Competitors or other enterprises in other sectors

8.2 Private Knowledge Sources:
- 8.2.1 Abu Dhabi based specialists, commercial or private knowledge providers
- 8.2.2 Dubai-based specialists, commercial labs or private knowledge providers
- 8.2.3 Other emirates based specialists, commercial labs or private knowledge providers
- 8.2.4 Overseas-based specialists, commercial labs or private knowledge providers

8.3 Public Knowledge Sources:
- 8.3.1 Universities or other higher education institutions
- 8.3.2 Government or public research institutes
- 8.3.3 Universities overseas
- 8.3.4 Scientific journals and trade/technical publications
- 8.3.5 Other- please specify

8.4 Other sources:
- 8.4.1 Conferences
- 8.4.2 Trade fairs
- 8.4.3 Exhibitions
- 8.4.4 Other- please specify

Product (good or service) innovation Performance
A product innovation is the introduction to market of a new good or service or a significantly improved good or service with respect to its capabilities, such as improved user friendliness, or sub-systems. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises.

9 During the Four years 2008 to 2011, did your enterprise introduce (If you answer Yes to any of these questions, please continue. Otherwise please go to section 15)
- 1. Yes
- 2. No
New or improved goods (not services) excluding the resale of new goods purchased from other enterprises and changes of a solely cosmetic nature:
New or significantly improved services

☐ 1. Yes  ☐ 2. No

Who developed these product innovations?

11.1 Mainly your enterprise or enterprise group  ☐ 1. Yes  ☐ 2. No
11.2 Your enterprise in collaboration with other enterprises or institutions  ☐ 1. Yes  ☐ 2. No
11.3 Mainly other enterprises (If mainly other enterprises),  ☐ 1. Yes  ☐ 2. No please go to Q. 14

How did your enterprise learn about the new innovation?

☐ 12.1 Customers
☐ 12.2 Suppliers
☐ 12.3 Competitors
☐ 12.4 Exhibitions Specify: ☐ 1. Local  ☐ 2. International
☐ 12.5 Exposure to international markets: 
☐ 12.6 Other, specify:

How did your enterprise acquire the product innovation developed by other enterprises?

☐ 13.1 License
☐ 13.2 Franchise
☐ 13.3 Off-shelf purchase
☐ 13.4 Other agreement, specify: 
☐ 13.5 Other channel, specify:

Were any of your product innovations during the last Four years 2008 to 2011

14.1 New to UAE Market?  ☐ 1. Yes  ☐ 2. No
Your enterprise introduced a new or significantly improved good or service into your national market before your competitors (it may have already been available in other markets)

14.2 New not only to UAE market but to International Markets too?  ☐ 1. Yes  ☐ 2. No

14.3 New to your enterprise only?  ☐ 1. Yes  ☐ 2. No
Your enterprise introduced a new or significantly improved goods or service that was already available from your competitors in your market.

Process innovation
A process innovation is the implementation of a new or significantly improved production process, distribution method, or support activity for your goods or services. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises. Exclude cosmetic changes to the organizational structure of the company.
15 **During the Four years 2008 to 2011, did your enterprise Introduce:**
(If you answer yes to any of the questions, please continue; otherwise please go to Q. 22)

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1 New or significantly improved methods of manufacturing or producing goods or services</td>
<td>1. Yes  2. No</td>
</tr>
<tr>
<td>15.2 New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services</td>
<td>1. Yes  2. No</td>
</tr>
<tr>
<td>15.3 New or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing</td>
<td>1. Yes  2. No</td>
</tr>
</tbody>
</table>

16 **Who developed these process innovations?**
Select the most appropriate option only

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1 Mainly your enterprise or enterprise group</td>
<td></td>
</tr>
<tr>
<td>16.2 Your enterprise together with other enterprises or institutions</td>
<td></td>
</tr>
<tr>
<td>16.3 Mainly other enterprises or institutions</td>
<td></td>
</tr>
</tbody>
</table>

(If mainly other enterprises), please go to Q. 19

17 **How did your enterprise learn about the new process innovation?**

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>17.1 Customers</td>
<td></td>
</tr>
<tr>
<td>17.2 Suppliers</td>
<td></td>
</tr>
<tr>
<td>17.3 Competitors</td>
<td></td>
</tr>
<tr>
<td>17.4 Exhibitions: Specify:</td>
<td>1. Local  2. International</td>
</tr>
<tr>
<td>17.5 Exposure to international markets</td>
<td></td>
</tr>
<tr>
<td>17.6 Other, specify:</td>
<td></td>
</tr>
</tbody>
</table>

