



Science, Technology & Innovation Policy Review

Oman 



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Preface

The Science, Technology and Innovation Policy Reviews prepared by UNCTAD aim to contribute to the development of national capacities in this field in order that national science, technology and innovation plans and programmes make an effective contribution to development strategies and improve the competitiveness of the productive sectors in a global economy in which knowledge is an increasingly important factor. This review is intended to be a tool for learning and reflection. It is an analytical instrument, not a rating mechanism, which examines a set of proposals from an external and neutral perspective.

This publication has three fundamental goals. Its first goal is to offer the Sultanate of Oman an up-to-date assessment of the framework conditions and interactions required for a functional national innovation system. The second goal is to draw attention to policy requirements for strengthening the national innovation system based on three important pillars: human capacities, intellectual property and economic diversification. The third goal is to provide a number of recommendations for strengthening policies and measures in order to improve technological capacity and encourage innovation.

The review of the science, technology and innovation policies of the Sultanate of Oman was conducted in response to a request by the Government of Oman and received the support of the Research Council of Oman. During visits to the Sultanate of Oman, the team held nearly 100 interviews and meetings with representatives of government agencies, research institutes, universities, trade unions, chambers of commerce, businesses and non-governmental organizations. An initial draft of this document was presented and discussed at a national workshop held in Muscat on 10 December 2013, with the participation of more than 100 experts and national science, technology and innovation stakeholders. The comments and suggestions made there have been taken into account in the preparation of this review.

This review would not have been possible without the cooperation of The Research Council of Oman and, in particular, H.E. Dr. Hilal bin Ali Al Hinai, H.H. Dr. Fahad bin Al Julanda Al Said and Dr. Abdullah bin Mohamed Al Mahruki (the national focal person). A special appreciation is owed to the National STIP Group and the Governance of the Grand Committee chaired by H.H. Sayyid Shihab bin Tariq Al Said. Gratitude is also extended to all participants in the national workshop and to the persons and entities, too numerous to be listed, that generously contributed their comments and ideas.

The assessments, opinions and conclusions expressed in this document are entirely those of the UNCTAD secretariat.

Acknowledgements

The review was prepared under the direction of Anne Miroux, Director of the UNCTAD Division on Technology and Logistics, and under the direct supervision of Angel González Sanz, Chief of the Policy Review Section of the Science, Technology and ICT Branch. The document was produced by UNCTAD economist Dimo Calovski with inputs from expert consultant Jean-Eric Aubert.

The document greatly benefited from inputs from the International Labour Organization which has been a partner in preparing parts of this report by providing substantive contributions, especially in the drafting of the section on human resources labour and employment. Professor Zafiris Tzanantos, ILO consultant and labour market expert, and Mary Kawar, ILO Regional Office for Arab States, provided comments on the draft text.

The manuscript was copy edited externally by Praveen Bhalla and typeset by Dimo Calovski. Sophie Combette designed the cover.

Contents

Front Matter.....	i–xx
Preface	iii
Acknowledgements	iv
Contents	v–vi
Abbreviations	vi
Executive summary.....	vii–xviii
Part I: The national innovation system of Oman.....	1–25
1. Introduction	1
1.1 A problem of sustainability.....	1
1.2 Requiring a new development strategy.....	1
1.3 Outline of Part I: The national innovation system of Oman.....	2
2. Overview of the innovation system of Oman	2
2.1 Global innovation indicators.....	2
2.2 An innovation system in need of reform.....	3
2.3 The need for creative dynamism.....	5
3. Framework conditions and the national innovation system	6
3.1 Overall governance.....	6
3.2 Macroeconomic context.....	7
3.3 Business environment.....	8
3.4 Infrastructure.....	10
3.5 Human capital and research.....	10
4. Key interactions I: Business and academia	11
4.1 The business and industrial world.....	11
4.2 The academic and research world.....	14
4.3 Conclusions.....	17
5. Key interactions II: Government policies and programs	17
5.1 Policy making institutions.....	17
5.2 The Research Council and research and development programmes.....	18
5.3 Support to innovation projects.....	20
5.4 Framework conditions' initiatives.....	22
5.5 Agriculture Public R&D structures.....	23
5.6 Overall assessment.....	24
Part II: Strategic innovation pillars.....	27–61
6. Human resources, labour and employment	27
6.1 Introduction.....	27
6.2 Population, education and labour supply.....	29
6.3 Employment and unemployment.....	33
6.4 Omanization.....	36
6.5 Conclusions and policy recommendations.....	40
7. Intellectual property, innovation and diversification	42
7.1 Introduction.....	42
7.2 IPR legislation in Oman.....	42
7.3 Strategic considerations and IPR.....	44
7.4 IP in practice.....	46
7.5 Traditional knowledge, culture and genetic resources.....	47
7.6 Conclusions and policy recommendations.....	49

8. Economic diversification and innovation strategy	50
8.1 Introduction.....	50
8.2 Progress in diversification.....	50
8.3 Strategic issues and diversification	52
8.4 Sectors with diversification potential.....	53
8.5 Conclusions and policy recommendations	60
Part III: Recommendations and conclusions	63–72
9. Policy recommendations	63
9.1 Strategic prerequisites.....	63
9.2 Innovation agenda: Actions with a short-term impact.....	65
9.3 Innovation agenda: Actions with a longer-term impact.....	66
9.4 An action plan for a national innovation strategy and system	69
9.5 Concluding thoughts: communicate, inspire, and lead.....	72
ANNEX: Summary table of recommended actions	73–75
References	76
Notes	77–79

Abbreviations

FDI	foreign direct investment
GCC	Gulf Cooperation Council
GDP	gross domestic product
GII	Global Innovation Index
IIC	Industrial Innovation Centre
ITA	Information Technology Authority
ICT	information and communications technology
ILO	International Labour Organization
IP	intellectual property,
IPR	intellectual property right
MOCI	Ministry of Commerce and Industry
NCSI	National Centre for Statistics and Information (Sultanate of Oman)
NISAP	National Innovation Strategy Action Plan
OCCI	Oman Chamber of Commerce and Industry
OMR	Omani rial
PACI	Sultanate of Oman Public Authority for Crafts Industry
PAIPED	Public Authority for Investment Promotion & Export Development
PDO	Petroleum Development Oman
PEIE	Public Establishment for Industrial Estates
R&D	research and development
SME	small and medium-sized enterprise
SQU	Sultan Qaboos University
STI	science, technology and innovation
STIP	science, technology and innovation policy
TIMSS	Trends in International Mathematics and Science
TRC	The Research Council
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UNCTAD	United Nations Conference on Trade and Development
WEF	World Economic Forum
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

Executive Summary

1. Introduction

Oman, located on the south-eastern corner of the Arabian Peninsula, has a long and rich history and a tradition of exploration abroad. With 3.9 million inhabitants and a per capita income of \$21,390, Oman has experienced robust economic growth and remarkable political stability since His Majesty Sultan Qaboos bin Said ascended the throne in 1970. Such economic growth has been made possible largely by earnings from the oil and gas sector, which dominates the economy and represents 51.6 per cent of the country's GDP. However, this development path is at risk: in the short-term, the economy is not generating enough jobs for Omani nationals, while in the long-term, oil reserves will decrease and their exploitation costs will grow against a backdrop of oil price volatility. Moreover, economic development based largely on exploitation of oil reserves is questionable from a long-term environmental perspective. Oman ranks among the top 20 countries globally in terms of its per capita carbon emissions, and growing and extensive urbanization is resulting in correspondingly high energy consumption, along with traffic congestion problems.

A further complication is that the growth of the economy has relied, to a large extent, and particularly during the last decade, on a considerable amount of cheap labour from abroad, which, today, constitutes about one third of the population. On the other hand, there is considerable unemployment among the local population, especially Oman's youth. These issues are not entirely specific to Oman; they are also prevalent in other countries that depend on oil revenues for growth and have a large proportion of imported labour. However, they will need to be addressed as a matter of priority in view of Oman's specificities and the unique nature of its economy and society.

His Majesty Sultan Qaboos and his Government are determined to influence the development trajectory of the country. The 8th Five Year plan (2011–2015) has a series of key objectives, including diversification of the economy, upgrading of human resources, support for small and medium-sized enterprises (SMEs) and promotion of foreign investment. There is clearly a need to accelerate the structural transformation of the economy, particularly with a view to job creation. A key strategic response by the Government has been the introduction of an active policy of Omanization of the labour force. However, while this may produce some short-term positive results, a more enduring and sustainable solution to Oman's development challenge is to achieve transformative and diversified growth underpinned by a strong national science, technology and innovation system and strategy.

While the establishment of an efficient national innovation system can lead to a more diversified, more productive and more sustainable economy, with higher quality and more attractive jobs, there are limits to the employment opportunities that an innovation-based diversification process can generate. Global economic competition, the nature of technological change and demographic trends will influence the dynamics of transformation. These in turn will feed back and change broad perceptions and expectations of conditions of employment, social services, and the nature and quality of education, leisure and retirement.

2. Oman's innovation system and global innovation indicators

Acknowledging the key role of innovation as a driver of economic development, it will be necessary for policymakers to be able to measure and assess outcomes. For this, they will require innovation indicators beyond the traditional metrics of inputs, such as the level of funding of research and development (R&D). Indicators are necessary to support policymaking as a continuous process. An example of a synthetic indicator is the Global Innovation Index (GII), developed by Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO), which combines some 80 indicators detailing the components of the innovation ecology both from the input and output sides. It uses objective and subjective data. Objective data are quantitative, such as school enrolments and Internet use; subjective data are derived from surveys of opinions of business and government leaders and executives. It also looks at GII in relation to per capita gross domestic product (GDP).

Oman is ranked 80th on the GII (2013).¹ To a large extent, this is due to sub-optimal efficiency in the use of an environment and assets that are advantageous from an innovation perspective. While GII rankings should not be understood as an absolute indicator, note should be taken of year-on-year relative changes which should encourage a more proactive policy involvement. The modest performance of the national innovation system in Oman suggests the need for accelerating its policy reform processes in the near future. Regional comparisons indicate that Oman needs to develop an effective and efficient innovation system, including improving its innovation infrastructure and climate, to augment its innovative outputs.

The GII confirms that Oman has sufficient institutional strengths and that its main challenge is that its economy is not sufficiently diversified.

3. Framework conditions and the national innovation system

Framework conditions constitute the overall environment in which a national innovation system functions. Variations in innovation performance between economies are largely due to differences in how the government, firms, universities, research centres, public agencies and other participants in innovation, interact within the existing framework conditions.

Governance

His Majesty Sultan Qaboos bin Said is firmly at the helm of Oman and benefits from a very strong aura of prestige. He determines the strategic course of the country, taking key decisions expressed in the form of royal decrees following consultations with concerned bodies. He occasionally intervenes in questions directly related to innovation and the business environment, as described later in the government policies and programmes section of this review. He is assisted by a Cabinet of Ministers, which is responsible for developing and implementing national policies on economic, political, social, executive and administrative matters, including presenting proposals for legislation.

A number of agencies, with varying degrees of autonomy, are in charge of specific economic, social and technical issues. The Research Council (TRC), which is in charge of R&D strategy and policy and covers innovation policy issues, plays a particularly important role in the development of the country's innovation system. The relative effectiveness of the political and institutional environment and high level of political stability have resulted in considerable trust of the citizens in public institutions, in the political class and in the independence of the judicial system. Conditions of social dialogue are good, with an active tripartite process referred to as Social Dialogue Oman, which includes the Chamber of Commerce, the trade unions and the Ministry of Manpower. The Government has a strong capacity to develop, enact and enforce legislation. This is complemented by a long-term and strategic planning approach, embodied in Vision 2020, which was adopted in 1996, and Vision 2040, which is currently under development. Five-year plans are systematically implemented and develop the Vision in operational terms to cover various economic sectors and social issues.

In order not to squander the positive strengths of Vision 2020 and upcoming Vision 2040 strategies, a particular challenge for policymakers is to improve horizontal and non-hierarchical consultations and communication flows. At present, these are sometimes bound by a hierarchical organizational structure and communication cultures of some domestic institutions. Enabling greater and faster horizontal communication would reduce the burden at the highest level of policymaking to act as information gatekeepers on details that are not meaningful in terms of seniority and competence. Improving inter-institutional communication is a fundamental requirement for developing an innovation system and institutional leadership, and policymakers should explore and eliminate any disincentives that prevent bureaucracies from developing broader linkages.

Macroeconomic context, business environment and infrastructure

The macroeconomic situation in Oman is likely to be the most problematic factor in developing its innovation system. Growth has been maintained at a satisfactory level of over 4 per cent a year thanks to a strong push for infrastructure development, including air and sea ports, roads, water, energy and housing. Financed by oil revenues, such projects have helped to create jobs, and the wealth created has had a trickle-down effect on trade, services and some manufacturing. However, many new jobs have been filled by lower cost imported labour, which, given the liberal local labour regulations, is easy to hire and fire. While an open labour market is often seen as a positive factor in international benchmarking on the business climate, it may present a serious challenge to resolving the issue of domestic unemployment. Furthermore, growth based on importing a large percentage of low-cost labour can be a strong disincentive to innovation and technology-based growth and economic diversification.

The Government's Omanization policy, aimed at encouraging the employment of Omanis, has had some positive results. Omanization can be a positive factor for innovation if the increased employment of Omanis in firms and industries is matched with improved productivity, business sophistication and, eventually, innovation. However, much remains to be done in linking the educational system with industry requirements so as to produce a workforce that has the skills needed by firms. At the same time, given its oil wealth and development ambitions, it would be counterproductive to overstate the goals of Omanization

while neglecting to consider trends in the global economy and migration which are key to the transfer of tacit knowledge and skills.

Another major macroeconomic condition that presents a challenge for innovation is the fact that the petrochemical industry and its oil revenues dominate the economy, which is moderately affected by the so called “Dutch disease”, resulting in a decline in global competitiveness of domestic sectors as imports financed by earnings from natural resource exports become more affordable. On the one hand, this creates disincentives to innovation and diversification because the economy grows mainly to service the petrochemical sector, but not to export. Moreover, with gasoline subsidized at 450 Omani Rial (OMR) per capita per year, private investment in the development of commercial renewable and sustainable energy resources is virtually impossible. On the other hand, in recompense, the Government uses oil revenues to build general infrastructure and it intends to increase spending on research and innovation to reach 2 per cent of GDP by 2020. Outside the oil and energy sector, industry has little interest in investing in R&D, as technology transfer is trade-based (i.e. it is imported), which is often seen as the better and cheaper solution.

A significant challenge for innovation is presented by an economic structure dominated by large firms even though there are 91,000 active SMEs. Of these, only about 100 SMEs file tax returns, indicating that the middle-intermediary layer of firms is insufficiently developed. The absence of a strong antitrust authority and competition law, and an underdeveloped technical capacity to manage intellectual property, inhibit the creation of an economic environment conducive to the development of a dynamic SME sector and especially innovative firms. Nevertheless, outside the State oil and gas businesses, private sector activity is steadily growing. Recognizing the relevance of SMEs for diversification and growth of the economy and its potential for increasing employment opportunities, several measures are already being taken to develop the required infrastructure and devise necessary policies for the SME sector, including improving access to finance. Finally, people do not aspire to entrepreneurship and innovation, as these are not part of basic education in a society where oil wealth makes people less eager to take risks. The result is a strong preference for investing in tangibles such as real estate and trade, rather than in industry. Safe and well-paid public sector jobs also serve as a disincentive to entrepreneurship.

Oman has a high quality physical infrastructure, which is being constantly improved. The well-developed transport and energy infrastructure is an asset, connecting the different provinces and, notably, the interior of Oman with its capital. While these are positive developments, they have only a mild impact on innovation and entrepreneurship. Policies favouring procurement from local SMEs and enforcing environmental norms could help improve the impact to some extent. In contrast to the physical infrastructure, development of the information and communications technology (ICT) infrastructure requires urgent policy attention. Broadband subscriptions are relatively low, and broadband costs could be made more favourable for firms and households. Diversifying the economy through innovation necessarily means enabling full and unhindered access to the global knowledge commons and the Internet. By contrast, government web services are well developed as a result of an active policy of e-government. Achievements in ICT infrastructure development are more the result of government agencies' internal efforts than those of the private sector.

Human capital, education and research capabilities

Basic education in Oman needs to be improved as evidenced by the fact that most tertiary educational establishments require their students to take “foundation courses” before beginning their undergraduate studies. The education system lacks accreditation standards and mechanisms, with quality control relying on an inspection system and a qualitative assessment of inputs rather than outcomes. The Ministry of Education is developing professional standards for teachers, school principals and supervisors, as well as curriculum and assessment standards. While primary and secondary education presents important challenges, indicators in tertiary education show a mixed picture. The level of gross tertiary enrolments is higher than the average for the Gulf Cooperation Council (GCC), and, together with enrolments abroad, the proportion of graduates in science and engineering disciplines is increasing. However, social sciences continue to attract the majority of students, which is creating a serious mismatch between the output of the education system and the requirements of the labour market.

While there are no official statistics on spending on scientific and technological R&D in Oman, it is generally estimated that the country spends 0.2 per cent of GDP on such activities. This percentage is very low, particularly in relation to the level of GDP per capita, but it is in the order of magnitude of other GCC countries. Most of the public research infrastructure is in academia and in government research centres established in the agriculture and fisheries sector. The total number of researchers in full-time equivalent is estimated to be about 2,000 persons.

4. Key interactions: Business, academia and government

Interactions involving the innovation system are fragmented

The innovation system of Oman is fundamentally fragmented; cooperation between key entities (between academic and business structures, among academics and among businesses) is uneven and often based on personal acquaintanceships. Most research bodies are rather small, and it seems difficult to scale them up. Innovations and innovative undertakings are yet to emerge in order for virtuous clustering processes to take place. On the other hand, there are also several positive features. Although not very innovative, the larger Omani companies demonstrate an inner dynamism that should be exploited. There is a clear understanding of problems in most of the concerned communities, in the business sector as well as in the academic world and in government entities. And last, but not least, the whole innovation system and its components display a significant internationalization trend which is a source of dynamism and change that Oman is well positioned to exploit, given the openness of its economy.

Business and industry

Oman's economy is dominated by large firms that operate mostly in the petrochemical and natural resources, construction and trade sectors. Their innovative activity is not negligible, but it is insufficient to spur innovation throughout the economy and buttress the functioning of a meaningful national innovation system. Whatever innovation takes place benefits mainly several large firms and the companies operating under their umbrellas. For example, Petroleum Development Oman (PDO) dominates the oil and gas sector and has a solid R&D infrastructure. It has been developing advanced technology for enhanced oil and gas recovery. However, there are few, if any, spin-off businesses emerging from this innovative endeavour, and interactions with academia and other R&D institutions seem to be limited.

Most large Omani firms do not have in-house R&D, and new technologies are introduced mainly through joint ventures with international partners. There is little incentive to innovate inside the firm or in cooperation with other, smaller firms, R&D entities or academia. The private sector is perceived as relatively conservative, as many top executives in large companies tend to have a hierarchical, top-down style of management. This does not usually encourage spin-off activities or fruitful subcontracting and linkages between large and small firms, and there is an overwhelming preference to conduct technology transfer through international trade. Similar challenges are encountered when international joint ventures are expected to interact and support the domestic SME sector and include it in the value chain in a supportive role. As the authority for negotiating the responsibilities of joint ventures and FDI firms is fragmented, involving different ministries, it is difficult to exercise policy in this realm. Better synchronization and coordination would greatly benefit the activities of the Public Establishment for Industrial Estates (PEIE), the Public Authority for Investment Promotion and Export Development (PAIPED) and the Ministry of Commerce and Industry (MOCI).

Finally, Oman is a relatively small economy and technology market, and will need to rely more on regional cooperation within the GCC to improve technology transfer. Basic laboratory and testing facilities are available in Oman and seem well-equipped, according to the firms and universities visited by the UNCTAD mission. However, a major issue for the SME sector and aspiring innovators is the lack of independent facilities for prototyping. Such activities are often outsourced abroad.

Industrial activity takes place in eight industrial estates and four free zones. Their role in industrial growth is important, particularly as the oil and energy sector is capital-intensive and has not generated many jobs. However, there are a number of fundamental problems common to the industrial estates and free zones: a low level of collaboration, a lack of strategic perspective, and a focus on mining and services and construction materials, with modest innovation ambitions. A recent survey of estate tenants found little or no investment in product design, innovation and productivity. There were no intellectual property (IP) issues raised by any of the businesses located there. A major obstacle to innovation is that young graduates do not have the right competencies relevant for firms, such as communication or business research skills. It would be helpful if firms had greater input into curricula designs at vocational schools and universities. There is clearly a need to improve cooperation between firms and universities on R&D and technology adaptation and innovation.

The world of academia and research

Oman has relatively well-developed universities and colleges. The first public university in Oman, the Sultan Qaboos University (SQU), founded in 1986, has nine colleges: Arts and Social Sciences, Economics and Political Science, Education, Law, Nursing, Agriculture and Marine Sciences, Medicine and Health

Sciences, Engineering, and Science. It runs a number of research centres, and has a university hospital on the campus. SQU is open to Omanis only and hosts more than 10,000 students. In addition, the Ministry of Higher Education administers six colleges of applied sciences in regional centres outside Muscat with a total of 8,000 students. The Ministry of Manpower operates the Higher College of Technology in Muscat and six colleges of technology throughout Oman. Several government bodies run their own training, research and academic programmes. The Ministry of Health runs a number of health institutes to train nurses, paramedics and pharmacists. The Ministry of Awqaf and Religious Affairs operates the Institute of Sharia Sciences. The Central Bank of Oman runs the College of Banking and Financial Studies. Nineteen private colleges and seven universities are in operation as well, and respond to popular demand for studies in business administration, engineering and computer sciences. Most of them are affiliated with European, Australian or United States institutions, thus their language of instruction is typically English.

Higher education establishments face a number of challenges. First, there is a need to systematically retrain students entering these establishments through foundation courses so that they reach a minimum level of competence in language and maths skills. Secondly, retaining research staff within these establishments poses particular problems, often due to insufficient incentives. Thirdly, cooperation with government bodies often depends on established personal relationships, as there is no formal innovation strategy to provide an institutional framework for collaboration. Finally, from the industry perspective, research themes and projects tend to be overly academic mainly aiming at having research results published, as the ultimate validation, rather than on practical applicability, thus a priori limiting the potential for cooperation.

The public research and technology infrastructure has been developed mainly in the agriculture and fisheries sector by the Ministry of Agriculture and Fisheries. The research focuses on challenges arising from abiotic and biotic factors, including climate change, which has been affecting local ecosystems through the associated effects of natural disasters such as cyclones, flooding, droughts, ocean acidification and human activity. A major problem is that salaries for researchers are not competitive and budgets are regimented, leaving no room for developing incentives. As a result, researchers often leave their field of research on completion of their doctorates to seek better earnings elsewhere.

Policymaking institutions

The main entity for science, technology and innovation (STI) policy in Oman is The Research Council (TRC). Established in 2005, TRC acts both as a policymaking and a funding institution. It has a unique position in the government setting since it does not have the status of a ministry. It is more of an adjacent body, chaired by His Highness Sayyid Shihab bin Tariq Al Said, as high-level adviser to His Majesty Sultan Qaboos. It has a staff of 170, led by a Secretary General.

Other important bodies involved in supporting innovation or improving its climate include the IT Authority, the Ministry of Industry and Commerce, and the Ministry of Higher Education. The Education Council of Oman is charged with the advancement of all types of education at all levels, and works to ensure that educational development is coherent with national economic and social priorities. The Cabinet of Ministers, the Supreme Council for Planning and the Council of Oman can and do consult with a number of representatives of the business sector and civil society, including trade unions and the Oman Chamber of Commerce and Industry (OCCI), when designing their policies. However, there are indications that the OCCI has not been fully accepted as a strategic partner in government initiatives.

The key challenge is to improve coordination in the conduct and management of STI policies. While there is not much overlap, the absence of a national innovation strategy allows each ministry and related agencies to elaborate STI policies without much cross-consultation and coordination. As a result, there appear to be poor synergies and implementation. The bulk of the R&D programmes are developed by TRC within the context of the National Research Strategy, which consists principally of 14 diverse programmes designed mainly to foster a research culture in Oman. Programme implementation appears to be slow: often it takes a minimum of two years from presenting an idea for a programme to the first call for proposals for implementation. This may be due to a lack of capacity within the agency, a search for consensus, or highly cautious selection processes. It seems that none of the programmes include mechanisms to involve the business sector in their design phase, which would maximize innovation performance and impact.

With regard to practical support for innovation, an Industrial Innovation Centre was recently established in the Knowledge Oasis in the Muscat industrial estate. However, it is operating on a fairly small budget of OMR 1.5 million, and few of the programmes are aimed at directly supporting private firms' innovation and technology needs. There seems to be reluctance or a lack of consensus among Oman's STI policymakers to directly support innovation efforts of private firms. This may be due to a literal interpretation of free

market principles. While academics are free to take ideological positions, policymakers worldwide have often tended to adopt a pragmatic approach to supporting innovators and technology R&D.

Unless there is greater spending on R&D and support for innovation, there is unlikely to be much progress in innovation, in practical advances and in the development of a national innovation system. The national priority of diversification through innovation requires a fundamentally larger financial commitment in order to realize the innovative potential of Oman's private sector and industries. The lack of venture capital is hindering innovation, although there is a project under consideration to establish a national venture capital company.

An emerging innovation policy

Policies to improve the innovation climate and system are embryonic and fragmented. The most explicit policy is the National Research Strategy, though the National Innovation Strategy is yet to be implemented. The National Research Strategy is involving a steadily increasing number of researchers, and is aiming at linking their efforts and activities with perceived needs. Unfortunately, the business sector is not sufficiently involved in co-funding or in partnering in R&D work. The development of a national innovation system is not yet integrated within national strategic planning and operational decision-making; it is critical that it become a key component of the Vision 2040 mandate.

Implementation of policy measures appears to be relatively slow and stems from a cautious approach to selecting projects and allocating funds. Other obstacles to implementation include cumbersome bureaucratic procedures, as well as the political and social culture of risk aversion and consensus-building.

Overall public financial support to research and innovation remains quite small compared to, say, developing the road network infrastructure. In private firms, there is little support or incentives for R&D and innovation efforts. Public and joint public-private innovation support measures that aim at stimulating university-business cooperation in R&D and innovation are critically needed. In the light of this situation, it is important for the PDO to lead by example and expand its initiatives to increase its interaction with the rest of the economy. Finally, the general public needs to be made more aware of innovation issues.

5. Pillars of strategic innovation

Policymakers in Oman will need to prioritize their actions in order to be effective and efficient. There are three key areas that require their undivided attention; if left unaddressed, these could hamper the development of a functional national innovation system. The three areas are the development of national human resources, strengthening of the national IP system and invigorating economic diversification.

Human resources development

A major challenge for the national economy is the development of new industries to provide an increasing number of higher productivity jobs and to accelerate Oman's growth while gradually reducing the role of oil production in the economy. This inevitably means fostering processes of innovation through the strategic development of a national innovation system. It also means developing adequate human resources capable of implementing such a strategy

Oman may be characterized as being simultaneously a labour shortage and a labour surplus economy. Shortages arise because private sector employment opportunities are growing faster than Omani human skills and capabilities. A surplus arises simultaneously, as many Omani nationals are reluctant to accept offers of employment in the private sector in the hope that the Government will continue to provide employment opportunities for nationals. Private sector employment is often seen as a temporary measure while job-seekers wait for openings in the public sector.

From the point of view of the development of STI capabilities in Oman, the labour market suffers from two basic imbalances. The first is that Oman's education system produces too many graduates in the humanities and liberal arts and a clearly insufficient number in technical and scientific fields. The second is that Oman's growing economy and relatively open job market attract foreign labour with qualifications up to secondary school level that is willing to work for less than the prescribed minimum wage for Omani nationals. The policy solution so far has been to hire the excess graduates in public service jobs and, through the Omanization process, to encourage private firms to employ an increasing numbers of Omani nationals. However, these solutions may fall short of what is needed to promote an innovative and diversified economy, and move away from its dependence on oil revenues.

The viability of the public sector as the “employer of last resort” depends almost entirely on oil revenues. Strategies aimed at developing innovative and diversified industrial and services sectors and reducing or replacing the role of the oil sector will need to consider the unlikelihood of the non-oil economy generating sufficient profits to replace oil revenues. Technologically advanced and innovative products and services capable of generating higher margins to replace oil revenues may not entirely fit in with aspirations to develop labour-intensive sectors such as tourism.

A policy priority should be to reduce university enrolments in non-vocational studies, while placing greater emphasis on education and training institutes to increase the production of expertise needed by firms and industry. Achieving this requires active interaction between industry and educational institutions, which is more likely to be achieved within the context of an innovation system strategy. The regulation of public employment growth with a view to achieving quality public service, rather than as a means of managing unemployment, could improve diversification and spur innovation. The Government and its education authorities should offer opportunities for studies in non-vocational disciplines only if they are prepared to provide public sector employment for the graduating students. Growth in public sector employment needs to be regulated, bearing in mind future developments in oil revenues (as a result of the potential depletion of oil reserves and volatilities in the global price of oil) which have enabled such employment growth.

The great majority of jobs in the private sector in Oman is held by non-Omanis, and is concentrated in semi-skilled and skilled occupations where wages are fairly low. The general preference for public sector jobs that offer better wages, benefits and working conditions diminishes progressively as people move up the wage, education, skill and experience ladder. There have been proposals to bring remuneration in the public sector in line with that in private firms. However a more realistic policy target would be to restrain future increases in remuneration. While Omanization is a serious social policy concern, policymakers need to be aware that the presence of a large and mobile foreign population is a source of diversity and can create opportunities for innovation-based development.

Finally, in order to upgrade technological and innovation capabilities, raising the level of educational attainment must become a central policy concern. This will require improvements in both the provision of school education and in the take-up of educational opportunities by families and their children. It is essential that the quality of teaching is improved and that national expectations concerning standards are raised.

Intellectual property

A well-designed and properly implemented intellectual property rights (IPRs) framework can encourage innovation and enable technology transfer. It should allow inventors and creators to focus on their competencies and free them from the need to become entrepreneurs. For entrepreneurs, it should reduce uncertainty in the commercialization of an innovation. From an economic development perspective, the policy attention warranted by IPRs needs to take into account local specificities, as there is no universal policy recommendation for all countries. An IPR framework requires committed support from policymakers in order to become an effective incentive and enabler of innovation. Oman’s economy, outside the oil sector, operates below the technological frontier, therefore increasing the innovation capacity of firms and diversifying the economy will depend on the country’s ability to identify, import, adapt, absorb and diffuse technologies, in addition to creating its own technological knowledge. Oman’s policymakers should measure the success of implementation of IPRs by its socio-economic impact.

As an economy and its sectors and industries grow, IPRs increasingly become an integral and essential part of a complex innovation system. Creating capacities to use IP instruments to promote and support innovation is important at this stage of Oman’s technological development. Policymakers should also consider the necessity and complementarities of proprietary and public domains and their strategic role in spurring competitive and innovation-based economic growth. Oman’s IPR policy needs to include an overall strategic position on the issue of open access to ensure that publicly funded research outcomes can be made publicly available. IPRs need to be seen as a critical policy component that will help Oman become a knowledge-based economy with a functional national innovation system.

Current IP laws in Oman are generally compliant with conventions and obligations of the World Intellectual Property Organization (WIPO) under the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization (WTO). However, this does not mean that Oman has the capacity to take full advantage of its national domestic innovation potential, nor should the development of an IPR framework in Oman be considered a done job. For example, building greater awareness about the system of utility patents can encourage the notion of incremental innovation.

Oman is developing a number of research and innovation areas of strategic interest, and where IP needs to play a paramount role, such as the Animal and Plant Genetic Resource Centre. Innovative uses of genetic material in advanced agriculture and industry as well as in pharmaceutical development require a fully functional IP framework. However, such endeavours also present a challenge, as outcomes with commercial potential can be the result of a mix of traditional knowledge and research-driven efforts that require the coexistence of a policy of openness with a policy that protects against unwarranted appropriation.

Patents are a prime IP tool for fostering innovation and industrial development and diversification. Policymakers, and in particular the Ministry of Commerce and Industry, which hosts the IP Department of Oman, need to consider how deeply the currently non-existent capacity to evaluate and approve patent applications is hindering innovation. It is also important to be aware that the application, filing and maintenance of patents, in particular if a patentee seeks international protection, is a costly endeavour unattainable for the majority of SMEs striving to develop IP on their own. Solutions to this problem range from developing joint filings with other STI stakeholders, providing financial support, directly or through an appropriate tax policy, and encouraging the broader use of national-only utility models.

In conclusion, development objectives require that the benefits of IP accrue to IP owners and to society as a whole. Therefore, an IPR policy should bear in mind the need to create linkages between invention and innovation on the one hand, and economic growth and diversification on the other. IP has become an essential part of the globalized economy, and national and regional IP systems are becoming increasingly connected. Such considerations underscore the need for a strategic approach to IP with clear objectives and in concert with the highest level of policymaking for national development.

Diversification

Oman's economy and export sector are not sufficiently diversified. Since 1995, Oman has managed to increase the diversity of its exports which are now more diversified than those of Saudi Arabia, but below the GCC average. While its increase in export diversification is evidence of progress, the current rate is insufficient to meet the strategic goal of reducing the importance of the oil sector.

Economic development is fundamentally a process of structural transformation whereby countries innovate and diversify from producing basic goods to increasingly more sophisticated industrial goods and services. While domestic markets can play a role in stimulating demand for such a transformation, for small countries like Oman, exporting and participating in global value chains are critical factors. Given the large export earnings generated by the oil industry, reducing its significance and diversifying the economy cannot rely on domestic demand alone; it will require the development of export-oriented sectors and industries. Policymakers will also need to decide on the level and nature of involvement of FDI in their diversification strategy.

They will also need to develop a coherent national innovation strategy and establish incentives for diversification. Diversification through investment in innovation can be an important growth factor for Oman's economy if it results in the development of diverse industries that do not depend on the oil sector. However, innovation is an uncertain process, and where it succeeds in creating new firms, the risk-taking entrepreneurs will be unable to appropriate all the gains, as competitors will quickly emerge. Conversely, when an innovation fails, the losses are fully appropriated by the original innovator. This unbalanced and asymmetric condition is a known cause of underinvestment in innovation and is a factor that also inhibits diversification. Intellectual property can help reduce such innovation risk and uncertainty.

Diversification highlights the need to develop and use a national innovation system framework to establish and coordinate linkages among key stakeholders. In the case of Oman, institution-building may be necessary, provided it is placed at the highest level in government – above the ministries – and reporting directly to His Majesty Sultan Qaboos and his Cabinet of Ministers. A second prerequisite is to establish an evidence-based policy management system that monitors and evaluates the progress being made across targeted sectors.

A number of sectors and their potential for contributing to diversification are discussed in the main section on diversification of this Science Technology and Innovation Policy (STIP) Review. However, it is important to highlight here that, when considering sector potential, a central question for Oman's policymakers is whether it is wise and opportune to pick winners and start a specialization process without abandoning broader diversification policies. Evidence from developed economies indicates that, beyond a certain level of GDP per capita, technology specialization is a viable economic policy. While Oman may not be in such a

position today, it is not far from this point and policymakers will need to plan and prepare an appropriate strategy in the not too distant future.

Labour and human resources development policies will need to be adjusted according to objectives for the short, medium and long term, as diversification is a continuous process. This means increasing the level of interaction between firms and educational and academic institutions in order to better match supply and demand for new specializations and competencies, including the provision of training on entrepreneurship. However, the idea that entrepreneurs can be formed in an educational environment is misguided, and, while it should not be discouraged, encouraging newly graduated young Omanis to develop start-up businesses if they cannot find employment opportunities is a suboptimal policy. The critical role of tacit knowledge, uncodified and informal competencies that are acquired through on-the-job experience, should never be underestimated.

6. Recommendations and conclusions

In a context where several simultaneous challenges need to be addressed, many measures can be envisaged. However, it is important to identify what is essential and persevere, particularly because Government capacities are limited. Such an approach must be supported by a profound process of change management that will help identify the root causes of fragmentation.

Strategic prerequisites

Innovation should be at the core of the 2040 Vision. National mobilization is needed, along with a discourse that will establish a common mission. Building a society and economy fully engaged in the global knowledge economy by engaging in a number of bold reforms and programmes will make Oman a positive example for the GCC region and beyond.

To realize this ambition, policymakers need to propose to the Omani society an Innovation Compact that will highlight the following key concepts:

- *The Omani identity.* The innovation policy should build on the image of an Arab country with a maritime heritage, open to the outside world and confident of its identity, with an inner diversity and ease of interaction with other cultures – an image particularly adapted to insertion in today's global economy;
- *The Omani sense of excellence.* This should inspire all sectors of the economy and society, and will act as a major foundation for international competitiveness;
- *The imperative of sustainability.* What is usually an environmental issue will need to be expanded to a broader concern about social and economic issues, such as the sustainability of quality jobs offered to everyone, improved welfare for all, as well as sustainability of the national cultural heritage.

In order to implement efficient STI policies for boosting the economic development of a country, it is necessary to have strong coordination from the very top of the State leadership, as illustrated by some of the most emblematic development success stories, such as those of Finland, the Republic of Korea and Singapore. In particular, the coordinating mechanisms put in place in Finland – a country functioning with a consensus-based culture – can serve as an example of best practice for Oman. A key mechanism in Finland is the Research and Innovation Council.² Chaired by the Prime Minister, and involving all key ministers and heads of concerned agencies, as well as top representatives of businesses and civil society (trade unions), the Council meets frequently to discuss the orientation and the state of implementation of strategic decisions, such as budgets, sector reforms and new programmes.³

In Oman, a similar mechanism could be established, which would report to His Majesty Sultan Qaboos. The Grand Committee established for this UNCTAD STIP Review could constitute the nucleus of such an institution, but enlarged to include other key ministers, such as the Finance Minister, and senior representatives of the business sector, trade unions and civil society. It would need to meet regularly and focus on strategic issues and decisions. It should not be involved in operational tasks and activities, including the management of policy measures, schemes or incentives; rather, it should be concerned only with broad resource allocations. It is important to emphasize that overall coordination does not mean centralization, and particularly not centralization of funding for STI.

High-level coordination must not be allowed to devolve into committees that become discussion clubs without sufficient ability or authority to implement horizontal and cross-sector programmes to counteract fragmentation. To minimize this risk, the Omani innovation system is clearly in need of an entity entrusted with a mandate to actively initiate and coordinate cross-sector programmes at the level of implementation,

to complement the strategic orientation role of the higher body referred to above. A stronger TRC, with the status and capabilities that make it an effective counterpart to line ministries could play such a role. An important future activity for TRC may be to introduce policy training at a high level in order to build a corps of agents of change to ensure the sustainability of and commitment to agreed policies.

Regarding implementation, or the “how to”, international experience suggests that a pragmatic, gradual approach, with clearly defined policy stages, should be considered. In a first stage, the national innovation strategy would initiate well-targeted, micro and meso-level projects. When successful, they could help build credibility and stimulate changes in attitudes, including among policymakers. A second phase could follow, including developing a critical mass of projects, which would prepare the ground for a third phase, during which broad reforms could be implemented. This approach suggests a short-term agenda with rapidly achievable results mixed with a longer term agenda for deep transformations. To a certain extent, Oman has completed the first stage and is ready to embark on the second stage. Regarding the substance of policy actions, policymakers will need to adopt a holistic approach and address four critical issues:

- 1) The provision of adequate financial, technical and other support;
- 2) The elimination of obstacles to innovation, including a cumbersome bureaucracy and anti-competitive behaviours;
- 3) Increasing research efforts and technology and knowledge transfer from abroad; and
- 4) Strengthening the education system to provide needed technical and entrepreneurial competencies.

Innovation agenda: Actions with short term-impacts

Harvesting low-hanging fruit means implementing measures that can have an immediate and important effect on the economy. The major ones are lowering the price of Internet access, and increasing bandwidth and geographic access to broadband. Most critical, however, is to put in place a framework for stimulating linkages between ICT and innovation, especially with a view to developing content and creative industries. Another set of measures that can bring benefits in a relatively short period of time involve projects supported by the Industrial Innovation Centre and other incubating structures. An increase in success stories will build awareness and generate pride and self-confidence, inspiring the youth of Oman to become innovators and entrepreneurs.

Conducting an institutional audit is necessary to discover and eliminate obstacles of a formal and informal nature. In the Oman economy and society at present, there are a variety of obstacles that deter the establishment of an innovation climate. An institutional audit should be designed as a continuous exercise with due follow-up mechanisms. Dissatisfaction and complaints of STI stakeholders are a productive starting point. The goal is to identify regulatory, legal and behavioural obstacles to innovative undertakings and remove them in a decisive manner without too much delay from excessively considerate consultations.

Leveraging public procurement and infrastructure projects can promote innovative products through, for example, requirements for tenders, the setting of norms for energy consumption, regulations for environment-friendly materials, guidelines for food safety, and setting standards for work and safety conditions. Procurement policies should be used to help SMEs upgrade their technologies or offer innovative products. Recent measures reserving 10 per cent of public procurement for purchases from SMEs is a positive policy development, and there should be a strong bias in favour of small and local firms with innovation potential.

Innovation agenda: Actions with long-term impacts

Measures that can have a short-term and visible impact need to be complemented with actions with longer term goals, possibly beginning with pilot initiatives for selected policy fields that require experimentation or demonstration effects. Several possible policy examples are described as follows.

