CHAPTER 12

Transforming an Economy through Research and Innovation

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INTRODUCTION

In the race to diversify their economies beyond oil and gas predominance, several Middle East Countries are moving to develop "knowledge-based" economies. Higher education, particularly in technical areas, and innovation are seen as key to making that transition. New higher education institutions are being built to implement this vision. In the United Arab Emirates, the Khalifa University of Science, Technology and Research (KUSTAR) is a primary example of these developments.

Building dynamic economies that are based on the creative application of human knowledge is currently an aspiration of all developing countries. The United Nations Development Program has conducted a number of studies of the Arab world's progress in developing the knowledge, skills and institutions needed to compete in today's global economy. Its 2003 report (UNDP, 2003) presented a comprehensive picture of the "knowledge deficit", and suggested needed reforms. Since then, the 22 countries of the Arab world have worked on reducing this deficit. A recent report (Lord, 2008) analysed what has been achieved, what has failed, and what remains to be done. The 2008 report concluded that Arab countries as a group have made significant progress when measured against their own histories. Significant success has been achieved in access to education, including new universities with global standards, and Arab governments have begun investing more in research and development.

As part of this effort to reduce the "knowledge deficit", the six Arab counties that form the Gulf Cooperation Council (GCC) have come to understand that they must diversify their current oil-based economies, investing some of today's income flow in economic diversification. In particular, these countries

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are focusing on developing "knowledge-based economies" by developing higher education programs that will provide the human capacity to initiate and support such new economic thrusts.

In this paper, we briefly discuss the efforts of the emirate of Abu Dhabi in transforming its economy into a "knowledge-based economy" and we use the establishment of Khalifa University of Science, Technology and Research (KUSTAR) as a case study for this effort.

ABU DHABI — TOWARDS A DIVERSE KNOWLEDGE-DRIVEN ECONOMY

Vision and Plan for Economic Development

The government of Abu Dhabi, the largest of the seven emirates that comprise the United Arab Emirates, has established an aggressive plan for diversification of the currently heavily oil-based economy (Government of Abu Dhabi, 2008). The vision for Abu Dhabi, currently being implemented, includes:

- Premium education for human capacity building.
- Research and development (R&D), leading to innovation.
- Commercialization of R&D results.
- Creation of a sustainable knowledge-based economy.

The plan for economic development of Abu Dhabi, aimed at implementation by the year 2030, has three major objectives:

Objective 1 — Reduce GDP volatility through diversification

Abu Dhabi will aim to reduce the volatility of overall economic and Gross Domestic Product (GDP) growth through diversification. Diversifying away from oil into other economic sectors will minimize the impact of oil price fluctuations and other shocks, ensuring more stable and predictable economic growth. In order to do this, Abu Dhabi will focus on capital-intensive, export-oriented sectors where the Emirate can have or build a competitive advantage.

Objective 2 — Enlarge the enterprise base

It is important to enlarge the enterprise base, both through the continued growth and expansion of large national champions, attraction of foreign direct investment in leading edge technology sectors, and through the stimulation of a more vibrant Small-Medium Enterprise (SME) sector. This will provide more meaningful opportunities for U.A.E. nationals, encourage innovation in higher value-added sectors, and mitigate the risk to the economy of shocks to

larger enterprises. Coupled with the traditional support mechanisms — financial or technical — that could be offered to SMEs, it is expected that the revision of anti-trust laws, the removal of entry barriers into some economic sectors, and encouraging market-based competition mechanisms will encourage entrepreneurship and foster the SMEs sector growth.

Objective 3 — Enhance competitiveness

Abu Dhabi will enhance competitiveness and productivity. Not only will steps in this regard bolster the entrepreneurial SME sector, but it will also generate significant economic growth in an underperforming segment of the economy. By focusing on capital-intensive industries and internationally traded services and optimizing the workforce in low-productivity areas, companies will be able to make capital and labour work more efficiently, greatly increasing the overall competitiveness of the economy.

To illustrate the current heavy reliance on oil and the need for diversification, Figure 1 shows how enterprise contributions in Abu Dhabi compare with those in other economies. The planned diversification of the Abu Dhabi economy is set to reduce the dependence on oil GDP to 36% by 2030, as shown in Figure 2.