18 **How did your enterprise acquire the process innovation developed by other enterprises?**

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18.1 License</td>
<td></td>
</tr>
<tr>
<td>18.2 Franchise</td>
<td></td>
</tr>
<tr>
<td>18.3 Off-shelf purchase</td>
<td></td>
</tr>
<tr>
<td>18.4 Other agreement, specify:</td>
<td></td>
</tr>
<tr>
<td>18.5 Other channel, specify:</td>
<td></td>
</tr>
</tbody>
</table>
Collaboration Activities around Innovation
Innovation co-operation is active participation (e.g. creating a joint project) with other commercial or non-commercial institutions on innovation activities. Both partners do not need to commercially benefit (this excludes pure contracting out (consulting) of work with no active co-operation)

19 During the Four years 2008 to 2011, did your enterprise collaborate on any of your innovation activities with other enterprises or institutions?

☐ 1. Yes ☐ 2. No (Go to Q. 21)

20 Please indicate the type of co-operation partner and location

<table>
<thead>
<tr>
<th>Type of co-operation partner</th>
<th>Abu Dhabi</th>
<th>UAE</th>
<th>Foreign</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.1 Other enterprises within your enterprise group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.2 Suppliers of equipment, materials, components, or software</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.3 Universities or other higher education institutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.4 Government or public research institutes</td>
<td></td>
<td></td>
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<tr>
<td>20.5 Other, specify:</td>
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</tbody>
</table>

Main client for innovation
Businesses innovate in order to improve their efficiency and productivity but also in order to improve the quality of their products and services and/or produce new products and services to satisfy their customers.
### 21 What are the main sectors of demand for innovation in your enterprise?

#### 21.1 Public Sector
- [ ] 21.1.1 Government procurement (public administration, public agencies, etc)
- [ ] 21.1.2 Public Services (public schools, hospitals, roads, infrastructure etc)
- [ ] 21.1.3 Public Companies (includes utilities, manufacturing, other)
- [ ] 21.1.4 National Oil & Gas Companies

#### 21.2 Private Sector
- [ ] 21.2.1 Social sector (not-for-profit)
- [ ] 21.2.2 Tourism Sector
- [ ] 21.2.3 Multimedia Sector
- [ ] 21.2.4 IT Services
- [ ] 21.2.5 Health Services
- [ ] 21.2.6 Other Services
- [ ] 21.2.7 Construction
- [ ] 21.2.8 Manufacturing sector (outside oil & gas)
- [ ] 21.2.9 Other Natural Resources Sector
- [ ] 21.2.10 Other sector – please specify: 

TO BE ANSWERED BY ALL ENTERPRISES:

**Factors hampering innovation activities**

#### 22 During the Four years 2008 to 2011, were any of your innovation activities or projects:

- [ ] 22.1 Abandoned in the concept stage
- [ ] 22.2 Abandoned after the activity or project was begun
- [ ] 22.3 Seriously delayed

#### 23 Reasons not to invest in innovation related activities:

- [ ] 23.1 Competition policy does not support innovation
- [ ] 23.2 Intellectual Property Rights regime is weak
- [ ] 23.3 Absence of government standards and regulations that necessitate innovation
- [ ] 23.4 Lack of specific government support - please specify: 
- [ ] 23.5 Lack of transparency
During the Four years 2008 to 2011, how important were the following factors for hampering your innovation activities or projects or influencing a decision not to innovate?

### 24.1 Cost Factors:
- **24.1.1 Lack of Funds for innovation within your enterprise or group:**
  - 1. High
  - 2. Somewhat
  - 3. Low

- **24.1.2 Lack of finance from sources outside your enterprise:**
  - 1. High
  - 2. Somewhat
  - 3. Low

- **24.1.3 Innovation costs too high:**
  - 1. High
  - 2. Somewhat
  - 3. Low

### 24.2 Knowledge Factors:
- **24.2.1 Lack of qualified personnel:**
  - 1. High
  - 2. Somewhat
  - 3. Low

- **24.2.2 Lack of nearby sources of expertise:**
  - 1. High
  - 2. Somewhat
  - 3. Low

- **24.2.3 Lack of information on markets:**
  - 1. High
  - 2. Somewhat
  - 3. Low