Stimulating youth creativity and entrepreneurship is a fundamental long-term goal, as creating a critical mass of such people will take time. Vocational schools and business incubators that provide appropriate coaching and support need to be multiplied in universities and colleges nationwide. The proposed institutional audit should help reduce the obstacles of excessive bureaucracy and administrative burdens. More effort is needed to reach down to the primary school level, and possibly even to early childhood education. It is absolutely fundamental to develop the creativity of children by replacing rote learning, involving repetition and memorization of texts and concepts, with experimentation and discovery.

Strengthening R&D and innovation support comprises three different measures: (i) financial, in the form of new funding schemes; (ii) technical, commercial and other support in the form of “local innovation houses”; and (iii) strengthening leadership capabilities in their role of information gatekeepers. New financial support schemes would foster university-industry collaboration in research on a shared (50/50) cost basis, and may be added as a new initiative for TRC. Local innovation houses should support innovation initiatives aimed at diversifying activities in the industrial, agricultural and tourism sectors, in particular outside the capital, Muscat. Enterprise and institutional management acting as de facto communication gatekeepers are often at odds with the reality of the increasingly networked nature of knowledge flows. Oman's policymakers need to actively encourage an increase in interdepartmental, inter-institutional and interdisciplinary communications among their staff and experts.

Launching a large-scale programme on environment stewardship will mobilize Oman's creativity on issues of global importance, and which relate directly to major problems it is facing now and, increasingly, in the coming decades. Oman's carbon footprint needs to be reduced, its agriculture is underperforming due to its scarce water resources, and its public transport system is underdeveloped.

Fostering international and regional integration can be achieved through programmes of technology transfer and support for joint R&D between foreign firms and local businesses and universities. Links with international research networks need to be strengthened, as the smaller GCC economies, taken individually, do not have the critical mass of researchers for many disciplines. Such activities are present in the oil and gas sector, such as the National Oil Companies Technology Managers Group, and other sectors should explore similar cooperation.

Developing evidence-based policies is needed to overcome difficulties in performing policy assessments and reviews, such as this one. A lack of information on national science and technology assets, on performances achieved in a number of domains (e.g. in innovation and education) is a great handicap for policymakers. More than ever, countries base their policies on factual evidence. Oman needs to establish R&D statistics and conduct regular innovation surveys. International education tests, such as the Programme for International Student Assessment,⁴ allow policymakers to accurately measure performance gaps and compare their results with a large set of countries at all development levels. Programme evaluations are crucial, and it is recommended that such evaluations be conducted by third parties with no vested interests in the outcomes. Finally, job creation and destruction will require close monitoring, in particular when associated with concurrent innovation policies or disruptions from new innovation activities or technologies.

An action plan for a national innovation strategy and system

An action plan for the development of a national innovation system in Oman will need to follow immediately after a high-level policy decision to establish a national STI strategy as a primary lever for the innovation-led development and diversification of the Omani economy. Given the demanding requirements that such a strategy is likely to place on competencies, capacities, resources and funding, a strongly expressed political commitment will be needed to reduce uncertainty and to mobilize and incentivize stakeholders.

An action plan needs to be elaborated at a level of detail that requires the intervention of policymakers with the authority to earmark and commit funding and resources, and to assign responsibilities. The National Innovation Strategy Action Plan (NISAP) for Oman will be the conduit for turning the outcome of the STIP Review and the Oman National Innovation Strategy into a reality, with tangible and measurable outcomes. For maximum impact, the NISAP will need to be comprehensive in both the changes it aims to trigger and the stakeholders it needs to involve. Finally, the NISAP will need to address current needs but with a long-term perspective, working towards Vision 2040. In this sense, it will need to anticipate newly emerging opportunities as well as risks and potential barriers that are more than purely economic and commercial in nature. It will also have to consider issues such as sustainability, finite natural endowments and shifting politics in a multipolar world.

The development of the NISAP should follow quickly from the international and national presentations of the STIP Review and the promulgation of the National Innovation Strategy – ideally within the first six months and before the end of 2015. This assumes that the overall vision, objectives and strategy for the innovation-led development and diversification of the Omani economy is in place, has been well communicated and has broad support among all stakeholders. The NISAP will always be a work in progress as institutional relationships evolve and learning processes strengthen. The NISAP will require an effective planning group, and the STIP National Group may be a good starting point, given that it has a diverse representation of Oman's STI stakeholders.

Concluding thoughts: communicate, inspire, and lead

To boost its innovative capabilities, Oman should, first and foremost, spearhead a change in mindset. In concluding, the recommendations of this Review highlight three key words that should capture the attention of the Government and guide its actions: communicate, inspire and lead.

Communicate. Developing a large media programme is fundamental. It is important to present innovation campaigns, notably local success stories, in national programmes on television, using community radios to reach traditional groups, and making use of Internet technologies and social media to reach the younger population.

Inspire. The leadership, policymakers and government administrators need to set an example in all aspects of work and life, wherever their functions lead them. They must include business communities, academic circles and civil society groups, who should find as many opportunities as possible to cooperate and express their creativity and sense of entrepreneurship.

Lead. The importance of an inspiring and efficient leadership will be key to igniting and sustaining the required changes. Therefore, politicians, policymakers and administrators at all levels of government, from the summit of the Sultanate down to the smallest villages, need to take on the challenge of the critical leadership role they will play.

Part I. The national innovation system of Oman

1. Introduction

Located on the south-eastern corner of the Arabian Peninsula, Oman occupies an area of about 300,000 square kilometres and has a population of 3.9 million inhabitants⁵ The country has a long and rich history and a tradition of exploration abroad, with communities established along the coast of Africa and in Asia. Its per capita income of \$21,390⁶ is the result of robust growth in the context of remarkable political stability experienced since His Majesty Sultan Qaboos bin Said ascended the throne in 1970.

Such economic growth is mainly due to earnings from oil and gas exports. The oil and gas extraction sector dominates the economy and represents 51.6 per cent of GDP,⁷ while the services sector accounts for 34.9 per cent, and construction, manufacturing and agriculture for 17.3 per cent.⁸ However, this development path is unlikely to be sustainable for long. There are two primary problems: in the short-term, the economy is failing to generate enough jobs for Omani nationals; in the long-term oil reserves will decline and their exploitation costs will grow.

1.1 A problem of sustainability

The growth of the economy has been based, particularly in the last decade, on the extensive import of cheap labour, which now accounts for about one third of the population. At the same time, a high unemployment rate, which stood at 24 per cent – and at 64 per cent among the youth aged 15–24 years – is indicative of the immense employment challenge for the local population (General Census, 2010; ILO, 2010). The lack of employment opportunities was a major area of discontent expressed during Oman's "Arab Spring" in 2011. An increase in minimum wages and unemployment benefits, along with a number of

Government reforms, contributed to restoring calm (Jeffreys, 2012).⁹

Adding to the problem is that the economy, as it is structured today, is unsustainable in the long run, since the forecast for proven gas and oil reserves is only 15 to 20 years,¹⁰ although probable reserves, which better describe the reserves base, are much larger. On a five-year rolling average, the PDO is adding more proven plus probable reserves than it is extracting. Nevertheless, unbalanced oil-based economic development is questionable from a long-term environmental perspective. Oman ranks among the top 20 countries globally in per capita carbon emissions,¹¹ and a growing and extensive urbanization trend is resulting in correspondingly high energy consumption, along with traffic congestion problems.

The issues mentioned above are not specific to Oman; they apply to other Arab Gulf countries as well. Oil-driven growth and a very large proportion of imported labour create problems that have challenged, and will continue to challenge Governments in the region (CMI, 2013). These issues need to be addressed in view of Oman's specificities and the unique nature of its society and culture.

1.2 The need for a new development strategy

His Majesty Sultan Qaboos and his Government are determined to influence the development trajectory of the country. The 8th Five Year plan (2011–2015) has a series of key objectives, including diversification of the economy, the upgrading of human resources, support for the SME sector and promotion of foreign investments (see box 1 below). A number of possible strategies aimed at diversification of the economy would include the exploitation of recently discovered

Box 1: Eighth Five Year Development Plan 2011–2015

The 8th Five Year plan (2011–2015) has as its main objectives:

- Realizing a growth rate of not less than 3% and low inflation rates
- Boosting social development, to be granted priority in allocating government expenditure
- Expanding new work opportunities for national workforce
- Achieving full enrolment rates in general education, raising intake capacity of higher education and upgrading education quality
- Improving coordination between fiscal and monetary policies
- Giving more attention to the regional and environmental dimensions
- Increasing production rates of oil and gas and better managing reserves and power resources
- Developing the sectors of tourism, industry, agriculture, fisheries and water resources
- Stimulating investment of domestic and foreign private sectors and development of small and medium enterprises (SME)
- Implementing strategies of scientific research and Oman Digital Society
- Developing and raising the efficiency of the Governments administrative apparatus, upgrading the statistical work and directing media activity to serve the development process

Source: Ministry of Information, www.omanet.om/english/commerce/econ1.asp.

mineral ores (copper and non-metallic), the promotion of tourism, and the development of agriculture and fisheries – a sector that contributes only 1.2 per cent to GDP, but employs 5.2 per cent of the active population.¹² It is clearly necessary to accelerate the structural transformation of the economy, particularly in view of the need for job creation. So far, the main strategic response by the Government has been to introduce an active policy of Omanization of the labour force, particularly in the public sector and civil service. But clearly, this alone will not resolve the more fundamental issues.

New activities offering quality jobs need to be generated through a transformative economic and social model with the establishment of an efficient national innovation system at its core. This would lead to a more diversified, more productive and more sustainable economy, with better quality and more attractive jobs. However, as experienced all over the world, there are limits to the employment opportunities that an innovation-based diversification process can generate. Among other factors, global economic competition, the nature of technological change and demographic trends will influence the dynamics of transformation. This will inevitably lead to a deep reorganization of the conditions of employment and expectations of education, leisure and pensions within a new “social contract” (Dervis, 2013).

1.3 Outline of Part I: The national innovation system of Oman

An analysis of the national innovation system is the subject of Part I of this STIP Review of Oman. It presents benchmarking indicators on the innovation system of Oman that show low efficiency in terms of innovation inputs/outputs. This is followed by a discussion of the overall framework conditions: the governance context, infrastructure development, business environment, human resources and research capabilities. It then analyses the innovation system and the strengths and weaknesses of key actors – the business sector, higher education and research structures – and their interactions. It also describes relevant government programmes and policies, which are still embryonic and need to be strengthened to address the key issues identified.¹³

2. Overview of the innovation system of Oman

2.1 Global innovation indicators

Acknowledging the key role of innovation as a driver of economic development, policymakers will require innovation indicators that go beyond the traditional metrics, such as the level of R&D funding. Given the multi-stakeholder nature of the innovation system, indicators are necessary to support policymaking based on measurable evidence. A valuable resource in this respect is the recently published Global Innovation Index (GII) Report (Cornell University, INSEAD and WIPO, 2013), which presents about 80 indicators, covering 142 countries, that detail components of the innovation ecology, both from the input and output sides (see box 2 below). A series of innovation indexes can then be computed.

The data compiled in the input and output sub-indexes are both of an objective and subjective nature, depending on the topics documented. The “objective” data are quantitative measures provided by international organizations on well-identified physical or intangible elements (e.g. school enrolments and Internet use).

The “subjective” data are mostly derived from surveys of the opinions of business executives (local and international) conducted by the World Economic Forum (WEF). The latter have been used in the Oman SRI International (SRI, 2011) study.

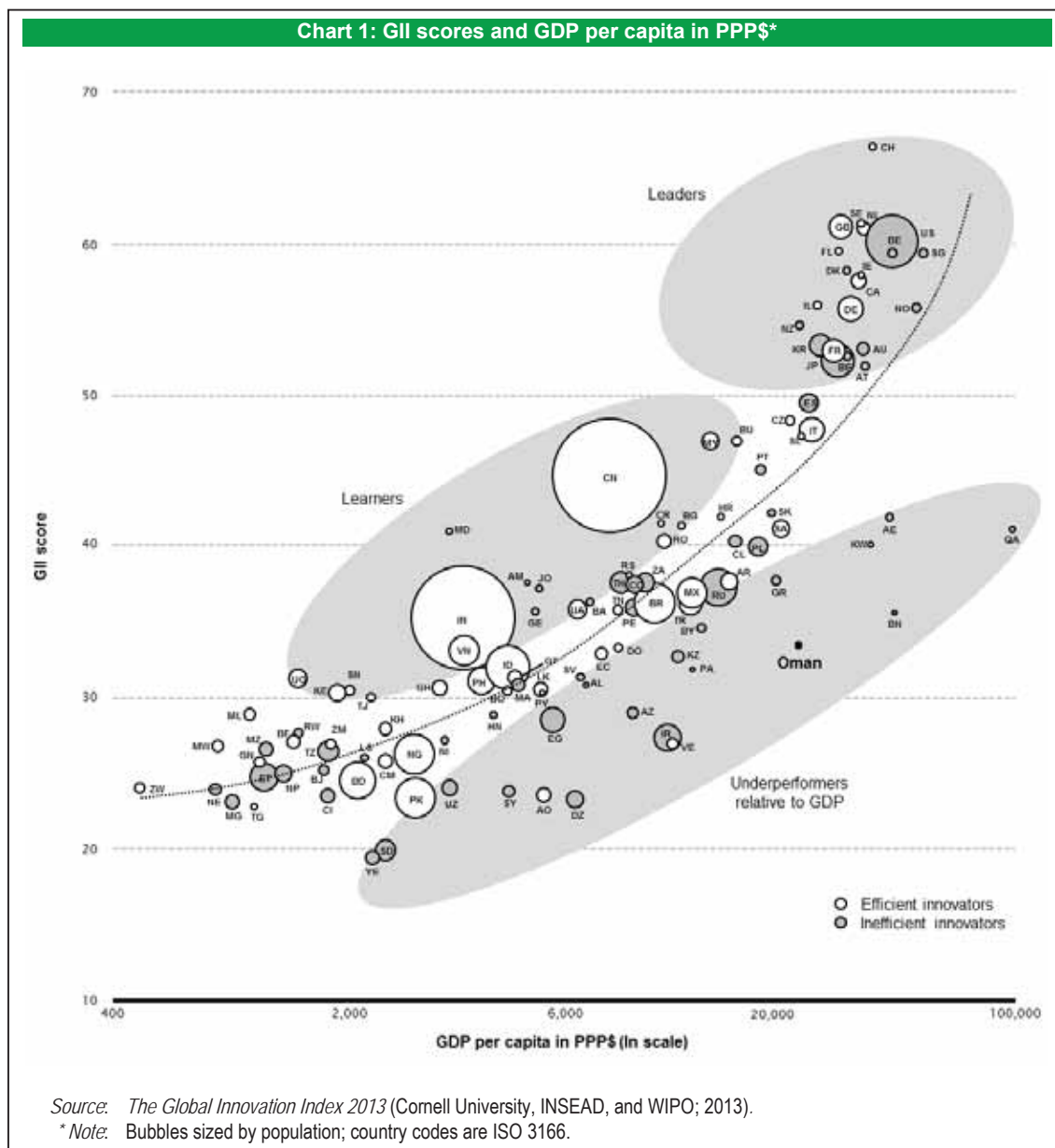
It is instructive to position GII performances of countries in relation to their GDP per capita. The following groups can be distinguished: leaders, learners and underperformers (chart 1). Oman is located in the group of innovation underperformers, along with other GCC countries such as Qatar, Bahrain and the United Arab Emirates, along with a number of other oil-rich countries such as Brunei Darussalam, Kazakhstan and the Bolivarian Republic of Venezuela. Chart 1 shows Oman’s position based on a GII score of 33.25 and a relatively high GDP per capita of more than \$20,000.

Box 2: The Global Innovation Index*

The Global Innovation Index is built on an innovation input sub-index and an innovation output sub-index.

1. The Innovation Input Sub-Index: Five input pillars capture elements of the national economy that enable innovative activities. Indicators are provided on (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication.
2. The Innovation Output Sub-Index: Innovation outputs are the results of innovative activities within the economy. There are two output pillars: (6) Knowledge and technology outputs and (7) Creative outputs.
3. The overall GII score is the simple average of the Input and Output Sub-Indexes.
4. The Innovation Efficiency Ratio is the ratio of the Output Sub-Index over the Input Sub-Index. It shows how much innovation outputs a given country is getting for its inputs.

* Note: For details on all the data used for computing the different indexes and their values for Oman, see *The Global Innovation Index 2013* (Cornell University, INSEAD, and WIPO; 2013).



2.2 Measuring Oman’s innovation system

Oman is ranked 80th on the GII, largely due to a lack of efficient use of an environment and assets that are advantageous from an innovation viewpoint. When comparing rankings on the input/output dimensions and the resulting ratio, Oman scores 53rd for innovation inputs, but only 111th for innovation outputs, producing an average rank of 80th in the global innovation index. In terms of efficiency ratio, its ranking is low: 134th out of 141 surveyed countries.

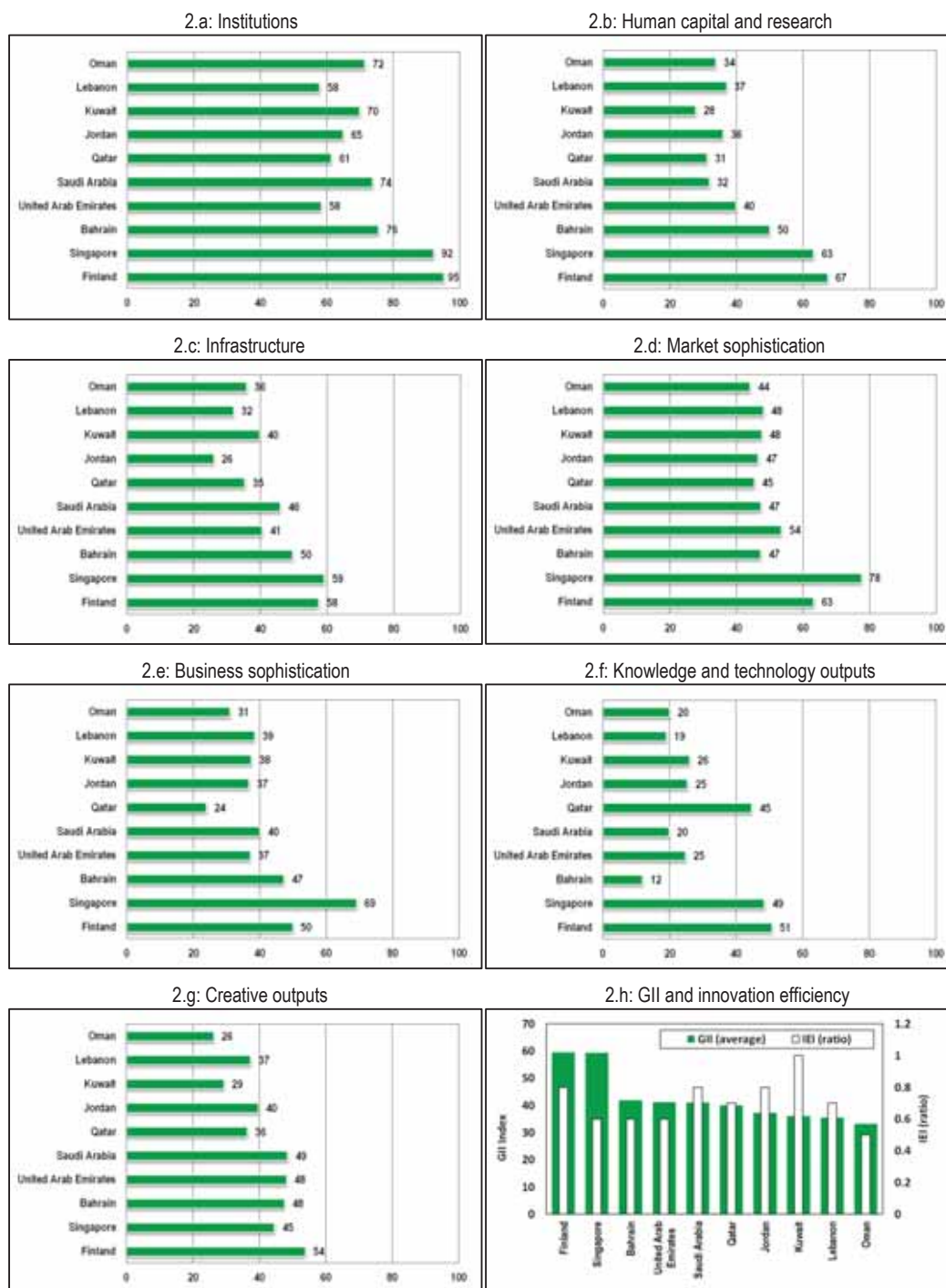
The GII rankings are only indicative, and should not necessarily be understood as an absolute evaluation of the innovation environment. However, they may suggest that Oman will need to scale up

its policy reforms process more rapidly in the near future.

It is useful to compare Oman’s performance in terms of the GII indexes and sub-indexes and their components with that of other countries in the subregion of similar size in terms of population. Bahrain, Kuwait, Qatar and the United Arab Emirates face, to some extent, similar challenges, while Jordan and Lebanon do not have oil or gas resources, but they have significant FDI inflows (charts 2.a through 2.h). For the sake of comparison with excellent performers at the global level, Finland and Singapore have been added to the picture.

Oman trails behind all the countries selected as comparators, both on the GII and the innovation

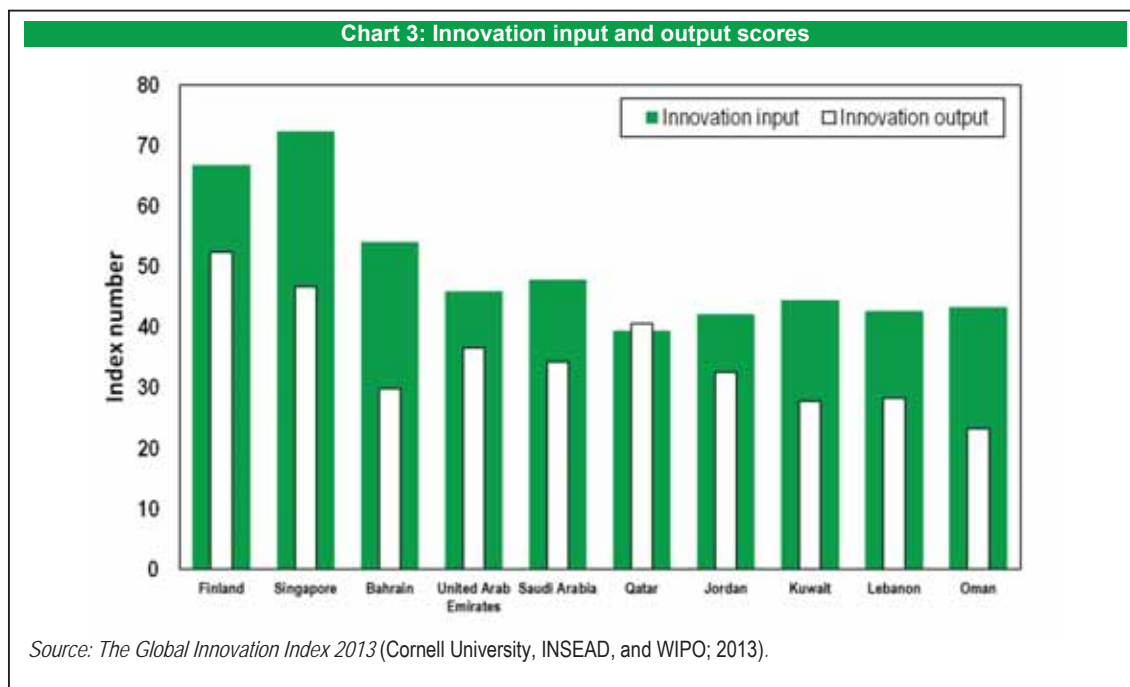
Chart 2: GII sub-indexes for Oman and selected countries, 2013



Source: *The Global Innovation Index 2013* (Cornell University, INSEAD, and WIPO; 2013).

efficiency index (chart 2.h). However, the picture presented requires a nuanced interpretation. It is interesting to observe that the United Arab Emirates has a much better performance than Oman on the GII (rank 38), but, like Oman, its performance is modest on the efficiency ratio (rank

133). Kuwait performs significantly better than Oman on the GII (50), while being very efficient (8). Qatar is relatively well positioned on the GII (43), but with a weak efficiency ratio (97). Jordan performs somewhat better than Oman on the GII (61), and is also much more efficient than Oman

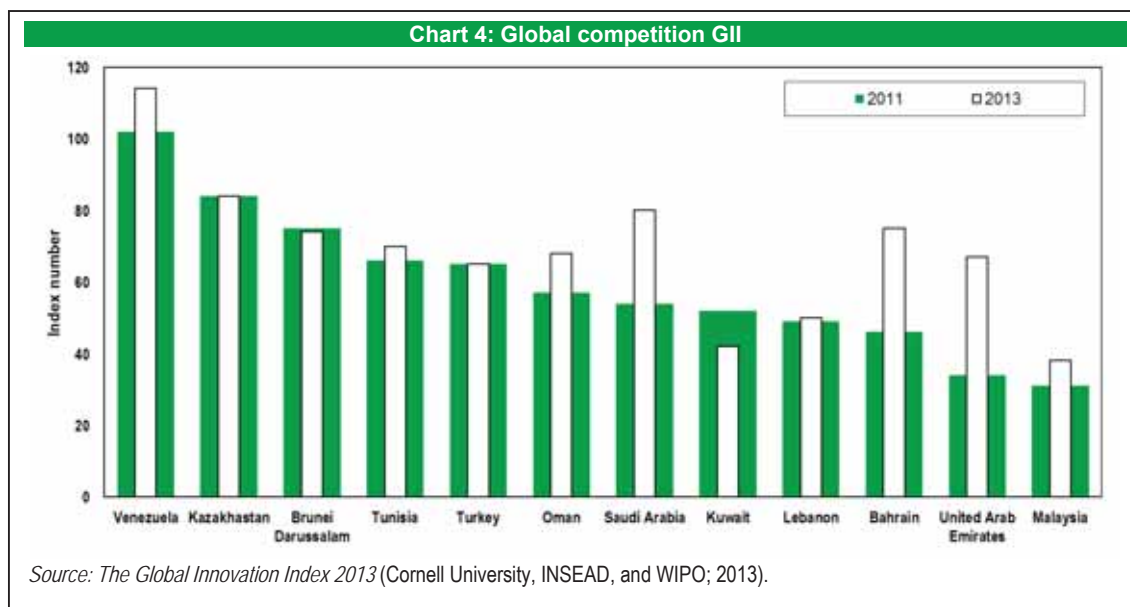


(73). Lebanon presents performances similar to Oman on the different sub-indexes. The main weaknesses of Oman on the input side appear to be on the market sophistication and the business sophistication indexes (charts 2.d and 2.e), indicating that its economy may not be sufficiently mature or adequately complex. On the positive side, and this is important, Oman is relatively strong on the institutions index (chart 2.a).

To conclude, in order to catch up with countries in the Arab Gulf region, Oman needs to improve its innovation infrastructure and climate and, most importantly, augment its innovative outputs through a more efficient use of its innovation assets (chart 3).¹⁴

2.3 The need for creative dynamism

On the output side the GII sub-indexes distinguish between two types of outputs: the “knowledge and technology outputs” (chart 2.f) indicator relates to traditional innovative products, such as patents, high-tech and other technology products; the “creative outputs” (chart 2.g) indicator includes trademarks, new business models, audio-visual creations and online creativity, such as web sites. Creative outputs embrace all forms of intangibles which proceed from innovation processes that are different from those leading to traditional innovation outputs, as they are easily reproduced, many having a digital incarnation and requiring



less finance to gear up for production. On both categories Oman performs poorly, with creative outputs faring slightly worse – ranking 119th – than knowledge and technology outputs with a rank of 102.

From a more dynamic perspective, it is possible to view the evolution of Oman's innovation performance in global GII competition compared with that of selected countries (chart 4). When looking at countries that are located near Oman in terms of GII and GDP per capita – with a GII score between 30 and 40 and GDP per capita of \$15,000–\$35,000 – and which, for the most part, are fairly dependent on oil and gas resources, Oman performs worse than practically all countries selected in the sample. The unfortunate reality is that Oman is losing ground in the global competition for innovation.

3. Framework conditions and the national innovation system

Framework conditions constitute the overall environment in which a national innovation system functions. Innovation systems theory postulates that the differences in innovation performance between economies are largely due to differences in how firms, universities, research centres, public agencies, and other innovation stakeholders interact, given certain framework conditions.

Indicators derived from the GII database and also from the WEF database¹⁵ can be used to establish the quality of key framework elements, including the governance climate, the business environment, infrastructure development, and human capital and research. These are discussed below.

3.1 Overall governance

The State organization

His Majesty Sultan Qaboos bin Said is firmly at the helm of Oman and benefits from a very strong aura of prestige. His Majesty determines the strategic course of the country, taking key decisions expressed in the form of Royal Decrees after consultations with concerned bodies. He occasionally intervenes in questions directly related to innovation and the business environment, as described later in the section on government policies and programmes. His Majesty Sultan Qaboos is Head of State, Prime Minister, its highest legislative authority and the Supreme Commander of the Armed Forces and Royal Oman Police. He is assisted by a Cabinet of Ministers, which is responsible for developing and implementing national policy on economic, political, social, executive and administrative matters, including proposing draft legislation.

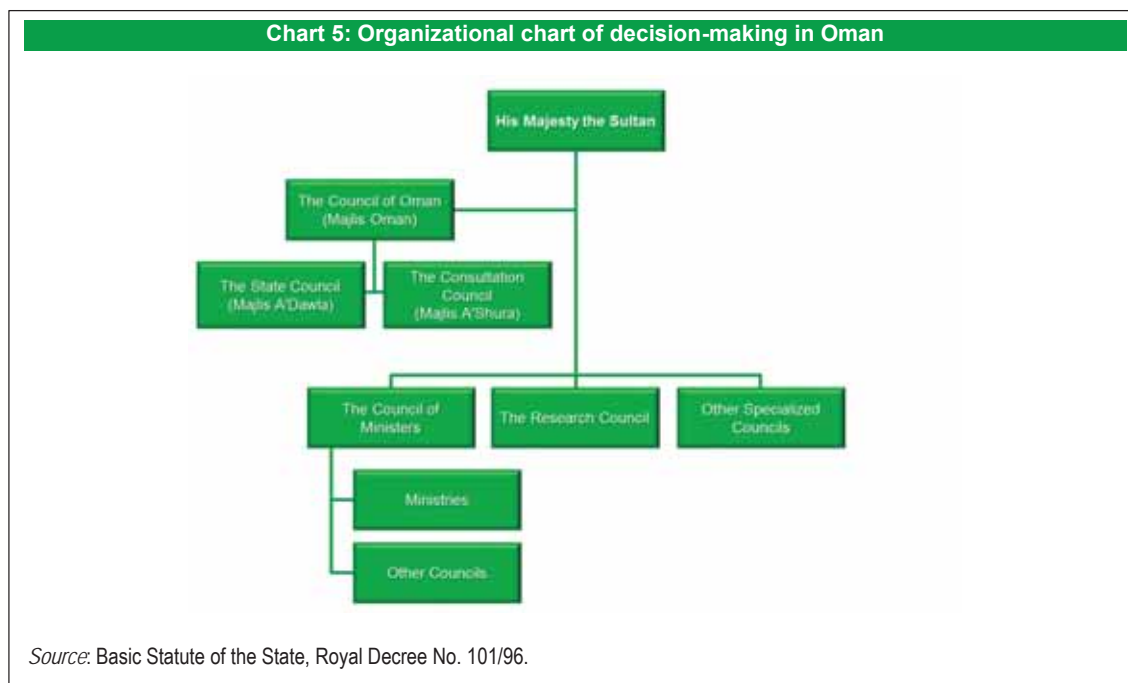
The Council of Ministers is chaired by a Deputy Prime Minister. Ministers enjoy considerable autonomy in their fields of responsibility. Particularly involved in the improvement of the innovation climate are the Ministers of Industry and Commerce, Education, Higher Education, Manpower, Agriculture and Energy. A Supreme Council for Planning, which replaced the Ministry of National Economy that was dissolved in 2011, was established to promote national reforms to address current and expected future challenges related to social, political and economic issues. It is charged specifically with development planning, services sector development, economic affairs and private sector affairs.

The Council of Oman, the highest level collective policy entity, consists of two bodies: the State Council (Majlis al Dawla) and the Consultation Council (Majlis al Shura) comprising in total 167 representatives and policymakers. The State Council members are appointed by His Majesty Sultan Qaboos and are distinguished Omani experts in their fields. The Consultation Council members are elected to represent their *wilayats* (districts). As of the Council's fifth term starting in 2011, His Majesty Sultan Qaboos has granted it new legislative and regulatory powers in a significant step forward in the modernization of Oman's governance processes. The State and Consultative Councils are now responsible for proposing legislative and regulatory decisions to support Oman's development. However, there are no firm indications that the Council is involved in policy design, implementation and monitoring of STI issues.

A number of agencies with varying degrees of autonomy are in charge of specific economic, social and technical issues. Among those of particular importance for the innovation ecosystem are The Research Council (TRC), which is in charge of R&D strategy and policy including innovation policy, the Information Technology Authority (ITA), and the recently established Public Authority for Small and Medium Enterprises Development (PASMED). Chart 5 presents the basic organization of decision-making in Oman.

Effectiveness of the political and institutional environment

According to international benchmark indicators, Oman has a relatively high level of political stability as also the trust of its citizens in public institutions and the political class. Moreover, there is significant confidence in the independence of the judicial system. There are 169 labour unions in Oman¹⁶ and an active tripartite process, "Social Dialogue Oman", which includes the Chamber of Commerce, the trade unions and the Ministry of Manpower. Oman performs relatively well on GII indicators for the effectiveness of government and



the regulatory environment – a sure sign that there is a strong government capacity to develop, enact and enforce legislation.

An important point to emphasize is the long-term and strategic planning approach that is systematically implemented by Oman. First of all, the adoption of a Vision policy initiated in 1996 had a time horizon to 2020. A large number of the planned objectives have been achieved, no doubt financed from national oil and gas revenues. A new Vision with a 2040 horizon is currently being elaborated. Secondly, there are the Five Year Plans that develop the Vision in operational terms, and for various economic and social sectors. This systematically structured, long-term approach is an obvious strength and a significant positive framework.

However, there are certain problems in governance that, while not specific to Oman, need the urgent attention of policymakers in order not to squander the strengths of the 2020, and upcoming 2040, Visions. One of these problems relates to decision-making processes, including inter-institutional consultations and joint policy development. The hierarchical organization and communication culture of certain institutions needs to be changed to permit more effective consultations and communication flows leading to decisions.

Greater and faster horizontal communication will also reduce the burden on the highest level of policy-making to act as information gatekeepers on levels of detail that are not meaningful in terms of seniority and competence. Improving inter-

institutional communication practices is a fundamental requirement for developing an innovation system. Policymakers should therefore try to overcome the natural tendency of their bureaucracies to compartmentalize their work; otherwise the lack of collaboration will hamper the work of the innovation system, resulting in delayed decisions and slow implementation of policies.

3.2 Macroeconomic context

Oman's economic growth rate has been maintained at a satisfactory level, at over 4 per cent a year, thanks to a very active policy of infrastructure development, including air and sea ports, roads, water, energy and housing. Fuelled by oil revenues, such investments have helped to create jobs and wealth, with a positive impact on trade, services and some manufacturing.

However, the underperformance of one of the main macroeconomic components – the national labour market – is among the major obstacles to the development of the innovation potential of Oman. Many new jobs have been filled by lower cost, imported labour, which, given the liberal labour regulations, is easy to hire and fire. Indeed, Oman is the world leader on this GII indicator.

A liberal and open labour market is often seen as a positive factor in international benchmarking on the business climate. However, overly lax labour regulations may raise issues relating to both the treatment of foreign labour and the development of a domestic labour force that is able to meet the needs of an innovative, knowledge-driven economy.

A problematic labour market for innovation and diversification

Economic growth based on importing a large amount of low-cost labour is a strong disincentive to innovation and technology-based growth and diversification of the economy. A minimum wage policy, established recently, has set a rate of OMR 325 per month.¹⁷ While this represents some progress, this rate is, nevertheless, quite low even though local labour also benefits from various social programmes that employers are obliged to provide to Omanis, and which ultimately increases the cost of employing them.

The Omanization policy, introduced in 1988¹⁸ and aimed at compelling the employment of local labour, has had some positive results, while having important goals. The proportion of Omanis now employed in the banking sector has reached 90 per cent, in the oil and gas sector 65 per cent (compared with a target of 85 per cent), in the construction sector 10 per cent (compared with a target of 30 per cent), but in the small business sector it is only 8 per cent (compared with a target of 30 per cent).¹⁹ This objective makes sense if the increased staffing of Omanis in the productive sectors of the economy leads to improvements, for example in productivity and in business sophistication. Improvements in qualifications, skills and incentives are necessary throughout the entire education system to respond to industry requirements. The fundamental link between productivity and remuneration needs strengthening. Much remains to be done in this regard. At the same time, given its oil wealth and development goals, it would be counterproductive to rely too much on the Omani labour force and isolate the country from the global economy and migration trends.

The dominance of oil wealth and other constraints

In addition to labour market issues, there are several other macroeconomic constraints on innovation, especially the economic dominance of the petrochemical industry and its oil revenues. Such dominance creates disincentives to innovation, because the economy grows mainly to service this sector. Another problem is that fuel is subsidized at OMR 450 per capita per year, which deters private investment in the development of commercial renewable and sustainable energy resources. Aware of this, the Government aims to use oil revenues to increase spending on research and innovation of up to 2 per cent of GDP by 2020. Some innovation has been achieved, such as the use of solar steam generators to replace gas in enhanced oil recovery.²⁰ Solar energy is getting increasing attention from the public and private sectors, but it is focused on applications related to

lighting and desalination, especially in remote and off-grid areas. Outside the oil and energy sector, industry has little interest in innovation, as technology is largely imported, and technology transfer often seen as the better and cheaper solution.

The economy seems to be moderately affected by the so called “Dutch disease”, by which an increase in the exploitation of natural resources (inducing a large inflow of income and a stronger national currency) leads to a relative or, in extreme cases, an absolute decline of the manufacturing or agricultural sectors. This occurs through a decrease in competitiveness of domestic sectors, as imports financed by natural resource exports become more affordable because of an appreciation of the national currency. While this process may be partially balanced out today by importing low-cost foreign labour, the Dutch disease phenomenon may become a more serious issue in the longer term (Ebrahim-Zadeh, 2003).²¹

3.3 The business environment

An economic structure dominated by large firms

The Omani economy is dominated by a few large companies even though there are 91,000 active SMEs contributing to 13.8 per cent of GDP.²² However, the bulk of the small and micro businesses are operating in the informal sector, and only about 100 SMEs declare taxes. The intermediary layer of firms is insufficiently developed.

Specific factors, such as the country’s merchant tradition and the current preference of Omani people for employment in the public, rather than the private, sector, largely explain the slow growth of SMEs in the manufacturing sector. This is because many public sector jobs offer better salaries and benefits than private sector jobs, but also, there are structural and institutional obstacles to the development of SMEs, as discussed later in the section on the business environment.

Multinational contractors and international firms were the initial investors in the economy during the 1980s and 1990s, but since then there has been a steady increase in the number of Omani companies. At the end of 2013, the MSM 30 index showed an increase of 18.6 per cent over the previous year. The market capitalization increased by around 21.4 per cent to reach OMR 14.2 billion (\$36.9 billion) in 2013 from OMR 11.7 billion (\$30.4 billion) in 2012. Outside the State oil and gas businesses, private sector activity is steadily growing. An indication of the relative size and importance of various sectors is presented in table 1.

Table 1: Revenues of Omani firms listed on the Muscat Securities Market, by sector (millions of Omani rials and United States dollars)

Sector	Revenue (OMR)	Revenue (\$)
1. Oil and Gas	1,251.8	3,254.7
2. Banks and Insurance	840.7	2,185.8
3. Telecoms and ICT	669.5	1,740.7
4. Engineering	402.0	1,045.2
5. Food and Agriculture	389.9	1,013.7
6. Metals	386.3	1,004.4
7. Power	259.0	673.4
8. Construction Material	172.0	447.2
9. Chemical, Plastics and Pharmaceuticals	118.8	308.9
10. Ports	69.0	179.4
11. Tourism	39.6	103.0
Total	4,598.6	11,956.4

Source: Thomson Financial (accessed November 2013).

The share of net foreign investment inflows in gross domestic product (GDP) tends to fluctuate substantially from year to year. This is probably partly because of Oman having a small economy without a major manufacturing sector, and partly because of large outflows of remittances by foreign workers. Those remittances in the form of net income sent abroad reached OMR 3.1 billion in 2012 against OMR 2.8 billion in 2011.²³ In addition, there is a considerable amount of hidden trade, and many Omani-fronted businesses are, in reality, managed, and possibly owned, by foreigners.

An unfavourable business environment for SMEs

According to GII indicators, Oman's overall business environment is satisfactory, at 45th place in the rankings. However the business environment looks less favourable in terms of such indicators as conditions to start a business, getting credit, venture capital deals, and other factors that determine the dynamism and renewal of the economic tissue through firm creation and growth. There are few, if any, angel investors and venture capitalists. The financial and banking sector needs to strengthen its support for SMEs. At the same time, public sector support for SMEs has been modest, though recent decisions indicate some improvement (see section on government policies below).