Figure 1: Enterprise Contribution to GDP (Government of Abu Dhabi, 2009)
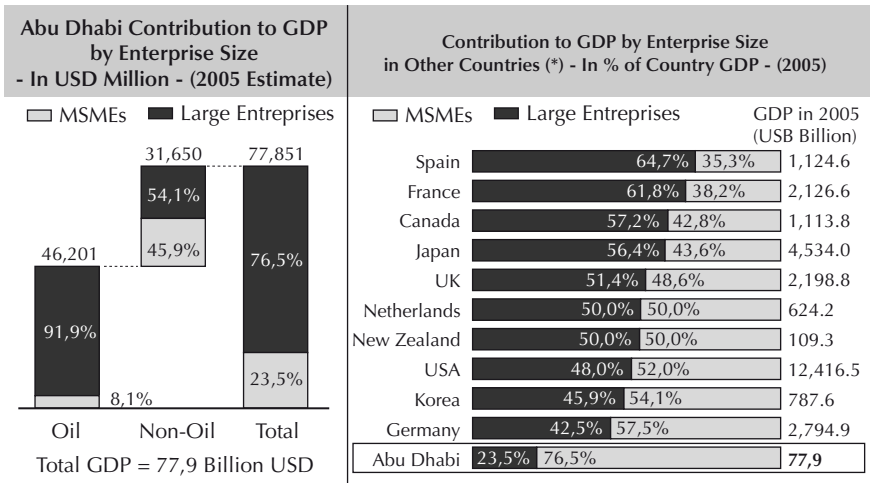
Figure 2: Target Abu Dhabi GDP (Government of Abu Dhabi, 2009)
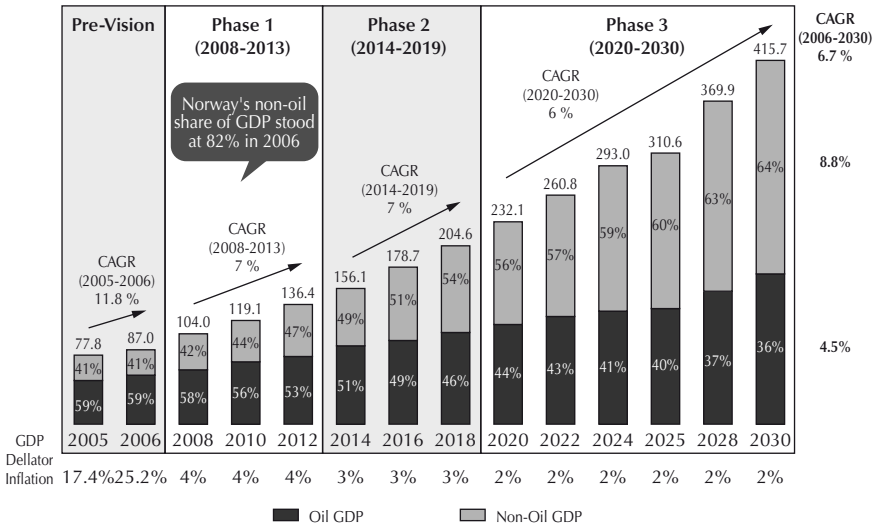
Strategic Initiatives

As already discussed, Abu Dhabi will build a sustainable and stable economy through the diversification and broadening of its enterprise base across a range of different sectors, and by taking steps to improve the competitiveness of the local private sector.

Elements of implementation of this vision include the creation of new educational institutions, investment in and acquisition of companies that are bringing diverse technological economic activities to Abu Dhabi, and the development of research activities and support mechanisms.

For example, Mubadala (2009) has been created as a government-owned company to develop new companies in Abu Dhabi. In operation for some six years, its portfolio of investments is currently valued at some $15 billion. Mubadala has, for example, purchased the chip manufacturing facilities of AMD, and will be moving significant parts of that operation to Abu Dhabi as part of the initiative of developing high-tech manufacturing in the U.A.E. It also is making investments in aerospace research and development, and parts manufacture, in association with the major expansion of U.A.E. airlines, including Etihad and Emirates.

Another example is the development of Saadiyat Island as cultural center, for both tourist attraction and local education purposes. The island will include five major cultural institutions: a branch of the Louvre Museum; a branch of the Guggenheim Museum; a National Museum named after the

founder of the U.A.E., H.H. Sheikh Zayed Bin Sultan Al Nahyan; a Maritime Museum; and a Performing Arts Center.