- **24.2.4 Difficulty in finding cooperation partners for innovation:**
  - 1. High
  - 2. Somewhat
  - 3. Low

### 24.3 Market Factors:
- **24.3.1 Market dominated by established enterprises:**
  - 1. High
  - 2. Somewhat
  - 3. Low

- **24.3.2 Uncertain demand for innovation goods and services:**
  - 1. High
  - 2. Somewhat
  - 3. Low

- **24.3.3 Local/Regional market does not necessitate modification or change of existing products and services (i.e. not demanding).**
  - 1. High
  - 2. Somewhat
  - 3. Low

### 24.4 Other reasons- please specify:

**Intellectual property rights**

During the Four years 2008 to 2011, did your enterprise:

- **25.1 Apply for a patent:**
  - 1. Yes
  - 2. No

- **25.2 Register an industrial design:**
  - 1. Yes
  - 2. No

- **25.3 Register a trademark:**
  - 1. Yes
  - 2. No

- **25.4 Claim copyright:**
  - 1. Yes
  - 2. No
**Section Two: Employment and Innovation**

26. **Number of your employees currently within your enterprise?**

   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]

27. **Give an approximation of the percentage of skilled expats among them:**

   - [ ]
   - [ ]
   - [ ]

28. **In the period 2008-2011 did you have to recruit new people for innovation related activities?**

   (Innovation related activities include new product and service development, the implementation of a new managerial or technology system, and the introduction of new production process. Please answer with a Yes/No).

   - [ ] Yes
   - [ ] No

29. **In the period 2008-2011 did you face difficulties finding people with the skills needed to introduce innovations (Please answer with a Yes/No)**

   - [ ] Yes
   - [ ] No

30. **Where are your main channels of sourcing/recruiting critical human resources? Choose one only.**

   - [ ] 30.1 Nationally
   - [ ] 30.2 Arab Countries
   - [ ] 30.3 Internationally

31. **Does your firm make use of any of the following knowledge management practices?**

   - [ ] Yes
   - [ ] No

   If yes, please indicate:

   - [ ] 30.1 Incentives for employees to share knowledge within your enterprise
   - [ ] 30.2 Dedicated resources to monitor and obtain knowledge from outside your enterprise
   - [ ] 30.3 A policy to bring external experts to participate in project teams as needed.
   - [ ] 30.4 Specific incentives for staff to innovate?
Section Three: Enterprise Business Orientation

32 Are you primarily a business-to-consumer enterprise or a business-to-business enterprise? (please choose one answer only)
   - 32.1 Business-to-Consumer
   - 32.2 Business-to-Business

33 Are you a supplier of a manufactured good or a service? (please choose one answer only)
   - 33.1 Good
   - 33.2 Service

34 What is your number one market? (please choose one answer only)
   - 34.1 Manufacturing- consumer products
   - 34.2 Manufacturing- business related products
     (industrial includes all non consumer products that are purchased by firms rather than individuals)
   - 34.3 Business Services
   - 34.4 Personal Services (including leisure, tourism, etc)
   - 34.5 Mining & Hydrocarbon
   - 34.6 Others- please specify:

35 Please specify the percentage of the share of output that is exported?
   - %
### 36 Which geographic market has been the most important in the period (2008-2011)?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
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<tbody>
<tr>
<td>36.1 National:</td>
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<tr>
<td>36.1.1 UAE</td>
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</tr>
<tr>
<td>36.2 Regional:</td>
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<tr>
<td>36.2.1 Middle East</td>
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<tr>
<td>36.3 Asia:</td>
<td></td>
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<tr>
<td>36.3.1 Australia/New Zealand</td>
<td></td>
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<tr>
<td>36.3.2 South Asia</td>
<td></td>
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<tr>
<td>36.3.3 East Asia</td>
<td></td>
</tr>
<tr>
<td>36.3.4 China</td>
<td></td>
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<tr>
<td>36.4 EUROPE: 36.4.1 EU</td>
<td></td>
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<tr>
<td>36.4.2 Specific EU country, please specify:</td>
<td></td>
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<tr>
<td>36.4.3 Russia</td>
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<tr>
<td>36.5 North America</td>
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<tr>
<td>36.5.1 US</td>
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<td>36.5.2 Specific US State, please specify:</td>
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<tr>
<td>36.5.3 Canada</td>
<td></td>
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<tr>
<td>36.6 Other Countries 36.6.1 Please specify:</td>
<td></td>
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<tr>
<td>36.7 All countries/ worldwide</td>
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</table>