The result is that many SMEs have not been able to grow. Recognizing the potential contribution of SMEs to diversification and growth of the economy, and for increasing employment opportunities, several measures are being taken to develop the required infrastructure and devise necessary policies for SME development. The Central Bank of Oman has advised banks to allocate 5 per cent of their total credit to SMEs by December 2014. To encourage lending to SMEs, the prudential requirement for banks to lend to such enterprises

has also been relaxed in terms of general provisioning requirements and risk weighting.

Another problematic issue is the competitiveness of the domestic economy and its markets. According to business executive surveys reported in the GII, the conditions of local competition are moderately good (with a rank of 52 for intensity of local competition). However, the absence of a strong antitrust authority and an enforced competition law impedes the creation of an economic environment conducive to the development of a dynamic SME sector, and especially of innovative firms, as abundantly demonstrated by the literature and by international experience.²⁴ Also, bidding conditions and the process for attribution of public procurement contracts remain opaque. Finally, the protection of IP is of functionally limited, even though the perceptions gathered through international surveys are positive. According to the WEF indicator on perceptions of IP protection in Oman, including anti-counterfeiting measures, Oman ranked 20th out of 139 countries for IP protection in 2010, up from 26th out of 133 in 2009. With a score of 5.28, perceptions of Oman's IP protection framework are considerably higher than the average of 3.7. However, local inventors and business people in the SME sector are much more critical – a divergence that can be explained by the biased view of large firms' executives responding to international surveys. Part II of this report deals more substantively with IP issues.

A risk-averse society

Entrepreneurship and innovation are not part of the basic education, and are not seen as goals to which people aspire in a society where oil wealth makes people less eager to take risks. The result is a strong preference for investing in tangibles, or in short-term trade. People may not find sufficient reasons to take the risk of starting or joining

businesses if safe and well-paid public sector jobs are available.

An important source of poor innovation performance in Oman is the extremely risk-averse disposition of entrepreneurs, financiers and policymakers. This general assessment was confirmed in a number of interviews during the interaction of UNCTAD's STIP Review team with Omani stakeholders. Failure seems to be perceived as an irreversible process, and this strangles the development of tacit knowledge – a major innovation component – as failures are rarely translated into experience that can be used to succeed in a subsequent iteration of innovation. Policymakers need to lead in bringing about a shift in broad societal attitudes towards risk and uncertainty, as any investment in innovation is fundamentally and potentially perilous.²⁵

3.4 Infrastructure

Good physical infrastructure

Overall, the general physical infrastructure is excellent. The quality of roads is high and continuously improving. The electricity network functions well, and distribution and consumption rates (measured in terms of kilowatt-hours per capita – kWh/cap) are high. The development of such basic transport and energy infrastructure is an asset for the country, as it helps to connect the different provinces, and notably the interior of Oman, with the capital. At the same time further infrastructure development through major port, airport and railway projects²⁶ can stimulate economic growth. However, such activities have only a mild impact on innovation and entrepreneurship. Certain measures can be taken to enhance the STI stimulus of an improved physical infrastructure, such as public procurement favouring local SMEs, and regulatory actions to promote environmental norms and sustainable environment-friendly practices during the construction and later, the use of infrastructure facilities.

Inadequate digital infrastructure

In contrast with the physical infrastructure, the current development of the ICT infrastructure should be a source of concern. While mobile telephone equipment is available and use is high, as in the rest of the Arab Gulf region, indicators for ICT access and use are not good (WEF/SRI). Oman ranks the lowest of the GCC countries, with a low broadband subscriber rate of just 2.7 per 100 inhabitants.²⁷ Another key factor in broadband use is the cost of connection. Oman's telecommunications providers charge significantly higher prices than those of their neighbouring countries. In addition, GCC country providers supply an Internet connection that is three to four

times the bandwidth speed of the Omani providers (WEF/SRI). The monopolistic position held by the national company, Omantel²⁸ (with government ownership of 70 per cent) is an obstacle to improving the situation, and the establishment of a second private operator (Nawras, owned by Qatari Qtel and partners) has not led to any significant change in this situation. With the blocking of VoIP channels – for example, Skype, which cannot be used locally – Oman performs poorly on the e-readiness index, trailing behind other GCC countries (WEF/SRI).²⁹ While government web services are well developed, thanks to an active policy of e-government (see section below on government policies), there is a lack of vibrant Omani ICT companies. Achievements are more the result of government agencies' internal efforts than those of the private sector or of community development (Andersson et al., 2010).

3.5 Human resources and research

An education system in need of reform

The performance of the education system requires concerted policy attention aimed at substantively improving educational outcomes. The need to improve basic education in Oman is confirmed by the fact that most tertiary educational establishments require their students to take "foundation courses" before beginning undergraduate studies. Piecemeal information from Trends in International Mathematics and Science Study (TIMSS) produced by the International Association for the Evaluation of Educational Achievement (Boston) indicates that Oman performs rather poorly in international education tests. This seems to be partly explained by the Omanization policy that, in the education sector, has involved systematically replacing foreign teachers with local ones, even though a number of those local teachers do not have the required level of competence. Another issue is the tendency to focus on quantity rather than quality. As the Omani system lacks accreditation standards and mechanisms, and quality control relies on an inspection system, foreign accredited schools are now being established and private schools are proliferating, with about 470 private schools operating today.

In response, the Ministry of Education is in the process of developing professional standards for teachers, school principals and supervisors. These standards will be important for helping to clarify roles, evaluate staff performance and determine needs for appropriate staff development programmes. The Ministry is also developing curriculum standards and assessment standards. These should define for schools and the public what Omani students of different ages are expected to achieve in a range of important

subjects, and the progress expected of them from year to year. The standards should also help to establish the criteria for assessing the attainment and progress of students at each grade level, and form the foundation for a framework for evaluating and managing the performance of schools and teachers.

Tertiary education on the rise

Indicators on tertiary education present a contrasting picture. The level of gross tertiary enrolments is above the GCC average and is increasing -- with a majority of female students. The gross tertiary outbound enrolment (Omani students going abroad) is good, and indicates a satisfactory quality of learning. An increasing number of students are choosing science and technology (S&T) disciplines, although social sciences continue to attract the majority of students.³⁰ Despite these positive trends, there is a serious mismatch between the output of the education system and the requirements of the labour market, as in other Arab countries (Centre for Mediterranean Integration, 2013; Andersson and Abdelkader, 2012). Because of this, public corporations and the private sector, which demand competence and productivity, depend heavily on foreign expatriates with tertiary degrees. The public sector, on the other hand, makes only moderate demands on workers and offers generally high salaries. It therefore attracts a number of Omanis who prefer working in the government sector and civil service.

Limited research capacities

There are no statistics available on R&D efforts in Oman. It is generally estimated that the country spends 0.2 per cent of GDP on R&D.³¹ This is a very low percentage, particularly considering the level of GDP per capita, but it is in the order of magnitude of other GCC countries. The extent of sharing of R&D spending between the government and the business sectors is not known. It is possibly equally shared if one includes the public oil and gas company, PDO, in the business sector. The bulk of the public research infrastructure is in the universities and in the government research centres established for the agriculture and fisheries sector. The total number of researchers in full-time equivalent is estimated to be about 2,000 persons.³² The quality of the research institutions is considered to be broadly comparable to that of the other GCC countries (WEF/SRI).

4. Key interactions I: Business and academia

Most indicators of the GII assessment show modest performance on knowledge and innovation outputs, such as scientific articles, patents or the manufacture of technology products, as well as on

creative goods and services such as media products and web services. The foundations of the innovation system seem fairly weak based on data such as the knowledge capabilities of firms (expressed as the number of knowledge workers or R&D performed by businesses) and knowledge absorption, as measured by imports of ICT services. On the other hand, innovation linkages seem to be growing, with increasing university-industry research collaboration and within joint-venture strategic alliances, mainly in the energy sector. However, the depth of such inter-linkages seems to be modest. This section examines in more detail the strengths and weaknesses of key actors of the innovation system and their interactions. It makes extensive use of the information gathered by the UNCTAD mission's field interviews.

4.1 Business and industry

Oman's economy is dominated by large firms that operate mainly in the petrochemical and natural resources, construction and trade sectors. The innovative activity deployed by such holdings is not negligible, but it is insufficient to spur innovation throughout the economy and buttress the functioning of a meaningful national innovation system. The innovation that takes place mainly benefits several large firms and the companies operating under their umbrellas. This part of the assessment is largely based on discussions between business leaders and UNCTAD experts held in May 2013, and is qualitative in nature. It also presents a summary of key issues and concerns.

Large Omani companies: Cautiously engaged in innovation

The Government has majority (60 per cent) ownership of Petroleum Development Oman (PDO), in addition to stakes in Royal Dutch Shell (34 per cent), Total (4 per cent) and Partex (2 per cent). PDO dominates the oil and gas sector and has a solid R&D infrastructure. It has been developing advanced technology for enhanced oil and gas recovery. So far, such technology seems to have been used only by Shell for its own operations worldwide. There are few, if any, spin-off businesses emerging from this innovative endeavour. Contacts and joint work between PDO and university and other R&D structures seem to be limited. More generally, PDO seems to function as a kind of isolated island within the Omani innovation system. A few large private holdings and conglomerates have ventures in many diverse fields as described in box 3.

The UNCTAD team visited several companies that are parts of these holdings, including Bahwan Engineering Company (BEC). BEC illustrates well the modus operandi of large Omani industries. It is

Box 3: Omani private sector holdings

The Shaksy Group holding company was founded by Said bin Salim Al Shaksy and has interests in companies operating throughout the GCCs since 1976 including several Joint-Stock Companies, Al Bank Al Ahli Al Omani SAOG, Oman Fisheries Co. SAOG, and Oman Hotels Co.. The group includes also Shaksy Engineering Services, Hani Projects and Marketing, Midwest Oilfield Services, Hani Oilfield Supplies & Services, Western Engineering, and Scitech Laboratories.

Another much diversified company is The Suhail Bahwan Group. Established in 1965 in the Muscat Souk, it is today a large operation in engineering and construction, manufacturing and industrial investments, information technology, trading, and specialized services activities. The Suhail Bahwan Group comprises more than 40 companies with a combined annual turnover of more than \$3 billion (2008). It is particularly active in fertilizer production projects, in Oman and internationally, and it plans to become one of the largest urea producers of the world.

Mohamed & Ahmed Alkhonji LLC (MAA). MAA is a contracting, technology-based products and services company, offering a wide range of products and services for machinery, engineering, automotive, building and construction, and health and safety markets. Founded in 1920 as a trading organization, MAA is fully private owned and controls its own capital.

engaged in very diverse activities, including manufacturing, chemicals (urea, sulphuric acid), services, and travel and tourism. The company started out as an air conditioning service company in 1977, and it now employs 20,000. While it has 600 engineers, there is no in-house R&D. The introduction of new technologies is mainly accomplished in joint ventures with international partners, and therefore there is little incentive to innovate inside the firm or in cooperation with other, smaller firms, R&D entities or academia. For example, in enhanced oil recovery, BEC has been partnering with SNF France for using polymer-flooding technology. Local subcontracting is managed by an “in- country value” policy, whereby local suppliers are preferred even if their prices are higher – but only up to 10 per cent higher – than the best international price.

The private sector is perceived by dynamic segments of the economy as relatively conservative: many top executives in the large companies have a hierarchical, top-down style of management. Large Omani firms are generally managed in a reactive manner, adjusting to changes after the fact, instead of leading through innovation. This does not encourage spin-off activities, or fruitful subcontracting and linkages between large and small firms. Local demand for innovation is poor, as there is an overwhelming preference to conduct any technology transfer through international trade.

Limited technology transfer and upgrading via FDI

Many, if not the majority, of the large firms in Oman have some kind of joint-venture arrangements with foreign partners, and work under their technological guidance. For instance, in the engineering field, most companies work on design plans provided by foreign partners. In general, there are no particular obstacles to this kind of cooperation to develop indigenous technological capacity. However, problems arise when such international partnerships are expected to interact and support the domestic SME sector

and bring it into the value chain in a supportive role. Outside the petrochemical industry interactions are low.

Another issue relates to fiscal and other incentives to enhance technology through joint ventures and FDI activities. One important obstacle is that the export promotion agency, PAIPED, has no authority to negotiate on the responsibilities of joint ventures and FDI firms or to propose incentives, while the authority for negotiating these is fragmented among different ministries. A number of large international technology companies that are active in the GCC region are based in Saudi Arabia, rather than in Oman, as Oman offers a relatively small domestic technology market. In addition, regional cooperation processes in the GCC are weak, with most firms and institutions looking to partner outside the region rather than among each other.

Uneven distribution of laboratory and testing facilities

The basic laboratory and testing facilities available in Oman seem to be well equipped, according to the firms and universities visited by the UNCTAD mission. However, for larger scale and more sophisticated equipment, facilities in the United Arab Emirates or Saudi Arabia are used. There are some private facilities to serve the needs of industry, such as Scitech Laboratories, a multidisciplinary facility based in Muscat. Established in 2007, it provides testing services to industries, for example for construction materials, and for chemical, environmental and microbiological testing. Scitech Laboratories has an ISO 9001: 2008 certification and is a partner of the Chinese Certification and Inspection Company.

While large companies operating in the engineering, building, chemical and related sectors may be adequately served by the existing laboratory and testing services, there are no independent facilities for prototyping, which remains a major problem for the SME sector and for aspiring innovators. Such activities are often

outsourced abroad, with Malaysia cited as one destination. Innovation projects that are funded through TRC can have their prototyping outsourced worldwide, according to the innovator's preference, on the condition that comparable facilities are not available locally and high standards of execution are maintained. Several sectors also lack certification and standards structures and procedures. Those that exist, as in the PDO, are not available to firms outside the business network or holding, and therefore exclude most SMEs.

Industrial and technology parks and free zones

Today, much of Oman's industrial activities take place in one of eight industrial estates – Rusayl (near Muscat), Sohar, Raysut, Sur, Nizwa, Buraimi, Al Mazunah and Smail. Oman also has four free zones, in Salalah, Sohar, Al Mazunah and Al Duqm. The Oman Public Establishment for Industrial Estates (PEIE) supervises these sites. Additional free zones are being planned in border regions, and business centre facilities are being developed for visiting entrepreneurs exploring opportunities. Their role in industrial growth is important, especially since the oil and energy sector, being capital-intensive, does not generate many jobs.

A recent development has been the establishment of a ninth high-tech industrial estate – Knowledge Oasis Muscat (KOM), a technology park located near Muscat and close to the Rusayl Industrial Estate, Innovation Park Muscat and Sultan Qaboos University. It provides office and business incubator accommodation to technology-oriented businesses, including technology start-ups. KOM currently hosts more than 60 firms. Despite its location, however, few links and synergies with academia have evolved, associated foreign companies appear to have a weak presence and hardly any R&D, and the incubation efforts are still at an early stage.

As for free zones, this is a relatively new concept for Oman, as the legal framework was established only in 2002 through Royal Decree 56/2002. The goal of the free zone policy is to attract FDI by providing a receptive business environment. FDI is attracted more to free zones than to industrial parks, as the former have no requirements concerning local linkages, labour or sourcing. While technology transfer occurs through investment – for example OCTAL has a \$5 billion polyethylene investment operating since five years in Salalah Free Zone – the Government could play a greater role in facilitating such transfers.

There are a number of fundamental problems common to the industrial estates and free zones.

There is considerable independent action and a low level of collaboration, along with the lack of a strategic perspective among firms. Sector development is focused on mining and services, and construction materials, with modest innovation ambitions. With regard to SMEs, their activities are poorly linked among each other as well as with sector stakeholders, and many of them are very traditional in their business approach and not innovative. A recent survey of PEIE tenants showed no investment in product design, innovation or productivity. There were no IP issues raised by any of the constituent businesses, indicating a low level of technology transfer. Representatives of parks and zones maintained that a higher level of system-wide leadership on innovation strategy was needed, while support at a single ministerial level was welcome, but insufficient.

Efforts are being made for setting up SME incubators, such as in the Salalah Free Zone, but many requests for incubation come from entrepreneurs with academic knowledge and modest entrepreneurial and practical experience. To remedy this, PEIE provides some skills training for industry needs, such as ethical business practices and the creation of business opportunities. It is clear that SME start-ups require more than physical space; they also need advice, coaching and contact with venture capitalists. Often, firms have to provide full logistics themselves, such as transport (for workers), catering and medical services.

Free zone representatives suggested that a major obstacle to enhancing technology transfer is the quality of education, and were concerned that, SQU, for example, does not produce graduates with competencies relevant for firms. For example, communication skills are generally missing and curricula do not contain courses on business practices, management skills and business research skills. It is not helpful that firms do not participate in curriculum development for schools and universities. As mentioned earlier in this review, there is a need to improve cooperation with universities on R&D and technology adaptation and innovation.

On several occasions, PEIE has arranged for private financing to enable the development of particular firms. PEIE estimates that the success rate of SME start-ups is about 50 per cent after three years, which is the time allowed in the incubator. Such a success rate is fairly high by developed-country standards, but it suggests that new businesses are not innovative and do not seek risk and opportunity with the same eagerness as their peers in more developed economies. For example, the Silicon Valley start-up incubator Y Combinator³³ has a 93 per cent failure rate of its investments after five years, and this is based on a

highly selective acceptance rate, where, on average, one in twenty applicants are accepted for incubation.³⁴ Similarly, the United States National Venture Capital Association estimates that only one to two out of ten businesses backed by venture capital produce substantial returns.³⁵

Several private and State-owned firms suggested that the agendas of PEIE, PAIPED and MOCI would benefit from better synchronization and coordination. In particular, the UNCTAD mission in December learnt that the free zone relationship with PAIPED was dormant, and that its role was not clear to firms and entrepreneurs. Given this situation, the Supreme Council should revise instructions on commitments under Vision 2020 and agree on a global framework linking all the above agencies for the joint promotion of Oman.

Between the contrasting opinions, on one hand that promotion is a solitary effort and on the other that over-coordination can be a disincentive to entrepreneurs, there is considerable middle ground. Creating new business opportunities through innovation, rather than linking existing SMEs which may be competing at similar low-technology levels, requires deeper consideration. There is also an element of competition among parks and zones, and therefore third parties, such as PAIPED, are not always involved, as negotiations with clients are often confidential.

With regard to clustering, surveys by WEF give high scores to Oman.³⁶ This seems to be mostly due to the development of industrial parks, as described above. Certain sectors, such as fisheries and aquaculture, could only develop in a cluster with related services. However, according to experts and entrepreneurs whom the UNCTAD mission met, there seems to be little collaboration among clustered firms, and more effort is required to generate real results, including engaging in international collaboration with foreign firms, universities and research institutions. This is clearly an area where cross-cutting policy action will need to match efforts at physical clustering, and where an innovation system strategy may offer better results.

4.2 Higher education and research

Relatively well-developed university and colleges

The first public university in Oman, the Sultan Qaboos University (SQU), was founded in 1986. SQU has nine colleges: Arts and Social Sciences, Economics and Political Science, Education, Law, Nursing, Agriculture and Marine Sciences, Medicine and Health Sciences, Engineering, and Science. It also runs a number of research centres.³⁷ And there is a university hospital on the campus. SQU is open to Omanis only and hosts

more than 15,000 students. The first year of studies is a foundation year and focuses on the study of English.

The Ministry of Higher Education administers six colleges of applied sciences in regional centres outside Muscat, in Ibri, Nizwa, Salalah, Sohar, Sur and Rustaq. Their goal is to build capabilities in international business, communications, information technologies, design, engineering, applied biotechnology and education. The total number of students is about 8,000.

The Ministry of Manpower operates the Higher College of Technology in Muscat and six colleges of technology in the regional centres of Al-Mussana, Ibra, Ibri, Nizwa, Salalah and Shinas. The programmes for the colleges were designed in cooperation with various industrial sectors in 2003 to respond to industry needs. They have a total of 40,000 students, and some 4,000 diplomas are awarded each year. The rate of employment of those leaving the colleges with a diploma reaches 65 per cent, but it is uneven, depending on the disciplines, the highest rate being for engineering graduates. The Higher College of Technology in Muscat is the second largest higher education institution in Oman with 7,300 students.

In the National Project Program, a training curriculum is being designed and developed jointly by a firm and a private training institute to meet specific needs for particular jobs. The Ministry of Manpower allocates Omani job-seekers to study the approved occupational programmes along with the necessary financial support. After follow-up and evaluation by the Ministry, successful graduates are hired by employers in the concern/industry. On average, 3,000 Omani job-seekers are improving their qualifications and finding jobs through the National Project Program every year.

Several government bodies run their own training, research and academic programmes. The Ministry of Health runs a number of health institutes to prepare nurses, paramedics and pharmacists. The Ministry of Awqaf and Religious Affairs operates the Institute of Sharia Sciences. The Central Bank of Oman runs the College of Banking and Financial Studies.

There are also 19 private colleges and 7 universities, which respond to popular demand for studies in business administration, engineering and computer sciences. Generally affiliated with European, Australian or American institutions, their language of instruction is typically English. Two illustrative cases are the German University of Technology, affiliated with Aachen, which hosts 650 students, and Al Sharqiya University, a private university established in 2009 in Ibra in

cooperation with Oklahoma State University and Texas Technological University, which has 1,200 students.

Higher education, research and innovation: Mixed experiences

In order to grasp opportunities and obstacles facing the development of higher education in Oman, the UNCTAD mission visited several important establishments of diverse size, status and orientation: SQU, University of Nizwa, the Caledonian College of Engineering, and the German University of Technology. The following are brief descriptions of its findings.

SQU has acquired a reputation in the Gulf countries for the quality of its academic programmes, and ranks 50th among Arab universities. At the same time, it is confronted with a number of issues.

- The teaching staff numbers about 1,000 lecturers and professors, with two thirds holding PhD degrees. A significant proportion of the faculty used to come from foreign countries, including developed economies. However, in recent years there has been a significant turnover of lecturers and professors – more than 25 per cent a year. This worrying trend seems to be due to low salaries for the teaching staff, compared with those offered by other establishments in the region (Qatar, United Arab Emirates and Saudi Arabia), and also to unfavourable working conditions that are affected by a heavy administrative burden and excessive bureaucracy.³⁸
- Over the years, SQU departments have built research capabilities. However, due to their time spent on administrative and teaching tasks, there is little research conducted in the university departments, although several research publications have been launched. To remedy this situation, SQU is working on establishing “research only” academic staff, and the Government is providing incentives for research activities, some of which are described in the section on government STI policies. Indeed, SQU receives the bulk of the funding of TRC research programmes.
- Contacts with other academic institutions in Oman are developed principally on a personal basis, and do not lead to much effective joint research or to an effective and efficient use of research infrastructures and facilities, including laboratories and equipment.³⁹
- Contacts for research projects with the business sector remain few and are rather informal. Researchers are more interested in publishing in international journals and participating in conferences. A number of projects are developed with the Industrial

Innovation Centre, and SQU has established an IP office to advise on and manage IP issues.

- International cooperation takes shape on an occasional basis through formal networks established principally in the Arab world, and notably in the Gulf region, for instance with universities in the United Arab Emirates, on a 50/50 cost and outcome-sharing basis.

The University of Nizwa (UoN) was established in 2002 as a private, non-profit entity. It is located 250 km west of Muscat in the old inland capital of Oman, which has a historic tradition of teaching and instruction in the disciplines of law and government. The university aims to serve both national interests in specific needs and the development of the surrounding region.

- While R&D structures are established in UoN in order to collaborate with firms, a culture of cooperation and links with industry has not yet developed. Most companies in and around Nizwa are very small and few have the capital and the capacity to support research. There are some research proposals for tourism, but there are difficulties in demonstrating value added to firms. A Centre for Consultancy Studies has been established recently, which provides mainly feasibility advice, and has cooperation arrangements with the Industrial Innovation Centre (IIC) and TRC on the crafts industry and agriculture and fisheries.
- In order to finance its activities, UoN is also an investor, and is embarking on developing a retail business which it proposes to use for training in entrepreneurship and commercial disciplines to complement its academic programme. It is also setting up an incubator for businesses and innovation-related R&D projects. In addition, it is developing cooperation with suppliers and producers of technical equipment used in research with the aim of becoming a training centre for equipment operators.
- Although it is a private entity, UoN is very closely supervised by the Ministry of Higher Education. There have been comments that the Ministry is adopting a micro-management approach, leaving little autonomy to the heads of establishments, and taking on a decision-making role relating to non-strategic issues such as conference programmes, speakers and related expenses.⁴⁰ This presents the risk of the Ministry losing sight of broader strategic issues by being bogged down in the details of governance of establishments, which can be an arduous task, unnecessarily using up resources while slowing down progress in programme implementation.

The Caledonian College of Engineering (CCE) was established and funded by the GALFAR Engineering and Contracting Company, and provides courses in several fields of engineering and technology, principally to train students and staff for its own needs. A number of concerns were raised by the CCE leadership:

- A general issue raised by CCE is the relatively poor quality of primary and secondary education. While the CCE has supported planned policy changes to develop a unified standard curriculum, in tackling this issue today CCE requires its entrants to complete one foundation year of study.
- The modest level of cooperation with industry is a major concern. At the time of writing this review, there were 19 projects with industry funded by the IIC or TRC and other organizations like Middle East Desalination Research Center totalling about OMR 2.4 million. The CCE indicated that it basically responds to industry needs and has some experience in tackling problems in process and transport engineering. The main obstacle to becoming more innovative and proactive is staff with the right skills and knowledge, lack of motivation and insufficient incentives for graduating engineers to continue with research.
- Entrepreneurship courses are obligatory for engineers, and the CCE has a Centre for Creativity and Innovation as well as small-scale incubation facilities. The biggest challenge is to develop operational linkages with like-minded institutions.

The German University of Technology (GU Tech) was established in 2007 in collaboration with Rheinisch-Westfälische Technische Hochschule, Aachen University, a leading technology and research university in Germany. In the fall term of 2012, approximately 650 students were enrolled at GU Tech and 2,000 students are expected in 2014. It offers BSc programmes in process engineering, environmental engineering and mechanical engineering and an MSc programme in Petroleum Geoscience. Curriculum development and delivery is overseen by Aachen University, and most of the professors are on secondment from that University. Several issues that could affect STI policy were raised in discussions with the STIP Review team.

- A major problem in primary and secondary education is that it produces a very low quality of university entrants, in particular from State secondary schools, so that most require foundation studies to prepare them for their degree programmes.
- Most activities are focused on education, though some research activities are starting and some innovation activities are in the pipeline. One such project is the passive eco

house research project, but it does not seem to have much market demand and potential for commercialization.

- In its interaction with STI stakeholders, GU Tech is in contact with TRC, but appears to have had difficulty in reaching and influencing decision-makers involved in urban and infrastructure planning, notably the Supreme Council.
- GU Tech has developed collaboration with SQU on geological and seismic research. The success of collaboration tends to be based on personal contacts while formal cooperation channels are not working as they should.
- Research staff are in short supply.

The following are a few common problems that emerged from the above observations:

- 1) A general problem is the poor level of language and maths skills of students entering universities, which makes it necessary to offer them foundation courses to give them a minimum level of competencies in these subjects.
- 2) It is difficult for higher education establishments to engage in research and innovation activities that are directly pertinent to the needs and demands of the local economy and industry.
- 3) Grooming and retaining research staff within the educational establishments pose particular problems, often due to insufficient incentives.
- 4) Formal relationships appear to be difficult, as government bodies appear to be distant, and sometimes those relationships are unwelcome and bureaucratic. Thus any success in cooperation often depends on personal relationships.

*Labour, technology and education:
Ongoing issues*

The UNCTAD mission observed that linkages between labour and technical education and training are underdeveloped, and that the technological needs of economic sectors vary widely. Underdeveloped regions, which lack large businesses, have fewer jobs available, and job opportunities associated with the knowledge economy are generally lacking. It is difficult to link higher education to innovation when incubators established at technical colleges cannot find firms interested in cooperating beyond some involvement in the design of curricula. Even simple activities, such as placing students in internships in companies, seem to be a challenge, as there are no legal obligations for firms to offer internships. Foreign managers do not seem particularly

interested in training Omani students, as job vacancies can be easily filled by foreign workers.

As long as salaries differ greatly between private and public sector jobs, especially as lower qualified Omani nationals are better paid in public service, while those with higher qualifications are better paid in private and foreign firms, there will be persistent tensions in the labour market. The Ministry of Manpower is the main mediator in wage negotiations, but it will be difficult to solve this problem if this Ministry cannot coordinate with other entities such as the Ministries of Commerce and Industry, Agriculture and Fisheries, and Higher Education, as well as the Chamber of Commerce.⁴¹

There are also a number of non-technical issues related to attitudes and work ethics, which point to a suboptimal level of professional commitment. It was reported that the youth felt rejected in firms, as the attitudes of employers were sometimes influenced by the corporate management practices of expatriate experts or executives, or due to inadequate training in management skills and competencies of nationals. Revised legislation and perhaps a new labour law would be needed to deal with equitable treatment and improved labour inspections, as well as social corporate responsibility. As previously noted, Oman has an active tripartite social dialogue and a culture of consensus-building that would prove useful in developing a dialogue to address the linked problems of education, behavioural attitudes and employability issues.

4.3 Conclusions

In conclusion, although the information on the innovation system is cursory and piecemeal, a few major weaknesses can be discerned. Firstly it is seriously fragmented. There seems to be insufficient cooperation between key entities (between academic and business structures, between academics themselves and among businesses), and where it exists, it is often on a personal basis. Secondly, most of the research bodies are rather small, and a more disconcerting issue is that it seems difficult to expand them, due, notably, to the salary structures in the economy as a whole. Thirdly, currently there are not many innovations and innovative undertakings, and at least not a critical mass to enable virtuous clustering processes to take place.

There are also several positive features. Although not very innovative, the large Omani companies demonstrate an inner dynamism that should be exploited. There is a clear understanding of problems in most of the concerned communities, in the business sector, and in the academic world and the Government. And last, but not least, there is a significant internationalization trend of the

whole innovation system and its components. This source of dynamism and change should be further exploited.

5. Key interactions II: Government policies and programs

5.1 Policymaking institutions

Main entities

The key body for science, technology and innovation policy in Oman is TRC, which was established in 2005. It has an atypical position in the Government in that it does not have the status of a ministry, but is more of an adjacent body chaired by His Highness Sayyid Shihab bin Tariq Al Said as high-level adviser to His Majesty Sultan Qaboos. A staff of 170, led by a secretary general, manages TRC and administers its programmes. TRC acts both as a policymaking and a funding institution. It has three main departments: the research department, the innovation department, and the international relations department. It has an International Advisory Board comprising several internationally renowned experts in science and science policy.

Other important bodies involved in supporting innovation or improving the innovation climate include the IT Authority, the Ministry of Industry and Commerce and the Ministry of Higher Education. The Education Council of Oman is charged with the advancement of the education sector at all levels and types, and serves as an umbrella organization for education policy development, analysis and implementation. The Council seeks to ensure that the development of the education sector is in line with national economic and social priorities.

Lack of coordination

It is difficult to evaluate an administrative and political system without a good understanding of how its formal and informal contacts, information channels and networks function. However, from what is observable in terms of policy initiatives, the conduct and management of STI policies appear to be rather uncoordinated. There is not much duplication, because administrative territories have been relatively well defined and distributed among ministries. But in the absence of an overall STI strategy, policies conducted in each ministry and related agencies seem to be elaborated without much cross-consultation and coordination, as pointed out during the UNCTAD team's meetings with government officials.

As a consequence, there is not much apparent synergy, and policies underperform as synergies across the system of institutions remain underexploited. For example, it would be useful to

develop research programmes that will increase research activities in universities, but they will have a limited impact on innovation if administrative regulations and procedures governing research activities fail to provide incentives to faculty members to collaborate effectively in research work.

Also, it should be noted that the Cabinet of Ministers, the Supreme Council for Planning and The Council of Oman can and do consult with a number of representatives of the business sector and civil society, including the trade unions (which were recognized in 2006) and the Oman Chamber of Commerce and Industry (OCCI), when designing their policies. However, there are indications that the OCCI has not been fully accepted as a strategic partner in government initiatives. More formal policy mechanisms are required to achieve this. While the OCCI may offer advice to the Cabinet, the two Councils and other policy bodies, it needs to be more involved in policymaking, particularly on technology and innovation issues.

5.2 The Research Council and its R&D programmes

Diverse set of programmes

Most of the R&D programmes are developed by TRC in the context of the National Research Strategy. Implementation of this strategy began in 2009, following intense consultations for several years. In essence, it consists of a series of 14 programmes (table 2), of very diverse nature and size. A major priority for TRC was to set the programmes in motion and energize the creation of a research culture corresponding to Oman's needs.

For TRC it was important to develop a series of research activities based on international best practices while responding to specific local needs. The programmes were designed to take advantage of and develop synergies among various research entities. The Oman Vision 2020 and strategic plans and interests of various economic sectors were taken into consideration in the selection of the programmes. These programmes, led and monitored by TRC, aim to kick-start the development of Oman as an important regional hub for research.

Potentially significant impacts of the R&D programmes

Several observations can be made about the programmes:

- The programmes aim at fostering the application of technology research to serve the economic, social and environmental needs of Oman.

- Most of the programmes are administered by TRC, though a few also involve other partners through participation in the programmes' steering committees.
- In total, these programmes involve a significant number of researchers (several hundred, if undergraduate students and other beneficiaries of scholarships are included) as a proportion of the total number of researchers working in the country.
- Significant resources have been allocated to individual research projects and chairs – up to OMR 250,000 per project.
- Several programmes have a pedagogical and educational purpose, and there is also a plan to build a large science information infrastructure, such as a virtual science library.
- The Animal and Plant Genetic Resources Centre receives substantial support, with more than OMR 80 million allocated over a period of 12 years, in stark contrast to most other programmes which are very modestly funded by comparison. The project was set up in response to the desire to derive the maximum possible benefits from Oman's biodiversity, while positioning it as a centre of excellence in biodiversity research and preservation. The centre was created following a direct instruction by His Majesty Sultan Qaboos (see box 4).
- Programme implementation appears to have been rather slow: a minimum of two years between the conceptualization of a programme and the first call for proposals for many programmes. This can be due to a lack of capacity within the agency, or a search for consensus, or a high level of prudence in the selection process.
- Some programmes are already sufficiently advanced to require evaluation both in terms of outputs (scientific achievements) and outcomes (potential technology, economic or social impacts).

Apparently, none of the programmes include mechanisms to involve the business sector in their design phase in order to maximize innovation performance and impact. This feature may be explained by the reluctance of the Government to directly support the business sector's R&D. However, such hesitation may result in losing the economic relevance of the programmes as well as the opportunity for application of their results. To some extent this is compensated for by the academic Innovation Programme, which is working towards commercializing 15 research outcomes within the next two years. Universities are free to pursue the commercialization of their research output by linking with the Innovation Hub.

Table 2: Research and Development Programmes of TRC

Programme, starting year and budget	Purpose and instruments	Status of program development
Open Research Grants Program 2009, 3 million OMR per year	Competitive Research Grants awarded to researcher(s) affiliated to local institutions based on individual or group submitted proposals. Six local grant committees and national/international peer-reviewers.	More than 17 academic and research institutions benefiting from the program. More than 180 proposals submitted to the program since launched by the end of 2009. More than 90 proposals were approved for funding with budget exceeding 9 M RO. More than 39 PhD's and 79 MSc scholarships were included in the approved proposals.
Strategic/Directed Research Program : Road Safety Research 2009, 2.5 million OMR (5 years)	Competitive Research Grants thematically designed to tackle specific issues related to road accidents in Oman.	More than 40 proposals submitted, 8 full proposals retained for screening, 3 finally selected and contracts signed at end 2012. UK-TRL awarded for developing data base (with GPS/GIS).
Strategic/Directed Research Program: Dubas Bug Research 2010, 2.5 million OMR (5 years)	Competitive Research Grants thematically designed to tackle specific issues related to the Dubas bug which attack dates trees in Oman.	26 pre proposals, 14 selected for screening, 4 finally retained. TOR for an international and local research database. One company selected for developing the database, to be operational at the end of 2013.
Strategic/Directed Program: Social Observatory Research 2012, 5 million OMR (5 years)	Competitive Research Grants thematically designed to tackle specific issues related to social issues in Oman specifically related to youth, income/employments and family stability.	TRC board has approved, road map and national task force on data bases established; director recruitment in process.
Strategic Research Program: Renewable Energy 2013, Budget TBD	Competitive Research Grants thematically designed to promote renewable energy utilization in the Sultanate.	Board approval, steering committee formed under chairmanship of Public authority for water and electricity; road map being developed
Research Chairs Program: Nanotechnology Chair at SQU 2011, 3.07 million OMR (5 years)	Research Chair Grant awarded to SQU for the development of a centre of excellence in the area of Water Desalination Using Nanotechnology.	Chaired hired, students recruited, lab space equipped, first report submitted by SQU and judged satisfactory.
Faculty Mentored Undergraduate Research Award Program 2013, 200,000 OMR per year (5 years)	Competitive small Research/innovation Grants (max 2,400 OMR per project) awarded to undergraduate students at local academic institutions under the leadership of an academic mentor.	First calls launched and proposals expected in June 2013.
(FURAP) Oman Eco-House Design Competition Program 2012, 750,000 OMR (2 years)	The Eco friendly House Competition is an award-winning program that challenges collegiate teams to design, build, and operate Eco friendly houses that are also cost-effective and attractive. The winner of the competition is the team that best blends consumer appeal and design excellence, with optimal energy production and maximum efficiency.	Five teams entered competition, design phase completed, building permits accorded, two workshops conducted.
The Virtual Science Library (VSL) 2012, 13 million OMR (5 years)	The Virtual Science Library (VSL) is a modular Digital Library Portal that provides the science community with comprehensive access to modern international research tools customized for national needs.	Negotiation with publishers is going on. Setting up trials for the SSP for the search engine.
Electronic Research Information System 2012 (planning), no budget	Improvements in TRESS, FundPlus, Researchers Directory, Science and Technology Indicators, Reviewers database and including various funding programs into the electronic submission system such as FURAP and Strategic/Directed Research programs.	Significant improvements in FundPlus to handle Submission of Progress and Final Reports. Implementation of FURAP Program. Completion of the STI Report/survey.
Education Innovation Assistance Program 2011, 700,000 OMR (3 years)	The Educational Innovation Support Programs have been set to develop innovative education in the public education sector and to enhance the research skills of students within the national innovation system.	8 teachers trained, and incubating facilities established in 8 schools.
Research Outputs Incentive Program 2012, 200,000 OMR per year	Rewarding researchers of Open Research Grant (ORG) on the basis of their research output came as a means to promote their research excellence and build a research capacity in order to support the economic and social growth in the Sultanate of Oman.	Guidelines and process procedures approved. Posted on line. Workshops and visits held in concerned research and higher education structures.
Animal and Plant Genetic Resource Centre 2012, 83 million OMR for 12 years	Establishment of a research centre for animal and plant genetic resources that will help in coordinating national efforts in preserving national wealth from local Genetic resources and to help in adding value from such resources via research and innovation.	Board approval at least for next three years, Director has been hired as well as three supporting staff; Plans for first years actions are being acted (see below).
Institute of Advanced Technologies Integration (IATI) Start and budget to be determined	Establishment of the Institute of Advanced Technology Integration (IATI) as the first research institute under TRC auspices. IATI to be established in collaboration with an international technical strategic partner.	Planning phase. TOR developed by German Helmolz Association has proposed support in involving three research centres and pilot projects

Source: TRC, Presentation by the Head of the Research Department, June 2013.

Box 4: The Animal and Plant Genetic Resource Centre of Oman

The Animal and Plant Genetic Resource Centre (APGRC) project was established by Royal Decree with the aim to look into developing a genetic centre for animal and plant species native to Oman. Its objective is to collect and study diverse plants and animal species as important national resources. The preservation of plant and animal genetics for future generations is a key element. The APGR Centre is based on three pillars: policy, education and value – the last focusing on research that can extract value. The Center has four committees to guide research priorities, species selection, facilities, and human resource needs. It reports to TRC.

Oman is home to some 47 species of terrestrial mammal, 19 species of marine mammals, over 1,000 fish species, 1,208 species of plants, around 10 livestock species, 128 breeding species of birds, over 130 coral species and 5 turtle species. Currently, in Oman, there is a modest seed bank and most seeds are sent abroad for conservation.

A number of initiatives are planned, including a regular Science Café event, as well as mobile exhibitions to educate and capture traditional knowledge. There is a general lack of capacity at universities training for research in genetic conservation. As in most sectors, research capacity is diluted due to teaching obligations, administrative problems and the small size of projects. The success of the project will depend to an important extent on the quality of the cooperation between the APGRC and related institutions such as The Ministry of Agriculture and Fisheries and SQU.

Source: Based on an interview with the Program Director, Nadiya Saady (May, 2013).

5.3 Support to innovation projects

A national innovation strategy is in the making at TRC to complement the National Research Strategy. It is expected to be based on several policy pillars that will take into account Oman's innovation potential and ambitions. Significant efforts have been made to provide practical support for innovation with the establishment of the Industrial Innovation Centre located in the Knowledge Oasis of the Muscat industrial estate.

Limited government support

The Industrial Innovation Centre and the projects on which it is working have a relatively low budget allocation of only OMR 1.5 million in total, which creates major problems in setting up a national innovation system. However, this is not surprising considering the design of the R&D programmes, only a few of which are aimed at supporting the business sector's innovation needs or efforts.