On the education front there are a number of strategic initiatives. New York University (NYU)-Abu Dhabi is being established as a comprehensive liberal arts and sciences campus in Abu Dhabi (NYU-AD, 2009). New York University has long been committed to building its international presence, and had increased study-abroad sites to places such as Singapore, Accra and Buenos Aires. But the plan that has been developed for a comprehensive, residential liberal-arts and sciences branch campus in the Arabian Gulf, set to open in 2010, is in a class by itself. The NYU-Abu Dhabi project will see a flow of professors and students between New York and Abu Dhabi, allowing seamless transfers. The NYU-Abu Dhabi project meets several needs of the U.S. university, and simultaneously addresses a major goal of Abu Dhabi, to be identified as a hub of knowledge transmission and creation in the region, as well as attending to the need to build human capacity in its citizens and its significant expatriate population.

Another liberal arts branch campus has been established — the Paris-Sorbonne University-Abu Dhabi (2009). This a French-speaking higher education institution that aspires to attract not only the best students from the U.A.E., but also the best students from all over the Middle East and the world.

The Masdar initiative, spawned by Mubadala, includes three major thrusts: investments in alternative energy to initiate the follow-on to the petroleum years as a major part of the U.A.E. economy; development of a $22-billion demonstration city, Masdar City, which will be carbon neutral and be powered entirely by solar and wind energy; and establishment of the Masdar Institute of Science and Technology (2009), a graduate level specialty institution focused on research and education in alternative energies. The MIST is offering master's degree programs — and eventually doctoral programs — in engineering and science disciplines. Current programs are Engineering Systems and Management, Information Technology, Materials Science and Engineering, Mechanical Engineering, and Water and Environment. It is a research-driven institute being developed with the support and cooperation of the Massachusetts Institute of Technology (MIT). The MIST will be located in Masdar City.

In addition to higher education, Abu Dhabi government is also addressing school education. The Abu Dhabi Education Council (2009) was established in 2005 to develop education and educational institutions in the Emirate of Abu Dhabi, implement innovative educational policies, plans and programs that aim to improve education, and support educational institutions and staff to achieve the objectives of national development in accordance with the highest international standards.

As part of the initiative to develop schools of the highest international standards, the Institute of Applied Technology (2009) was founded in 2005. The IAT offers Career-Based Technical Education (CTE), in English language, at the secondary school level. The IAT has five campuses located throughout the U.A.E.

KUSTAR — A CASE STUDY

Overview

Almost all of the above higher educational initiatives are branch campuses of well-known international institutions.

The U.A.E. has created three home-grown higher education institutions at the Federal level: U.A.E. University (2009), Higher Colleges of Technology (2009), and Zayed University (2009). The main aim of these federal-level institutions is to provide as many U.A.E. nationals as possible with higher education.

However, the Abu Dhabi government has identified the need for a home-grown university that caters for the elite and that is focused on building the high caliber human capital needed for the economic development of the emirate as it evolves from an oil-based economy to a diverse knowledge-driven economy. This need was addressed by the establishment of Khalifa University of Science, Technology and Research (2009).

KUSTAR was established to address the full chain starting from undergraduate education, to graduate education, to research and development, and even to incubation and spin-off of companies.

In what follows we give a more detailed description of KUSTAR and its plans to address the needs of Abu Dhabi government and the U.A.E.

History

KUSTAR has been built on the strong base of a predecessor institution, the Etisalat University College (EUC). Established in 1989 in Sharjah, EUC has offered engineering programs in the telecommunications area in three degree tracks: Communications Engineering, Computer Engineering, and Electronics Engineering. Having graduated some 500 engineers over the past two decades, EUC has populated the technical and leadership ranks of the telecommunications sector of the U.A.E. As the Sharjah campus of KUSTAR, it currently enrols 350 students in its undergraduate and graduate programs.

KUSTAR was established by Royal Decree in 2007, and merged with EUC.

Vision and Mission

Vision: To be a leading international center of higher education and research in technology and science.

Mission: KUSTAR is an independent, non-profit, coeducational institution, dedicated to the advancement of learning through teaching and research and to the discovery and application of knowledge. It pursues international recognition as a world-class research university, with a strong tradition of inter-disciplinary teaching and research and of partnering with leading universities around the world.

The University endeavours to serve the Emirate of Abu Dhabi, U.A.E. society, the region and the world by providing an environment of creative enquiry within which critical thinking, human values, technical competence and practical and social skills, business acumen and a capability for lifetime learning are cultivated and sustained. It sets itself high standards in providing a caring, rewarding and enriching environment for all of its students and staff. It ensures that its graduates, on entering the workplace, form a superlative cadre of engineers, technologists and scientists, capable of making major contributions to the current and future sectors of U.A.E. industry and society as leaders and innovators.