### 37 What were your total sales/turnover for year 2011? Please provide an estimate

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.1 Less than AED 1 million</td>
<td></td>
</tr>
<tr>
<td>37.2 AED 1 million to less than AED 5 million</td>
<td></td>
</tr>
<tr>
<td>37.3 AED 5 million to less than AED 10 million</td>
<td></td>
</tr>
<tr>
<td>37.4 AED 10 million to less than AED 20 million</td>
<td></td>
</tr>
<tr>
<td>37.5 AED 20 million to less than AED 50 million</td>
<td></td>
</tr>
<tr>
<td>37.6 AED 50 million/ more</td>
<td></td>
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</tbody>
</table>
38 **Legal Form of your enterprise**
- 38.1 Simple Limited Partnership
- 38.2 Joint Participation Company
- 38.3 Public Joint Stock Co
- 38.4 Private Joint Stock Co
- 38.5 Limited Liability Co
- 38.6 Establishment
- 38.7 General Partnership
- 38.8 Partnership Limited by Shares
- 38.9 Branch

39 **What is the educational background of the Chief Executive of your enterprise/branch?**
- 39.1 Business Administration/Finance/Marketing/ Economics
- 39.2 Engineering/Technical
- 39.3 A combination of Engineering/Technical & Managerial.
- 39.4 Other- please specify:

40 **Please specify the number of years of your enterprise establishment**

41 **Do you prefer to participate in this survey in the future by using the following modes:**
(You may select more than one mode)
- 1. Telephone
- 2. E-mail
- 3. Web Form
- 4. Face to Face Interview
- 5. Others- please specify:
Appendix E: Sectoral Insights from the Abu Dhabi Innovation Survey

Part I: The Innovation Activities of Abu Dhabi Firms

Figure E1: Breakdown of Abu Dhabi’s innovation activities over the period 2008-2011 (manufacturing sector)

Figure E2: Breakdown of Abu Dhabi’s innovation activities over the period 2008-2011 (construction sector)
Figure E3: Breakdown of Abu Dhabi’s innovation activities over the period 2008-2011 (transport sector)

Figure E4: Breakdown of Abu Dhabi’s innovation activities over the period 2008-2011 (ICT sector)
Figure E5: Breakdown of Abu Dhabi’s innovation activities over the period 2008-2011 (financial and insurance activities)

Figure E6: Breakdown of Abu Dhabi’s innovation activities over the period 2008-2011 (professional, scientific and technical activities)
Figure E7: Cross-sectoral share of firms which introduced at least one product, process innovation or both, over the period 2008-2011

Part II: Product Innovation Activities of Abu Dhabi Firms

Figure E8: Cross-sectoral share of firms which introduced at least one new good, new service or both, over the period 2008-2011
Figure E9: Cross-sectoral novelty of product innovations introduced by Abu Dhabi firms over the period 2008-2011

Figure E10: Cross-sectoral nationality of business units acquired by Abu Dhabi firms
Figure E11: Cross-sectoral method of acquiring new product innovations developed by other enterprise

Figure E12: Method of learning about new product innovations developed by other enterprises (manufacturing sector)
Figure E13: Method of learning about new product innovations developed by other enterprises (construction sector)

Figure E14: Method of learning about new product innovations developed by other enterprises (transport sector)
Figure E15: Method of learning about new product innovations developed by other enterprises (ICT sector)

Figure E16: Method of learning about new product innovations developed by other enterprises (financial and insurance activities)
Part III: Process Innovation Activities of Abu Dhabi Firms

Figure E17: Method of learning about new product innovations developed by other enterprises (professional, scientific and technical activities)

Figure E18: Cross-sectoral breakdown of Abu Dhabi’s process innovation activities over the period 2008-2011
Figure E19: Cross-sectoral share of firms which introduced at least one process innovation over the period 2008-2011

Figure E20: Who developed Abu Dhabi’s process innovations? (manufacturing sector)
Figure E21: Who developed Abu Dhabi’s process innovations? (construction sector)

Figure E22: Who developed Abu Dhabi’s process innovations? (transport sector)
Figure E23: Who developed Abu Dhabi’s process innovations (ICT sector)

Figure E24: Who developed Abu Dhabi’s process innovations? (financial and insurance activities)
Figure E25: Who developed Abu Dhabi’s process innovations (professional, scientific and technical activities)