There seems to be some reluctance or a lack of consensus among Oman's STI policymakers, not least at TRC, to directly support innovation efforts of private firms. This may be due to their literal interpretation of the principles of the free market. While academics are free to take ideological positions, most – if not all – policymakers worldwide have tended to adopt a pragmatic and nuanced approach to stimulating innovation, and to supporting the risks and uncertainties of innovators and technology firms, which can lead to valuable economic and social benefits of national importance. Without necessarily advocating strongly interventionist policies in favour of national industrial champions, well-managed financial support to the business sector to stimulate its R&D and innovation efforts, based on clearly identified needs and competencies, has proved to be a useful investment benefiting the entire economies of most developed and emerging countries.

More broadly, the modest budget for R&D and innovation support will not allow much progress in innovation, in terms of either piecemeal innovations or the development of a national innovation system, when compared with what is spent on infrastructure. For example, Oman's express highway costs approximately OMR 3 million per kilometre, compared with approximately OMR 20 million per year spent on TRC's R&D and innovation programmes. The national priority of diversification through innovation requires a larger financial commitment in order to tap the innovative potential of Oman's private sector and industries. Nevertheless, a number of initiatives have been launched recently, as discussed below.

The Innovation Hub Project

The Innovation Hub (I-Hub) is a pilot project designed to spearhead the culture of innovation and entrepreneurship and unleash new possibilities for economic diversification, wealth and job creation. The I-Hub serves as an innovation platform to support local innovators to transform their ideas into businesses through funding, mentoring, linking and knowledge networking, and by facilitating the commercialization process. This is expected to be achieved through four well-integrated innovation assistance programmes to stimulate innovation at four levels: industrial, educational, academic, and individual and community. In addition, LINKING Oman and commercialization programmes have been developed and deployed to support and facilitate innovation by providing support for in networking, clustering and match-making. To further support innovation, databases and information services on such matters as prototyping, IPR, funding and incubating agencies, have been developed, along with rosters of scientists and researchers in diverse fields and sectors of innovation. The objective is to support the commercialization of promising innovations.

The National Innovation Centre

Following a decision taken at the Bahla SMEs symposium held in January 2013, the Research Council was requested to develop a roadmap leading to the establishment of a National Innovation Centre. Accordingly, a road map was designed and submitted to the Supreme Council of Planning at end of December 2013 for approval. It envisages the creation of a national centre that would support innovation in the public, private and academic sectors. The overall concept of the centre is illustrated in chart 6.

The Industrial Innovation Centre

The Industrial Innovation Centre (IIC) was created in 2011, jointly by TRC and the Public Establishment for Industrial Estates, with a budget of OMR 1.5 million. It was conceived as a project-incubating unit open to both Omanis and foreign firms. It funds 50 to 75 per cent of the cost of a project. While some matching funding is expected, SMEs can use the available funding however they like, for example to hire researchers and consultants, develop technology/processes, and cover travelling expenses and overall R&D-associated expenses.

So far the IIC has been engaged in 29 projects of which 10 have made significant progress in the form of prototype completion and/or market testing. Some projects that deserve mention include: a water/oil separation technology, a new packaging method for abalones (a high-quality Omani product

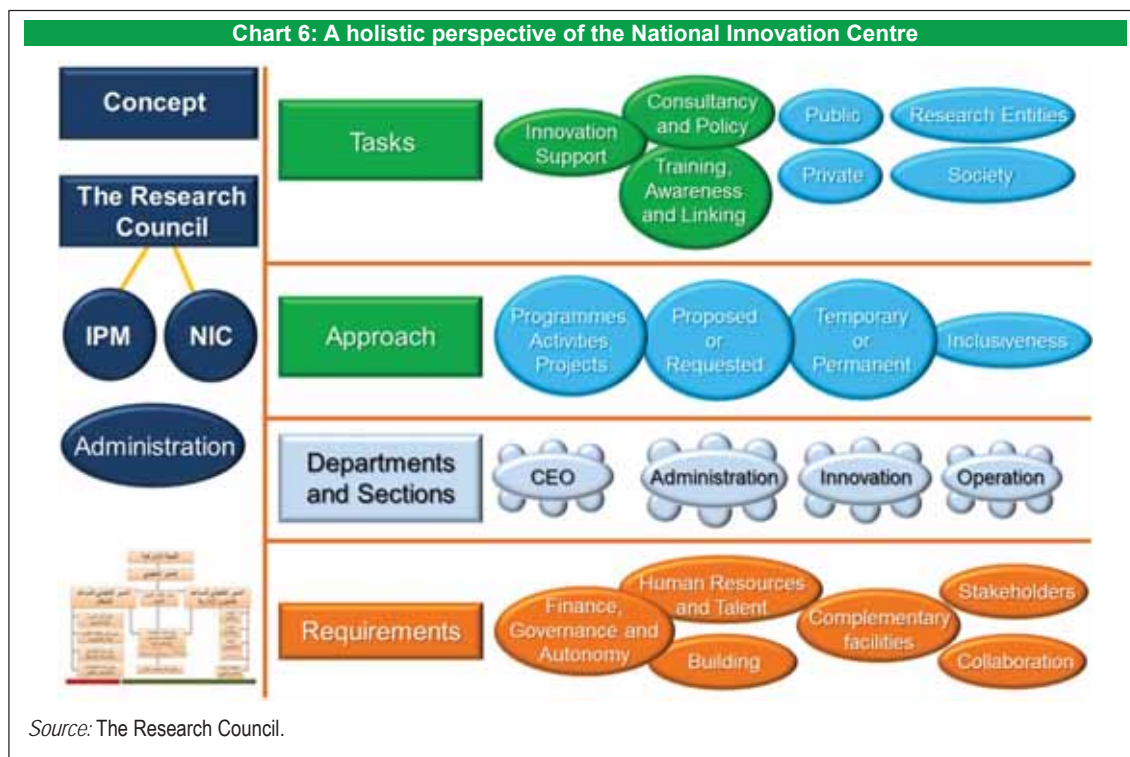
in great demand by markets abroad) and a new way of producing halwa – the traditional Omani sweet made of starch, ghee, sugar and flavourings – with a new low-cholesterol formula. Unfortunately, the commercialization of the latter product has been discouraged by the Royal Court (Diwan), which believes the recipe alters the traditional Omani method, taste and brand.

The Innovation Centre is staffed by several consultants (Omanis and foreign) who have access to an international network of experts to search for appropriate knowledge, technology and potential markets abroad. There is a plan to transform the Centre as an autonomous company in which TRC would be a partner along with other bodies.

Innovation Fair

Innovation Fair Oman (INFOM) has been established to provide and disseminate information on state-of-the-art innovations in Oman. It gathers innovators and motivates them to broaden their outlook and further develop and share ideas and experiences.

Two INFOM events have been held, in 2011 and 2012 respectively. In 2011, INFOM invited submissions of applications resulting in 81 applications, of which 44 prototypes were chosen to showcase at INFOM. Each prototype was registered with the local Department for Patents, and participants were invited to attend workshops on innovation, finance and marketing.



Venture capital

The lack of venture capital is an issue hindering innovation. TRC has approved the establishment of a venture capital company in cooperation with the investment firms of Oman Oil and Oman Tel to commercialize successful innovations supported by the innovation hub and its projects, as well as to target innovation with an investment of OMR 50 million. The venture capital company will target firms with locally generated R&D as well as those that have the capacity to identify, import and transfer innovative technologies.

5.4 Framework conditions: Initiatives

Work in progress

The Government has perceived the need to act in a few areas that present important challenges or opportunities for improving the innovation climate. In some areas, work already began several years ago and is bearing fruits, such as the Information Technology Authority (ITA) to boost the digital economy and society in Oman, and particularly e-government. Recently, SME issues have received considerable attention with the organization of a major symposium, followed by a number of actions. A new research-oriented university is also being planned. In addition, a large new Innovation Park is being built in Muscat, along with a Science City and Medical City, to advance the level of higher education, research excellence and innovation.

Digital economy and society

The Information Technology Authority (ITA), created in 2006, elaborated and put in place a national digital strategy in 2008. Its objective is to improve the efficiency of government services, and support businesses and citizens in the use of ICTs. An Electronic Transactions Law was enacted in May 2007 to establish the protection of online privacy and validate digital signatures, in addition to the introduction of electronic messaging regulations.

Another cross-cutting initiative, the ITA's SAS Programme for Entrepreneurship targets SME ICT businesses, students and job-seekers interested in starting a business. It also aims to develop a competitive ICT sector by seeking to increase both foreign and local investment, while encouraging and supporting innovation.⁴² In the education field, various ideas and plans have been elaborated in the concerned ministries and are expected to be implemented in the near future.

A national e-Payment gateway project has also been launched to enable electronic payments for e-Government services. An e-tendering service has been put in place in five ministries as a first step. An official e-Government service portal is

operational, which provides facilities for the creation of identity cards and visas, and even for divorce procedures. A national IT training and awareness programme has been launched, apparently to the great satisfaction of those who have attended it.⁴³ This e-Government programme benefits from a sizeable budget allocation of OMR 250 million.

Support to SMEs

Regarding SMEs, the Ministry of Industry and Commerce organized a major symposium in February 2013, in accordance with instructions from His Majesty Sultan Qaboos. A large number of businessmen and entrepreneurs participated, and it was widely promoted by the media. Its aim was to generate ideas for reforms and policy improvements. It led to 20 recommendations, including the simplification of administrative procedures and increased financial support to SMEs, as well as the development of the National Innovation Centre (described above), which is being spearheaded by TRC.

The Al Rafd fund, capitalized at OMR 70 million, has been established to finance SMEs with a 2 per cent service charge and no collateral requirements. A budget of up to OMR 100,000 can be allocated to each SME on the condition that the requesting entrepreneurs are unemployed and would like to become self-employed. In addition, the Oman Development Bank (ODB), which also funds SMEs but is generally oriented to financing corporations without funding limits (i.e. even if the requested budget exceeds OMR 1 million), has announced that it will provide technical support to SMEs to help them upgrade and develop transparency and management capabilities, and improve accounting skills.⁴⁴ Following recommendations, the Central Bank of Oman is obliged to dedicate 5 per cent of its commercial loans to SMEs and reserve 10 per cent of tendering for public procurements from SMEs. Additional measures are envisaged, but not yet approved, including a training programme for promoting entrepreneurship among interested government employees, as well as a regulation that requires government employees desiring to manage their own businesses to work in those businesses full time, though they will receive their salaries from the Government for one year after resigning their posts to become entrepreneurs.⁴⁵

Thus, funding is available, along with opportunities for business creation. Meanwhile, coaching initiatives for entrepreneurship have started from modest beginnings, but are increasingly available through several programmes that have been established, for example in cooperation with Ernst and Young and KPMG. Universities and higher education colleges as well as other institutions, such as Enjaz Oman, the National Business Centre (NBC), the Public Authority for SME

Development (PASMED) and ITA, are also teaching entrepreneurship and providing training. The Sharaka programme for developing youth entrepreneurship is active, but capacity is weak and ideas are lacking. Based on the belief that international cooperation could have a positive effect, the Knowledge Oasis Muscat (KOM) has a coaching programme which is actively linking up with similar activities in the EU. Offset funding for project management and training is available, but the Oman Development Bank and 16 other funding agencies face the problem of a lack of identifiable innovation opportunities. Many project proposals have questionable innovation content.

Education

The Government, with the Ministry of Higher Education as the lead agency, is working on developing an S&T University that would be entirely dedicated to research. It is expected to have a high international status, to be actively associated with global research networks, and to concentrate on a limited number of programmes and topics closely linked to Oman's needs and strengths. The university would be located in the new, purpose-built innovation park, adjacent to S&T city, which is hoping to attract five or six foreign universities (see below).

In the field of vocational education, the Deputy Minister for Manpower in charge of Technical and Vocational Education and Training (TVET) has developed plans aimed at sensitizing students of the seven colleges supervised by that Ministry to the opportunities and realities of business and commerce. The Ministry has plans to establish centres for entrepreneurship and innovation in each technical college. The overall objectives in the long term are as follows:

- To give students an early exposure to entrepreneurship in schools in order to unlock their ambitions and initiatives;
- To improve mobility between study and work; and
- To raise awareness of entrepreneurship and innovation issues (with ongoing cooperation with UNCTAD Empretec).

If well implemented, such measures, involving some 40,000 students, could have a significant impact in terms of changing the mindsets of the students and improving their qualifications.

A new Innovation Park

Work on Innovation Park Muscat has been under way since 2013. The park will be located beyond SQU and KOM and close to GU Tech. A business plan and a marketing plan have already been developed, while several prospective sectors have been identified including oil/gas and water. The

Innovation Park Muscat covering an area of 4,000m² will house TRC, business incubation facilities and SME facilities, and phase 1 is scheduled to be operational in 2015. It will include a fabrication workshop for prototyping and a social centre to encourage interactions among technologists and entrepreneurs, and will also provide space for multinational corporations to establish a regional and national presence. The Institute of Advanced Technology Integration, the Health Research Institute, a mosque and a hotel will be opened in phase 2. The Food and Biotechnology Institute, the Centre for Environmental Innovation and Research, a park administration, a recreation centre and a school are planned for phase 3.⁴⁶ There are also plans to install at least three large international tenants. Finally, a separate company is to be incorporated to manage the Innovation Park. International companies have been surveyed in an "engagement session" to gauge their interest, though there is no local SME involvement at present.

The idea behind Innovation Park Muscat is to provide an opportunity to link academic research and academics with entrepreneurs. Indeed, academics have been demanding facilities to conduct applied research. Plans for the Park to provide "free-zone" types of incentives, including fiscal/tax incentives, are not yet approved.

The Oman Innovation Park, which will host the headquarters of TRC, retains a strong emphasis on R&D. The university part will be occupied by the planned new University of Oman back to back with a Science City and Medical City, which would be located at the end of the Barka region. These institutions, together with the recently opened Oman-German University, represent a highly ambitious effort to create a viable knowledge platform for the knowledge industries of the future.

5.5 Agricultural research laboratories and technology services

Outside the oil and gas sector, research and technology infrastructure has been developed principally in the agriculture and fisheries sector. Agriculture accounts for only 1.2 per cent of the GDP and employs 5.2 per cent of the economically active population, mainly at the smallholder and subsistence level. Oman is a net food importer, importing \$2.5 billion worth of food per year while exporting only about \$1 billion worth. The total land under cultivation is estimated to be only 6 per cent of the total land area, but agriculture plays a crucial role in maintaining regionally balanced development within the country.

Agriculture and fisheries, while growing in absolute terms and in productivity, have been steadily declining in relative importance for the economy

since the start of oil exploitation in the late 1960s. Land use is determined primarily by the availability of water. There is extensive cultivation in coastal areas (Al Batinah and Al Sharqiya), while in the interior, agriculture is dependent on *wadis* and on the *fallaj* water canals for irrigation owing to insufficient rainfall. The coastal regions are suffering from a drop in the water table and increasing salinity.

The principal agricultural product is the date, with almost 300,000 metric tons produced in 2010. Other products include bananas, mangoes, coconuts, lime, alfalfa, tomatoes, cabbages, eggplants, okra and cucumbers. Frankincense is traditionally produced from trees growing wild in Dhofar. Along the Al Batinah coast (in the north-east), wheat, and Rhodes grass are grown in addition to fruit. Sorghum and alfalfa are primarily animal feed plants.

The Ministry of Agriculture and Fisheries has developed a comprehensive research strategy that focuses on challenges arising from abiotic and biotic factors, including climate change which has been affecting local ecosystems and their flora and fauna through the associated effects of natural disasters such as cyclones, flooding, droughts, ocean acidification and human activity. The future food security of Oman will be closely linked to the development and progress of the agricultural and fisheries sector.

Constrained research structures

The Directorate General of Agriculture Research, established under the Ministry of Agriculture and Fisheries, has 126 Omani researchers and supervises six entities: the Plant Production Research Centre, the Plant Protection Research Centre, the Soil Research Centre, the Date Palm Research Centre, the Livestock Production Research Centre, and the Veterinary Health Research Centre. It has a budget of OMR 12 million, mostly to cover salaries.

Research stations or farms focus on identification and diagnosis of production problems in various agro-ecological zones and adapt technologies for increased production at the farm level, including, specifically, the improvement of arid land. Some research is carried out collaboratively with international and regional organizations, universities and non-governmental organizations (NGOs).

Donors and technical agencies, such as the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the World Bank, have funded R&D programmes targeting the improvement of pasture resources, which is a key concern. There is also collaboration with the

International Centre for Agricultural Research in the Dry Areas (based in the Syrian Arab Republic). General problems relate to salaries for researchers at the Ministry of Agriculture and Fisheries, which are not competitive, are tied to budgets and lack an incentive element. The research budget can only be spent on technical operations with only a small amount dedicated to short-term consultancies, but it has no provision for incentives. Doctoral candidates tend to leave immediately after completing their degrees, as salaries at the Ministry's research centres are low compared with those offered in the academic or business sectors.

Insufficient human resources for extension services

A relatively well-developed network of extension services provides various types of services to local agricultural communities. It offers assistance through subsidies for greenhouses, irrigation, machinery, pest and disease control, and in particular for date palms, with a budget allocation of OMR 30 million. While funding does not seem to be a big problem, human resources in the category of "skilled extensionists" are missing. Animal health is another important programme activity with a budget of OMR 5.6 million, with one part of these funds set aside for improving veterinary clinics. Mobile veterinary clinics are being planned and set up. Unfortunately, staff in extension services work without formal linkages to staff in research.

5.6 Overall assessment: An embryonic policy that needs to be strengthened and expanded

The following is an appraisal of government action in the field of STI.

The policy to improve the innovation climate and system in Oman is still at an embryonic stage. The most explicit part is the national R&D strategy, while the Innovation Strategy is yet to be instated. The overall STI policy remains fragmented and uncoordinated among government entities, as well as with the business sector. A general awareness of innovation issues is lacking among citizens. The development of a national innovation system is not yet integrated within national strategic planning and operational decision-making.

As a whole, overall funding support to research and innovation remains quite small when compared with funding by the government for other items, such as the road infrastructure. Implementation of policy measures seems relatively slow, possibly due to a series of factors such as a lack of capacity in concerned government bodies, a cautious approach in selecting projects or delivering funds, cumbersome bureaucratic procedures, and the political and social culture of consensus-building.

The R&D strategy is modest, cautious and gradual in its approach, but this seems to be justified in view of the relative weakness and modest size of the Omani research base and a lack of obvious recipients of R&D outcomes among entrepreneurs or particular sectors.

Nevertheless, the R&D strategy is involving a steadily increasing number of researchers, while aiming at connecting their efforts and activities with perceived needs. Unfortunately, there is insufficient involvement of the business sector in co-funding or in partnering R&D work. Increasing the impact of R&D and innovation on commercial outcomes requires reducing fragmentation in innovation policy and action, as well as revisiting and assessing incentive structures.

For example, on several occasions the UNCTAD team heard that researchers who receive funding cannot pay themselves compensation, even when their own institutions/universities generally do not offer compensation for R&D activities. Moving forward would require strategic actions, such as joint programmes, involving public and academic institutions, on capacity-building and research, and a greater emphasis on collaborative research where the private sector would play an important and critical role.

More generally, R&D and innovation efforts in the business sector receive little support and few incentives. This situation may be due to a lack of consensus within the Government about such support, with a debate between those who favour a clear but misguided adherence to a purely free market approach and those who prefer to be more

interventionist. It may also be due to the inexperience of the policymaking community with certain types of innovation support measures that are in place in other countries, notably those that aim at stimulating university-business cooperation in R&D.

There is no solid public research and technology infrastructure, except in the agriculture and fisheries sector, which suffers from the problem of retaining its human resources, and in the oil sector, which remains isolated from the rest of the economy. This is a serious issue as the oil sector is dominated by an Omani public company in a joint venture with a foreign partner and it should recognize the need for initiatives to increase its interaction with the rest of the economy.

As far as the framework conditions are concerned, the issue of small firms in the innovation system and their potentially important role to complement or supplement big businesses is only just beginning to be addressed following the SME Symposium held in February 2013. On the education front, the Government has been considering measures concerning vocational schools, but they need yet to be implemented.

Measures for building a digital economy and society are beginning to bear fruit, notably those related to e-government procedures (e.g. online services, citizens' participation, legislative information, and training and awareness sessions). However, the development and spreading of a digital society are hampered by costly Internet tariffs and a poor broadband infrastructure.

Part II: Strategic innovation pillars

6. Human resources, labour and employment

6.1 Introduction

Oman may be characterized as having simultaneously a labour shortage and a labour surplus economy. Shortages arise because private sector employment opportunities are growing faster than Omani skills and capabilities, while a surplus arises due to many Omani nationals' reluctance to accept employment in the private sector. Indeed, private sector employment is often seen as a temporary measure, while job-seekers wait for openings in the public sector. Omani university graduates seem to believe that public sector employment is readily available, and that it is a very desirable career path. What is more, there is a general expectation that the Government will continue to provide employment opportunities for its nationals. Recent increases in public sector jobs in response to concerns about social unrest, particularly among the youth, have reinforced such expectations.

Education

In common with other GCC countries, educational attainment in Oman is at the lower end of the international spectrum, and it is significantly lower among boys than among girls. The current response of lowering university admission standards for boys needs to be reconsidered as this weakens incentives for attaining high standards. In interviews during the UNCTAD mission in May 2013, many respondents observed that experienced non-Omani teachers were being replaced by freshly graduated Omanis as a part of the Omanization policy, even if they were somewhat lacking in competencies and abilities. A generalized fall in the quality of teaching will necessarily cause deterioration in educational attainment and reduce prospects for Omani nationals to compete for positions, both in the public and private sectors, which require university degrees or advanced levels of technical competence.

A closely related problem is the misalignment in the provision of higher education and the actual needs of the labour market. The distribution of degree courses between engineering and occupational disciplines on one side, and the humanities on the other, is similar to that found in many countries around the world. However, employment prospects for humanities graduates are much less favourable in Oman. The private sector, with its few large and capital-intensive enterprises and large contractors, has limited need for administrative and managerial staff. SMEs also

have little need for humanities graduates and, as a result, such graduates often remain unemployed until they find a job in the public sector, even though government agencies are fully staffed most of the time. The only practical solution is to reduce the number of humanities graduates.

Omanization

The policy goal of Omanization has been established with the medium- to long-term objective of reducing the share of non-Omani labour in the country's overall employment. However, while such a policy goal is a worthy consideration, from an innovation perspective it cannot be a primary objective. It is more important to raise productivity and undertake the investment and reforms needed in educational and industrial policy that will enable Omanization as an outcome of a broader process. In this way, Omanization will promote meritocratic management in institutions and firms, and contribute to developing incentives that have positive effects on productivity and innovation.

In the short run, to reduce the contribution of non-Omani workers to labour supply, it may be necessary to establish overall quotas by skill level, and a national system for allocating permits perhaps through an auction system. This would undoubtedly increase production costs which may be passed on to consumers, and thus such policies may find opposition. Firms would have to adapt to higher cost labour while seeking to offset wage increases by investing in increasingly capital-intensive production. This would, at the same time, be an important incentive for innovation. The success of such a strategy would depend on the implementation of policies to develop an adequate supply of Omani workers and managers with stronger technical qualifications and skills than exist at present.

The Omanization policy of promoting the employment of Omani nationals in the private sector has seen some success, but further measures to reduce unemployment among nationals are required. The overwhelming preference for employment in the public sector is the main factor undermining progress in the Omanization policy. An important policy outcome will be to equalize the attractiveness of public and private sector jobs for Omani job-seekers. This will require a combination of reducing the perceived advantages of public sector employment and an improvement in salaries and benefits in the private sector. By gradually providing incentives to the private sector to switch to the use of capital-intensive technologies, the resulting rise in productivity may enable the disbursement of higher

wages. Regulating minimum wages and improved working conditions could establish a baseline for decent work and equitable social and economic opportunities. However, its application to only Omani nationals could produce a variety of adaptive reactions from private sector firms, thereby reducing its effectiveness.

Innovation and economic diversification

Employment generation is closely linked to economic diversification, which in turn is intimately linked with the development of innovation capabilities. Employment creation can be spurred by investment in tourism, agriculture, construction materials, and shipping and ports linked to industrial zones. Some of these are energy-intensive industries and may serve employment and diversification objectives by creating demand for downstream activities (e.g. food processing, packaging, and water and waste management).

In order for revenues from diversification to successfully replace oil revenues, including revenues used to finance public sector spending, the absolute size of future diversified sectors will need to be much greater than the size of the current oil sector, as their profit margins would be much smaller. Roughly speaking, the cost of exploiting oil in Oman today is one quarter of its international market price; this level of margin is unattainable in globally competitive industries, such as tourism or shipping, which could offer significant employment opportunities. Achieving such diversification is an ambitious objective that presents Omani policymakers with serious challenges (see section 8 for a broader discussion of the diversification issue). Among them will be the need to generate planning, implementation and evaluation capabilities through human resources development. Policy experimentation and the means to generate a stronger entrepreneurship culture are other challenges.

Evidence-based policies and strategic perspectives

Evidence-based policymaking is crucial for developing national human resources. Given the importance of employment in tackling economic and social issues, and its linkages to innovation, labour surveys and labour market information systems need to complement each other and contribute to improving the capacity for macroeconomic analysis.

Structured and accessible data also enable projections based on comparing different scenarios and assessing the probabilities of different outcomes. The assumption of best-case scenarios, wherein oil prices stay high and oil reserves get re-evaluated upwards indefinitely, can raise questions about the utility of Omanization, labour and human

capacity-development policies. Assumptions of worst-case scenarios, wherein oil depletion or a fall in oil prices is not followed by adequate policies for innovation, suggest a dual contraction of both public and private sector jobs and wages to an extent that public sector employment no longer presents any advantages over the private sector, and non-Omani workers leave the country as earning opportunities in Oman become unattractive. The need for the development of human capabilities increases in this extreme scenario as a significant proportion of the population becomes poor, moves into the informal economy and engages in low-tech and traditional economic activities, such as subsistence farming.

A far more positive scenario would see the emergence of higher productivity employment opportunities for Omani nationals in a more diversified economy, with sustainable, high living standards in the context of a declining contribution of the energy sector to GDP, providing alternative fiscal income for a viable public sector and avoiding the social disruptions, and eventual political tensions associated with a swift, radical change in the composition of the labour market.

Policy priorities

Given the above considerations, this section focuses on clarifying the rationale for the following policy priorities aimed at meeting head-on some of the challenges that lie ahead for Oman over the next 20 years.

- 1) Manage the number of employees in the public sector with a view to achieving the goal of providing a high quality and efficient public service.
- 2) Make salaries, benefits, pension entitlements and age of retirement in the public sector comparable to those in the private sector.
- 3) Rebalance the proportions of Omani and non-Omani workers to total employment by bringing more Omanis into productive employment.
- 4) Align enrolments in the universities with employment prospects.
- 5) Train and educate teachers to a higher standard at all levels of education.
- 6) Address the problem of under-achievement of boys in primary and secondary schools, and target gender-balanced outcomes in higher education.
- 7) Develop capacity for the analysis of economic data and for the development of scenarios of interaction between the productive sectors and national human resources development.

Table 3: Omani population by age and gender, 2013*

Age	Male	Female	Total	Per cent
0-4	158,205	152,619	310,824	14.3
5-14	221,454	212,904	434,358	20.0
15-24	242,679	232,129	474,808	21.9
25-64	430,144	429,360	859,504	39.6
65+	48,132	44,376	92,508	4.3
Total	1,100,614	1,071,388	2,172,002	100.0

Source: National Centre for Statistics and Information (NCSI), *Population Statistics Bulletin*.

* Note: Mid-year data.

6.2 Population, education and labour supply

Population

In 2013, the population of Oman was 3,957,040 persons, of whom 2,212,693 were Omani nationals. Table 3 shows that Oman has a young population that is a valuable resource, but this also presents formidable policy challenges. It is estimated that every year between 40,000 and 50,000 Omani nationals become eligible to enter the workforce, but the number that actually succeed in finding jobs varies due to a number of social and economic factors.

Education

Following reforms implemented in 1998-1999, the structure of primary and secondary education in Oman was changed, with ten years of basic education subdivided into two cycles (grades 1-4 and 5-10) followed by two years of non-compulsory post-basic education. Promotion is automatic during the first cycle of basic education (i.e. Grades 1-4), and thereafter it depends on assessment. While only about 15 per cent of students drop out before reaching Grade 12, there is widespread concern that the standard of educational attainment is low and irregular, and in particular, that the level of attainment of boys tends to be significantly lower than that of girls.⁴⁷ Table 4 provides summary data on enrolments by level of

education and gender, based on data provided by the National Centre for Statistics and Information (NCSI) of Oman.

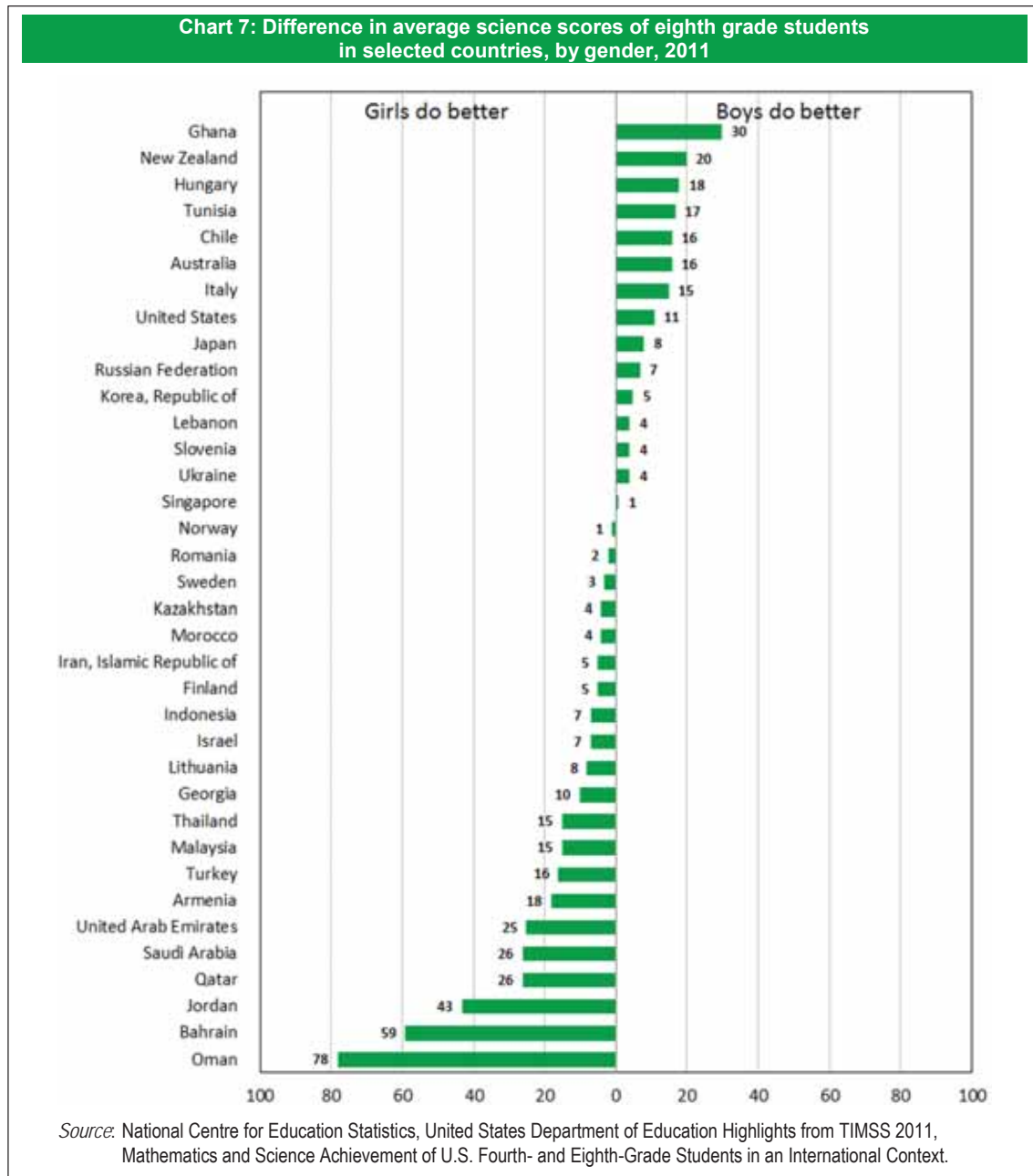
Chart 7 and table 5 describe the findings of the TIMSS 2011⁴⁸ report on international scholastic aptitudes in maths and sciences in primary and secondary education. The best performing countries in sciences, for both genders, are those in East Asia. These countries have a tradition of placing a very high value on education, and have succeeded in achieving impressive economic development, despite their lack of natural resources. In 2011, an estimated 46,000 students were enrolled in Grade 12, evenly split between males and females – a liberal estimate of the number of youth seeking to enrol in higher education, technical education and training centres in the following year. The actual number will have been somewhat lower as some pupils will not have passed their General Certificate examination, while others will have chosen not to pursue further education after Grade 12. Success rates among females tend to be notably higher: in 2009, 95 per cent of females and 81 per cent of males earned their General Certificate.⁴⁹

Table 6, which shows the intake into higher education, diploma courses and bachelor's degree courses, for 2011-2012, indicates that about half of Omani secondary school graduates enrol in higher education.

Table 4: Enrolments by level of education and gender, 2012-2013 (thousands)

	Male	Female	Total
Basic education	218	209	427
Old system (Grades 1-9)	33	31	63
Upper secondary	39	48	88
Private	43	36	79
Community schools	26	24	50
Total	359	348	707

Source: NCSI, *Statistical Year Book*, 2013: 436, 449, 454 and 473; NCSI, *General Education Statistics Bulletin*, 3, 2013:12.



Public higher education is provided by the autonomous Sultan Qaboos University, six Colleges of Applied Sciences administered by the Ministry of Higher Education, the Higher College of Technology in Muscat and six regional colleges of technology administered by the Ministry of Manpower, several institutes administered by the Ministry of Health, the College of Banking and Financial Studies administered by the Central Bank of Oman, and a number of specialized professional or technical colleges and institutes. All admissions to public institutions of higher education are handled by the Higher Education Admissions Centre.

Typically, studies at the Sultan Qaboos University begin with a foundation year devoted to English, mathematics, information technology and study skills, while the actual degree courses are three-year programmes held at one of the nine colleges or faculties. The annual intake in 2011-2012 was 3,130 students and total enrolment grew to 15,345 students. Table 7 shows that there is an almost even intake of students in liberal arts programmes and science, engineering and vocational studies. While this proportion is not obviously out of balance, when compared to the structure and human capability requirements of Omani industry, the proportion of students pursuing non-technical

Table 5: Average science and mathematics scores of eighth grade students in selected countries, 2011

Science		Mathematics	
Education system	Average score	Education system	Average score
Singapore	590	Korea, Republic of	613
Korea, Republic of	560	Singapore	611
Japan	558	Japan	570
Finland	552	Russian Federation	539
Slovenia	543	Israel	516
Russian Federation	542	Finland	514
United States	525	United States	509
Hungary	522	Hungary	505
Australia	519	Australia	505
Israel	518	Slovenia	505
Lithuania	514	Lithuania	502
New Zealand	512	Italy	498
Sweden	509	New Zealand	488
Italy	501	Kazakhstan	487
Ukraine	501	Sweden	484
Norway	494	Ukraine	479
Kazakhstan	490	Norway	475
Turkey	483	Armenia	467
Iran, Islamic Republic of	474	Romania	458
Romania	465	United Arab Emirates	456
United Arab Emirates	465	Turkey	452
Chile	461	Lebanon	449
Bahrain	452	Malaysia	440
Thailand	451	Georgia	431
Jordan	449	Thailand	427
Tunisia	439	Tunisia	425
Armenia	437	Chile	416
Saudi Arabia	438	Iran, Islamic Republic of	415
Malaysia	428	Qatar	410
Georgia	420	Bahrain	409
Oman	420	Jordan	405
Qatar	419	Saudi Arabia	394
Lebanon	406	Indonesia	386
Indonesia	406	Morocco	371
Morocco	378	Oman	366
Ghana	308	Ghana	331

Source: National Centre for Education Statistics, United States Department of Education, Highlights TIMSS 2011

studies is too high in relation to employment opportunities, which creates problems for many graduates.

The colleges of technology offer four-year programmes. Completion of the second year leads to the award of a diploma. Students with sufficiently high grades are allowed to continue to the third year, the completion of which leads to the award of a higher diploma, while some are subsequently permitted to continue for a fourth year and earn a bachelor's degree. The award of any qualification requires completion of prescribed on-the-job training.

As the national demand for higher education greatly exceeds what is on offer in public institutions, the Government has supported the establishment of private schools and universities. Official support has taken the form of concessions for land, subsidies for construction, and the payment of fees of government-sponsored students. The Ministry of Higher Education is responsible for accreditation and for monitoring the quality of education and the degrees awarded. While accreditation and monitoring can serve to disqualify schools with unacceptably low standards, the main constraint on academic standards is the level and quality of knowledge and

Table 6: Higher education intake, 2011-2012

	TOTAL			EXPATRIATE			OMANI		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Sultan Qaboos university	1,510	1,620	3,130	11	10	21	1,499	1,610	3,109
Universities and colleges abroad	1,628	1,264	2,892				1,628	1,264	2,892
Private universities, colleges	4,389	11,057	15,446	295	194	489	4,094	10,863	14,957
Colleges of Applied Sciences	959	1,117	2,076	6	7	13	953	1,110	2,063
Technical colleges	3,500	1,635	5,135				3,500	1,635	5,135
Health institutes	166	462	628				166	462	628
Institute of Shariah Sciences	135	83	218	25	11	36	110	72	182
Total	12,287	17,238	29,525	337	222	559	11,950	17,016	28,966

Source: NCSI, *Statistical Year Book*, 2013: 472.

Table 7: Enrolment of Omani students at Sultan Qaboos University, 2011-2012

Specialization	Males	Females	Total	%
Society and culture	551	329	880	5.7
Education	819	1,042	1,861	12.1
Religion and philosophy	814	1,511	2,325	15.2
Management and commerce	1,158	1,170	2,328	15.2
Agriculture, environment, etc.	653	652	1,305	8.5
Information technology	148	180	328	2.1
Natural and physical sciences	1,034	1,328	2,362	15.4
Engineering and related	1,988	645	2,633	17.2
Health	517	806	1,323	8.6
Total	7,682	7,663	15,345	100.0

Source: NCSI, *Higher Education Statistics Bulletin*, Issue 2, 2013: 28.

competence of secondary school graduates entering university. Critical thinking, problem-solving ability, and mathematical ability are major concerns, which limit the academic ambitions and performance of both students and institutions, including their capacity to be involved in research projects, interact with industry and contribute to innovation processes.

Private universities are required to be affiliated with overseas universities, often from developed countries. However, with a few exceptions, many of these affiliations are with universities that in their own environments have modest admission standards and rank low in unofficial rankings. The quality of the teaching staff and the rigour of examinations vary and can be detrimental to the academic success of students, while being inextricably linked to admission standards. If universities and colleges are to maintain the same teaching and examination standards as they do in their developed-country campuses, they need to apply the same admission standards. Given the shortcomings of secondary school attainment in Oman, practical compromises are reached and deter top-level schools from entering into affiliation agreements. An alternative would be to provide

students with the opportunity to prepare for and take examinations at a university with high and internationally recognized standards. This approach does not, however, resolve the fundamental problem of low standards of attainment in secondary education.

Labour supply

In Oman, the supply of labour is growing faster than the population due to high enrolment rates in secondary education, in particular among females who, in addition, academically outperform their male counterparts. Estimating the growth of the labour supply is an important task for the authorities responsible for employment policy.

Table 8 shows the trend in labour force participation. An obvious trend is the growing number of women in the labour market. For example, there was a threefold increase in the participation rate of women in the 20–24-year age group between 1993 and 2010. This change is likely to have been due partly to a change in attitudes and partly to an increase in the availability of government jobs that attract women; but the main determinant was almost certainly the change

Table 8: Labour force participation rates by gender and age group

Age group (years)	1993 Census		2003 Census		2010 Census	
	Male	Female	Male	Female	Male	Female
15-19	22.4	3.1	17.2	9.2	20.2	10.7
20-24	84.5	16.5	75.4	34.6	74.5	36.8
25-29	96.3	11.9	95.9	35.4	95.6	46.1
30-34	96.0	7.4	95.3	22.2	97.0	37.9
35-39	95.3	5.1	94.4	12.8	95.3	27.6
40-44	93.1	4.6	89.8	8.6	91.4	17.1
45-49	89.6	4.1	84.5	6.3	80.7	9.8
50-54	81.4	3.2	62.3	4.0	68.3	6.2
55-59	75.4	2.5	50.2	3.2	53.3	4.3
60-64	52.5	1.7	32.3	1.7	32.2	2.6

Source: Omani Women in Labour Market: Facts and Challenges (Al-hawatia, 2011),

in educational attainment. For men, the main development is the reduction in the participation rate for the 20–24-year age group as a consequence of the greater numbers enrolled in higher education, as well as an earlier and sharper decline in the older age group, reflecting the growth of public sector employment with its regulated retirement and pension and benefits schemes.

