CHAPTER 2.3

Promoting Technology and Innovation: Recommendations to Improve Arab ICT Competitiveness

SOUMITRA DUTTA, INSEAD

ZEINAB KARAKE SHALHOUB, American University in Sharjah

GEOFFREY SAMUELS, INSEAD

The Middle East has begun to embrace the Internet. During the past six years, the region recorded the largest growth in Internet users among the major world areas as the number of Middle Eastern citizens accessing the Web soared by more than 600 percent, three times the world's average increase. The mobile telephone market has become a prodigy market, as liberalization across the region has led multiple vendors competing to lower costs and improve performance to attract record numbers of new customers.

However, more important than rising Internet access or ringing mobile telephones is official awareness at the highest levels of Middle Eastern governments that it is no longer possible to relegate information and communication technology (ICT) policies to an administrative sideshow. A country's ICT capabilities can profoundly affect its capacity to innovate and its global competitiveness, as well as improve the socioeconomic prospects of its less-advantaged citizens. Senior-level attention to ICT as a key enabler of innovation has been expressed in different ways in different countries, but a fundamental and salutary change is that these issues now rank as top agenda items. Whether this attention will usher in effective policies, however, remains a debatable issue.

The Middle Eastern technology challenge

The international community has confirmed ICT's potential to enable innovation and to advance a country's development agenda. Although innovation is often associated with large projects in cutting-edge sectors, such as biotech or nanotechnology, the cumulative effect of small improvements occurring throughout the entire spectrum of economic activity is likely to have an even more pronounced effect on the development process of a country as argued by Mokyr (1990) and Trajtenberg (2006). ICT, the leading general purpose technology of our time is probably the most important enabler of such improvements, which cumulate to innovation in products as well as processes.[1] At the same time, a particular characteristic of general purpose technologies is that they entail interdependencies—for example, the use of ICT can also trigger innovation by requiring products and processes to be adapted to the new technology. This in practice is often carried out by small- and medium-sized enterprises (SMEs). Countries that do not use ICT technology intensively forego many opportunities for fostering innovative activity.

Recording the world's highest growth rate of Internet access over the past six years is an encouraging sign that Middle Eastern countries are approaching the technology challenge with much more dedication. However, delay investing in ICT technologies, infrastructure, and human skills has meant the Middle East lags considerably in its development relative to the rest

Table 1: Summary of country indicators

Country	NRI rank 2005–06 (out of 115)	NRI rank 2003–04 (out of 102)	GCI Innovation Rank 2006–07	EIU e-readiness rank 2006 (out of 68)	Internet users per 100 population	Internet bandwidth (Mbps per 10,000 population)	PCs per 1,000 population	Broadband subscribers per 1,000 population	Secure Internet servers per 1 million population	Schools connected to the Internet (percent)
Bahrain	49	—	101	—	21.61	2.75	—	—	—	—
Egypt	63	65	82	55	4.37	0.11	22	0.4	0.4	66
Jordan	47	46	64	54	8.11	0.17	55	0.9	3.9	18
Kuwait	46	—	81	—	22.82	0.32	122	5.4	21.1	—
Oman	—	—	—	—	7.1	—	37	0	2.3	—
Qatar	39	—	41	—	19.93	2.5	190	—	—	—
Syria	—	—	—	—	4.5	—	19	0	—	—
United Arab Emirates	28	—	40	30	33.99	2.69	117	13.1	40.4	—

Source: World Economic Forum and INSEAD, 2005; World Economic Forum, 2006, Economist Intelligence Unit, 2006; World Bank, 2006.

of the world. Only sub-Saharan Africa posts lower average ICT access and performance standards.[2]

If Middle Eastern governments are to lift their countries' technology capabilities to developing and emerging world averages, they will need to make considerable financial and resource investments as well as introduce policy changes to encourage innovation that, in some areas, will rub against long-established business practices. New policies must be carefully considered because their impact and scale are considerable, the issues are complex, and they must coordinate with on-going development programs to ameliorate pressing socioeconomic, and even political, needs. Prioritizing initiatives is essential.

Equally important are designing and supporting processes to implement these initiatives. The cultural and administrative challenges for Middle Eastern economies where state bureaucracies play a prominent role should not be underestimated. This is especially true because technologies and innovative capabilities evolve at ever-faster rates. New ways to connect users to the Web, such as WiMax, can potentially extend access to more citizens at more affordable costs. If Middle Eastern governments are to make the right investment and regulatory decisions to encourage innovation, they should engage the private sector from consulting on priorities and technology potential to participating in various forms of public-private partnerships.