Figure E26: Method of acquiring new process innovations developed by other enterprises (manufacturing sector)
**Construction**

- License: 35%
- Off-shelf: 39%
- Other channels: 13%
- Other means such as acquisition: 9%
- Franchise: 4%

*Figure E27: Method of acquiring new process innovations developed by other enterprises (construction sector)*

**Transport and Associated Services**

- License: 25%
- Off-shelf: 63%
- Other means such as acquisition: 6%
- Franchise: 6%

*Figure E28: Method of acquiring new process innovations developed by other enterprises (transport sector)*
Figure E29: Method of acquiring new process innovations developed by other enterprises (ICT sector)

Figure E30: Method of acquiring new process innovations developed by other enterprises (financial and insurance activities)
Part IV: Innovation Expenditures of Abu Dhabi Firms

*Figure E31: Method of acquiring new process innovations developed by other enterprises (professional, scientific and technical activities)*

*Figure E32: Cross-sectoral share of R&D and other innovation expenditure on total innovation expenditure over the period 2008-2011*
Figure E33: Cross-sectoral composition of total innovation expenditure over the period 2008-2011

Figure E34: Breakdown of Abu Dhabi’s innovation related expenditure over the period 2008-2011 (manufacturing sector)
Figure E35: Breakdown of Abu Dhabi’s innovation related expenditure over the period 2008-2011 (construction sector)

Figure E36: Breakdown of Abu Dhabi’s innovation related expenditure over the period 2008-2011 (transport sector)
Figure E37: Breakdown of Abu Dhabi’s innovation related expenditure over the period 2008-2011 (ICT sector)

Figure E38: Breakdown of Abu Dhabi’s innovation related expenditure over the period 2008-2011 (financial and insurance activities)
Part V: Collaboration Activities around Innovation

Figure E40: Cross-sectoral share of firms with innovation co-operations on all firms and all innovative firms over the period 2008-2011
Figure E41: Cross-sectoral share of co-operating firms with a particular external co-operation partner over the period 2008-2011

Figure E42: Cross-sectoral breakdown of sources of information and co-operation for innovation activities in Abu Dhabi over the period 2008-2011
Figure E43: Sources of information and co-operation for innovation activities in Abu Dhabi (manufacturing sector)

Figure E44: Sources of information and co-operation for innovation activities in Abu Dhabi (construction sector)
Figure E45: Sources of information and co-operation for innovation activities in Abu Dhabi (transport sector)

Figure E46: Sources of information and co-operation for innovation activities in Abu Dhabi (ICT sector)
Financial and Insurance Activities

Figure E47: Sources of information and co-operation for innovation activities in Abu Dhabi (financial and insurance activities)

Professional, Scientific and Technical Activities

Figure E48: Sources of information and co-operation for innovation activities in Abu Dhabi (professional, scientific and technical activities)
Part VI: Clients for Firms’ Innovation

Figure E49: Main sectors of demand for innovation in Abu Dhabi over the period 2008-2011

Figure E50: Cross-sectoral B2B vs. B2C breakdown of innovative firms in Abu Dhabi
Figure E51: The most important geographic market for Abu Dhabi firms over the period 2008-2011 (manufacturing sector)

Figure E52: The most important geographic market for Abu Dhabi firms over the period 2008-2011 (construction sector)
Figure E53: The most important geographic market for Abu Dhabi firms over the period 2008-2011 (transport sector)

Figure E54: The most important geographic market for Abu Dhabi firms over the period 2008-2011 (ICT sector)
Figure E55: The most important geographic market for Abu Dhabi firms over the period 2008-2011 (financial and insurance activities)

Figure E56: The most important geographic market for Abu Dhabi firms over the period 2008-2011 (professional, scientific and technical activities)
Part VII: Barriers to Innovation

Figure E57: Relative importance of factors hampering innovation over the period 2008-2011 (manufacturing sector)

Figure E58: Relative importance of factors hampering innovation over the period 2008-2011 (construction sector)
Figure E59: Relative importance of factors hampering innovation over the period 2008-2011 (transport sector)

Figure E60: Relative importance of factors hampering innovation over the period 2008-2011 (ICT sector)
Figure E61: Relative importance of factors hampering innovation over the period 2008-2011 (financial and insurance activities)

Figure E62: Relative importance of factors hampering innovation over the period 2008-2011 (professional, scientific and technical activities)