6.3 Employment and unemployment

Determinants of employment

The ultimate determinants of employment in any country are macroeconomic factors that influence the level of demand for goods and services and, consequently, the demand for labour. In Oman, the key macroeconomic determinants, in the short to medium term, are oil exports and oil revenues. The key long-term determinant will be the success of a diversification strategy, ideally largely driven by innovation and the development of an industry-oriented entrepreneurial culture.

At present, oil revenues finance public spending, and therefore public sector salaries, which represent more than 10 per cent of the salaries of the total workforce and a disproportionately higher level of wages than those of semi-skilled and low-wage imported labour. The latter wage levels drag down wage averages in the private sector. Such downward pressure on wages represents a powerful incentive for businesses to strategize based on low capital requirements, low technological intensity and therefore low productivity. These in turn deter technological innovation. However, this factor should not be generalized as the majority of imported low-cost labour is employed in the construction sector which does not require academic qualifications or a high level of skills.

While these characteristics of the Oman labour market are unlikely to change dramatically in the near future, it should be borne in mind that innovation and technology transfer potential must be considered with the entire economy in mind.

The oil and energy sector represents about half of all economic activity in Oman, and any deterioration in its performance, through declining reserves or a drop in oil prices, would dramatically weaken the productive activity of the economy, apart from limited activities in agriculture. Table 9, which provides an overview of public sector finances for the period 2001–2011, highlights the importance of the oil sector.

A major problem that needs to be highlighted is that all sectors in which Oman could diversify will be significantly (and in multiples) less profitable than the oil sector. This will result in significantly lower direct government revenues and a much reduced tax base, while fiscal contractions may follow, including a freeze or reduction in public sector hiring as well as lower expenditure on infrastructure and public works. However, actual oil reserves have been augmented as fast as they have been depleted by new discoveries of deposits and by advances in extraction technology. This must not be seen by policymakers as an opportunity to continue business as usual, but rather as an opportunity to improve future prospects by providing significant support to innovation and diversification and developing employment opportunities in the non-oil economy.

It is evident that in Oman there is a misalignment in the provision of higher education and the actual needs of industry, as mentioned earlier in this review. The profile of the distribution of degree courses, in terms of occupationally orientated disciplines and the humanities, is similar to those found in many countries around the world, particularly in Western Europe and North America. However, the profile of the demand for graduates is very different, in that there is low demand for humanities graduates. The resulting imbalance is likely to exacerbate the problem of unemployment among graduates, which could give rise to social problems that are predictable, serious and enduring.

While planning for human resources development may seem the obvious policy direction, in practice it is a dubious proposition to develop targets and

Table 9: Public sector finance, 2003–2012 (OMR millions)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total revenue	3,305	4,040	4,511	4,980	5,921	7,639	6,748	7,917	10,625	13,475
Revenue from oil	2,316	2,905	3,162	3,226	3,678	5,093	4,491	5,470	7,798	9,831
Revenue from gas	87	251	394	614	811	910	731	930	1,173	1,584
Other revenue	902	884	955	1,141	1,432	1,636	1,527	1,517	1,654	2,060
Total expenditure	3,189	3,810	4,208	4,936	5,880	7,560	7,429	7,965	10,738	13,555
Current expenditure	2,373	2,661	3,179	3,531	3,858	4,420	4,219	4,791	6,104	8,773
Investment	700	1,035	967	1,200	1,697	2,281	2,691	2,597	2,960	2,887
Participation support	116	114	62	206	326	859	519	578	1,675	1,896
Surplus	116	230	303	44	41	78	-680	-49	-113	-81

Source: NCSI, *Statistical Year Book*, 2013: 350–351, updated with data received from TRC.

implement policy actions that guide the national education system to produce predetermined numbers of competent, skilled and expert workers. Instead, emphasis should be given to the promotion of skills related to critical thinking and problem solving. The fundamental objective should be to develop a capacity to acquire specific skills and discharge new responsibilities when needed. A solid command of the national language, foreign languages and numeracy are important but insufficient prerequisites; familiarizing students with basic notions and skills related to entrepreneurship are also important.

A functional innovation system based on a high level of interaction between firms and educational institutions will help determine which fields of study and what mix of skills and competencies will be in demand by industry. Stronger linkages between productive sectors and knowledge-diffusion institutions would be important in this regard. They could trigger a virtuous circle whereby clearly perceived signals about the needs of the economy could facilitate improvements in the supply of human resources, which in turn could represent the basis for further technological upgrading and increased demand for science and technology skills. However, given the obvious excess of humanities graduates in Oman, compared with the needs of industry and public sector institutions, limiting the number of liberal arts degrees offered may be a practical policy option.

Labour market institutions

The main institutions directly concerned with employment are the Ministry of Manpower, whose primary responsibility lies with issues relating to employment in the private sector, the Ministry of the Civil Service, the Manpower Registration Authority, the Oman Chambers of Commerce and Industry and the General Federation of Oman Trade Unions. There is no umbrella body that might provide a forum for coordinating the policies and initiatives of these institutions, especially since the Manpower Registration Authority, which was part of the Ministry of Manpower, became an independent institution reporting to the Council of Ministers. This is a major shortcoming from a national innovation systems perspective, in particular when informal interactions are hindered through pervasive risk averseness and information gate-keeping, as discussed in part I of this review.

The Ministry of Manpower is composed of the Directorate General of Employment and the Directorate General of Technical Education and Vocational Training. In addition, it hosted the Sanad Programme that promotes self-employment until that was recently taken over by the Al Rafd Fund. The Directorate General of Employment is in charge of the Omanization policy and operates the Employment Service. It is also responsible for an

inspectorate concerned with compliance with labour legislation. In the Ministry of Manpower, the Directorate General of Technical Education, Vocational Education, Occupational Standards & Curriculum Development and Training has introduced a number of training programmes to support Omanization, such as the Training Program Coupled with Employment, On-the-Job Training, the Career Development Program and Employment, the Vocational Training Program and the Abroad Training Program.

The Ministry of Manpower is endeavouring to introduce fundamental changes in the delivery of education, with emphasis on the learning aspects rather than on teaching. Methodologies such as the student-centred learning approach and compulsory on-the-job training (OJT) at business and industrial sites at the end of each qualification level are used to enhance the employment prospects of job-seekers and in turn improve Omanization rates. As a result of the OJT programme, 20–25 per cent of the trainees secure offers of employment at the training places themselves.

The Sanad Program, which had been operating under the Ministry of Manpower, provided support for the creation and development of self-employment and small businesses. It offered general guidance, training in business skills and soft loans. It also supported the policy of reserving certain occupations for Omani nationals by assisting in coordination with local governments and with implementation. The Ministry of Manpower's publication, *Manpower 1970–2010*, reports that nearly 28,000 individuals benefited from the reserved occupations scheme over the period 2002 to mid-2010. Following the National SME Development Symposium held in January 2013, Sanad, along with other small funding schemes for SMEs, was merged with the Al Rafd Fund, with a budget of OMR 70 million.

The Manpower Registration Authority is responsible for keeping records on Omani nationals seeking employment in general and for facilitating their recruitment by public sector bodies. The number of unplaced job-seekers provides an estimate of Omani unemployment, but in the past it has been inflated by the inclusion of those who have found jobs but have not informed the Registration Authority. To address this problem, the burden of informing has been shifted to all employers, be they private and public firms or institutions. The ultimate objective is for the Authority to maintain a real-time data base that records the employment status of all Omani nationals. A major problem for the registry is that registered job-seekers may actually be employed but looking to transfer from their present jobs to more attractive ones, perhaps in the public sector, or they may not be available for work at all.

Table 10: Employment of Omanis and non-Omanis by gender, 2013

	Omani nationals			Non-Omani workers		
	Male	Female	Total	Male	Female	Total
Public sector						
<i>Civil Service</i>	71,244	63,173	134,417	9,616	7,650	17,266
<i>Diwan & Royal Affairs</i>	20,596	1,998	22,594	7,507	131	7,638
<i>Public corporations</i>	6,764	3,029	9,793	1,372	1,246	2,618
Total, public sector	98,604	68,200	166,804	8,495	9,027	27,522
Total, private sector	143,860	38,000	181,860	1,219,349	27,858	1,247,207

Source: NCSI, *Statistical Year Book*, 2013: 97; NCSI, *Monthly Statistical Bulletin*, February: 19-20.

Formerly a department of the Ministry of Manpower, in 2011 it was upgraded and accorded an independent status reporting directly to the Council of Ministers.

Employment, unemployment and self-employment

Table 10 confirms that an overwhelming number of Omanis work for the public sector while the vast majority of foreign workers are employed in private firms.

The success of self-employment initiatives such as SANAD is difficult to assess, but it is unlikely that they have a significant impact on the national economy, however much they manage to improve the lives of individual successful entrepreneurs. A major problem is getting such schemes to target the right audience. Supporting school-leavers who have neither practical experience nor tacit knowledge is largely misguided. A particular policy lapse is assuming that such programmes will reduce youth unemployment.

From the technology and innovation point of view, self-employment is also highly unlikely to significantly narrow the technological gap between Oman and economies closer to the technology frontier. For this to happen, no alternative can replace diversification strategies that focus on knowledge-intensive, industrial-scale activities and generate widespread opportunities for knowledge diffusion and complex productive collaboration.

Public awareness of the success of small businesses started by individuals with no experience is limited to the minority that have been successful, and ignores the multitude that have failed, while presenting false hopes to Oman's youth as well as a delusion of successful policy outcomes for its policymakers. Self-employment and entrepreneurship programmes should be targeted at would-be entrepreneurs who wish to take the risk of abandoning working for an employer.

Table 11 provides data on the number of Omani nationals seeking jobs for the first time, the number recruited, and the number remaining unemployed, for the period 2005 to mid-2010. The 2011 data, when available, can be expected to show major changes as a result of the political decision in March 2011 to find jobs for 50,000 Omani nationals registered as job-seekers.

The data in table 11 suffer from a number of drawbacks, and should not be seen as a precise description of the state of unemployment. Many job-seekers are self-employed or are working while looking for a better job, and many job-seekers are not keen to accept a private sector job. Moreover, the data do not include data of the Manpower Registration Authority or data on public sector hiring and employment terminations.

This is an important issue for evidence-based policymaking and can be remedied by developing surveys to complement administrative records.

Table 11: Private sector job-seekers and recruitment, 2005–2010

	2005	2006	2007	2008	2009	2010*
New job-seekers	48,959	44,992	65,641	88,040	88,402	25,811
Unplaced job-seekers from previous year	8,512	16,049	17,414			
Separated workers	5,134	13,753	15,802			
Unplaced plus separated - less inactive job-seekers	13,646	29,802	33,216	28,364	23,769	53,268
Total number of job-seekers	62,605	74,794	90,462	116,404	112,171	79,079
Recruited workers	46,556	57,380	66,327	82,231	71,477	48,309
Unplaced job-seekers	16,049	17,414	24,135	34,173	40,694	30,770

Source: For 2005–2007, Ministry of Manpower, *Annual Statistical Report 2007*; for 2008–2010, *Manpower from 1970 to 2010* (Ministry of Manpower, 2010).

* Note: Data for 2010 are only until July 2010.

Table 12: Targeted Omanization rates in retail occupations in big outlets, 2003–2007

Category	2003	2004	2005	2006	2007
A	100%	100%	100%	100%	100%
B	40%	55%	65%	80%	90%
C	20%	30%	35%	50%	60%
D	10%	15%	20%	30%	40%
E	10%	15%	20%	20%	30%
Category	Classification of occupations and jobs in each category				
A	Cashier - Driver - Farash - Lift Driver - Public Relations Officer - Human Resources Director - Security Official - Trolley Worker – Unskilled Labourer				
B	Shelf Classifier - Promoter- Customer Services Assistant - Skilled Maintenance Technician - Storekeeper				
C	Butcher - Bakery Worker - Flowers Decorator - Fresh food Salesman - Fruits & Vegetables Salesman - Data Entry Clerk - Accountant				
D	Controller - IT Controller - Fresh food Manager - Store Controller - Store Assistant Manager - Accounts Head				
E	Analysis Manager - Finance Manager – IT Manager				

Source: Omanization percentage in the selling and distribution sector as per ministerial decision No.159/2003; see: <http://www.manpower.gov.om/portal/en/OmanisationPlan.aspx> (accessed 18 May 2012).

Surveys could generate qualitative data on subjective and behavioural issues, such as reasons for seeking (or not seeking) employment, and the conditions for accepting a job, or the scale of encouraged unemployment.

6.4 Omanization

The development of Oman's oil sector led to a heightened demand for labour associated with rapid economic growth and which could not be met locally. This resulted in the importing of foreign labour, much of it to take up low-wage and semi-skilled jobs. Soon enough, unemployment for Omani nationals became a source of social and economic tensions. In 1988, an Omanization policy was launched aimed at replacing expatriate workers with Omani nationals.

Today, Omanization is a core mission of the Ministry of Manpower. The Ministry sets global targets for Omanization by sector and occupation, while at the firm level it steers individual firms to comply with Omanization targets, using its authority as issuer of work permits for non-Omani workers. The Ministry is also responsible for the colleges of technology and vocational training centres that impart the skills required by the private sector. As a result, and in contrast to other GCC countries, in terms of absolute numbers, there are more Omanis working

in the private sector than in the public sector.

Omanization in practice

In practice, the Omanization policy divides the economy into different sectors of activity, and typically establishes targets for the proportion of Omani nationals working in the various occupational groups employed in each sector, with a time line for progressive increases in those targets. Generally, the Omanization target is inversely related to the skill level, reflecting the fact that it takes time for Omani nationals to acquire the training and experience required in certain occupations. Table 12, which shows the targets for the retail trade by occupation, provides a typical example.

The setting of targets is pragmatic and takes account of the fact that different approaches may be appropriate for different sectors. Hence, the disaggregation of the sector may be by activity or by sub-sector. Table 13 provides an example of the latter, where targets are set for different sectors within the tourism industry. For an occupation that is generic across sectors, such as truck and bus drivers, the targets may be set in terms of detailed occupation, without reference to each sector. In that particular case, a target of 100 per cent Omanization was already set by a decision in 2005.

Table 13: Omanization targets by different activities in the travel and tourism sector as per Ministerial Decision No. 165/2003 (per cent)

Activities	2003	2004	2005	2006	2007
Aviation Companies	76	78	80	82	83
Tourist Restaurants	35	50	70	85	100
Travel & Tourism	42	50	60	70	80
Hotels (3, 4, 5 Stars)	40	50	60	70	75
Car Rentals	52	62	75	85	97

Source: <http://www.manpower.gov.om/portal/en/OmanisationPlan.aspx>.

Table 14: Non-Omani recruitment limits by size of establishment

Establishment class	National	Workforce		Omanization percentage
		Expatriate	Total	
World class	9,992	13,012	23,004	43.44
Excellent	156,399	339,699	496,098	31.53
Consultative	533	1,619	2,152	24.77
First class	43,204	254,221	297,425	14.53
Second class	4,140	110,669	114,809	3.61
Third class	2,052	155,890	157,942	1.30
Fourth class	3,629	433,737	437,366	0.83
Total	219,949	1,308,847	1,528,796	14.39

Source: *Manpower from 1970 to 2010*, (Ministry of Manpower, 2010), Table 18.

The Ministry enforces Omanization targets mainly by controlling the recruitment of non-Omani workers by restricting permits. While Article 18 of the Oman Labour Law requires that foreign permits be issued only if “there are not among the Omanis the sufficient work force for the posts or occupations” and if “the employer has complied with the prescribed percentages of Omanization”, the actual guidelines for the recruitment of non-Omani workers differ for companies of different sizes as defined by capitalization. Table 14 shows the distribution of Omani and non-Omani employees by category of employer in 2013.

Private sector companies seeking to recruit Omani nationals are required to submit details of the kinds of workers required. Omani nationals seeking work in the private sector attend personal interviews at the Ministry of Manpower and their data are entered or updated in a general database of job-seekers. The Ministry uses the database to match candidates to the vacancies notified by an employer, usually two candidates for each vacancy, and then arranges interviews of the candidates with representatives of the employer and under the supervision of Ministry staff.

When private sector hiring occurs through direct contact, without the mediation of the government employment service, companies that recruit Omani nationals are still required to submit the employment contracts to the Ministry of Manpower for approval. In addition, Article 14 of the Labour Law of 2003 requires every employer to submit to the Ministry a detailed statement on the number of workers classified according to their type of job, occupation, wages and gender. Private firms must also submit a statement giving reasons for not filling vacancies and a statement on the expected increase or decrease of employees in the subsequent year.

Following the implementation of the Omanization policy, there has been a relative increase in the number of Omani workers compared with non-Omani workers. Between 2000 and 2010 the number of paid Omani employees in the private

sector increased from 56,000 to 190,000, while the number of non-Omani workers only doubled, from half a million to one million.⁵⁰ From a regional perspective, Oman is unusual among GCC countries in that a relatively large number of Omani nationals work in the private sector.

Incentives and preferences for public sector jobs

The success of the Omanization policy in the long term will continue to depend on factors affecting the supply of Omani nationals willing to work in the private sector, and factors affecting the demand for Omani nationals by private sector employers. There are currently about one million jobs staffed by foreigners working in Oman’s private sector. Based on a population of 2 million nationals and about 100,000 new entrants into the job market each year – many of whom will express a strong preference to work in the public sector – it is unlikely that there will be a dramatic change in the near future. Some determinants are cultural, while others are objective and can be expressed as measurable incentives. A willingness to work in services and the structure of earnings and benefits on offer are factors that are often cited. While private firms can offer competitive remuneration and can outbid public institutions in their quest for expertise, at many interviews held during the UNCTAD STIP mission it was often heard that many Omani nationals working in the private sector will have accepted such employment only because they have not found employment in the public sector.

One of the main reasons for the strong preference for jobs in the public sector was said to be higher salaries. Data presented in tables 15 and 16 attempts to describe the options and dilemmas that Omanis face in the job market. The data indicate that the public sector pays secondary school graduates (the largest group by number) 45 per cent more than they receive in the private sector (OMR 475 vs. OMR 326). In Oman, as in other countries, there are large wage differentials at a given educational level in the private sector, so

Table 15: Civil service monthly pay and allowances, by level of education, April 2014 (OMR)

Grade	Basic Salary	Annual Allowance	House Rent	Electricity	Water	Telephone	Transport	Cost of Living
First	2,600	80	600	60	40	40	390	50
Second	1,950	60	550	60	40	40	290	50
Third	1,500	40	500	55	35	35	225	50
Fourth	1,260	40	450	50	35	35	190	50
Fifth	1,080	25	425	50	30	30	160	50
Sixth	950	20	400	45	30	30	145	60
Seventh	830	20	375	40	30	30	125	60
Eighth	730	15	350	40	25	25	110	60
Ninth	550	15	275	30	20	20	80	60
Tenth	460	15	250	30	20	20	70	60
Eleventh	400	15	180	25	20	20	60	80
Twelfth	360	8	120	25	15	15	55	80
Thirteenth	310	8	100	20	15	15	50	80
Fourteenth	270	8	100	20	10	10	40	90
Fifteenth	250	7	80	20	10	10	40	90
Sixteenth	230	6	80	10	6	5	30	100
Seventeenth	200	6	60	10	6	5	30	100
Eighteenth	170	5	60	10	6	5	30	100

Source: TRC, Ministry of the Civil Service.

that educational levels do not guarantee a particular level of wages. Indeed the figures indicate that there are almost 6,000 university graduates earning less than OMR 600 per month, while almost 7,500 workers with a secondary degree or less earn more than OMR 600 per month. Regarding those with advanced university degrees, a comparison of salaries between the two sectors is much less clear. The fact that foreigners with a secondary degree or less earn less than the minimum wage of OMR 350 set for Omani nationals is indicative of potential strains in the labour market.

Working hours and working conditions are stipulated by law and enforced by the Ministry of Manpower. Firms are obliged to observe the minimum standards of the nine-hour work day, the

full two-day weekend, and prescribed annual salary increments of 3 per cent. However, there have been suggestions that foreign workers are generally more willing to tolerate some of the following irregularities: an adverse environment, a requirement to be available at irregular or non-standard hours, high expectations of the speed and standard of execution of tasks, and low expectations of promotion or advancement.

This may be a result of incentives, such as significantly poorer earnings prospects in countries of origin, and should not necessarily be seen as a work culture issue. Moreover, it is questionable whether this applies to executives, entrepreneurs and specialists holding advanced degrees and with significant work experience or those who are owners or partners of a business.

Table 16: Private sector monthly pay by level of education, 2012 (in OMR)

	200-300	301-450	451-600	601-750	751+	Total	Average
PhD	0	0	3	1	79	83	884
MSc	0	0	88	48	716	852	849
Postgrad Dip	0	0	10	6	48	64	820
Bachelor's	1,562	1,828	2,541	2,072	5,022	13,025	639
Diploma	3,987	4,138	2,374	1,205	1,936	13,640	466
Secondary graduate	54,209	16,078	5,631	2,186	2,548	80,652	326
Preparatory	36,729	7,577	1,905	650	638	47,499	296
Primary	18,759	3,662	713	192	191	23,517	287
Read & write	22,936	3,437	1,076	392	762	28,603	299
Illiterate	8,501	829	149	39	24	9,542	269
Total	146,683	37,549	14,490	6,791	11,964	217,477	339

Source: Ministry of Manpower, see <http://www.manpower.gov.om/Portal/media/Statistics.aspx>.

In interviews with STI stakeholders during the UNCTAD mission for the STIP Review in 2013, a number of explanations were advanced for the current stratification of the labour market. One indisputable fact is that, however low the salaries for unskilled and semi-skilled labour in Oman, they are sufficient to attract an endless supply of job-seekers from abroad. Two medium- to long-term processes may change this situation. One could be a general wage deflation in Oman due to the shrinking of the oil economy and the failure to replace it with sufficiently high productivity and high-margin industries. The other could be economic development in the countries and regions that are the sources of low-wage labour imports, a factor that is beyond the control of Omani policymakers, unlike the first one.

From a broad development perspective, the success of an Omanization process would be more easily compatible with the maintenance of living standards and socio-political stability if it were driven by a strategy of employment creation rather than employment substitution. This implies an increase in productivity levels through guided capital allocation and technological absorption and development. The challenge would thus be not to replace foreign workers with Omani nationals, but to develop stronger demand for higher productivity workers through industrial diversification.

With regard to developing an innovation culture, deeper research and consideration is needed for promoting on-the-job training, developing a culture of life-long learning and facilitating the transfer of tacit knowledge. These are issues that an innovation policy can support and stimulate, but which ultimately need to be tackled by business and industry. With regard to the training of non-Omanis, employers can make this investment with some, but by no means absolute, level of surety that the employee will remain for the duration of the contract, as there are formidable disincentives to changing jobs common to all expatriate staff, i.e. changing jobs can be a fundamentally disruptive process not easily undertaken in a foreign country and without a broad social and family network. In the case of Omani nationals, however, the acquisition of transferable skills can often lead to job-seeking elsewhere, unless accompanied by an appropriate wage rise. If the skills are such that the employee can secure a public sector job with a significantly higher wage than the current employer cannot match, the employee will be lost, and so also the investment in training.

Policy options and effects

Wage changes are the main lever for Omanization and destratification, regardless of whether they occur through a reduction of nominal and/or real wages in the public sector or an increase in wages in the private sector. A fundamental concern is

maintaining social stability and avoiding social tensions, grievances and economic uncertainty that can paralyse public development policy as well as the willingness of firms to invest and operate with a long-term perspective.

Rationing of permits for non-Omani workers through a permit auction system makes them scarce and increases their market value. Permits can be classified into a number of categories according to skills, education and competencies, with assigned quotas for each category.

This would allow policymakers some leverage over incentives, and could be used to influence national human resources development that would be in line with strategic development objectives, including the objective of diversification of the economy through the greater use of science and technology to innovate existing and new products and services. The reduction of non-Omani labour is likely to drive private sector wages up towards and beyond levels in the public sector.

As a result of the wage increases, firms should expect profits to fall and many will attempt to restore profit margins by raising prices; in some sectors it may also encourage investment in labour-saving equipment and process innovation. The overall effect will reduce labour's share in national income, particularly the participation of employees in the public sector, where there should be no wage increases if the policy is to have an effect. A total fall in the demand for goods and services may be offset to some extent by increased earnings through higher wages in the private sector, and by Omani nationals switching to employment in the private sector, as well as through a reduction in transfers of wages earned by foreign workers in Oman to their home countries. The production of goods or services that depend on the availability of cheap foreign labour may no longer be economically viable with existing technologies and processes, and may stimulate innovation and investment in technology.

Omanization of the private sector is potentially a much more constructive approach to resolving the problem of unemployment. With destratification of the labour market, a large number of the one million jobs currently held by foreigners may become attractive to Omani nationals. An increase in the employment of Omani nationals in the private sector is one of the objectives and, at the same time, an underlying basis for the economic diversification strategy. As stated earlier, the overall preferable outcome of the Omanization policy should not be merely the replacement of foreign workers with Omani nationals, but the achievement of overall levels of productive employment in the economy, with a significantly higher share of Omani workers employed.

6.5 Conclusions and policy recommendations

Labour supply and demand

From the point of view of the development of STI capabilities in Oman, the labour market suffers from two basic imbalances. The first is that Oman's education system produces too many graduates in the humanities and liberal arts and a clearly insufficient number in technical and scientific fields. The second is that Oman's growing economy and relatively open job market attracts foreign workers with schooling up to secondary school level who are willing to work for less than the prescribed minimum wage for Omani nationals.

The policy solution so far has been to hire the excess Omani graduates in public service jobs and, through the Omanization process, encourage private firms to take on an increasing number of Omani nationals. However, these solutions may fall short of what is needed to promote an innovative and diversified economy with a view to moving away from an excessive dependence on oil revenues.

Bringing in line the number of places for non-vocational studies should be a policy priority. In order to improve access to private sector jobs that offer comparable remuneration and work conditions to those currently found in the public sector, education and training institutes need to focus on producing the kinds of skills and expertise needed by firms and industry. However, achieving this requires active interaction between industry and educational institutions which is more likely to occur within the context of an innovation system strategy.

A major practical problem for policymakers is the paucity and poor quality of relevant data, as well as uncertainty as to its interpretation. For example, data on persons seeking public sector employment may not be completely accurate, as many individuals may in fact be employed in the private sector while being registered with the Manpower Registration Authority in the hope of changing jobs or in the hope of receiving a monthly unemployment allowance.

Managed growth of public sector employment

An important policy tool that can be implemented with immediate effect is management of employment growth in the public sector. Public service jobs have a variable impact on development policy targets and can play a number of roles. The effects on diversification and spurring innovation differ depending on whether jobs are created in back-office administration, public health and extension services, or in the provision of education.

A second, but equally important issue is that public sector job growth needs to be managed conservatively bearing in mind what is happening in the productive economy and in the private sector. It would be prudent to bring public expenditure and public service job creation in line with forecasts of oil revenue streams that take into account the fact that oil depletion or a fall in oil revenues is a probable outcome even if the details are uncertain. From a long-term perspective, the two issues should be delinked, and public employment targets should be a function of desired levels of public service supply and compatible with the needs of a diversified economy's productive sectors.

Managing the expectations of Omani nationals seeking employment is an important task, and as long as they believe the Government is willing to create further public sector jobs, it will likely reinforce their strong preference for work in that sector. Due consideration should be given to reducing the proportion of young people completing their education in disciplines such as the humanities and liberal arts, which do not equip them with the kinds of skills that are needed in the private sector. The Government and its educational authorities should not provide the opportunity for studies in such disciplines unless they are prepared to continue to provide public sector employment for the graduating students. An innovation system approach would necessarily mean strengthening the linkages between firms and educational and training institutions so that the latter develop in students the skills and capabilities needed by industry. It would also involve significant interaction between various socio-economic groups and government agencies at every stage of policy planning, implementation and evaluation of human resources development.

Destratification of the labour market

Most of the jobs in the private sector in Oman that are held by non-Omanis, and which are unlikely ever to be acceptable to Omani nationals, are concentrated in semi-skilled and skilled labour where wages are typically below minimum wages prescribed by Omani law which is applicable exclusively to Omani nationals. While there is a general preference for public sector jobs, as wages and benefits are higher and working conditions are better, this does not apply as much to jobs higher up in the wage, education, skills and experience ladder. There have been proposals for remuneration in the public sector to be brought in line with that in private firms. However, this may not be viable in current socio-economic and cultural conditions and with the set of incentives that exist for workers and employers. It may also lead to tensions and instability.

Wage levels should be more closely aligned with productivity across the economy. Since it is impractical to reduce public sector wages in absolute terms, restraining future increases should be a minimum policy target. Accessing higher paid jobs in the private sector then becomes an issue of developing appropriate human capabilities and skills, developing new employment opportunities in higher productivity sectors as well as regulating foreign work permits. To increase private sector pay, a more careful management of immigration will be needed. This should include consideration of the economic, but also the social realities – including the positive impact of the social and academic diversity of immigration and the advantages it may present to an innovation-friendly environment – which the presence of a high proportion of foreign workers has created in Oman.

Educational standards and attainment

The under-attainment of males in education, compared with females is a major social problem in Oman. This divergence affects both the economy and society, and urgently needs to be addressed. More broadly, and similar to other GCC countries, the educational attainment of both males and females is low by international norms. Females perform better than males, but even their performance needs to be improved substantially if it is to attain international norms. In addition, female students often do not find employment matching their competencies and skills, as fragmentation works against communication between industry and academic and educational institutions.

It is beyond the mandate of this report to propose specific policies to improve the quality of the Omani education system. However, it is clear that in order to improve technological and innovation capabilities in the country, the quality of education and the problem of under-attainment should be addressed. This will require both improvements in the provision of education by the schools and in the take-up of educational opportunities by families and their children. It is essential that national expectations concerning standards of achievement be raised. Without going into specific measures to be taken, international best practices provide a number of options to consider in terms of providing greater incentives for higher achievement. In this regard it is suggested that improvement in the standards of teaching should continue to be a top priority. A key reason for this is that improving the quality of the teaching staff will take less time than changing cultural attitudes.

Following a Directive from His Majesty Sultan Qaboos, the Ministry of Education has established a Specialised Centre for Teacher Training. Its aim is to develop highly skilled, confident and motivated educators through sustained, intensive

and accredited professional development that is benchmarked against international standards. The Specialised Centre's first training Programmes began in March 2014.

Fiscal sustainability

The fiscal sustainability of the public sector is critical for labour policy, as it is Oman's largest employer: one in three Omanis work in the public sector. Public sector salaries, together with public procurement, play a very significant role in aggregate demand, and hence stimulate employment in the private sector. Today, the public sector, which serves as the "employer of last resort" for Omanis, is viable almost entirely because of oil revenues. Therefore it is essential that strategies aimed at developing innovative and diversified manufacturing and services sectors and reducing or replacing the dominance of the oil sector in the Omani economy be well managed in a way that does not imperil public finances. The core problem is that it is unlikely that the non-oil economy can generate sufficient profits to completely replace oil revenues. Strategies that seek to develop technology that could use or generate products and services that may also have an important knowledge content, and are therefore capable of generating higher profit margins, may not fit in well with the objective of developing labour-intensive sectors, such as the tourism industry.

A second consideration is the need to plan a transition towards an alternative fiscal system in which public revenue draws more on the incomes generated by non-oil production activities. This would necessarily be a long-term undertaking that would involve a profound change in the behaviour and the mentality of economic and social actors, and in the balance of Omani and non-Omani labour supply. It should include the design of incentives that encourage investments and behavioural changes that are more supportive of technological upgrading and innovation.

Strategic priorities

The key issue for the national economy is the development of new industries to provide more jobs with higher productivity and to push forward Oman's growth, while gradually reducing the role of oil production in the economy. This inevitably means spurring processes of innovation through the strategic development of a national innovation system. The creation of employment opportunities for Omani nationals and the maintenance of a tax base that will support government expenditure are interdependent objectives. Hence, it is important that the policies and initiatives of the different branches of government take into account simultaneously impact of diverse policies, preferably within the framework of an innovation

system approach. This would require strengthening the capacity for conducting labour surveys and economic analyses jointly by the Ministry of Manpower and the Supreme Council.

7. Intellectual property, innovation and diversification

7.1 Introduction

A well-designed and implemented intellectual property rights (IPR) framework can encourage innovation and enable technology transfer. It should allow inventors and creators to focus on their competencies and free them from the need to become entrepreneurs. For entrepreneurs, it should reduce uncertainty in the commercialization of an innovation. From an economic development perspective, the policy attention that IPRs warrant needs to be closely considered in the light of local specificities, as there can be no universal policy recommendation for all countries.

This section proposes that in the case of Oman, a country with a thriving oil sector, a population of 3 million, a GDP per capita of \$21,390, a long history and tradition of trade, and with a fundamental need to spur innovation and diversify its economy, an IPR framework requires committed support from policymakers in order to provide an effective incentive and enable innovation. Oman's policymakers are striving to energize the national innovation system, including by creating awareness about the use of IPRs.

Being an economy that, outside the oil sector, operates below the technological frontier, increasing the innovation capacity of firms and diversifying the economy will depend on Oman's ability to identify and import, adapt, absorb and diffuse technology, in addition to creating its own technological knowledge. In an early phase of development, economic policy may need to focus on improving the national capacity to import and absorb technology. With progress in development, technology creation becomes increasingly important as firms and industries catch up with those in developed markets. The challenge of innovation eventually moves into creative territories as the number of immediately transferable and readily applicable technological solutions slowly decreases. In a parallel shift of circumstances, intellectual property (IP) increases in economic importance. Oman is at this juncture today.

The fact that academic debate is not unanimous about the level of effectiveness of IPR is a certain indication of the complexity and dynamism of national innovation systems and the vibrant nature of economic development. There are examples, from earlier as well as recent industrialization processes, where a weak IPR regime has enabled

reverse engineering and imitation as paths to technology absorption and innovation, such as in the Republic of Korea and China (Yu, 2007). However, countries that have used imitation and a weak IPR regime to innovate and diversify their economies eventually embark on policies for strengthening IPRs as development gains are captured. Therefore, Oman's policymakers should accept that the success of implementation of an IPR regime should be measured not only in legal terms, but also by its socio-economic impact. While IPRs may not be a prerequisite for development in the early phases, when technological capacities are weak and economic output low, as an economy and its sectors and industries grow, they increasingly become an integral and essential part of a complex innovation system.

Creating capacities to use IPR instruments to promote and support innovation and improving awareness about the role of IPRs in national development is important at this stage of Oman's technological development. Policymakers should also highlight the role, necessity and complementarity of proprietary and public domains, as well as their strategic role in spurring competition and innovation-based economic growth. IPRs need to be seen as a critical policy component of a national innovation policy that will help Oman to become a knowledge-based economy with a functional national innovation system.

7.2 IPR legislation in Oman

The first IP law in Oman was passed in 1987 as Royal Decree No. 68/1987 – Law on Trademarks and Trade Indications. But it was mainly after Oman acceded to WIPO in 1996 and became party to its treaties that there was a rapid acceleration in the development of IP laws in Oman, with the creation of a comprehensive legal framework for protecting copyrights, trademarks and patents. A second major development occurred after Oman became a member of the WTO in 2000, which led to a review of its legislation in order to conform to the provisions of the TRIPS agreement. This was followed in 2004 with Oman's signing of a free trade agreement with the United States, which entered into force in 2009 and which required Oman to further adjust its IP legislation.⁵¹

Laws and treaties

The legislative foundations for IPRs in Oman are established through its participation in key international treaties, conventions and protocols, and through the implementation of domestic IP laws. Current IP laws cover procedure, and define civil and criminal breaches and corresponding remedies. What may be missing is an

Box 5: Oman's Intellectual Property Laws and Treaties

Laws:

- Law on the Protection of Breeders' Rights in New Varieties of Plants, Royal Decree No. 49/2009
- Industrial Property Rights and their Enforcement for the Sultanate of Oman, Royal Decree No. 67/2008
- Law on Copyright and Related Rights, Royal Decree No. 65/2008
- Law on Consumer Protection, Royal Decree No. 81/2002
- Law on Civil and commercial procedure Royal Decree No.29/2002
- Law on the Protection of National Heritage, Royal Decree No. 6/1980
- Executive regulations of the Law on Copyright and Neighboring Rights, Ministry of Trade and Industry Ministerial Decree No. 103/2008
- Regulations No. 105/2008 under the Law on Industrial Property Rights & Their Enforcement for the Sultanate of Oman
- Omani Penal Code No. 7/74 (1974)
- Basic law of the Sultanate of Oman, last amended by Royal Decree No. 99/2011

Treaties:

- Registered with Gulf Cooperation Council (GCC) Patent office;
- Member of the World Trade Organization, Royal Decree No: 112/2000;
- Signatory of Trade Related Aspects of Intellectual Property Rights (TRIPS);
- Member of WIPO Convention since February 1997, Royal Decree No: 74/96;
- Signatory to the Paris Convention since July, 1999, Royal Decree No: 63/98;
- Member of the Berne Convention since 14th July 1999;
- Member of the Patent Cooperation Treaty since October 2001, Royal Decree No: 37/2001;
- Party to the Hague Agreement Concerning the International Registration of Industrial Designs since March 2009;
- Acceded to the Madrid Agreement on International Registration of Trademarks in 2007.

Source: WIPO, see <http://www.wipo.int/wipolex/en/profile.jsp?code=OM>.

accumulated record of experience and practical knowledge among IP authorities, courts and the legal practice. Box 5 lists the IP laws and treaties and conventions to which Oman has become a party so far.

The Law on Industrial Property Rights and their Enforcement for the Sultanate of Oman (Royal Decree No. 67/2008), together with the Law on Copyright and Related Rights (Royal Decree No. 65/2008), regulate the majority of IP issue, and replace the Law on Trademarks (Royal Decree 38/2000), the Law on Patents (Royal Decree 82/2000), the Law on Industrial Designs (Royal Decree 39/2000) and the Law on Copyrights (Royal Decree 37/2000).

Industrial property rights

The Law on Industrial Property Rights stipulates that a trademark must be registered in the Register of Trademarks and Trade Names at the Ministry of Commerce and Industry. Trademarks are protected for 10 years, and may be renewed on expiry. Infringement of a registered trademark is punishable with imprisonment of up to two years or a fine of up to OMR 2,000. Punishable offences include the manufacture and trade of counterfeits and misleading the public. Under the Law, preliminary injunctive relief is available for trademark infringement. The Law also provides a list of permitted trademarks.

Regarding patents, the Law on Industrial Property Rights stipulates that an invention is patentable if it

is new, contains a novel idea and is worthy of industrial application. At the same time, it must not be inconsistent with public morals, undermine national security, or be incompatible with Sharia Law. The work for hire doctrine applies, and when a patent arises from an employee's work, the employers become the owners of the patent, while the inventor is entitled to certain remuneration. Patent applications are submitted to the IP Department of the Ministry of Commerce and Industry. Patents that are also registered at the GCC Patent Office in Riyadh acquire protection throughout other member States of the GCC.⁵² The GCC Patent Regulations are fully compatible with Oman's legislation on patents.

On the issue of industrial design, the law protects industrial drawings and patterns provided they are registered with the Ministry of Commerce and Industry. The creator is the owner, and the design must be original and, again, must conform to common standards of decency. Protection is awarded for a period of 10 years. Geographical indications are also protected under the Law on Industrial Property Rights which aims to protect natural, agricultural, industrial, and handicraft products having a distinctive characteristic or reputation attributable to their geographical origin.

Copyright

The Law on Copyright and Related Rights defines an author's works as original literary, scientific, technical, and cultural, irrespective of their monetary value. Aside from economic rights related to reproduction, this law defines moral

rights as the right of an author to attribution in the manner of his or her choice, and the right to object to any distortion, mutilation, modification or other derogatory action in relation to his or her work that could prejudice the author's honour or reputation. The duration of copyright protection is the lifetime of the author plus 70 years starting from the beginning of the year following the death of the author. Similar to trademarks, copyright infringement is punishable by imprisonment for up to two years or a fine of up to OMR 2,000. Besides copyright protection, the Law on Copyright and Related Rights provides additional protection for performances, sound recordings and broadcasts.

International treaties

As a member of the WTO, Oman is party to the TRIPS Agreement and is bound by its obligations. As a member of the GCC, the GCC Patent Regulation and Implementing Bylaws apply in Oman. Oman is also party to the Paris and Berne Conventions, the WIPO Copyright and Performances and Phonograms Treaties, the Madrid Agreement and the Hague Agreement among others (see box 5). In this sense, Oman is fully integrated into international IPR networks of cooperation.

Oman is also party to the WIPO Patent Cooperation Treaty. The Treaty aims to facilitate the filing and protection of patents internationally. A single filing can secure an effective filing date in all of its member countries. To date, the Treaty has been adopted by 146 countries.

7.3 Strategic considerations and IPRs

Developing national IP policies that are adapted to the specific needs of the economy at its stage of development is a strategic component of knowledge- and innovation-based economic development and diversification. In order to function effectively in the context of an innovation system framework, IP strategy needs to be matched with human capacity among the legal professions and authorities, as well as among research institutions, entrepreneurs, inventors and innovators.

Strength of the IPR regime and its contribution to innovation

The strength of the IPR regime can be assessed by looking at the level of harmonization with international legal frameworks for IP, as well as the capacity to assess and register IP and implement legislation, competently rule on disputes, and implement decisions and enforce legal remedies where justified and deserved. A functional and strong IPR regime means that a country has committed resources and developed human and institutional capabilities. An IPR strategy would aim

to develop these capabilities as a component of a national innovation system, in cooperation with STI stakeholders, and in line with overall national development objectives and strategies.