Public-public partnerships across the region also hold the promise to help governments share experience, expertise, and resources to craft innovative regional approaches that could advance each country's specific development agenda and priorities. There is considerable potential for regional partnerships by pooling cross-country infrastructure investments, negotiating with vendors, and sharing best practices. The region is home to countries considerably more advanced than their neighbors—such as Jordan, Tunisia, and the United Arab Emirates—in developing and applying technologies. These countries' shared expertise and experience can greatly assist all governments in assessing appropriate policies, investment priorities, and innovative development techniques.

This chapter will explore the link between ICT and innovation in the region and present an overview of current technology capabilities and issues for a subset of Middle Eastern countries (Western Asia) to indicate the wide variations in the Arab world for this key enabler of innovation.[3] The chapter will then link these variations to the results of a recent Arab world executive survey about innovation, present brief case studies of innovation-enabling initiatives in the United Arab Emirates and Jordan, and recommend policies to improve ICT performance by stimulating innovative approaches across the Arab world.

Innovation and divides

A visitor to the Middle East's Western Asian region will quickly see vast differences between and within each state. All these countries confront divides—in demographic, economic, social, educational, and natural resource arenas, for example. The digital divide is the most recent, but it mirrors long-standing regional and historical issues because technology touches and reflects so many facets of a country's economy and society. Table 1 provides a snapshot comparison of each nation's major ICT statistics.

These statistics and rankings have been assembled, compiled, or analyzed by, among others, the International Telecommunication Union (ITU), the World Bank, the United Nations, the Economist Intelligence Unit, and the World Economic Forum. For reasons beyond the scope of this paper, acquiring basic technology and innovation data in developing countries, let alone accurate market statistics, can be problematical. The Middle East is no exception, and various statistical techniques were applied to produce these figures.[4]

The reason this caveat is not a footnote is because monitoring and evaluating technology development initiatives are essential to discovering what works and what does not. Domestic and cross-country performance

Table 2: Ranking of Middle Eastern countries according to maturity level in information society, 2005

Country	Policies	Legal framework	ICT infrastructure	Capacity building	ICT sector building	Government	Education	Commerce and business	Health	Arabic content	Average
United Arab Emirates	3	3	4	3	3	3	3	4	3	3	3.2
Bahrain	4	3	4	3	1	3	3	4	3	2	3.0
Jordan	4	3	2	3	3	3	3	3	2	3	2.9
Kuwait	3	2	3	2	1	2	3	3	3	2	2.4
Saudi Arabia	3	2	3	2	2	2	2	3	2	3	2.4
Qatar	2	2	3	3	1	3	2	3	2	2	2.3
Egypt	3	2	2	3	2	2	2	2	2	3	2.3
Lebanon	2	2	2	2	2	3	2	3	2	2	2.2
Oman	2	2	2	2	1	2	2	3	2	1	1.9
Syria	2	1	2	2	1	2	2	1	2	2	1.7
Palestine	1	1	2	2	1	1	1	1	1	2	1.3
Iraq	1	1	1	2	1	1	1	1	1	1	1.1
Yemen	1	1	1	2	1	1	1	1	1	1	1.1
Average	**2.38**	**1.92**	**2.38**	**2.38**	**1.54**	**2.15**	**2.08**	**2.46**	**2.00**	**2.08**	**2.14**

Source: UN-ESCWA, 2005.

comparisons require surveys to be conducted in a consistent manner. Government officials and corporate officers are at a serious disadvantage if they cannot refer to reliable, timely data to assess and modify policies. Unfortunately, this is largely not the case today in the Middle East.

Notwithstanding the above caveats, the general outlines of the region's relative technology development can be discerned. The Gulf Cooperation Council (GCC) countries exhibit the highest level of ICT development. A Madar Research study finds these states have more than 40 percent of all Internet users in the Arab world, but only 11 percent of the total Arab population.[5]

The United Nations Economic and Social Commission for Western Asia (UN-ESCWA) for the past several years has conducted major investigations into the region's ICT evolution. On a scale of 1 to 4 (with 4 being the highest), the Commission ranked each country's performance (see Table 2).

The GCC subregion scored an average of 2.53 points, compared with the non-GCC Western Asian average of 1.8 points. However, the entire region's shortfall in comparison with the developed world can be appreciated by observing that developed countries would earn top (4) or nearly top scores in every category.