The University insists on the highest world-class standards of academic excellence in all that it does. It complements other universities in the region by providing, in its chosen areas of activity, the best teaching and research available in the region. It strives to meet demands for expansion while never compromising on quality.

Governance

The senior governing bodies of KUSTAR are the Board of Trustees and the Board of Governors. The prime responsibility of the Board of Trustees is the formation of the higher policy of the University as well as any further duties in accordance with the decree setting up the University. The Board of Governors is the executive governing body, responsible for matters including the finance and property of the University. It is specifically required to determine the educational character, vision and mission of the University and to set its general strategic direction.

The Chairman of the Board of Trustees is His Highness General Sheikh Mohammed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the U.A.E. Armed Forces.

Academic Organization

KUSTAR is developing four colleges:

- Engineering.
- Management and Logistics.
- Health Sciences.
- Sciences.

In addition it has an Institute of Homeland Security, and plans to develop more such institutes.

The Sharjah Campus offers the following undergraduate and graduate degree programs:

- Bachelor in Communications Engineering.
- Bachelor in Computer Engineering.
- Bachelor Electronics Engineering.
- MSc by Research (Communication, Computer, or Electronics Engineering).
- MSc in Information Security (planned start in Fall 2009).
- PhD in Engineering (planned start in Fall 2009).

The Abu Dhabi Campus admitted its first class of students to the foundation year in Fall 2008. This class, plus additionally admitted direct entry students, will inaugurate the following engineering programs in the Fall of 2009:

- BSc Communications Engineering.
- BSc Computer Engineering.
- BSc Electronics Engineering.
- BSc Aerospace Engineering.
- BSc Mechanical Engineering.
- BSc Software Engineering.
- BSc Biomedical Engineering.

Additional programs will be introduced each successive year at the Abu Dhabi Campus: Civil Engineering and a Post Baccalaureate Premedical Program in 2010; Medical School and two additional engineering programs in 2011; and four new engineering and science programs each year from 2012 through 2015. The potential new programs to be developed include:

- Electrical Engineering.
- Avionics Engineering.
- Manufacturing Engineering.
- Materials Engineering.
- Industrial Engineering.
- Mechatronics Engineering.
- Energy Engineering.
- Environmental Engineering.
- Construction Engineering.
- Chemical Engineering.
- Bioengineering.
- Mathematics.
- Physics.

- Chemistry.
- Biology.
- Logistics Management.
- Supply Chain Management.
- Crises Management.
- Homeland Security.

Enrolment Projections

The Sharjah Campus, providing a center of excellence in telecommunications, is expected to grow from its current enrolment of 350 to approximately 450. It plans to move from male-only to coed, and to expand enrolments in its masters and doctoral programs substantially.

The Abu Dhabi campus will have some 300 students enrolled in seven programs in the Fall of 2009, and will grow to some 3400 students by 2020, distributed as shown in Table 1 below.

Table 1: Enrolment Projections by the Year 2020

College	Students by 2020
Engineering	1560
Medical	480
Management	480
Science	480
Post Graduate	400

Faculty

World-class faculty members are being recruited to provide challenging education to the KUSTAR students, and to conduct leading edge research. In keeping with standards at other world-class research-driven universities, KUSTAR faculty members will spend approximately half of their time on research. Teaching loads will be two to three courses per academic year. This pattern will require some 500 faculty members by 2020.

Collaborations with top world universities are being developed to assist in faculty recruitment, as well as in facilities development and research initiation.

Research and Development

KUSTAR is a research-driven university. This is emphasized by the explicit inclusion of the word "research" in the name of the University. This is also reflected in KUSTAR's vision and mission statements.

The research goal of KUSTAR is to conduct globally competitive research. The University pursues a research strategy that addresses the balance of basic and applied research, emphasizes the value of collaborative and interdisciplinary research, and takes into account the global and national trends and the needs of government, industry, business and the community.

KUSTAR is recruiting faculty and research staff with a proven international track-record of conducting and managing competitive research. Faculty and researchers are provided with an environment conducive to research. Policies and procedures are designed to be flexible and supportive, teaching loads are set to allow for research-active faculty to spend at least half-time on research, and support services such as fund management, contracts, exploitation of intellectual property rights, and knowledge transfer and enterprise, are provided.

Research activities within KUSTAR colleges are organized into centers/ groups. These tend to be interdisciplinary and are fully supported to become internationally recognized.