However, the critical contribution of IPR to technology and innovation-led development may be even more closely linked to microeconomic factors, particularly the technology use and capacities of sectors and firms, and the competitiveness of the national and international markets in which they operate. Certainly, more advanced firms and sectors may benefit from innovating by adopting technology through licensing, and Oman's IPR regime would need to support this. Other industries or sectors are less developed and less competitive, and their implementation of IPRs will be weaker due to a lack of resources and capacities. In such sectors, technology owners – such as multinational firms from developed countries – will often prefer intra-firm trade with a local affiliate or foreign direct investment (FDI). However, such circumstances are not static and can be influenced by policy.

IP and diversification

The development of stronger IP capabilities should be an important part of Oman's strategies to industrialize and diversify in order to reduce its dependence on the oil sector. This involves several important considerations.

First, Oman's policymakers need to be able to identify all relevant international sources of technology transfer and establish the needed IPR capacities for their use. For example, technology licensing could be important when striving to spur innovation and economic diversification. This particular mode of technology transfer depends entirely on a functioning IPR regime. Other strategies such as those based on FDI or domestic innovation may require a different mix of policies, institutions and capacity-building. They may also require greater efforts to improve enforcement and performance on conflicts relating to trade and industrial secrets and non-disclosure, or developing local capacity that can facilitate the patenting and commercialization of domestic innovation. However, having a legal base in the form of IP laws is a fundamental but insufficient precondition; it is also important to strengthen the human and institutional capacity to design an IPR regime in a way that benefits strategic directions set out in the national development policy, particularly its innovation-driven diversification goal.

Second, domestic R&D, invention and commercialization of innovation, require that research institutions and firms develop their own IP strategies. They need to move away from purely "work for hire" policies towards enabling shared or joint IP registration and filing in order to provide

greater incentives for creativity and innovation to staff and employees, and encourage and facilitate the commercialization of research outputs. It is necessary to bear in mind that registering and maintaining IP is a cost for the innovator, and consequently a cost for the country. This is particularly important for small countries like Oman that may increasingly seek worldwide IP protection for their research and knowledge institutions, and entrepreneurs and innovators.

If Omani invention and innovation is to be globally competitive, relevant and have a positive impact on Oman's export performance, it may need to enhance its use of IPRs. However, owning and managing IPRs to this end requires paying fees for international filing and translation, examination and approval, and annuities and renewals in export destinations and potential markets. Although at the current level of Omani participation in global markets this is an issue of limited relevance, international protection of IPRs may require significant financial outlays, and therefore needs to be openly discussed among STI stakeholders. For example, a comprehensive patent registration covering North America, Europe and select middle-income developing countries would cost about \$150,000 per year per patent.⁵³ (LSE, 2006) If Omani IP is found to be violated, enforcing patents through litigation abroad may also require very large financial outlays while bearing the risk of an uncertain outcome.

Given the size of firms in Oman's SME sector, it is clear that for many of them the costs of international patenting are prohibitive. However, there are a number of approaches to help overcome this problem. The first is for several institutions to share the cost of patenting: Omani firms partnering with local academia and in cooperation with large local or international corporations may be able to pool sufficient resources. However, in order for such an approach to work, the various institutions involved need to support such interaction each in their own guidelines on IP cooperation and outcomes. Where there is a keen public and strategic interest to establish IP, for example over certain aspects of natural and biological heritage (such as the project, Database of Oman's Genetic Resources), government funding would need to include a budget for IP filing, registration and maintenance.

Third, policymakers need to have a clear picture of the full scope of IP policy, including the fact that creative endeavours and scientific research feed on and require access to an ever-expanding global network of scientific and technological knowledge. Key public policy concerns would include making publicly funded research openly accessible and, when appropriate, distributed under public and open copyright licences, while patents that are the result of publicly funded research should be

considered for licensing under non-exclusive terms and conditions.

Open access is essentially a copyright policy that proposes that there should be an explicit choice for the type of distribution licence a publicly funded work may use in order to maximize its social utility and, by association, its innovation impact. While an "all rights reserved" copyright may work for literary fiction, for example, a scientific research paper may have greater impact if distributed under a "some rights reserved, some rights allowed" copyright. Given the large public funding of tertiary education and of the attached research institutions, the question of open access needs to be subject to a policy discussion as it is an IPR strategy issue.

In addition, there are vast amounts of knowledge and technologies already in existence with recently expired patents – and therefore in the public domain – or under open and public licences. These need to be identified and exploited as part of a technology transfer policy. It should be noted that open and public licences also require IP protection in conformity with their explicit terms and conditions, and may require the intervention of the IPR authorities. As innovation implies a novel application of a technology in a particular location, but not globally, IP concerns should guide entrepreneurs and academics to explore technologies and knowledge under open and non-exclusive licences, or those that are in the public domain, before deciding to buy, import or develop proprietary solutions.

Finally, beyond the established IPR legislation, policymakers may need to consider taking decisions on several non-legislative IPR issues. IPR policy should be fully integrated within an overall innovation system framework, and should be used to achieve an innovative and diversified economy. A critical precondition for this will be the establishment of a large number of high-quality linkages with all active stakeholders in the innovation system, both national and international. The establishment of technology transfer offices and technology and innovation support centres is an important component of such a policy. Regionally, the only active support centre at present is located at the King Abdulaziz City for Science and Technology in Saudi Arabia; much can be gained by establishing linkages with it and drawing on its existing experiences.

Institutional considerations

Finally, there are a number of particular considerations relating to the strategic issue discussed above. For example, the Ministry of Commerce and Industry is currently responsible for the IPR office. While this may be a workable arrangement today, it is also subject to internal budgetary and institutional considerations that any

public organization needs to consider in the context of a changing economic and social environment. If the Ministry should face an institutional or budgetary crisis, how would this affect the IP department? IPR has as much to do with industrial patents as with health and education, and given its multidisciplinary nature, the establishment of a specialized IPR institution should be studied without prejudging the outcome and the recommendations emerging from such an exercise.

Oman's judicial system and IPR implementation

The legal system in Oman is based primarily on Islamic law and Sharia Law. The Basic Statute of Oman (Royal Decree No. 101/1996) stipulates the rule of law, the impartiality of judges and the independence of the judiciary. Article 61 on the independence of judges stipulates that there is no power over the judges in their rulings except the law, that no party may interfere in a lawsuit or in matters of justice, and any such interference is a crime and punishable by law. The law specifies the conditions and procedures for the appointment of judges, their transfer and promotion, and the security offered to them. The Sultan of Oman makes all judicial appointments (Article 42 of the Basic Statute) and presides over the Supreme Judicial Council. The Supreme Judicial Council oversees the judiciary (Article 66 of the Basic Statute) and formulates judicial policies. Only Omani lawyers are permitted to practice in the courts. Oman has a three-tier court structure: (1) courts of first instance, (2) appellate courts, and (3) the Supreme Court. There are six appellate courts and 45 courts of first instance. Courts of first instance constitute the lowest rung of the judicial hierarchy. The Supreme Court can hear appeals and overturn or confirm the rulings of all the lower courts. The first instance courts are competent to hear cases alleging infringement of intellectual property.

There are a number of concerns that may influence the effectiveness of the courts with regard to IP cases. As Oman's legal system has relatively little experience with IPRs, there may be concerns about its ability to handle the increasing

complexity of international IP issues. Another problem is that all court hearings are in Arabic, while any documents prepared in a foreign language must be translated into Arabic. There is no principle of precedent, and a judge is not bound by prior decisions, as in common law. Most judgments can face multiple appeals without significant cost sanctions and, as a result, disputes can be protracted. Damages are typically awarded to compensate for direct losses but there is no clear-cut definition of what constitutes a "direct" or an "indirect" loss. Foreign judgments are not easily enforced, and may often be used only as evidence while the case is heard in an Omani court anew. Finally, while there is no doubt that the legislation indicates a clear goal of protecting IPRs in Oman, many of the laws designed to protect IPRs remain untested.⁵⁴

7.4 IP in practice

In reality, only a handful of patents have been filed by Omani nationals, most of which relate to civil engineering, and were filed and granted abroad. Moreover, according to the WIPO IP statistics database, there do not seem to be any patents filed with the Ministry of Commerce and Industry, which is the filing office. This is probably due to the fact that the office has only one patent examiner. The GCC Patent Office holds 15 patents for Oman, but its efficiency could be improved, as patents pending approval typically face delays of up to 4 years. The policy plan under consideration to remedy this situation is to outsource patent examination, and the current proposal is to use patent examiners in Egypt's Patent Office, though no decision on this has been reached so far.

There seems to be a larger number of filings of trademarks and industrial designs, as presented in table 17. It shows that the vast majority of trademarks are filed domestically. The MOCI Patent Office awards trademarks typically within six months of filing. Tables 18 and 19 give an indication of the classifications, or sources, from where registrations for trademarks and industrial design are originating. The tables are not comprehensive and the classifications listed are the largest ones, which account for at least two thirds of all registrations.

Table 17: IP in Oman: Patents, trademarks and industrial design

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total patent applications by applicant's origin				3		5	3	15	8	3	9
Patents in force by applicant's origin						1	1	1	8	21	18
Total trademark registrations* by filing office								118	1837	2097	1907
Total trademark registrations* by origin ¹	2	2	3	88	3	5	26	4	10	81	57
Total industrial design registrations* by filing office										110	171
Total industrial design registrations* by origin ¹		1								54	5

Source: WIPO IP Statistics Data Centre.

Note: (*) Direct and via the Madrid system, (1) by applicant's origin, (°) direct and via the Hague system.

Table 18: Registrations of trademarks in Oman, by selected classifications, 2007–2011

Nice Classification*	Description* / Year	2007	2008	2009	2010	2011
Class 09	Scientific, nautical, surveying	20	372	393	328	453
Class 05	Pharmaceutical and veterinary preparations	11	255	403	331	403
Class 03	Bleaching preparations and other substances for laundry us	31	297	328	279	338
Class 35	Advertising; business management	18	278	280	235	331
Class 16	Paper, cardboard and goods made from these materials	17	191	195	137	229
Class 25	Clothing, footwear, headgear	18	273	261	221	227
Class 42	Scientific and technological services and research and design	18	206	203	162	201
Class 41	Education; providing of training	16	165	178	124	200
Class 14	Precious metals and their alloys	18	203	191	162	196
Class 12	Vehicles	15	140	162	149	184
Class 07	Machines and machine tools; motors and engines	11	124	163	127	173
Class 18	Leather and imitations of leather	14	172	190	133	170
Class 30	Coffee, tea, cocoa and artificial coffee	16	175	157	117	156
Class 11	Apparatus for lighting, heating, steam generating, etc.	11	133	131	132	154
Class 37	Building construction; repair; installation services	13	125	131	118	147
Class 01	Chemicals for industry, science, agriculture, etc.	18	91	117	94	131

Source: WIPO IP Statistics Data Centre; available at: <http://www.wipo.int/classifications/nivilo/nice/#>.

* Note: These descriptions are only for indication; the Nice Classification is considerably more extensive.

From an innovation perspective, the fact that there is activity in the registration of industrial designs and trademarks is indicative of a certain level of awareness of the role and functions of IP. However, it may also show that while there is some diversification in the national economy, there is not sufficient diversification of export-oriented firms and sectors or in the form of knowledge-intensive industries. Policymakers need to look into the reasons for the low level of patent registration on its own and without reference to other IP instruments. One reason may be that publicly funded research is not generating patentable applications. They may need to consider what kinds of policies are needed to encourage cooperation between firms and academia in order to develop research outcomes that are commercially relevant. From an SME point of view, it could be that the costs of patenting or registering utility patents are too high and that additional funding or fiscal support may be required.

IP is a fundamental issue for technology transfers. Outside the Ministry of Commerce and Industry, Sultan Qaboos University runs an Innovation Affairs Department that focuses on supporting innovation and is charged with assisting the development of licensing agreements between SQU and private companies or publicly-owned

firms that seek to commercialize inventions (box 6). The Innovation Affairs Department is incubating the Academic Innovation Assistance Program funded by TRC. The Department has also established an Innovation and Entrepreneurship Society to provide guidance and support to entrepreneurs.

7.5 Traditional knowledge, culture and genetic resources

The protection of Oman's culture is an important step forward for protecting its heritage, establishing IP awareness and values and spurring innovation. Oman can draw upon its traditional knowledge and expressions of its cultural heritage to generate new ideas for the future. The protection of traditional knowledge through IP is an important condition for realizing its innovation potential. The challenge for Oman is to innovate by drawing on local traditions, culture and heritage as a source of inspiration and knowledge for new designs and contemporary solutions to current problems.

IP policy needs to encourage national custodians, such as the craft centre project run by the Public Authority for Crafts Industry (PACI) and the Animal and Plant Genetic Resource Centre of Oman, to register their designs and resources with a view to

Table 19: Registrations of industrial design in Oman, by selected classifications, 2009–2011

Locarno Classification*	Description* / Year	2009	2010	2011
Class 10	Clocks and watches and other measuring instruments, etc.	66	75	80
Class 11	Articles of adornment	14	20	17
Class 15	Machines, not elsewhere specified	4	18	13
Class 03	Travel goods, cases, parasols and personal belongings, etc.	2	1	8
Class 12	Means of transport or hoisting	6	4	7

Source: WIPO IP Statistics Data Centre; available at: <http://www.wipo.int/classifications/nivilo/locarno/#>.

* Note: These descriptions are only for indication; the Locarno Classification is considerably more extensive.

Box 6: Innovation Affairs Department, Sultan Qaboos University

The Innovation Affairs Department (IAD) manages all intellectual property generated by staff and students of SQU. The IAD consists of three sections:

- Intellectual Property
- Students Initiative Support
- Marketing

The objectives of the IAD are:

- Exploit University-owned intellectual properties in response to the needs of industry, the University, its faculty, and Oman.
- Marketing SQU research to foster relationships with industrial partners that broaden the opportunities for faculty to engage in sponsored research.
- Manage the IP protection developed by SQU researcher/students by working closely with SQU researchers/students when preparing to publish or collaborate with other institutes.
- Maintain close relation and continuous interaction with industry and identify opportunities to support industries through research capabilities.
- Provide the University with thoughtful and up-to-date consulting concerning its IP policies.
- Assist the university to create and develop a research park and the technology incubators.

Source: <http://www.squ.edu.om/tabid/11772/language/en-US/Default.aspx>.

improving their innovation potential for Oman's economic development.

If Oman's innovation policy considers IP to be the prime mechanism for protecting local traditional knowledge, culture and genetic resources, it needs to develop three key mechanisms:

- 1) Policy initiatives to build broad awareness of the value of local traditional knowledge, culture and genetic resources and the need for their IP protection;
- 2) Infrastructure, including inventories and databases, which will require increased human capacity and financial support in order for IPRs to provide effective protection; and
- 3) Practical tools, such as guidelines, protocols and model contracts and agreements, and the development of the people's capabilities to use them.

IP, innovation, preservation and access

Using IP to protect and regulate the use of traditional knowledge, cultural expressions and genetic resources is an essential element in a national innovation strategy. However, it should be clear that IP protection is not the same as preservation and safeguarding, which involve identification, documentation, popularization and promotion of cultural heritage. IP aims to conserve the innovation and commercial potential of traditional knowledge and cultural expression.

While these two distinct policy actions may be mutually supportive, they may also be contradictory, as efforts to preserve and safeguard traditional knowledge and cultural expression may result in placing their digital reproductions in the public domain, where they are unprotected. When IP enters the public domain, any existing or potential moral rights are relinquished. This implies that, while Oman's culture becomes more

accessible, the risks and vulnerability to uses that are against the sensibilities of its people will increase as well.

Such concerns make the case for greater consideration of the use of open or public licences, such as general public licences or creative commons licences, as these allow a detailed specification of permissions and restrictions, and do not allow the protected content to be placed in the public domain (Brown and Crews, 2010). While many museums have sought to control print and digitalize reproductions through a usual "all rights reserved" copyright, arguments citing the fact that much of the underlying art and artefacts are in the public domain is changing perceptions and have led cultural authorities to re-evaluate their IP policies relating to online images of their collections.⁵⁵

IP and genetic resources

Genetic resources as found in nature are not creations of the human mind, and thus are not directly protected as IP in most countries. On the other hand, inventions based on genetic resources, whether they are related to traditional knowledge or not, may be protected as IP. Judgment on this issue can be problematic, as traditional knowledge will sometimes provide researchers with indications about their value for medical or other uses. An added complexity is that genetic resources are subject to access and benefit-sharing regulations under the Convention on Biological Diversity and related protocols and treaties.⁵⁶ The creation of a database on genetic resources, as is being done at the Animal and Plant Genetic Resource Centre of Oman, will help patent examiners identify prior art, enabling them to dismiss certain patent applications, including those that do not comply with obligations under the Convention on Biological Diversity on prior informed consent, mutually agreed terms, fair and equitable benefit-sharing, and disclosure of origin.

7.6 Conclusions and policy recommendations

IPRs are a valuable STI policy tool. However, focusing policy efforts on facilitating IP registration processes, while extremely necessary, is an insufficient condition for enabling the dynamics that IP can bring to an innovation system and, ultimately, for building a knowledge-based innovative economy. An innovative economy will be achieved only when firms, entrepreneurs, innovators and researchers have clear incentives to take risks that are manageable. This is where an IP system can play a major role, as it protects them from the unauthorized use of their technological and knowledge-based solutions in producing a commercial product or service.

Current IP laws in Oman are generally compliant with WIPO conventions and obligations under the WTO TRIPS Agreement. However, this does not mean that Oman has the capacity to take full advantage of its domestic innovation potential; nor should the development of an IP framework in Oman be considered a done job. For example, building greater awareness about the system of utility patents can encourage incremental innovation. Such a system is already incorporated into the Law on Industrial Property Rights, but it could be refined in order to provide incentives for domestic inventors to lay a claim to such rights.

A number of research and innovation areas of strategic interest have been identified, where IP must play a paramount role. One of these is the Animal and Plant Genetic Resource Centre of Oman. Innovative uses of genetic material in advanced agriculture, industry and pharmaceutical development require a fully functional IP framework. However, such endeavours also present a challenge to IP policy, as outcomes with commercial potential can result from a mix of traditional knowledge and research-driven efforts.

The database of the Genetic Resource Centre, as its central policy tool, itself can test IP policy. As a digital database, it can be easily shared and copied, as its role is to serve as a tool for knowledge and information-sharing among STI stakeholders. This suggests a certain level of openness, but it also means that policies are needed to protect its contents from unwarranted appropriation.

More generally, with regard to research and in particular to education issues, Oman's IPR policy needs to consider an overall strategic position on open access to ensure that publicly funded research outcomes, when published, are distributed as openly licensed materials. This is an important consideration that determines the public's right to reuse nationally funded knowledge development, in particular if research is conducted with publicly funded grants.

Application, filing and maintenance of patents, in particular if a patentee seeks international protection, is a costly endeavour unattainable by the majority of SMEs striving to develop IP on their own. Solutions to this problem range from developing joint filings with other STI stakeholders, providing financial support directly or through a tax policy and encouraging the broader use of national-only utility models.

All economies need to balance the intensity of competition in their internal markets with their IP strategies, since by definition the granting of IP protection results in a temporary restriction on competition. Unfortunately, in Oman the policy discussion so far has been largely focused on the international competitiveness of the national economy as a whole.

While this is a paramount consideration and is a framework condition for developing a national innovation system, it falls short of considering the competitiveness of internal markets and, from an IP strategy perspective, developing the capacity to address cases where there exists an abuse of an exclusive IPR.

The Consumer Protection Law (Royal Decree 81/02) requires the Government to curtail monopolies or over-dominant firms in the market, but it does not specify what action must be taken. Although there is no separate competition authority in Oman, the Law is implemented by the Ministry of Commerce and Industry, which is also the IP authority in Oman. This may present a conflict of interest and may impede an open policy debate in situations where the interests of IPR holders conflict with having competitive domestic markets that are in the public interest.

In conclusion, the challenge to developing Oman's innovation system has an important and strategic IP component. Part of this is a result of conditions specific to Oman, where its high per capita GDP, relatively rich natural resources and well-developed oil industry require matching investments in the creation of knowledge- and technology-based growth and economic diversification. Such developments and ambitions require a profound understanding of IP issues beyond the immediate legal technicalities.

This is in addition to challenges posed by global phenomena such as the revolution in information technology and the worldwide spread of Internet-based technologies and content. Breakthroughs in fields such as biotechnology, life sciences and genetics raise humanistic and ethical concerns. The objective to preserve, enable access to and commercially exploit traditional knowledge, expressions and natural and genetic resources can involve conflicting issues that need to be resolved.

Development objectives require that the benefits of IP should accrue to society as a whole, not only to IP owners, and that IP be considered beyond industrial property issues to also take into account its role in health and education. The linkages between IP, invention and innovation and economic growth through diversification require proactive policy support, best assured through an innovation system framework. This includes support for funding IP registration and maintenance, financially or by developing cooperative frameworks and supportive regulations and guidelines that allow the pooling of resources for joint registration. Finally, IP has become an essential part of today's globalized economy in which national and regional IP systems are becoming increasingly connected. Such considerations underscore the need for a strategic approach to IP with clear objectives and in concert with the highest levels of national development policymaking.

8. An economic diversification and innovation strategy

8.1 Introduction

Economic development is fundamentally a process of structural transformation where countries innovate and diversify, from producing basic goods to increasingly higher value added and sophisticated industrial products and services. While domestic markets have a role in stimulating demand for such a transformation, for small countries like Oman, exporting and participating in global value chains are critical factors. Given the large export earnings generated by the oil industry, reducing its significance and diversifying the economy cannot be based on domestic demand alone; it will require the development of export-oriented sectors and industries as well. Central to Oman's diversification efforts is the Vision 2020 strategy outlining objectives to be achieved by the year 2020, and setting direction for industrial development, tourism and the services sector, among others.

Diversification through investments in innovation can be an important growth factor for Oman's economy, eventually resulting in the emergence of sectors and industries that could succeed the oil sector. However, innovation is an uncertain process, and where it succeeds in creating a new firm, the risk-taking entrepreneur will not be able to appropriate all the gains, as competitors will quickly emerge. Intellectual property, once understood in the context of the complexity of policy actions and linkages that develop into an innovation system, is an important tool in reducing and managing entrepreneurial and investment risk and uncertainty. However, when an innovation

fails, the losses are fully appropriated by the original innovator.

This unbalanced and asymmetric condition is a known cause of underinvestment in innovation, and is a factor that hampers diversification. Therefore, a coherent national innovation strategy that builds innovation capabilities and provides incentives to economic actors to invest in innovation can also be a powerful enabler of diversification through industrial growth and structural transformation.

8.2 Progress in diversification

In terms of GDP growth and diversification, Oman has made considerable progress since the early 1970s, and the overall outlook appears robust. To reduce Oman's dependence on oil, 35 years ago the Government established a series of five-year development plans to encourage industrial diversification. Today, approximately 59 per cent of Oman's GDP is generated outside the oil and gas sector compared with 33 per cent in 1975, when the first five-year development plan was implemented (Ernst & Young, 2011). The Vision 2020 strategy has set a rather ambitious target to increase the share of the non-oil sectors to 81 per cent of GDP by 2020. However, as this share has been steadily declining over the past decade, it is unlikely that this target will be reached by 2020. The share of manufacturing in GDP nearly doubled between 1996 and 2010, but most of it can be attributed to downstream petroleum activities (Mansour, 2013).

Oman's economy and export sector remain relatively undiversified, as indicated by its export diversification index,⁵⁷ compared with some other GCC countries and other selected developing and developed countries and regions (table 20). An index of zero is the fully diversified world index, while an index of 1 indicates a highly undiversified economy. Since 1995, Oman has managed to, on average, reduce its index and increase the diversity of its exports by approximately 0.005 points per year, giving it an index of 0.67 in 2012 – lower than Saudi Arabia, but higher than the GCC average. While this increase in export diversification is evidence of progress, it is insufficient to meet the strategic goal of reducing the importance of the oil sector.

It is inevitable that Oman's oil reserves will eventually be exhausted, or become economically unviable, at some time in the future, and this provides a major reason for urgent policy action. Moreover, in the short and medium term, its overdependence on oil exports and revenues makes it vulnerable to unstable global demand and prices, which may put at risk Oman's development goals. Chart 8 presents a historic overview of oil price volatility, some of which may be due to

Table 20: Concentration and diversification indices of merchandise exports, Oman and selected developed and developing economies and regions, 2002–2012

ECONOMY / YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Saudi Arabia	0.82	0.83	0.79	0.81	0.79	0.78	0.77	0.77	0.76	0.76	0.75
Major petroleum and gas exporters: Developing econ.	0.75	0.76	0.74	0.73	0.74	0.72	0.70	0.69	0.70	0.67	0.67
Oman	0.74	0.77	0.77	0.77	0.77	0.74	0.72	0.70	0.71	0.70	0.67
GCC (Gulf Cooperation Council)	0.72	0.72	0.70	0.70	0.70	0.69	0.66	0.64	0.66	0.64	0.64
Jordan	0.62	0.59	0.59	0.59	0.65	0.58	0.61	0.59	0.64	0.65	0.62
ANCOM (Andean Community)	0.63	0.64	0.63	0.61	0.61	0.60	0.58	0.61	0.62	0.62	0.61
Egypt	0.64	0.63	0.62	0.61	0.60	0.59	0.54	0.55	0.57	0.55	0.54
Turkey	0.55	0.54	0.51	0.53	0.47	0.46	0.47	0.51	0.46	0.48	0.44
ASEAN (Association of South-East Asian Nations)	0.38	0.37	0.37	0.35	0.34	0.34	0.34	0.34	0.33	0.32	0.31
EU27 (European Union)	0.16	0.18	0.18	0.19	0.19	0.20	0.21	0.22	0.22	0.22	0.23
NAFTA (North American Free Trade Agreement)	0.19	0.18	0.18	0.19	0.19	0.20	0.20	0.19	0.20	0.20	0.20
Developing economies	0.26	0.27	0.26	0.25	0.24	0.24	0.23	0.23	0.21	0.20	0.20
World	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: UNCTAD, UNCTADstat.

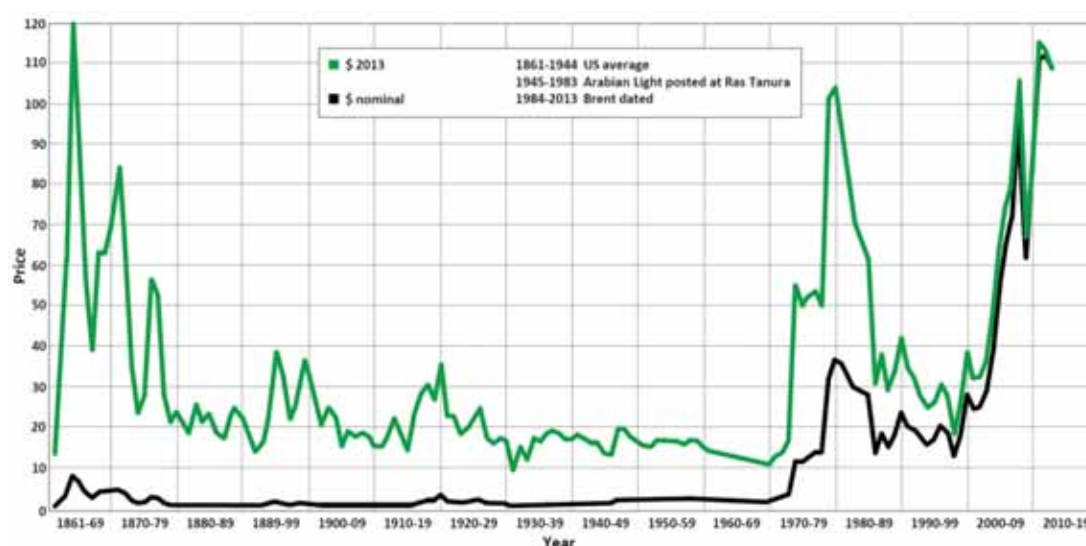
uncertain and unpredictable socio-historic events that are not directly related to economic fundamentals or speculative market volatility.

An equally critical problem is related to the profitability of Oman's non-oil industries and sectors. At current oil prices, extraction is profitable and produces significant earnings which can finance Oman's infrastructure development and public spending. Today, the development of new sectors and industries does not replace the oil industry, but adds to it and to the economy. Moreover, infrastructure development and public spending on education, health and social welfare are not under threat. However, at some point, oil production or oil prices may decline, and revenues and earnings from this sector will need to be replaced by non-oil sectors. While actual revenues from non-oil sectors may be comparable, taxable earnings cannot be expected to match those

generated through oil exploitation at current prices. The International Energy Agency (2008) estimates that conventional oilfields have production costs of between \$6 and \$28 per barrel, while enhanced oil recovery production costs are significantly higher and more variable, in the range of \$30–\$80 per barrel.

The key issue is that public spending in Oman relies critically on oil revenue, and the true gauge of feasibility is the so-called fiscal break-even oil price below which public services start to suffer. In a recent report published by Moody's investor services, Oman's fiscal break-even oil price was estimated to be among the highest in the GCC, at around \$104 per barrel, having shown a very strong increase of \$80 since 2003.⁵⁸ While extraction and oil recovery technologies have been improving, historical periods of barely cost-effective oil production are still quite recent, and oil

Chart 16: Crude oil prices since 1861 (\$ per barrel)



Source: BP Statistical Review of World Energy 2013 (see: <http://www.bp.com/en/global/corporate/about-bp/statistical-review-of-world-energy-2013.html>).

exporters and their organizations have been constantly concerned about keeping oil prices profitable.

8.3 Strategic issues and diversification

Given the important concerns about Oman's overdependence on oil and gas revenues, policymakers have agreed on the necessity of diversifying the national economy. A number of economic sectors have already shown some promise and will be noted in the discussion that follows.

The role of SMEs and FDI in innovation and diversification

Productive diversification will require a balanced development of large and smaller enterprises. For it to be viable, diversification implies a process of industrialization at a scale that enables competitive exports. The larger enterprises and their sectors should be linked to a strengthened SME sector in more labour-intensive activities that can generate much-needed new jobs. In this regard, the role of SMEs in the diversification process has been recognized, in particular after the SME Development Symposium held in Bahla in January 2013. Following the Symposium, Royal Directives were issued and policymakers, with the Ministry of Commerce and Industry at the helm, have been charged with developing regulations and supporting policies for SME development.

The phenomenon of hidden trade and fictitious companies, whereby firms conduct operations that are not listed in their commercial records, or firms that are registered as Omani-owned but are actually owned and managed by expatriates, is a major concern and disincentive to innovation and competitiveness, in particular among SMEs. A more effective implementation of commercial regulations needs to be followed through with research on the role of Omanis in owning and operating existing SMEs in each sector and how this links up with human capacity-building, as discussed in section 7. It is also important to explore the current profile of Oman's SMEs in terms of their sectors, the markets they address and the demographics of these markets, and the level and potential for diversification or specialization.

A diversification strategy needs to be fully matched to a human capacity-building strategy. To achieve clarity of policy action, Oman needs to identify its competitive sectors and industries bearing in mind that labour is a major contributor to their success. It is therefore no surprise that national labour market policies and their relation to the Omanization policy are issues where consensus is weakest. During UNCTAD's mission in May 2013,

it was often heard that educated and trained Omanis did not meet the requirements of industry.

Another potential source of diversification is FDI, which can play a multifaceted role, particularly in the technology transfer required to spur innovation and diversification. In addition to providing technology, capital and employment and involving local partners in established international value chains, FDI can be a vehicle of knowledge transfer, including for many soft technologies, such as managerial skills, marketing, and knowledge of standards and regulations in export markets. The overall effect of FDI will, however, depend on the absorptive capacities of Oman's firms, and the ability of its innovation system to establish and support the required linkages between investors, SMEs and STI stakeholders in general.

However, there should be no doubt that the commercial interests of foreign investors may not coincide with a host country's development objectives, in particular in terms of technology transfer or diversification. Indeed, among the many reasons that lead international companies to favour an FDI strategy, over licensing production from existing facilities in the host country, is that they can reduce or limit technology transfer and knowledge spillovers. However, the host country is responsible for creating conditions that enable it to compete with, partner with or complement FDI, including developing the competitiveness, productivity and absorptive capacity of its domestic firms and sectors. For example, if human capital in the host country is lacking, investors may not engage in hiring locally or partnering with local firms and trade prospects may suffer, thereby reducing opportunities for diversification.

Policymakers may choose to implement local content requirements tied to technology transfer by foreign investors, such as obliging them to use local technology suppliers and scientific staff, and cooperating with public research institutions. The question is, do such measures provide incentives for local technology stakeholders to advance their knowledge and absorptive capacities, or do foreign investors treat this issue as a tax or tariff and seek to ensure minimum formal compliance, but no more? Such policies need to be based on empirical evidence generated through transparent and unbiased surveys and research to assess whether there is a positive experience with technology transfer for the technology and sector under review.

Diversification for export and proactive industrial policies

It is worth considering the relationship between innovation in a purely domestic context and innovation in an export diversification strategy. Countries seeking to diversify domestically can aim

to support innovation in the broadest sense, that is, supporting the introduction of products or processes that are new to the specific market or to the firm, rather than only those that are absolute novelties for the world. However, given Oman's critical need for export diversification and its relatively high GDP per capita, it should give stronger consideration to innovation that takes the form of products or processes that incorporate a higher content of new-to-the-world knowledge. This has strategic implications for its innovation system and the strength of the policy support it receives. Assuming the need for export diversification, linkages that support the commercialization of new knowledge become a much greater concern.

This necessarily points to the need for a significant increase in investment in capacity-building for generating new scientific knowledge and technological inventions. In addition to increasing investments, strategic intelligence capabilities, which are currently extremely scarce in the country, need to be developed in order to identify key strengths in the scientific and technological establishment and knowledge-based diversification opportunities. The requirement of stronger innovativeness for export diversification also means that cooperation among private sector and academic research institutions must receive support from the highest levels, so that such knowledge and inventions can be effectively commercialized. IP policies must bolster the development of patentable outcomes while creating public awareness that trademarks and industrial design – which represent the bulk of Oman's IP – while important in themselves, can also help in the export diversification process, though to a lesser degree.

Diversification and regional and industrial sector development are overlapping policy issues, and they also touch other policy domains, including human resources and fundamental innovation policy concerns, such as the need to create clusters and centres of excellence or to avoid creating pockets of underdevelopment. Finding a policy balance between such demands is crucial, and the above-mentioned strategic concerns about the roles of SMEs and FDI are key considerations.

A central question for Oman's policymakers is whether it is wise and opportune to proactively support certain industrial sectors without abandoning broader diversification policies. This is a key policy concern, and evidence from developed economies indicates that, beyond a certain threshold of income and absorptive capacity for technology and knowledge, specialization in several select sectors is a viable strategy. While Oman may not be in such a position today, it is not far from this point and policymakers need to plan ahead. Given the high

level of uncertainty in strategies that require picking industry winners, and the early development stage of its innovation system, including the structures that should perform its strategic intelligence functions, it will be necessary to nurture suitable public-private partnerships and a stronger network of innovation linkages to provide the fundamental conditions for the emergence a wide range of economic activities that demonstrate potential for innovative diversification.

8.4 Sectors with diversification potential

A limited number of economic sectors will be noted and possible linkages among them will be described. These are not suggestions for policy; they are simply intended to illustrate that the country's innovation and diversification potential can be enlarged through cross-sector linkages aimed at creating commercial and technological synergies.

When considering the extractive industries, it is important not to overestimate their potential. These industries generally have underdeveloped innovative linkages with the rest of the economy in the locations where they operate. While their potential to generate innovative diversification should not be overstated, some leverage could be obtained by developing linkages between them and large infrastructure construction projects in Oman and regionally in the GCC.

The oil sector and diversification

While development goals require diversification away from the oil industry, the significance of the sector for the economy of Oman requires consideration of its role and contribution within a nascent and developing national innovation system. A starting point is recognizing that reserves are smaller and the complexity of oil exploitation in Oman is greater than in other GCC countries. Therefore, innovation has become critically important for PDO, which has developed enhanced oil recovery (EOR) technologies to extend the life and productivity of active oil fields. Annual capital expenditure amounts to about \$5 billion, some of which is for R&D. PDO has a large number of active research projects and technology trials, and is continuously evaluating the latest R&D outcomes and technologies globally. Having amassed research and practical experience in EOR, PDO receives regular invitations for international collaboration.

To maintain its research and innovation activities, PDO has a large human resources development programme that includes scholarships for several hundred staff. Half of all senior well engineers employed are trained by the company, and it has invested in upgrading human capacities that are

relevant for both college graduates and school leavers. PDO has been cooperating with SQU for a number of years, funding research and state-of-the-art laboratory facilities. However, until recently, not much of research resulted in practical applications due to the lack of focus on industry needs; instead priority was given to publishing in scientific journals. Missed opportunities have stemmed partly from a fragmented research agenda developed with insufficient inputs and cooperation, in spite of regular events such as the annual PDO-SQU souk. On the other hand, SQU has world class laboratory facilities for oil technology development.

Cooperation with local firms is clustered under a so-called in-country value programme designed to strengthen PDO's interaction with the local and national business community (see box 7). However, there are a number of problems that are indicative of potential barriers to innovation and diversification. Of the 200 local firms conducting business with PDO, many are just fronts for foreign companies, with questionable local content. The solution is to increase the competitiveness of local firms through technological advance and innovation, and by developing a certain level of specialization.

One opportunity, discussed earlier in this review, is that of water management and treatment, as oil exploitation requires the production and use of large quantities of water (see section 9, box 10 on the Nimr Reed Beds). More generally, a diversification policy should consider using the oil sector to leverage competitive advantages by having it support the development of several nascent sectors such as tourism, ports and transport and logistics.

Natural gas

Even though natural gas exploitation is similar to that of oil, its contribution to diversification should not be overlooked. Its use in power generation provides a base infrastructure for diversification and innovation in other sectors. Natural gas reserves are estimated to be about 800 km³.⁵⁹ However, Oman requires increasing natural gas supplies to meet the growth of its domestic consumption as well as its enhanced oil recovery projects and contractual obligations of its liquefied natural gas (LNG) exports. Gas is a major source of fuel for power stations and for desalination. Oman LNG, the national gas company, supplies nearly all of Oman's natural gas requirements.

Box 7: PDO In-Country Value activities

In-Country Value (ICV) is defined as the total spend that is retained in-country that can benefit business development, contribute to human capability development and stimulate productivity in the Omani economy. PDO, recognizing that ICV is "good business", has issued an ICV policy in January 2012, which establishes four pillars:

- In-Country Manufacturing and Services Provision;
- Omanization/Job Creation/Training;
- Social Investment; and
- Local Community Contracting/SME Development.

In 2013, PDO awarded contracts worth more than \$3.1 billion to locally registered companies, and broadened its support of domestic businesses through a variety of tactics, including technical assistance, ring fencing the supply of locally manufactured goods, the establishment of Omani repair facilities and in-country engineering services. In addition, PDO and its contractors created more than 10,000 training and employment opportunities for Omanis across its contractor workforce since His Majesty's National Objectives Programme was launched in 2011. A scheme to produce a pool of 400 skilled welders, training them to the highest international level to work on the company's three mega projects, was launched in 2014.

To further increase the capacity and capability of local community businesses, PDO has established four Super Local Community Contractors (SLCCs). These Omani businesses, which collectively have in excess of 6,000 shareholders, are all from within PDO's concession area. A total of 460 Omanis were newly employed by SLCCs up to the end of 2013 with 200 trained. Contracts worth \$540 million were awarded. The SLCC concept is being replicated locally in other sectors and also seriously being considered regionally. Many SMEs, or Local Community Contractors (LCCs), are increasingly carrying out work scopes which were one day limited to international contractors, while the larger SLCCs have started tendering for contracts outside Oman.

The ongoing efforts to drive ICV culminated in a major industry ICV business opportunity conference in December 2013 in which the Omani's Oil & Gas ICV Blueprint Strategy was unveiled. Details of the ICV opportunities identified between now and 2020 were presented in the three key areas: in-country manufacturing, in-country services provision and the development of a skilled Omani workforce. The strategy analysis has identified the potential for the creation of a market for \$64 billion in goods and services and 50,000 skilled jobs for the Sultanate up to 2020.

The Oman ICV approach is based on the active collaboration of the Government and Private sector. However, there is no ICV legislation in Oman and all achievements have been made through the collaborative effort of private and public enterprises. The international NOCs and Governments Local Content Conference held in London in October 2013 and leading local content thinkers view Oman's approach as best-in-class. Other Government sectors in Oman are now looking at adopting it across their business portfolio.

Source: PDO.

Since 2007, there have been discussions on a project to build a gas pipeline from gas sources in the Islamic Republic of Iran across the Strait of Hormuz to Oman. Given recent progress in United States-Iran relations, there is an increasing likelihood that this project will eventually take off. It is also an indication of the political sensitivities involved in exploiting hydrocarbon resources, and another reason why development policy needs to diversify and innovate to reduce vulnerability to geopolitical tensions. The proposed project would be worth \$60 billion and would take the form of a 25-year supply deal. Oman plans to use some 15 billion m³ of gas imports for domestic purposes and process the remainder for export from its LNG terminals.⁶⁰

Downstream hydrocarbon industry

The downstream hydrocarbon industry started some 20 years ago with the operation of the ORPIC refinery, built to produce motor fuel. A polypropylene plant opened in 2006, using feedstock from the refinery, and an aromatics plant started operation in 2009 in Sohar. All aromatics and polypropylene feed are exported, as well as about 50 per cent of other base chemicals for plastics, benzene and pyroxene. Motor fuel is sold locally to Oman Oil, Almaha and Shell, while the primary trading entity, OTI (London), markets aromatics and polypropylene feed internationally. For the time being polypropylene feed has a limited domestic market until methanol and PET plants are constructed.