The UN Commission raised a number of important issues the policy recommendations will address, most notably:

- There are deficiencies in monitoring and evaluating e-strategies, as well as in financing initiatives.

- ICT sector development scores the lowest performance because Western Asian countries have a poor record producing and exporting ICT products and services; there is weak official support for developing the ICT sector; and, until recently, foreign companies have been reluctant to consider investing.

- Improving ICT legislation, regulations, and enforcement are high priorities because most of the region lacks laws and regulations protecting consumers' confidential information and privacy, national copyright and intellectual property laws are poorly enforced, and inadequate regulatory structures govern the Internet and telecommunications.

Technology infrastructure

Technology infrastructure in the Middle East is relatively more advanced because, candidly, it is a less politically contentious issue. Laying cables, stringing wires, and buying boxes are largely a question of finance. By contrast, changing legal, regulatory, and institutional structures requires transforming well-established socio-cultural practices.

The region has recently been upgrading connectivity to the global Internet. For example, Internet bandwidth in Egypt increased considerably in one year, from 850 Mbps in 2003 to 2,060 Mbps the following year; Syria raised Internet capacity to 2.1 Gbps by year end 2005.[6] The United Arab Emirates has the region's highest bandwidth capacity at 10 Gbps, according to an Etisalat source.

However, Middle Eastern intraregional connectivity is not as well developed, partly reflecting long-standing historical regional relations. Most Middle Eastern Internet traffic is exchanged outside the region through network access points (NAPs) in the United States and other countries, resulting in higher costs and suboptimal performance. The ITU's Arab Regional Office is seeking to introduce new regional electronic connections by launching a regional US$200 million initiative—NAP for the Arab states—to engineer closer Arab Internet networks.[7]

However, if the region is to approach ICT infrastructure levels of the developed world, a much higher rate of investment is necessary. The UN Commission

estimates average regional ICT spending, as a percentage of GDP, at 2.87 percent—considerably below the global average of more than 6 percent.[8] Reflecting the GCC regional divide, estimated Egyptian ICT 2004 spending was 2.37 percent of GDP; UAE ICT spending was valued at 3 percent; while Bahrain invested twice as much, 6 percent of GDP, to record the region's highest ICT spending.[9]

As another sign of limited ICT integration in the economy, Middle Eastern average spending on ICT research, development, and innovation (RDI) is very low as a percentage of GDP even compared with that of developing countries. The Arab region invests 0.2 percent of GDP in RDI; global developing country estimates are 1.6 percent. Developed countries average 2.5 percent of GDP. Jordan is a notable exception, however, allocating a high RDI budget as a major component of its strategy to position the country as a knowledge-based economy.[10]

Legal and regulatory issues

The Middle East features an underdeveloped legal and regulatory environment that hinders efficient technology development and innovation. Laws and regulations regarding intellectual property rights (IPRs) and the ICT sector have, for the most part, been created to meet international demands such as WTO requirements, rather than responding to local business or public demand. The critical role of coherent and enforceable laws to encourage ICT investment and development is not widely appreciated in the Middle East. For example, because information privacy and security is not currently required by international entities, no country in the region has ventured independently to impose its own legal protections.[11]

Most countries have joined several international treaties and enacted some laws pertaining to IPRs. However, respondents to the World Economic Forum's Executive Opinion Survey, which forms the basis of the *Global Competitiveness Report*, indicate that the level of IP protection and enforcement varies across countries—yet even the technologically most advanced countries in the region do not reach the levels found in innovation-driven economies such as Japan or the United States (see Table 3). Several international organizations, such as the International Intellectual Property Alliance and the Business Software Alliance (BSA), consider enforcement to be inadequate and have placed several countries on watch lists. Software piracy is the most visible indication of lax regard to IPR. With the exception of the United Arab Emirates, whose strenuous efforts to control piracy earned it a position among the world's 20 countries exhibiting the lowest piracy rates, other Middle Eastern countries tolerate high piracy levels.

Lax IPR enforcement has direct and, perhaps, unanticipated consequences. According to a 2005 study undertaken by the International Data Corporation and

Table 3: IP protection in the Arab world in international comparison

Country	Score	Rank on pillar (out of 128 economies)
Algeria	3.28	73
Bahrain	4.08	48
Egypt	3.55	63
Israel	5.48	21
Japan	5.88	12
Jordan	4.21	44
Kuwait	3.62	59
Libya	2.80	94
Mauritania	3.25	78
Morocco	3.82	54
Oman	5.30	23
Qatar	4.84	28
Syria	2.89	90
Tunisia	4.62	32
United Arab Emirates	4.80	29
United Kingdom	6.20	6
United States	5.65	17

Source: World Economic Forum, Executive Opinion Survey.