Both undergraduate and graduate students are involved in research and independent study and are equipped with the capability to extend their understanding beyond what is covered in their curriculum.

KUSTAR is currently working on establishing links and partnerships with world-class research universities, groups and laboratories to instigate relevant joint research projects and exchange arrangements.

In addition, a Research & Development Center with state-of-the-art facilities and resources is being developed with a range of key partners. The mission of this center is to promote the economic development and competitiveness of Abu Dhabi and the U.A.E. by fostering innovation, technology transfer, and entrepreneurship. The R&D Center will identify and focus on the development of science and technology clusters that are most relevant to Abu Dhabi and the U.A.E.

One of the focus areas that has already been identified is the Information and Communication Technologies (ICT) area. KUSTAR has successfully formed a partnership with British Telecom (BT) and the Emirates Telecommunication Corporation (ETISALAT) to establish the Etisalat-BT Innovation Center at KUSTAR. This will be the first industry-led center in the Middle-East concentrating on ICT next generation networks, systems and services.

Another area of focus that has been identified is Nanotechnology. KUSTAR has formed an advisory panel from eminent nanotechnology and nanoscience academics and experts. The panel is currently working on a proposal for forming a world-class Nanotechnology and Nanoscience center at KUSTAR.

High performance and parallel computing is also an important area of focus. KUSTAR has recently signed an MoU with Intel to collaborate on this area.

KUSTAR is also discussing the establishment of an Aerospace center with Mubadala and other leading companies in this area of focus.

Other discussions are ongoing to attract well established R&D technology institutions and companies. The R&D center will also incubate new innovative technology start-ups.

The establishment of the R&D Center and its strong links with the academic colleges will have many benefits to KUSTAR. The center will build on the strengths of KUSTAR's research and graduate studies to support the relevant clusters within the center. In return, the center will enhance, influence and inform KUSTAR's research and teaching by providing faculty and students with opportunities to interact with potential users of the outcomes of the research and potential employers of graduates. In addition, the center will enhance the chances of faculty to attract research funding by providing them with collaboration opportunities with government, industry and business. The center will also provide faculty and students with access to its facilities and its services for funds managements, project management, and knowledge and intellectual property rights management. The center will also present students and graduates with internship and employment opportunities.

All the research and development activities of KUSTAR will be supported with an outreach program to foster greater understanding by the general public of the benefits and applications of research.

Facilities

The Abu Dhabi operation of KUSTAR is currently comfortably housed in new temporary facilities on Abu Dhabi Island. These facilities will be adequate for two to three years, at which time the growth of enrolments and research activity will require a move to a new, purpose-built campus. Land has been designated for that campus, in the education sector of the new 2030 national capital development, near the Abu Dhabi airport.

The permanent campus is being designed to include the following state-of-the-art facilities, including:

- Academic classroom and laboratory buildings for the engineering, management and logistics, and science colleges.
- Purpose-built Medical School building.
- Research and Development laboratories building.
- Administration Building.
- Multi-purpose Buildings/Student Hub (Book Store, Coffee Shops/ Restaurants, Shops, Printing/copying services, Laundry, Library, Student Union. Post Office, ATMs, etc.), Mosque, Sports/Recreation Building and fields.
- Conference Center.

- Museum of Technology.
- Student and Staff Accommodation.
- Car Park.

In addition to development of a physical campus, KUSTAR is leading the formation of a major broadband computer network in the U.A.E. The Emirates Advanced Network for Research and Education (ANKABUT) is a dedicated advanced network connecting academic and research institutions at a speed of 10 GB/S at the core and 1GB/s at the access level. It will initially connect 28 sites at public colleges, universities and schools with one another and to Internet2 in the U.S. It facilitates research collaboration by providing access to databases and supercomputers, and teaching collaboration through rich multimedia content and high-definition video conferencing.

CONCLUSION

Countries throughout the GCC region, and beyond in the Arab world, are striving to develop diverse economies which allow them to compete effectively in today's global economy. Much of the effort is appropriately directed to education and associated activities which aim toward building "knowledge-based" economies.

The Emirate of Abu Dhabi has embarked on a particularly enlightened and aggressive program of economic development, aimed at transforming its current oil-based economy to one based on knowledge and innovation. It is making substantial investments in higher education, particularly in engineering and science, to develop the human capacity to accomplish this transition. KUSTAR will play a major role in Abu Dhabi's journey towards a diverse knowledge-based economy.

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