There is innovation potential in transforming oil into a hydrocarbon industry and expanding services maintenance and repair activities. Similar to PDO activities, in-country value programmes should aim to develop linkages with other domestic activities to improve employment and foster the development of the local business community (see box 7 above). However, in-country value programmes outside the main oil exploitation industry require a critical mass of interactions. While Oman is growing fast, without the oil sector it is still a small economy.

There are a number of intersectoral issues related to downstream hydrocarbons that can be addressed through a dedicated innovation system approach. In the education sector, in particular, as noted earlier, primary and secondary education still needs to be reformed, though there has been some progress in tertiary education. However, engineering curricula do not focus sufficiently on developing practical competencies needed for graduates to start working productively, even if theoretical competencies and course contents are adequate. In particular, broader communication and leadership skills need to be developed. ORPIC should be able to influence academic curricula so that universities produce graduates with the

competencies required by firms such as ORPIC. So far, firms in Oman and in the entire GCC region continue to depend on hiring expatriates, and compete for available talent in downstream hydrocarbon engineering. The incentive to train Omanis is therefore strong as they are less likely to leave to work abroad than expatriates, but more coordination is needed. For technical staff at lower levels, a real concern is their lack of fluency in English.

Regarding research and innovation, greater cooperation is needed with Oman's academic institutions. ORPIC already has representatives on the board of Caledonian University, and it has collaborated with SQU on reverse osmosis water treatment. The main obstacles to deeper cooperation are mainly related to insufficient capacity for advanced research and the lack of alignment of R&D to potential commercially viable products. ORPIC itself does not conduct R&D, and relies entirely on licensing technologies as needed. Finally, while policymakers need to appreciate the innovation potential of the oil and gas sector and should work on developing the necessary means of realizing that potential, they cannot expect to achieve much employment creation from these efforts, as it is a capital-intensive sector and does not create many jobs.

Non-oil resources

The Sohar Aluminium smelting project was completed in June 2008 and produced its first ingots and sows. The project included the construction of a carbon plant, a metal casting facility, and port facilities for storage and shipping. Oman does not have a source of bauxite ore, but based on the experience of Dubai in the United Arab Emirates, it believed it had sufficient competitive advantages in energy and ports and logistics to be able to enter the sector. The Omanization policy was incorporated in the project from the outset with the creation of facilities to train local workers. In addition a summer students' programme is held every year for two months to give senior students and recent graduates practical experience in a professional working environment to supplement their academic knowledge. In order to improve downstream linkages and enable the production of higher value added manufactures, 200 hectares of land adjacent to the smelter in the Sohar Industrial Estate have been reserved for related industries, along with a commitment to reserve up to 60 per cent of the annual production capacity for local downstream manufacturing of aluminium products.

Copper mining and processing operations are located to the north of Sohar in the Al Batinah region (near the border with the United Arab Emirates). To date, mining operations have produced over 2.5 million metric tons of copper.

While the Sohar and Lasail mines were exhausted in the 1990s, the Ministry of Petroleum and Minerals has reported proven copper reserves of 8 million tons and proven chromite ore reserves of 1.6 million tons. At the Shinas mine, located 80km north of Sohar, over 1 million metric tons of copper have been mined since operations started in 2008; outstanding reserves still to be mined at the current pit are estimated to be about half a million metric tons. Recent exploration at Shinas has found a potential increase in reserves, which could result in a possible expansion of the pit. A feasibility study for the Safwa mine and the Mandoos mine projects was completed in late 2009, and relevant approvals from the Oman Authorities are awaited before exploitation can begin. Apart from these activities, at least five other locations for copper ore mining are undergoing feasibility study or are in the planning stage.

The Lasail Copper Concentrator near Sohar has a throughput of 130 tons per hour, and is designed to upgrade the mined copper ore from 2–3 per cent to 18–24 per cent. The copper concentrate is sold for further processing for export or to Oman Mining Company which operates the Lasail smelter and refinery complex adjacent to the concentrator. The concentrator is equipped with a water recovery system compliant with national environmental legislation. The Lasail Concentrator laboratories are certified and internationally accepted for sample preparation and geochemical analysis.

While copper is used mainly for electrical cabling, there are many secondary uses of potentially better value for Oman's diversification strategy. For example, it is used extensively in architecture and construction due to its anticorrosive qualities. Moreover, since it is biostatic and bacteria will not grow on it, it can be used as an antimicrobial material with public health benefits,⁶¹ as well as for possible use for nets in aquaculture to solve the problem of biofouling. This is a process that begins when algae spores, marine invertebrate larvae and other organic material adhere to aquaculture nets and encourage the attachment of secondary colonizers, leading eventually to a situation where fish stock acquire diseases and require treatment with antibiotics, with the overall effect of reducing yields. Copper aquaculture nets, on the other hand can remain without fouling for months.⁶² This is an example of a particular cross-sectoral issue worth examining, given Oman's objectives of promoting aquaculture and fisheries.

The production of non-metallic minerals increased sevenfold between 1996 and 2008. There are as many as 150 active quarrying and mining operations, including for chromite, marble, sandstone, gypsum, laterite, clay, limestone, salt,

and dune sand. Steel grade limestone is exported from south Oman to India. Large reserves of gypsum (165 million tons) have been surveyed in the Shuwaymiya area, and mining them is commercially viable. Other non-metallic minerals available for mining are: dolomite, silica sand/quartzite, various clays (including kaolin and attapulgite), marble, aggregate and armour rocks (construction materials), as well as low-grade iron ore (laterite).

Increased exploitation will require further investment in the development of mineral-based industries in Oman. Export markets are of major importance for developing non-metallic mineral industries. Investment in construction in the GCC has resulted in the export of 60 per cent of construction materials, 70 per cent of marble, 43 per cent of laterite (clay for bricks, roads and water supplies), 21 per cent of gypsum and 10 per cent of limestone.

Surveys have revealed important deposits of silica sand and quartzite in the north, south and central regions of Oman. These minerals are used in glass manufacturing and ceramics. While these materials can be exported in bulk from coastal ports, it would be opportune to consider moving up the value chain, in particular as Oman may have some competitive advantage due to lower energy costs. However, countries that import these raw materials or low value added products have an advantage of larger markets and scale. A number of foreign firms, such as Rauch of Austria and Tata Iron and Steel Co. (TISCO) of India, have expressed an interest in non-metallic mining and in the export of raw materials from Oman.

Information and communications technologies

ICT is often cited as a core sector for technological innovation. While the effects of ICT on firms, governance and households are important, these technologies have not had much of an impact in Oman, and therefore it is unrealistic to expect that a local ICT services market could improve diversification and innovation prospects. Table 21 compares computer use and Internet access – two core ICT indicators – in Oman, the GCC and a number of other countries.

On the other hand, Oman's geographical location, good security and the fact that it is not in a natural disaster prone area give it a competitive advantage in developing Internet backbone services. There have been significant investments in an overland cable to Europe and an underwater cable to Malaysia and Singapore, as the national operator, Omantel, has plans to become a global network operator.

Table 21: ITU Core indicators on access to, and use of, ICT by households and individuals

	Computer	Percentage of households with data year	Internet access	data year
Bahrain	92.7	2012	79.0	2012
United Arab Emirates	85.2	2012	72.0	2012
Qatar	91.5	2012	88.1	2012
Kuwait	69.0	2011	57.7	2011
Saudi Arabia	57.3	2010	54.4	2010
Oman	58.0	2011	46.0*	2012
France	81.0	2012	80.0	2012
United States	75.6	2011	71.7	2011
Malaysia	66.9	2012	64.7	2012
Turkey	50.2	2012	47.2	2012
Azerbaijan	45.0	2012	46.8	2012
Egypt	37.9	2012	32.3	2012
South Africa	21.5	2011	23.2	2011
Thailand	26.9	2012	18.4	2012

Source: ITU¹; TRA Annual Report 2012 (2013)

* Note: Figure for 2012 is an estimate assuming 7% growth for 2011 to 2012.

Local and regional innovation opportunities lie with content and products that are not truly global. ICT tools and applications aimed at tackling environmental, pollution and educational problems and for safety training in industry are possible areas that deserve to be explored. However, there are difficulties in competing with Egyptian and Saudi content development, as Oman's productive and export capacities are underdeveloped and Omanization (including raising of the minimum wage) is seen as working against export competitiveness. Egypt, with its very liberal labour laws, was cited as a positive example. Also, it was observed that exporters from other countries benefit from various forms of government support, particularly when bidding for international contracts. A number of local issues were also pointed out, such as delays in the project involving cabling of the urban fibre network through sewage channels in Muscat, which would benefit from better coordination among stakeholders. Currently, infrastructure sharing arrangements are not ready, but when the urban fibre network becomes operational, commercial arrangements for its use will have to be worked out. This is an obvious issue that could benefit from improved coordination within an innovation system framework. The latest effort in broadband infrastructure development is the establishment of a local entity to implement the Fiber to the Home Project.

Regarding university capacity to produce competent ICT engineers, Omantel has indicated that its skill requirements are not matched by graduates, as academics and firms do not have a common perspective on training and competency-building or on research goals. Greater cross-fertilization of ideas, skills and interdisciplinary cooperation would be a positive step. Omani ICT firms may be hesitant to invest in training as they fear that, after receiving training, staff will look for better paid jobs elsewhere. Reducing attrition rates is a complex issue and can be partially resolved by providing on-boarding activities including soft skills training and specific job-related skills training. The ITA is working on bridging this market gap by

supporting a number of initiatives such as the SAS Virtual Reality Centre, the SAS Mobile Applications Centre, community knowledge centres (CKCs) and women community knowledge centres (WCKCs).

Agriculture and fisheries

The agriculture and fisheries sector accounts for only 1.2 per cent of Oman's GDP, projected to rise to 3 per cent of GDP, and it engages 5.2 per cent of the economically active population, mainly in smallholder or subsistence farming. Fuel and energy are major inputs in agriculture, and therefore some linkage to the performance of the oil sector is unavoidable.

Oman is a net food importer, importing \$2.5 billion worth of food annually, while exporting only about \$1 billion worth. Agriculture and fisheries, while growing in absolute terms and in productivity, have been steadily declining in relative importance for the economy since the start of oil exploitation in the late 1960s. The total area under cultivation is estimated to be about 18,000 km², or 6 per cent of the total land area. The principal agricultural product is the date, with almost 300,000 metric tons produced in 2010. Other products include bananas, mangoes, coconuts, limes, alfalfa, tomatoes, cabbages, eggplants, okra and cucumbers. Frankincense is traditionally produced from trees growing wild in Dhofar. Along the Al Batinah coast (in the north-east), wheat and sorghum are grown in addition to fruit. Alfalfa and sorghum are used primarily as cattle feed.

Several observers commented to the UNCTAD mission in December 2013 that agriculture may not be a suitable sector for technological innovation and economic diversification. However, this is not in accord with the expressed strategic aims of the Ministry of Agriculture and Fisheries, which cited a number of examples of successful agricultural firms that have opted for greenfield projects involving industrial and technologically advanced operations, rather than for up-scaling of existing smallholder farming. It was further suggested that

Box 8: A strategic plan for fisheries

A strategic plan to develop fisheries sector has been approved and blessed by His Majesty Sultan Qaboos bin Said at a Shura Council session on 31 December 2013. Together with the Ministry of Agriculture and Fisheries, a number of institutions are involved in the follow-up strategizing, including the World Bank and FAO. Key objectives include sustainable development and enhanced while equally important would be the reform impact on economic diversification, food security, job opportunities and social stability. The number of Omani licensed fishermen was 43,000, and more than 2,700 labourers were involved in fish transport and 2500 at the fish installations, according to the agricultural census of 2012/2013.

HE Dr Fuad bin Ja'afar Al Sajwani, Minister of Agriculture and Fisheries, discussed a number of related themes during the Shura Council including the need to develop infrastructure to promote agricultural and fisheries development as well as a Strategic Plan to Develop Fisheries Sector for the period 2013-2020. Fish farming was another agenda issue as well as policies to regulate fish marketing. In discussion, the Shura Council members raised queries on various issues and topics, including rapid establishment of central and advanced fish markets in various provinces, the importance of marketing fish products, as well as regulating the export of fish to ensure self-sufficiency in Omani market.

Source: FAO, <http://neareast.fao.org/Pages/NewsDetails.aspx?lang=EN&I=0&DI=0&CI=0&CMSId=21&id=2407194>.

agricultural investment should not only have a financial outcome but also a positive social impact. In particular, fisheries are believed to have the potential to make a strong contribution to the economy. Currently, traditional boats are used for 98 per cent of the catch, but on 31 December 2013, a strategic plan to develop the fisheries sector was approved and blessed by His Majesty Sultan Qaboos bin Said, and a major investment of OMR 700 million is expected to be made available for modernization of the sector (see box 8).

An interesting example of technology-led agriculture is that of A'Saffa Foods, a company which produces one quarter of the poultry for the Omani market. It used technology to compete with Brazilian imports and to reduce dependence on low-cost labour imports. While current problems, such as manure treatment, wastewater and effluent disposal, present technological challenges, it has initiated cooperation with SQU on water treatment, and manure from poultry is used as an input in mushroom cultivation, for which commercialization prospects are being studied. It was stated that A'Saffa Foods had no plans to develop and register IP for any advances that might be achieved. The spokesperson for the company said that general infrastructure, such as power and Internet access, needed improvement in industrial zones.

Land use is determined primarily by the availability of water. There is extensive cultivation in coastal areas (Al Batinah and Al Sharqiya), while in the interior, agriculture is dependent on *wadis* and on the *fallaj* water canals for irrigation. However, the coastal regions generally suffer from a drop in the water table and its increasing salinity. The decline in the importance of agriculture as an economic sector is worrisome, especially in view of a number of established agricultural research and extension activities. Research is conducted not only under the aegis of the Ministry of Agriculture and Fisheries and the Directorate General of Agricultural Research, but also collaboratively with international and regional organizations, universities and NGOs. Donors and technical

agencies, such as the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the World Bank, have funded R&D projects relating to the improvement of pasture resources, which is an important area. Collaborative research activities include seed technology and biodiversity of pasture plants and a national gene bank.

Oman has a well-organized agricultural extension system that trains farmers on improvement of forage resources, and agricultural colleges and specialized agricultural cadres have been working on technologies related to forage production. Thus, given that the components of an innovation system in agriculture are in place, policymakers need to devote some attention to looking at the structure of incentives in the sector as a whole, and how adjustments in incentives could contribute to improving innovation outcomes. Apart from promoting linkages between agriculture and research, policymakers need to look at agricultural value chains and in industrial counterparts in agriculture, such as fertilizer production, construction and power generation, and transport and logistics.

Tourism

Oman has become an increasingly attractive travel destination over the past decade, generating 1–1.4 million international overnight stays per year, with each visitor spending about \$1,000 per overnight stay. The tourism industry in Oman is comparatively new, and while it constitutes a relatively small part of the total economy, its size is close to global averages, as indicated in table 22. International tourism represents one third of the total worldwide trade in services.

Tourism is seen as a major contributor to economic diversification, as it is an important export-oriented sector that engages a large number of industries and services as suppliers and providers of logistics. Policymakers also look to tourism for its potential to increase the level of employment of Omanis in the private sector and to

Table 22: Direct contribution of travel and tourism to GDP, 2003–2012 (per cent)

Region/Year	2003	2004	2005	2005	2007	2008	2009	2010	2011	2012
EU27	3.3	3.3	3.2	3.2	3.1	3.0	3.0	3.0	3.0	3.0
Middle East	3.3	3.4	3.3	3	3.1	3.1	3.2	3.2	3.0	3.0
Oman	4.7	4.8	4.8	3.2	3.6	3.1	3.4	3.1	2.9	3.0
World	3.1	3.1	3.1	3.1	3.0	2.9	2.9	2.8	2.8	2.8

Source: World Travel & Tourism Council; see: <http://www.wttc.org/research/economic-data-search-tool/>.

involve local communities and engage local businesses. There is an established awareness about developing sustainable tourism practices and nurturing respect for the natural environment, customs, traditions and cultural heritage. While government policy encourages FDI, it is conscious not to over-size the sector. A major obstacle to the development of the tourism sector is the multitude of ministries and authorities that are involved in regulating standards of operations, such as building codes or phytosanitary certification. This suggests the need for a more coordinated approach to the strategic development of the sector requiring all stakeholders and beneficiaries to act in concert.

The Government has set a number of policy targets for the tourism sector, including increasing the level of Omanization in the sector from the current level of 50 per cent, and involving and securing economic benefits for local businesses and communities. Key issues include sustainability and environmental impacts, as well as managing a positive impact on the preservation of local customs, traditions and cultural heritage. While increasing the number of visitors from the GCC is a primary objective, growing global recognition of Oman as a prime tourism destination will bring with it some challenges. For example, targeting wealthy niche tourists by focusing on cultural, environmental and adventure packages has become a strategic priority (Baporikar, 2012) in need of implementation. Oman has the advantage of being able to learn from the abundance of positive and negative experiences of other countries in their promotion of the tourism sector.

Policymakers need to undertake a more in-depth analysis of the nature of the contribution of the tourism industry and its impacts in order to make informed and evidence-based policy decisions (Ministry of Tourism, 2010). A large number of institutional and economic factors must be taken into account for achieving strategic goals and for supporting the overarching goal of diversification. For example, as in other sectors, human capacity-building is critical. It is essential for the Ministry of Tourism to participate in the design of the curriculum for the SQU's bachelor's degree in tourism and in that of the Oman College of Tourism. Increased coordination among the stakeholder institutions would result in an improved alignment of competencies of the graduating

students with the demands of the industry. This is important, given that many graduates with tourism degrees seek work in the Ministry and in other government offices instead of in tourism firms. Improving cooperation would also contribute to a better assessment of future trends in the tourism and travel sector which would help improve curriculum design. There is greater potential for SME involvement, but this requires their technological updating and a corresponding access to finance.

There is also the need for a better understanding of Oman's ecosystems and the value of its biodiversity for the present and future tourism industry. This necessarily means deepening institutional linkages between the Ministry of Tourism and investors, and between the Animal and Plant Genetic Resource Centre of Oman and academic research centres. With regard to regulatory issues, those enterprises that have taken the lead in integrating environmentally responsible behaviour in their core organizational practices should share their knowledge and help other tourism firms, many of which are their collaborators and suppliers, to achieve similar levels of corporate governance.

A key issue in tourism development is the source of investment funding. In Oman, the Government-backed firm, Omran, was set up to deliver major projects and to manage assets and investments in the tourism sector with a view to making tourism a major economic driver. Omran works with national and international partners to create successful, revenue- and job-generating projects. So far, there is no established break-even or profitability horizon, and success is measured primarily through build-out and expansion of capacities. In this sense, Omran invests strategically and ahead of precipitation of interest in the private sector.

The management of facilities is leased out to private firms, many of which are international operators and which provide enhanced opportunities for on-the-job training. Omran's interaction with other sectors includes sending its experts to lecture at the College of Tourism and developing local suppliers, such as farmers and cottage industries by encouraging their participation in general and technological upgrading programmes so that they can meet

required standards of quality. Among innovations that have been promoted are green construction, eco-friendly design, soft technologies and the development of a code of conduct for sustainable tourism.

Crafts and traditional industries

Crafts and traditional industries occasionally have been cited as having potential for innovation and diversification.⁶³ Crafts and technology may not seem to be the likeliest of partners; however, if innovation is viewed more broadly as the introduction of new products and services, or new technical or process innovations in the production or delivery of new or existing products and services, there is certainly scope for including this sector in a national innovation and diversification strategy.

The basic problem with traditional crafts is their small productive base, modest market demand and negligible impact on the overall economy. Thus, the fundamental issue is one of scaling up. It will be necessary to determine whether investment in innovation will enable expansion of these activities to generate an increase in sales and revenues, and whether demand could be managed and stimulated. Scaling up crafts to SME or industrial production is a major challenge. People engaged in crafts in Oman are eligible for SME project support. However, to access that support, the craft needs to be compatible with the goals of preserving and supporting the Omani identity. This is a key component of the definition of traditional crafts, reflected in the use of visual national symbols (e.g. forts, castles, the *khanjar* knife – a traditional, ornamental dagger worn by men for ceremonial occasions).

A more complex issue is how traditional industries interact with R&D entities and what outcomes can be expected, either in a commercial sense or from a purely learning and innovation systems development perspective. What lessons can be gleaned by bringing this sector under primary consideration of a national innovation strategy? Other problems exist that are not entirely typical of the sector, such as a lack of marketing skills and a level of risk aversion that is incompatible with the level of entrepreneurship required for commercial success.

The Public Authority for Craft Industries (PACI) is responsible for developing the crafts sector in Oman. PACI's objectives include executing approved plans and programmes relating to craft industries, surveying, documentation and protection of all craft industries and their raw materials and uses, and responding to their R&D needs, as well as assisting people engaged in crafts on administrative and technical issues. For example PACI provides support to local artists in

IP registration of design with MOCI. It also provides training and qualification services, helps develop creative, leadership and technical capabilities, assists in creating new marketing outlets for Oman's crafts domestically and globally, and develops cooperation with the private sector and with craft industries in other countries. The chief constraint is funding of research, as the largest proportion of the PACI budget is allocated to salaries.

The UNCTAD mission in December 2013 was informed that PACI has a strong motivation to engage in research only if there is a commercial outcome. For example, PACI has researched the options available for the use of various local wood species bearing in mind issues of sustainability and toxicity. From a potential selection of usable trees, more than 60 per cent of species have been identified, and some 1 per cent (10) will be used. Another issue is that raw materials are imported and are a fundamental cost consideration. Basic innovation efforts include the development of local materials to replace imports (e.g. wood, clay, glazes, dyes and bone). For example, PACI has received finance for projects from TRC for research, in cooperation with SQU, on the exploitation and use of locally abundant clay materials and natural dyes to replace imports.

PACI has 9,000 members many of whom are women homemakers in rural areas. Certification is done by PACI staff who visit crafts people and discuss, document (photograph) and offer membership. There is a need to improve the use of ICTs, but individual crafts people are increasingly using social media without waiting for any institutional support.

8.5 Conclusions and policy recommendations

Multiple policies need to be implemented to improve the chances for successful diversification with a strongly positive economic outcome. This is because diversification itself is a complex process that involves the interaction of all participants in development and all entities invested in technology and innovation processes. In order to develop the requisite linkages among key stakeholders it is necessary to establishing a national innovation system framework. Developing institutions is not necessarily a target if a coordinating structure can ensure implementation. However, given the general lack of communication at all but the highest institutional levels and the strong inclination of top government and corporate executives to act as information and communication gatekeepers, institution building may also be needed, provided it is mandated at the highest level of government, above the ministries, and reporting directly to His Majesty Sultan Qaboos and his Cabinet of Ministers.

A second prerequisite is to establish an evidence-based policy management system that uses active monitoring and evaluation to track progress, understand difficulties and obstacles, and ensure that solutions and remedies are implemented effectively and efficiently. This necessarily means dealing with failures in policy. It may also require a decisive and purposeful change in culture and attitudes for dealing with failure.

Thirdly, a labour and human capacity-building policy needs to adopt short- medium- and long-term perspectives, as diversification is a continuous process. This means increasing the level of interaction between firms and educational and academic institutions in order to better match supply and demand for various specializations and competencies. This would necessarily include instruction on entrepreneurship, though

this alone does not lead to the formation of entrepreneurs. While such instruction should not be discouraged, pushing newly graduated students to develop start-up businesses as a response to a lack of employment opportunities for young Omani nationals is a suboptimal policy. The critical role of tacit knowledge and uncodified and informal competencies that are acquired through on-the-job experience should not be underestimated.

Finally, policymakers need to determine the acceptable level and nature of involvement of FDI in the national diversification strategy, as well as the overall balance between technology transfer and domestic innovation and investment in R&D to generate competitive exports that can lead to diversification and reduce Oman's dependence on oil exports.

PART III: RECOMMENDATIONS AND CONCLUSIONS

9. Policy recommendations

In a context where several simultaneous challenges need to be addressed, many measures can be envisaged.⁶⁴ However, it is important to set priorities, particularly because government capacities are limited. First of all, there should be a clear and powerful engagement. With this in mind there are three important points related to national mobilization, top-level coordination and a gradual, but transformative, approach. Such an approach should be supported by a profound process of change management that will help set the organizational framework and mindset needed to identify the root causes of fragmentation and address this issue with determination. All three points of strategic importance are inspired by lesson learned from international experience, notably from countries with low or uneven science and technology capacities that have successfully embarked upon innovation-driven development strategies (Centre for Mediterranean Integration, 2013).

9.1 Strategic prerequisites

National mobilization

Oman is currently elaborating a new long-term vision with a horizon of 2040. Innovation should be at the core of such a vision and should mobilize society behind a common mission. Example: “*We are building a society and economy fully engaged in the global, knowledge economy in order to offer many opportunities to the youth of Oman to express their creativity and ambitions. With this in view, we will undertake a number of bold reforms and programmes*”.

To realize this ambition, it would be appropriate to propose to the Omani society an *Innovation Compact* built on a few appealing concepts, as follows:

- *The Omani identity*, which is that of an Arab maritime country open to the outside world, confident in its identity, with an inner diversity and at ease in interacting with other cultures – an image particularly adapted to insertion into today’s global economy;
- *The Omani sense of excellence*, which should inspire what is done in all sectors of the economy and society – a value which is a major foundation for competitiveness and which is familiar to Omanis;
- *The imperative of sustainability*, applicable to environmental protection and conservation, but also to broader societal issues such as the sustainability of quality jobs offered to

everyone, improved welfare for all, the safeguarding of the national cultural heritage.

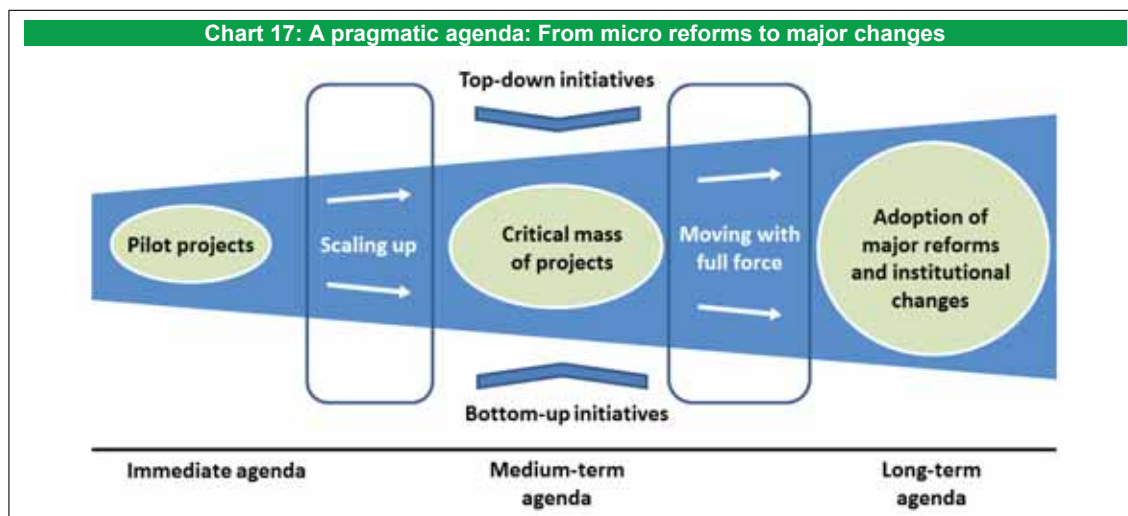
Of course, there will be a need to implement such a vision through concrete actions and also by communicating it to the population in a credible manner. At the same time, the “innovation compact” should include a number of measures that the Government commits to undertake with the active support of the population and key actors (i.e. business and academic communities), and progress in their implementation would need to be monitored.

To be coherent in the broader context of the elaboration of a new development strategy, this innovation compact should be developed and implemented in tandem with a new “*Social Contract*” in line with a redefinition of conditions of employment, training, pensions and leisure. These need to be among the fundamental pillars of the 2040 Vision.

Top-level coordination

In order to implement efficient STI policies with a view to boosting the overall economic development of a country, it is necessary to have strong coordination at the top level of government, as illustrated by recent success stories, the most emblematic being those of Finland, the Republic of Korea and Singapore. The coordinating mechanisms put in place in Finland – a country functioning with a consensus-based culture – can be a reference for best practices for Oman. Finland’s key coordinating mechanism has been the Innovation Policy Council (called the ST Policy Council at its creation in 1990). This Council is chaired by the Prime Minister, and involves all key ministers (including the Finance Minister) and heads of concerned agencies (e.g. the Academy of Sciences and the Innovation Promotion Agency), as well as top representatives of business and civil society organizations (e.g. trade unions). It used to meet twice a month to discuss implementation of strategic decisions, including budgets, sector reforms and new programmes.

In Oman, a similar mechanism could be established to report to His Majesty Sultan Qaboos. To a large extent, the National Innovation Strategy Grand Committee governing this UNCTAD STIP Review could form the nucleus of a similar institution.⁶⁵ It needs to be enlarged to include other key ministers, such as finance, and top-level representatives of the business sector, trade unions and civil society organizations. It should meet regularly, at least once a month, focusing on strategic issues and decisions and be concerned only with broad resource allocations.



It should not be involved in operational tasks and activities, including the management of policy measures, schemes and incentives.

It is important to emphasize that overall coordination does not mean centralization, or, particularly, centralization of support and funding for STI. There is the risk that in order to avoid duplication between agencies, or turf battles among government bodies, all financial and technical support may become centralized in one single administrative authority. This is not at all advisable. It would lead to an excessive concentration of power and to a situation that would be, in any event, inefficient and unmanageable. A certain distribution of power and judgment, adapted to the different functions to be assumed by STI policies, is necessary.

On the other hand, high-level coordination must not be allowed to devolve into committees that become discussion clubs without sufficient ability or authority to implement horizontal and cross-sector programmes to counteract fragmentation. To minimize this risk, the Omani innovation system is clearly in need of an entity entrusted with a mandate to actively initiate and coordinate implementation of cross-sector initiatives and programmes, rather than to take on a strategic orientation role that belongs to the higher body referred to above. A stronger TRC with the status and capabilities to be an effective counterpart to line ministries could play such a role.

In order to build a high-level corps of agents of change with a long-term, sustainable perspective, Oman's leadership could be inspired by another important measure taken by Finland in the 1970s consisting of an R&D support body attached to the Parliament (SITRA). This body used to organize regular weekly sessions for political leaders, senior government officials, members of parliament, business managers, trade unionists and city mayors, among others, in order to keep them

informed and involved in the main macroeconomic and fundamental policy issues of the day, including those relating to STI. These sessions involved hundreds of people each year, and have often been convoked to review policy and developments in subsequent years. This scheme, which is still operating today, has been instrumental in facilitating reform processes in Finland and adaptation to global opportunities and external shocks and pressures.⁶⁶

A pragmatic approach

In development policies the really difficult question is "how to do", rather than "what to do". In this regard, international experience suggests a pragmatic, gradual approach (as illustrated in chart 17). In a first stage, the strategy begins with some well-targeted, micro and meso-level projects. Successful projects help build credibility and create positive attitudes to change, including among policymakers.

The second phase should lead to a critical mass of projects, inspired by both bottom-up and top-down initiatives. This prepares the ground for a third phase when major, broad reforms can be implemented. This approach, which may be termed "radical gradualism", mixes a short-term agenda with quick-win results and a longer term agenda involving deep transformation.

To a certain extent, Oman has completed the first stage and is ready to embark on the second one. Such a strategic approach could have two elements: a first batch of measures with a short-term impact facilitating the rapid emergence of a critical mass of innovation projects and opportunities; and a second batch of actions of a more structural nature, with a longer term impact. Both batches would need to be implemented immediately, within the limits of government capacities and resources – financial, managerial and administrative.

Another important point to emphasize is the need for a holistic approach for improving the overall innovation climate, while being focused on what really matters. From this viewpoint, a gardening comparison can be useful for guiding government action. Innovation projects, to flourish, are like plants. They need: (a) watering, i.e. adequate financial, technical and other support; (b) eliminating pests and weeds that prevent the plant from growing, i.e. eliminating all kinds of obstacles to innovation, such as excessive bureaucracy and anti-competitive behaviours; (c) fertilizing the soil, i.e. research efforts, and technology and knowledge transfer from abroad; and (d) preparing the ground, i.e. establishing an appropriate education system and creating an adequate technical and entrepreneurial culture. Currently, Oman has identified the need to act on these four policy functions, but much more needs to be done in a more integrated manner.

9.2 Innovation agenda: Actions with a short-term impact

Harvest the low-hanging fruits

Among the measures that can have an immediate, important effect on the economy, priority needs to be given to Internet access, including lowering its price and widening its access. No progress towards an innovative industry, a knowledge economy and a creative society is possible without broad and affordable use of the Internet. As noted in this Review, Oman trails behind other countries of the region in this respect, including having strong restrictions in place (e.g. affecting the use of certain VoIP applications).

Efficient pricing and liberalization measures in this field would help boost the “creative industries”, so far embryonic in Oman. Adequate support for specific projects, including for the development of sites with Arabic content and the localization of software, in particular those under open and public licences, would be useful as well. Most critical, however, is to put in place a framework for stimulating linkages between ICT and innovation. This would require reforms to the education system as well as a more enabling role of the government vis-à-vis the private sector, including its adoption of policies that are more conducive to innovation and entrepreneurship looking to respond to unfulfilled needs with commercial products and services.

Another set of opportunities with short-term results consists of projects supported by innovation promotion measures that have been put in place in the past few years, such as the Innovation Hub project at TRC and the Industrial Innovation Centre and other incubating structures. Although modest in size and ambition, they have led to the

implementation of various innovation programmes and projects with good marketing and commercialization prospects. A focused, sustained effort to mobilize adequate trade networks and venture capital, and/or the removal of regulatory barriers, could foster entrepreneurship, build awareness of the need to innovate and generate pride and self-confidence. The resulting success stories would serve to demonstrate and inspire the young to become innovators and entrepreneurs.

Institutional auditing

As noted, there are many obstacles of a formal and informal nature, including the silo syndrome in government structures, cumbersome bureaucracy in government-business relations, anti-competitive behaviours that affect the business climate, overregulation within educational institutions, salary scales which adversely affect the recruitment or employment of researchers and technologists, regulations that prevent the commercialization of new products, or conversely, a lack of regulations that prevent, for example excessive pollution or energy use. These are among the many elements that deter the creation of an innovation climate in Oman.

Experience shows that eliminating obstacles to innovative initiatives immediately creates a more dynamic climate, even if it does not lead rapidly to the introduction of new products, processes or services on the market or the generation of an adequate turnover and profits.

Reducing or removing obstacles to innovation requires determined actions and adequate instruments. To be efficient, a body answerable to the highest level of government should be responsible for policy formulation. An enlarged National Innovation Strategy Grand Committee evoked above could be such a body. But it should be independent and open to any kind of investigations, and it should be staffed by representatives of the judicial system, the parliament and the government administration.

Importantly, the audit should not consist of simply producing a report (or reports); it should be a process conducted through an established, durable mechanism responsible for due follow-up to check that the proposed reforms and actions needed to remove any obstacles (e.g. deregulation or law enforcement) are effectively implemented. The best way to proceed is to start with recording dissatisfaction and complaints from the concerned actors and then examining in detail the issues raised and the factors and obstacles responsible. The goal is not to proceed with any kind of in-depth evaluation and subsequent discussions of institutions or programmes, but to identify regulatory, legal and behavioural obstacles to innovative undertakings and remove them.

Oman would be a pioneer in creating such a process. Although a number of countries have identified the importance of overcoming obstacles to innovation, none has really undertaken wide and sustained actions, as suggested above. They have tended to limit their actions to specific sectors (e.g. telecoms), or to the simple commissioning and publication of reports.⁶⁷

Leveraging public markets and infrastructure projects

The Government is very active in many sectors, notably those concerned with the development of transport infrastructure, energy and construction. It can substantively contribute to promoting innovative products, for example through norms for energy consumption, regulations for environment-friendly materials (such as the banning of plastic bags), guidelines for food safety and standards for working conditions. The identification of those areas requiring innovation-oriented regulatory measures can possibly be a task of the body responsible for fighting obstacles to innovation mentioned above.

Another dimension to be considered is the use of procurement policy to help SMEs upgrade their technology or offer innovative products. The measures recently taken to reserve 10 per cent of public procurement purchases to SMEs are welcome, but it is important that the use of public procurement for boosting the development and use of new technologies be clearly and actively integrated into innovation policy.

9.3 Innovation agenda: Actions with a longer-term impact

A series of actions with longer term goals should be implemented to complement the measures that can have a short-term, visible impact. Possibly, these could begin with pilot initiatives in selected policy areas that require experimentation or demonstration effects.

Stimulate creativity and entrepreneurship among Omani youth

The first and major hindrance to innovation in Oman is an insufficient number of entrepreneurs with innovative ideas and willing to take risks in uncharted waters. Creating a critical mass of such people will take time. Measures envisaged for people employed by the Government can be useful, but they are not sufficient. Measures envisaged by the Ministry of Manpower for the vocational schools seem to be excellent and need to be implemented as soon as possible, perhaps on a pilot basis before their implementation nationwide. In a similar vein, incubating structures, with appropriate coaching and support, need to be

increased in universities and colleges to attract and support interested students. A complementary action that has proved to be particularly stimulating is the development of “Fab Labs” in which students, innovators and entrepreneurs are invited to develop new products that could then be prototyped through 3D printing. Multiplying such workshops throughout the country could stimulate entrepreneurial creativity.

In universities and colleges, the proposed institutional audit should help reduce institutional obstacles arising from excessive bureaucracy and administrative burdens, as well as, hopefully, distortions resulting from low salary scales. For improving their governance and management capabilities, Oman’s universities could use the model created by the Centre for Mediterranean Integration and the World Bank for the Mediterranean and Arab countries based on a self-assessment scorecard (World Bank, 2012). Some experimental approaches should also be initiated. For example, the planned new S&T University could offer an opportunity to build a truly innovative academic institution, blending studies in science and technology, business management, and art and design. This model, pioneered in Finland’s Aalto University and spreading to a number of countries, is based on the notion that innovation results from the combination of several types of competencies.

In addition to reform of middle and higher education, more effort is needed to improve the quality of primary and possibly even early childhood education. It is fundamental to develop the creativity of children by radically changing teaching practices which encourage rote learning (i.e. requiring repetition and memorization of texts and concepts). Children should be taught ways and means of experimenting, discovering, using their judgment and testing their capabilities. Initiatives should be launched throughout the country, along with an overall improvement of teaching methods and teacher training courses to ensure quality teaching of basics: reading, writing and mathematics. If these much-needed reforms are not properly and rapidly undertaken by the Ministry of Education, private schools will continue to proliferate, and inequalities will grow between families who can afford to place their children in them and other families that are obliged to send their children to poor quality public schools.

Strengthen R&D and innovation support

As noted above, more sophisticated measures and increased support are needed to strengthen R&D and innovation. The following three types of measures could be implemented: (i) financial support schemes, (ii) technical, commercial and other support in form of “local innovation houses”,

and (iii) strengthening leadership capabilities in their role of information gatekeepers.

(i) New financial support schemes

To foster university-industry collaboration in research, a scheme, inspired from those used in a number of countries, is proposed. It will provide support to projects jointly identified by the collaborating entities on the condition that the business sector funds 50 per cent, with the government contributing the other 50 per cent. This new scheme could take the form of a new programme added to those implemented by TRC.

Individual innovators' projects could be supported by a scheme similar to the National Science Foundation's Small Business Innovation Research (SBIR) programme in the United States, which has been implemented for the past 30 years and has an excellent track record. It could be implemented gradually, initially with the Government providing full support in terms of seed money, and then gradually transferring support to the private sector, most notably to venture capitalists. An analogous scheme may be developed through the current financial assistance provided under the Individual and Community Innovation support scheme operated by the Innovation Hub while the Government needs to be prepared to provide more resources per project.

For stimulating investment in R&D in enterprises, notably in big businesses, a tax incentive in the form of a significant tax relief could be instituted on an experimental basis for several years (e.g. five years). Such a scheme has proved to work successfully in economies based on natural resources that are seeking industrial diversification (such as Australia and Norway), where large corporations are involved in resource exploitation. However, the potential impact of such a scheme in Oman remains rather uncertain, as the taxes imposed on businesses are already quite low. This is why it is suggested that the tax relief be instituted for a limited period of time initially, with a rigorous impact evaluation.

(ii) Local innovation houses

Innovation, particularly at the small firm and individual level, is fundamentally a local phenomenon that is initiated by highly motivated groups of people rooted in the place or area where they work and study. This is why several countries have set up small support structures to help such local innovation dynamics to take shape and grow. A similar structure could be set up in Oman where there remains a strong sense of regional and local identity in the different provinces and cities that constitute the Sultanate. In each of the main cities there are colleges and universities, as well as burgeoning innovation initiatives (e.g. in the form of

incubators), as well as clustering opportunities in the industrial, agricultural and services (tourism) sectors.

In order to take advantage of these assets and stimulate potential innovators and entrepreneurs, local innovation houses should be opened where they could find information on all types of support (e.g. technical, commercial and financial) for their projects. Such houses should be opened in all significantly large cities of the country (possibly a dozen). The local and provincial authorities should be involved in the establishment of these houses, their running and the funding of their staff (preferably paid as private contractors, rather than as civil servants).

(iii) Enterprise and institutional management

Successful absorption of knowledge and the capacity to innovate depends on efficient communication flows between an organization and its environment as well as inside the organization. In today's conditions of rapid and uncertain technological change, the function of the knowledge and technology gatekeeper can become highly formal or rigidly centralized in order to reduce anxiety in decision-making, as seems to be the case in Oman. Senior executives and policymakers tend to act as de facto communication gatekeepers, and have taken upon themselves the highly critical role of heavily influencing the innovative and creative capacities of the institutions they lead

However, when it is not obvious where and how new external knowledge can best be applied, a high-level gatekeeper may not provide an effective service. Relying on the chief executive of an institution as a gatekeeper may not allow the smooth flow of information across that institution and is at odds with the increasing knowledge networks at all levels of human endeavour. To remedy this problem, Oman's policymakers need to actively encourage greater interdepartmental, inter-institutional and interdisciplinary communications among their staff and experts. Organizing multi-stakeholder seminars focusing on specific technologies or issues (e.g. sector development, infrastructure renewal, or social needs) could be helpful in this respect.

Launch a large-scale programme on environmental stewardship

Oman needs to mobilize its creativity on issues of global importance, and which relate directly to major problems it is facing or will be facing in the coming decades. One such issue concerns stewardship of the environment. So far, this has received little attention: Oman's carbon footprint is

Box 9: TRC – GUTech Eco House project

The Sultanate of Oman is currently experiencing a rapid increase in population, a steep increase in energy consumption, and a steady decrease in fossil energy resources, which make the design of an ECO HAUS relevant and timely. Therefore, The Research Council of the Sultanate of Oman initiated a competition among five universities of the country to design, build and operate a zero-energy house on their campuses. The teams are collaborations of students, staff, consultants, and companies. Located on the new GUTech campus in Halban, the ECO HAUS is a two-storey residential building of 200m² that will serve as a guesthouse. The concept is based on ten strategies for energy-efficiency, which can be precedents for other projects.

- | | |
|------------------------|-------------------------|
| 1. Optimal Orientation | 6. Efficient Appliances |
| 2. Natural Ventilation | 7. Solar Power |
| 3. Protective Envelope | 8. Recyclable Materials |
| 4. Radiant Cooling | 9. Treated Water |
| 5. Energy Recovery | 10. Native Plants |

The Eco House concept results in a building that can be operated at net zero-energy and achieves full comfort for its users. The building will be constructed throughout 2013 and will be operational in 2014.

Source: GUTech



enormous,⁶⁸ its agriculture consumes considerable amounts of water, and its public transport system is underdeveloped.

An environmental stewardship programme should be cross-sectoral, involving many ministries. It requires actions in R&D, public procurement, norms and standards, training and education, among others. Moreover, it needs to produce visible results in the not too distant future, at least in the form of pilot operations and demonstration projects. There are a number of such operations that are currently supported by TRC, such as the “passive eco house” project (see box 9). Other ministries also have environment-friendly projects, such as water saving irrigation and tree planting in desert areas, which can constitute a promising nucleus and be scaled up and expanded. The media should be mobilized to promote campaigns in this area in order to create awareness and instil

pride among local populations. Local authorities and city mayors, as well as citizens of all ages, should be involved.

The Government of Oman has demonstrated that it can very effectively mobilize all needed resources and actors on very large infrastructure projects. This capacity should be applied to a Grand National Environment Stewardship Programme which could also serve as an example for other countries in the Gulf and Arab region.

Foster international and regional integration

As noted earlier, numerous steps have already been taken in many parts of the innovation system to enable it to participate in the international arena and benefit from global knowledge and technology inputs. However, more can be done in this respect.

Box 10: Nimr Reed Beds

Petroleum Development Oman, the Omani national oil company, currently produces 9 barrels of water for a barrel of oil. Part of this water is used for water injection to maintain reservoir pressure. Deep water disposal below the producing reservoir has so far been used to manage the excess water – a wasteful practice considering that Oman is situated in one of the world’s most arid regions. To remedy this situation a reed bed-based water processing system has been designed and implemented south of Muscat in Oman through a partnership between Bauer Environment and PDO. Evaporation ponds extend over a surface of 3 million m² while the overall area of the wetland is 3.8 million m². Compared to deep disposal wells, this reed bed approach has zero energy requirements and a significantly smaller carbon footprint.

The Nimr oilfield requires 250,000 m³/d of water to be managed to keep oil production going and deep disposal wells were the traditional solution. However, the Nimr reed beds are an innovative solution as they address the issues of loss of revenue from oil left in produced water, and the stricter environmental regulations, high energy costs and the carbon footprint associated with deep water disposal wells. The treatment starts with an oil and water separator after which the water is distributed into a wetland facility where it is channelled through four wetland terraces by gravity feed. Evaporation ponds are used for salt recovery, which is reused for drilling operations in the oilfields of Oman, and the reed beds produce biomass and are used for biosaline agriculture. More generally, the project is generating job opportunities and new business prospects for PDO and associated firms.

Current research is evaluating water re-use options through a cooperation between Bauer Nimr and the International Centre for Biosaline Agriculture, a not-for-profit, international centre of excellence for research and development in marginal environments hosted by the UAE. As well, there is ongoing research in cooperation with SQU evaluating the feasibility of generating hydropower.

Source: PDO and Bauer Environment

Firstly, in view of the importance of Omani joint ventures with foreign firms, the Government could adopt a more proactive policy to stimulate – possibly impose – local production of spare parts and components for some goods produced or imported in Oman. This could accompany programmes of technology transfer and/or management assistance to support the development and growth of local businesses. Ireland's national Linkage Programme for the electronics industry offers a good example (Görg, 2000). Schemes supporting joint R&D between foreign firms and local businesses and universities could also be encouraged, such as the collaboration between Petroleum Development Oman (PDO) with Shell and Schlumberger in Oman. The Nimr Reed Beds project is another interesting example of collaborative innovation with positive outcomes (see box 10).

Links with international research networks could also be strengthened, and, notably, more or less formal networks developed with establishments of the GCC countries through adequate incentives. The small economies of the Gulf, individually, do not have a critical mass of researchers for pursuing research in several disciplines, or even being associated with prestigious institutions abroad (such as Cornell in Qatar or La Sorbonne in Abu Dhabi). It would be useful to organize research networks at the GCC level by creating teams from several universities in programmes of common interest to two or several GCC countries on the model developed at the EU level, or on a more modest and feasible scale as in Canada. This has already taken place in the oil and gas sector where there are several GCC theme-based committees that meet regularly to exchange information, such as the GCC National Oil Companies Technology Managers Group, which explores joint research opportunities.

Another possibility is the creation of a free market area within the GCC. The small size of the GCC countries, with the exception of Saudi Arabia, inhibits the commercialization of new products or services developed in those countries. A certain harmonization of standards, and even some joint public procurement procedures open to businesses from all the GCC countries, would be very helpful for intending innovators, and Oman could take the lead in this.

Develop evidence-based policies

A major difficulty encountered in performing this review was the lack of information on Oman's science and technology assets, and on performances in a number of domains (e.g. innovation or education). This is also a great handicap for policymakers, because, more than ever, countries base their policies on the gathering of factual evidence.

For Oman, it is suggested that efforts be made in the following five domains as a matter of priority:

- Collect R&D statistics based on the model and guidelines of the Organisation for Economic Co-operation and Development (OECD), which have become the international standard (see the Frascati Manual, first published in the late 1960 and regularly revised thereafter).
- Conduct innovation surveys. Again the OECD/EU guidelines (Oslo Manual for Collecting and Interpreting Innovation Data) would be useful. However, simpler approaches using available web-based technologies could be adopted for a more rapid assessment of innovative activities.
- International education tests, such as PISA (the OECD-administered survey), which allows the measurement of all development levels, and shows how gaps vis-à-vis top performers are being reduced.
- Programme evaluations. It is crucial to perform such evaluations with international teams to examine how programmes are managed, comparing the results achieved vis-à-vis declared objectives, and the outputs obtained against dollars spent. This type of assessment would need to complement the national reviews.
- Innovation and job creation. There is a need for close monitoring and accurate forecasting of job creation (and destruction) associated with innovative activities and technologies, whatever their nature, disruptiveness, and degree of diffusion and adoption throughout the economic system.

9.4 An action plan for a national innovation strategy and system

An action plan for the development of the national innovation system of Oman will need to follow on from a high-level policy decision establishing a national STI strategy as a primary lever for the innovation-led development and diversification of the Omani economy. Given that such a strategy is likely to require considerable competencies, capacities, resources and funding, a strongly expressed political commitment will be needed to reduce uncertainty and mobilize and incentivize stakeholders.

This UNCTAD STIP Review draws certain conclusions based on its findings, and highlights a number of issues that need to be addressed, but it also aims to serve as an input in moving from an analysis to an action plan. An action plan itself needs to be elaborated at a level of detail that requires the intervention of policymakers with the authority to earmark and commit funding and

resources and assign responsibilities. To achieve this, there are certain principles and methodological approaches that need to be accepted and fully integrated into a future official national innovation strategy.

All action plans need to analyse the problem at hand supported by qualitative and quantitative assessments. Research for this STIP Review, with the close involvement of TRC, led to a number of observations. Inputs from the National Innovation Strategy Grand Committee, the National STIP Group meetings and the National STIP workshop provided a wealth of feedback (see box 11) which should help policymaking. This Review, together with TRC's proposals for a National Innovation Strategy based on its identification of the innovation pillars of human capacity-building, awareness of IPR issues and economic diversification, should provide a detailed understanding of the vision and development objectives that need to be communicated to all policymakers and STI stakeholders.

The NIS Action Plan (NISAP) for Oman should be able to implement the proposals of the STIP Review and the Oman National Innovation Strategy, leading to tangible and measurable outcomes. The Action Plan will describe how policymakers use the STIP Review and NIS Strategy to achieve the desired policy targets and increase Oman's innovation outputs. For maximum impact, the NISAP will need to be comprehensive in both the changes it aims to trigger and the stakeholders it involves. Responsibilities for implementation will need to be clearly assigned.

Finally, the NISAP should address current needs but with a long-term perspective, working towards Vision 2040. In this sense, it should be able to anticipate newly emerging opportunities as well as risks and potential barriers that are beyond the purely economic and commercial domains, and take into consideration issues such as sustainability, finite natural endowments and shifting politics in a multipolar world.

The NISAP should contain a sufficient depth of detail, and not aim at unrealistic targets, as this will lend credibility to the involved policymakers and their institutions. Greater clarity and realism will reassure the authorities responsible for authorizing funding and resources and improve accountability.

The development of the NISAP should follow on quickly from the international and national presentation of the STIP Review and the promulgation of the National Innovation Strategy, ideally within the first six months and before the end of 2014. This assumes that the overall vision, objectives and strategy for the innovation-led development and diversification of the Omani economy are in place, have been well

communicated and have received broad support from all the stakeholders. It should be stressed that the NISAP will always be a work in progress: as the institutional relationships evolve and learning processes strengthen, there may be a need to revise and update it.

Inclusiveness is a key factor for success, as many science, technology and innovation issues affect society broadly – such as human resources development through education and vocational training – and therefore require the involvement of institutions beyond the usual ones of government, firms and academia. The media, business associations and, in particular, SMEs, religious leaders, youth organizations, representatives of popular culture and performance artists, social services and public health institutions, and representatives of ethnic and cultural groups may need to be involved in the process of change.

Developing the NISAP will require convening a planning group, and for this purpose the STIP National Group may be a good starting point. The key is to have an operationally capable group that is inclusive with a membership comprising diverse STI stakeholders. It will, by definition, have a coherent vision of the task at hand and of the strategic underpinnings of NISAP.

The NISAP should develop clear goals and define the steps needed to accomplish them. More specifically, it should determine the actions and the corresponding changes that will need to occur. When possible, or necessary, specific tasks per action may be outlined as well. It should assign responsibilities for carrying out each action step, time frames and locations, estimate the required resources in terms of competencies and funding, and designate their sources. The NISAP will also have to decide on performance indicators and a method for their appraisal, as well as establish potential risks and problems, and plan the required contingencies. It will include a communication plan as a core action. Finally, periodic reviews will need to be organized to gauge implementation and adjust for perceived changes in the environment.

It is often common for national strategies and action plans to stop at mere declarations, with little action, if any, between the concluding meeting and the subsequent meeting of the planning group, which, in the meantime, transforms itself into a monitoring and evaluation body. The risk of this happening can be minimized by having a strong communications activity, not only at the planning group's host institution, but among all the NISAP stakeholders. Regular and useful feedback should be required without overburdening the responsible expert(s) or institution, as undue effort or unreasonable demands would serve as a disincentive to future cooperation. Accomplishments need to be reported through the media and celebrated as national successes.

Box 11: High-level policy discussions as a defining feature of the Oman STIP Review

The NIS Grand Committee

The Grand Committee, the highest level body of policymakers with which the UNCTAD STIP Review team interacted in the elaboration of this report, affirmed that championing innovation needed to become a national vision while STI stakeholders needed to take ownership of change process. However, no single agency was currently campaigning for innovation, nor building awareness on this issue, as its sole mission, while communication on innovation strategy between policymakers could be improved. The Grand Committee was very clear on its desire to see the STIP Review as a source for the next phase of policy work: the development of the national innovation strategy / system with an action plan.

Enhancing science and innovation culture went hand-in-hand with entrepreneurship education. Unfortunately, national spending on professional development was a very small part of the of the total education budget. The vocational training system also does not extend to develop competencies among foreign labourers where the general skill level can be very low. Regarding general education, research was needed to address the large differences in performance between schools and to examine why TIMSS⁶⁹ scores in Oman were on the low side.

The intellectual property rights issue, central to technology transfer, was highlighted as a key pillar of the innovation strategy of Oman. A key concern was the relationship between intellectual property and technology transfer in innovation policy. There were a number of difficulties in tackling this issue, among which was the need to improve the capacities of the IP office and raise awareness among firms and institutions that were potential sources of Oman's intellectual property. The underdeveloped intellectual property system was forcing inventors to become entrepreneurs – a role they did not necessarily desire. The oil and downstream industries, being capital and technology intensive, considered intellectual property policy through the lens of concession agreements and contracts and as a strategic issue and needed to share their experience with the broader economic community.

A number of specific innovation issues were raised. For example, off-grid energy and sustainable energy technologies are potential areas for consideration, while military procurement could be used to stimulate innovation including in food processing and water management. Innovation in agriculture and fishing was another serious consideration as its importance as a sector extended to issues of food security, employment, and social stability. Improving broadband access was, as well, a priority consideration. It was noted that Government regulation could trigger innovation in water management and energy use and generation.

Labour and employment were important issues that were linked to innovation strategy either through human capacity policy or by concerns regarding the implementation of the Omanization policy. Employment was very concentrated, with the 12 largest firms employing more than five thousand workers while 120 thousand firms had less than five workers. Unemployment was not the clear-cut an issue that available data might show as of some current 100 thousand job seekers about half were actually employed and seeking better jobs, preferably in government service. Many job seekers were women, however most new jobs were created in Muscat capital and were not relevant to the countryside which bore the brunt of real unemployment problems.

National STIP Group

The UNCTAD missions to Oman in May and December 2013 could also interact with the National STIP Group which gathered a number of key decision makers involved in the definition and implementation of policies relevant to STI. Their advice, wisdom and reflections deeply influenced the assessment presented in this STIP Review. There are a number of interesting and acute points that came out in the discussion and that bear highlighting on their own, even though they have been fully absorbed in the preparation of this Review. A key one was that implementing a national innovation strategy was a process of changing mind-sets and thus would require important capacity building inputs to bolster policymaking and governance on STI issues.

The National STIP Group affirmed that knowledge innovation and technology transfer are interlinked processes. Continuing on the question of linkages a discussion on the relationship between salary scales, innovation and ToT needed to be better understood in particular from the perspective of SME development whose primary competitive advantage often came from low-cost labour imports. An important question was that of quality over size, or: how far should policy support small sectors? Much like financial investment, investment in policy also needed to gauge its returns on efforts made.

The NSG discussed how fragmentation was sometimes the result of decisions being structured along departmental sectors and hierarchies in governance, rather than according to innovation priorities. This led to questions about whether consensus-based decision-making was a valid modality for developing and implementing a national innovation system action plan, post-STIP. While the fragmentation of processes encouraging FDI and the accompanying technology transfer and innovation were recognized, proximate to this issue was the problem of inadequate profiling of Oman's exports. This issue was as well of significance for tourism sector development where important political risk components were present globally and regionally and could destabilize growth prospects.

The NSG was keen to move on to developing an action plan that would address a number of structural and organizational issues, such as how innovation programmes hand-shake and where are the loci for formal coordination, what would be the time frames for implementation, success milestones and the required resources. The question of picking winners among sectors came up, while the determination to do so would need to come from a much closer technical examination and an assessment of the commercial environment in terms of markets and value chains.

Box 11: continued*STIP National Workshop*

The STIP National Workshop, held on 10 December 2013, gathered an outstanding representation of Oman's STI stakeholders from Government, business, universities and research centres and civil society. A number of issues were voiced and serve to support certain conclusions and recommendation of this STIP Review. The fragmentation of efforts to increase research and development and spur innovation was an important problem for the innovation system.

To address this problem policy needed to focus on several key issues. One was the strong ownership of the national innovation strategy by government. Another issue was the need to nurture entrepreneurship skills through education and human capacity development policy, while education policy needed to take a more critical stance towards primary and secondary education performance. Policies on entrepreneurship development, education and vocational training needed to be in concert among them and with overall development policies. Building an awareness of the differences and the linkages between R&D and innovation was a critical task and greater cooperation and coordination between universities and firms on human capacity development and entrepreneurial training was needed. More broadly, the outcomes of the STIP Review needed to be viewed as a matter of social responsibility.

The source or the drivers of greater innovation in Oman required closer consideration. Certain countries sourced their motivation and incentives from particularly challenging or opportunistic geographic, environmental or political conditions. However, some participants deemed that in Oman the incentives for wealth accumulation were strong and were not supportive of value creation which is underpinned by innovation. This was reflected in the ubiquitous risk-averse attitude in industry and meant that diversification efforts required particular policy attention and support. The workshop heard that key innovation potential lay with the oil and gas sector and that much could be accomplished by building on its achievements while addressing the issues of sustainability, in both a commercial and environmental sense.

The workshop discussed that turning policy and strategy into action and outcomes will face many challenges. A set of reference indicators to gauge implementation and performance would allow for the strengthening of evidence based policy management. Indicators need to have a clear transparent methodologies and documentation. Time-bound targets and milestones were an important component of evidence based policy. The question of designing and implementing a follow-up action plan was appropriately raised and there were demands that an assessment on policy outcomes be conducted following the publication of the UNCTAD STIP Review.

9.5 Concluding thoughts: Communicate, inspire and lead

To boost its innovative capabilities, Oman should, first and foremost, try to bring about a change in mindset. Three key words should capture the attention of the Government and guide its action: communicate, inspire and lead.

Communicate. Developing a large media campaign is fundamental. Notably, local success stories should be fed to national programmes on television and to community radio channels to reach traditional groups, while the Internet and social media could be used to reach the young population.

Inspire. The leadership, policymakers and government administrators need to set an example in all aspects of work and life, wherever their functions lead them, and must include business communities, academic circles and civil society groups. These groups should find as many opportunities as possible to express their creativity and sense of entrepreneurship.

Lead. The importance of an inspiring and efficient leadership is key in order to initiate and sustain the required changes. Therefore, politicians, policymakers and administrators at all levels of government, from the summit of the Sultanate down to the smallest villages, need to take on the challenge of the critical role they need to play.

ANNEX: Summary table of recommended actions

Domain	Recommended actions
National Innovation System: Strategic prerequisites	<p>Recommendation 1: Develop a national mission statement and incorporate it into the national innovation strategy. Suggested statement: "We are building a society and economy fully involved in the global knowledge economy by engaging in bold reforms and programmes that will turn Oman into a positive example for other countries."</p> <p>Recommendation 2: Develop an "Innovation Compact" that will feature:</p> <ul style="list-style-type: none"> • The Omani identity; • The Omani sense of excellence; • The imperative of sustainability; and • A new social contract. <p>Recommendation 3: Align the National Innovation Strategy with Vision 2040.</p> <p>Recommendation 4: Develop a top-level coordination mechanism, an Innovation Policy Council, bringing together key ministers, top-level representatives of the business sector, trade unions and civil society.</p> <p>Recommendation 5: Establish a sector-neutral operational programme with a long-term perspective and a management body to build a corps of high-level agents of change.</p> <p>Recommendation 6: Ensure implementation of all policies, adopting a gradual approach, and combining short-term projects, with quick-win results, and a long-term agenda with deep transformation objectives.</p> <p>Recommendation 7: Adopt a holistic approach for improving the overall innovation climate with the following actions:</p> <ul style="list-style-type: none"> 7.1 The provision of adequate financial, technical and other support; 7.2 The elimination of obstacles to innovation, including a cumbersome bureaucracy and anticompetitive behaviours; 7.3. Increasing research efforts and technology and knowledge transfer from abroad; and 7.4 Reforming and strengthening the education system to provide students with the needed technical and entrepreneurial competencies.
Innovation agenda: Actions with a short-term impact	<p>Recommendation 8: Harvest low- hanging fruit, i.e. implement measures that can have an immediate and significant effect on the economy, such as lowering the price of Internet access and increasing bandwidth to enable wide geographic access to broadband, stimulating linkages between ICT and innovation, especially with a view to developing content and creative industries. Obtain approval for the proposal of the National Innovation Centre and ensure its implementation so that it can support innovation inclusively and at all levels.</p> <p>Recommendation 9: Conduct an institutional audit. Identify and eliminate obstacles and deterrents to creating an innovation climate. Identify and remove regulatory, legal and behavioural obstacles to innovative undertakings, and develop follow-up mechanisms.</p> <p>Recommendation 10: Leverage public procurement and infrastructure projects to promote innovation. Review tender requirements and regulatory norms for energy consumption, regulations for environment-friendly materials, guidelines for food safety, work and safety conditions. Reaffirm procurement policies to support SMEs in the upgrading of their technologies or innovative products.</p>
Innovation agenda: actions with a longer term impact	<p><i>A. Stimulate creativity and entrepreneurship among Omani youth</i></p> <p>Recommendation 11: Stimulate creativity and entrepreneurship among Omani youth and develop a critical mass of entrepreneurs.</p> <p>Recommendation 12: Multiply the number of business incubators in all universities and colleges with appropriate coaching and support.</p> <p>Recommendation 13: Encourage universities to adopt the governance model developed by the Centre for Mediterranean Integration and the World Bank based on self-assessment techniques.</p> <p>Recommendation 14: Encourage universities to offer a balance of degree programmes in science and technology, business management and art and design.</p>

	<p>Recommendation 15: Revise primary school practices to replace rote learning (i.e. repetition and memorization of texts and concepts) with experimentation and discovery activities. Improve primary teacher training to ensure quality learning of basics: reading, writing and mathematics.</p> <p><i>B. Strengthen R&D and innovation support and sustainability</i></p> <p>Recommendation 16: Establish public-private financing schemes (with equal funding by both sectors) for joint business-academic R&D projects.</p> <p>Recommendation 17: Establish a number of local innovation houses, in particular in regions outside the capital. These should provide information and assistance to entrepreneurs on technical, commercial and financial matters.</p> <p>Recommendation 18: Encourage an increase in interdepartmental, inter-institutional and interdisciplinary communications of all staff and experts at institutions concerned with innovation.</p> <p>Recommendation 19: Launch a large-scale programme on environmental stewardship; develop R&D activities, revise public procurement norms and standards, and introduce environmental and sustainability concepts and thinking into all training and education curricula.</p> <p><i>C. Foster international and regional integration</i></p> <p>Recommendation 20: Increase local provision of goods and services to foreign or joint-venture firms in Oman; review and revise technology transfer and management frameworks, and support structures for local businesses and universities.</p> <p>Recommendation 21: Improve links with international research networks and, where necessary, formalize such networks with adequate incentives, for example by sponsoring conferences, visits or work-study cooperation.</p> <p>Recommendation 22: Explore the full potential of the GCC as a free market and export area for export-led diversification and innovation.</p> <p><i>D. Develop evidence-based policies</i></p> <p>Recommendation 23: Improve R&D statistics by considering and adopting the OECD model and guidelines (the <i>Frascati Manual</i>).</p> <p>Recommendation 24: Conduct regular innovation surveys using the OECD/EU model and guidelines (the <i>Oslo Manual</i>).</p> <p>Recommendation 25: Conduct international education tests such as PISA (administered by the OECD).</p> <p>Recommendation 26: Establish and conduct regular programme evaluations using neutral, third party or international teams to gauge performance in terms of results achieved vis-à-vis declared objectives and funding used.</p> <p>Recommendation 27: Improve the monitoring and forecasting of job creation, and establish linkages with innovation, since certain technologies have a disruptive nature with considerable effects on labour.</p>
<p>Strategic innovation pillars</p>	<p><i>A. Human resources</i></p> <p>Recommendation 28: At colleges and universities, reduce places for liberal arts, humanities and non-vocational studies.</p> <p>Recommendation 29: Development policy should consider a mixed approach, supporting both technologically advanced and innovative business, as well as developing labour-intensive sectors such as the tourism industry.</p> <p>Recommendation 30: Weigh the level and growth of public-sector employment against the needs of providing quality public service, rather than for managing unemployment.</p> <p>Recommendation 31: Restrain future increases in public sector wages in order to allow private sector remuneration to catch up.</p> <p>Recommendation 32: The National Innovation Strategy and Vision 2040 should explicitly recognize that the presence of a large and mobile foreign population is a source of diversity that creates opportunities for innovation-based development.</p> <p>Recommendation 33: Improvement in overall educational attainment should be a central policy concern and national expectations for standards to be achieved should be raised.</p>

	<p><i>B. Intellectual property</i></p> <p>Recommendation 34: Formulate a national IPR strategy with due consideration to local specificities, as there is no universal policy recommendation for all countries; the success of implementation of the strategy should be measured by its socio-economic impact, beyond strict IP measurements.</p> <p>Recommendation 35: Develop a position on public domain and open access to ensure that publicly funded research outcomes are made available to the general public. Policymakers should also consider the necessity, and complementarities of proprietary and public domains for their strategic role in spurring competitive and innovation-based economic growth.</p> <p>Recommendation 36: Develop the human and technical capabilities to evaluate and grant patents.</p> <p>Recommendation 37: Develop support for joint patent filings with other STI stakeholders, providing financial support directly or through tax policy, and encourage the broader use national utility patents.</p> <p>Recommendation 38: Review and revise IP guidelines and regulations in academic institutions to maximize the translation of R&D into innovation.</p> <p><i>C. Diversification</i></p> <p>Recommendation 39: Develop an export-oriented diversification strategy capable of partially replacing oil revenues.</p> <p>Recommendation 40: Decide on the level and nature of involvement of FDI in Oman's diversification strategy.</p> <p>Recommendation 41: Link the national diversification strategy to the National Innovation Strategy.</p> <p>Recommendation 42: Establish an evidence-based policy management system, using monitoring and evaluation to track the progress made in targeted sectors.</p> <p>Recommendation 43: Consider the policy question of picking winners among sectors and industries and the implications of such policies on broader diversification efforts and strategies.</p> <p>Recommendation 44: Ensure that labour and human capacity development policies are designed from a short-medium- and long-term perspective, as diversification is a continuous process; increase the level of interaction between firms and educational institutions in order that they impart the specializations and competencies needed by the firms, including instruction on entrepreneurship.</p>
<p>An action plan for a national innovation strategy and system</p>	<p>Recommendation 45: Develop an action plan to implement the National Innovation Strategy and STIP recommendations before the end of 2015.</p> <p>Recommendation 46: Secure a strong expression of political commitment to reduce uncertainty and to mobilize and incentivize stakeholders.</p> <p>Recommendation 47: Ensure that the National Innovation Strategy Action Plan (NISAP) addresses not only current needs but also long-term requirements as envisaged in Vision 2040; anticipate newly emerging opportunities as well as risks and potential barriers, taking into account issues such as sustainability and the finite nature of natural resource endowments.</p> <p>Recommendation 48: Bear in mind that the NISAP will always be a work in progress as institutional relationships evolve and learning processes strengthen.</p> <p>Recommendation 49: As NISAP will require an effective planning group, the STIP National Group should be considered as a starting point, given its comprehensive representation of Oman's STI stakeholders.</p> <p>Recommendation 50: Conduct the NISAP as a change in mindset that will be guided by the capacity of the national leadership to communicate, inspire, and show the way forward.</p>

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Notes

- 1 <http://www.globalinnovationindex.org/content.aspx?page=gii-full-report-2013>.
- 2 <http://valtioneuvosto.fi/hallitus/tutkimusneuvosto/en.jsp>.
- 3 Ministry of Education and Ministry of the Economy, Evaluation of the Finnish National Innovation System - Policy Report 2009, Helsinki University Print; available at: https://www.tem.fi/files/25702/Policy_Report.pdf.
- 4 See: <http://www.oecd.org/pisa/aboutpisa/>.
- 5 NCSI, Monthly Statistical Bulletin, November 2013
- 6 National Centre for Statistics and Information (NCSI), *National Accounts*, Sultanate of Oman, 2012.
- 7 Ibid.
- 8 Ibid.
- 9 See also: Royal Decree 38/2011, On the abolition of the Ministry of National Economy, and Royal Decree 39/2011, On the granting of the Council of Oman legislative and regulatory powers.
- 10 Estimates are based on proven reserves of 5.5 billion barrels and an annual production of 300 to 350 million barrels (Oxford Business Group, Oman enhances oil production, 17 November 2013; available at: http://www.oxfordbusinessgroup.com/economic_updates/oman-enhances-oil-production-0).
- 11 United States Energy Information Administration; available at: <http://tinyurl.com/oman-co2-pc>.
- 12 NCSI, National Accounts data, 2012
- 13 Oman's innovation system has already been the subject of a study published in 2011 based on a benchmarking exercise comparing Oman to neighbouring countries in the Gulf, and using indicators provided by the World Economic Forum (see SRI International, 2011). The present report draws occasionally upon data and analyses provided in this study. It will be referred to in this report by the abbreviation, WEF/SRI.
- 14 It is interesting to note that Singapore, although one of the best GII performers, appears to be not very efficient in using its exceptionally good assets to convert them into innovation outcomes (which, nonetheless, remain high).
- 15 In the followings we will refer to the 2013 GII data and the WEF data presented in the 2011 SRI report (relating to the year 2010)
- 16 General Federation of Oman Trade Unions, *Annual Report 2012*; available at: http://gfortu.org/cpanel/my_documents/my_files/122%20%20%20%20%20GFOTU-Annual%20Report%202012.pdf.
- 17 To curb the entry of foreign workers, Oman raised the minimum wage for locals; see: <http://www.reuters.com/article/2013/02/07/us-oman-jobs-foreigners-idUSBRE9160S020130207>).
- 18 Information Technology Authority – e.oman, <http://tinyurl.com/omanisation>
- 19 Data provided by the Ministry of Manpower, during the UNCTAD mission in May 2013.
- 20 Developed by the national oil company PDO, solar powered turbines produce over 13,000 tons of steam annually, thereby saving almost one million cubic metres of natural gas and reducing CO₂ emissions of over 1,800 tons.
- 21 The term was coined in 1977 by *The Economist* to describe the decline of the manufacturing sector in the Netherlands after the discovery of a large natural gas field in 1959. According to Ebrahim-Zadeh (2003), "*This syndrome ... 'Dutch disease' ... is generally associated with a natural resource discovery, [but] it can occur from any development that results in a large inflow of foreign currency, including a sharp surge in natural resource prices, foreign assistance, and foreign direct investment. Economists have used the Dutch disease model to examine such episodes, including the impact of the flow of American treasures into sixteenth-century Spain and gold discoveries in Australia in the 1850s. ... Let's take the example of a country that discovers oil. A jump in the country's oil exports initially raises incomes, [but] as more foreign exchange flows in ... real exchange rate appreciation weakens the competitiveness of the country's exports and, hence, causes its traditional export sector to shrink.*"
- 22 Source: Sheikh Salah al Maawali, Director General for the Directorate General of SME Development at MOCI, in Muscat Daily, 12 February 2013; available at: <http://www.muscatdaily.com/Archive/Business/SMEs-contribute-14-to-country-s-GDP-says-official-21dd>.
- 23 Central Bank of Oman, *Annual Report 2012*, pg. 27; available at: <http://www.cbo-oman.org/annual/CboAnnualReportEn2012.pdf>, and information received directly from the Central Bank of Oman.
- 24 See, for instance, World Bank, *Doing Business*, an annual publication, which monitors the competition climate in countries throughout the world.
- 25 R&D is not always successful, and investors cannot tell by observing researchers or managing their efforts if any particular research path will generate an innovation in the form of a profitable commercial product or service. This problem is closely linked to the problem of financing innovation. Financial institutions usually deal with calculated risks where risk premiums can be calculated and built into the cost of investment. Unfortunately, the level of uncertainty of R&D and innovation outcomes is difficult to establish, and the commercialization of a new technology will need to be financed by entrepreneurs or firms internally, or through venture capital or angel investors who actively take on entrepreneurial opportunities and innovation risks.
- 26 Examples of large-scale infrastructure projects include the creation of the Sohar sea terminal, the expansion of Muscat port, and the building of a train line to the United Arab Emirates.

- 27 National Centre for Statistics and Information, *Statistical Year Book 2012*. This can be partly explained by the fact that large mountains or desert areas intersect much of the country, making it difficult to expand broadband connections, particularly as some areas are still inhabited by rural populations.
- 28 The leading company listed on the Muscat Stock Exchange in terms of capitalization (more than OMR 4 billion)
- 29 Although security concerns are part of the reason, this should have been resolved in Oman, just as it has in the United Arab Emirates and Saudi Arabia, for example.
- 30 According to UNESCO statistics, in 2010 there were about 39 per cent of students in science, engineering and construction. However, the rate of successful completion of studies seems to be modest. The percentage of science and engineering first degree students (equivalent to an undergraduate degree) is very low (among the lowest of the GCC), according to the SRI report.
- 31 This figure was widely quoted during interviews conducted by UNCTAD in December 2013 and May 2014.
- 32 Of these researchers, approximately one fourth are associated with SQU and other universities (500 in FTE), one tenth with the Agriculture and Fisheries public research system (200, including extension services staff), and the remainder work for the PDO and other enterprises.
- 33 See: <http://ycombinator.com>.
- 34 See: <http://www.businessinsider.com/startup-odds-of-success-2013-5>.
- 35 See: <http://online.wsj.com/news/articles/SB10000872396390443720204578004980476429190>.
- 36 Oman is ranked 32 in the GII on this item according to the WEF Survey of Executives 2013.
- 37 Eight in total, two of them with physical facilities: the Oman Studies Centre and the Centre of Excellence in Marine Biotechnology.
- 38 These two issues (low salaries and bureaucratic burden) were acknowledged in the SQU Strategic Plan 2009-2013.
- 39 Some scientists met in the course of the UNCTAD visit summarized their experience as follows: "Dealing with SQU on joint research is too expensive as administrative overheads take up much of the funding, while administrative policies are not clear. Research grants at SQU could amount to OMR 150,000-OMR 250,000 for a period of 4 years, but access to SQU lab equipment and facilities is difficult".
- 40 During the UNCTAD mission in May 2013 similar comments were made by other establishments.
- 41 Data on wages available from the Social Security office are not indicative of the real situation, as only basic wages are tracked. Pensions and insurances are, however, not considered a disincentive to mobility.
- 42 <http://www.timesofoman.com/News/Article-18054.aspx>.
- 43 For more details, see the ITA website. <http://www.ita.gov.om/ITAPortal/ITA/>
- 44 <http://www.ameinfo.com/omani-smes-receive-technical-support-odb-328246>.
- 45 Information provided at a PASMED seminar held on 3 July 2013 following the SME symposium.
- 46 <http://www.timesofoman.com/News/Article-19229.aspx>.
- 47 *TIMSS 2007 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. National Centre for Education Statistics, United States Department of Education; available at: http://timss.bc.edu/TIMSS2007/PDF/TIMSS2007_InternationalMathematicsReport.pdf.
- 48 *Highlights from TIMSS 2011, Mathematics and Science Achievement of U.S. Fourth- and Eighth-Grade Students in an International Context*. National Centre for Education Statistics, United States Department of Education; available at: <http://nces.ed.gov/pubs2013/2013009rev.pdf>.
- 49 Ministry of Education (Oman) *Annual Educational Statistics Yearbook 2010/2011*: 196.
- 50 Ministry of Manpower (Oman), *Manpower from 1970 – 2010*.
- 51 See full text of the OFTA, chapter 15 on IPR, at: http://www.ustr.gov/sites/default/files/uploads/agreements/fta/oman/asset_upload_file715_8809.pdf.
- 52 Bahrain, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates
- 53 Figures developed by Kagan Binder PLLC Intellectual Property Attorneys; see: <http://www.kaganbinder.com/docs/7-EstimatedPatentCosts.pdf> and LSE (2006).
- 54 Diaz Reus Attorney and Solicitors, *Intellectual property rights in the Sultanate of Oman*; available at: <http://www.diazreus.com/news-articles-intellectual-property-sultanate-of-oman.html>.
- 55 Most recently the National Portrait Gallery of the United Kingdom has changed its image licensing to allow free downloads for non-commercial and academic uses through a standard creative commons license (see: <http://www.museumsassociation.org/museums-journal/news/22082012-npg-changes-image-licensing-to-allow-free-downloads>).
- 56 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity and the International Treaty on Plant Genetic Resources for Food and Agriculture of the Food and Agriculture Organization of the United Nations.

- ⁵⁷ The diversification index indicates whether the structure of exports or imports, by product, of a given country or group of countries differs from the structure of products of the world. This index, which ranges from 0 to 1, reveals the extent of the differences between the structure of trade of the country or country group and the world average. An index value closer to 1 indicates a bigger difference from the world average. The diversification index is computed by measuring absolute deviation of the country from the world structure, as follows:

$$S_j = \frac{\sum_i |h_{ij} - h_i|}{2}$$

Where h_{ij} = share of product i in total exports or imports of country or country group j , and
 h_i = share of product i in total world exports or imports.

This index is a modified Finger-Kreinin measure of similarity in trade. For more information, see Finger and Kreinin, 1979; see also: <http://unctadstat.unctad.org>.

- ⁵⁸ <http://www.muscatdaily.com/Archive/Business/Oman-economy-to-expand-4.6-in-2013-says-Moody-s-2htl>.
- ⁵⁹ United States Energy Information Administration; available at: <http://www.eia.gov/countries/cab.cfm?fips=MU>.
- ⁶⁰ Ibid.
- ⁶¹ See United States Environmental Protection Agency, at: <http://www.epa.gov/pesticides/factsheets/copper-alloy-products.htm>.
- ⁶² http://www.copper.org/applications/marine/cuni/pdf/marine_aquaculture.pdf.
- ⁶³ See, for example: http://www.wipo.int/wipo_magazine/en/2010/06/article_0007.html, <http://main.omanobserver.om/?p=61323> or <http://www.timesofoman.com/News/Article-20246.aspx>.
- ⁶⁴ See, for instance, the very numerous measures proposed by the stakeholders consulted in the SRI report.
- ⁶⁵ The Innovation Grand Committee is chaired by His Highness Sayyid Shihab bin Tariq Al Said, His Majesty the Sultan's Adviser, TRC Chairman and Secretary General, as well as the Ministers of Commerce, Agriculture, Education and Manpower..
- ⁶⁶ The fact that the Finnish economy may appear very dependent on the IT sector today, and most notably on one single company, Nokia, which is in serious difficulty, should not hide the successful performances of a number of other sectors and technologies, which contribute to further demonstrating its inner resilience.
- ⁶⁷ The first initial work in this area was a report commissioned in the United States by President Johnson in 1967. Entitled Technological Innovation and its Environment, and known as the Charpie Report, after Bob Charpie the chairman of the panel on technological innovation of the U.S. Department of Commerce (then CEO of Union Carbide), it was a pioneering work that identified clearly the specificity of innovation policy, as distinct from research policy, and highlighted a number of obstacles to the creation of an innovation climate in the United States, notably the development of small, innovative firms which it considered to be major vectors of innovation. However, since it was conceived simply as a report, without mechanisms to follow up and enforce the measures it proposed, the exercise had only a small impact.
- ⁶⁸ Oman's per capita CO₂ emissions from energy consumption are about 17 metric tons per annum, which places it in the top 20 countries for emissions per capita worldwide. However, it has a lower footprint than Qatar, the United Arab Emirates, Kuwait, Bahrain and Saudi Arabia, according to 2011 data from the United States Energy Information Administration; see: <http://tinyurl.com/oman-co2-pc>.
- ⁶⁹ The Trends in International Mathematics and Science Study (TIMSS) is an international assessment of the mathematics and science knowledge of 4th and 8th grade students developed by the International Association for the Evaluation of Educational Achievement (IEA). It allows participating nations to compare students' educational achievements across borders (see: <http://www.timss.org/>).