BSA between 2000 and 2004 Egyptian demand for software increased by 48 percent.[12] Egypt today hosts the largest regional software sector as a fraction of its IT sector. However, the study estimates the country could nearly double the size of its IT sector by 2009 if it were to reduce its 65 percent piracy rate by 10 percent.

The UN Commission notes that, although most Western Asian countries have proposed or are in the process of formulating IPR and ICT legislation, progress is slow. With the exception of Saudi Arabia, which has made strenuous efforts recently regarding IPRs and copyrights, no country has seen major changes in this area since 2003.[13]

The Commission further observes that no country in the region is in the process of developing regulations and laws regarding consumer privacy and security over the Internet. With the exception of e-banking services, which are largely on e-government sites, no warranties or laws guarantee consumer information privacy. There are no official consumer protection associations and no specific consumer protection laws. However, e-commerce laws have been enacted in Bahrain, Jordan, and the United Arab Emirates. Bahrain, Egypt, and Jordan have also approved electronic signature laws.

Most recently, the UAE Electronic Transaction and Commerce Law combined the United Nations guidelines with local qualifications. The United Arab Emirates also passed a Cyber Crime Law to fight misuse of cyberspace and new technologies. Although these new measures construct a sound platform on which to build a regulatory framework, they do not address some important aspects of electronic transactions, such as privacy, jurisdiction, data protection, and domain names.

Table 4: Personal computer penetration rate in selected countries and regions, 2004

	PCs per 100 people (percent)
GCC countries	11.7
Non-GCC Western Asia members	3.5
Total Western Asia region	4.3
World average	12.0

Source: Madar Research Group and Gartner (2005), cited in UN-ESCWA, 2005 p. 73.

Personal computer penetration and digital content

With the exception of the Gulf countries, Middle Eastern personal computer (PC) penetration rates are significantly below the world average (see Table 4). Since 2003, there have been some national campaigns in such countries as Egypt, Jordan, Saudi Arabia, and Syria to encourage citizens to buy computers under a variety of financing schemes and promotions. However, for many citizens, cost remains an issue; more importantly, there is a general shortage of Internet services considered essential by the average user.

A scarcity of Arabic digital content on the Web further diminishes the average user's perceived need to acquire a computer. While the world's Arabic speakers number 300 million, Arabic Web pages represented only 0.2 percent of total Web pages in 2006, or an estimated 100 million pages compared with approximately 40 billion pages in all other languages. By contrast, Korean Web pages account for 4.4 percent of the Web's content, although Korea has a population of 45 million.[14]

The low (10 percent) penetration rates across the entire Middle East limit the commercial incentive to create Arabic pages, as does the expectation of most Arab Internet users that information and Arabic content should be free. Unfortunately, penetration rates are not high enough to justify advertising-supported websites, so a cycle of neglect is perpetuated. Regional governments, to varying degrees, recognize the need to invest in Arabic content, but in most cases such investments take the form of e-government online publications and government information.

A previous barrier to finding Arabic content— the lack of a full search engine optimized for Arabic— will likely be removed in early 2007, when a joint Saudi-German project plans to launch the Sawafi search engine. Its anticipated high-powered local Arabic pages searching capabilities will undoubtedly assist the Arabic-speaking Internet users who do not speak English (this was 65 percent in 2005, according to Madar Research).[15] But the search engine will of course not create compelling content, so new policy initiatives should be considered to help the private sector produce content to stimulate consumer demand.

E-commerce

E-commerce activity is generally low in the region. In 2004, business-to-business (B2B) e-commerce was estimated at US$9 billion, or 1.45 percent of total regional GDP valued at US$620 billion, in substantial contrast to a global average estimated at 5 percent of GDP.[16] Indeed, across the Middle East only 28 percent of firms use the Internet for conducting business, almost a third less than the average 38 percent for the remaining developing world.[17] The principal drivers for B2B e-commerce are multinationals that require distributors and agents to use online channels. The second major factors encouraging e-commerce are local and federal governments moving increasing amounts of tender offer and payment activities online.

Domestic transactions are expanding at a much slower pace. E-commerce offers the potential to lower costs, increase business opportunities, and stimulate cooperation among business partners and suppliers. However, many Middle Eastern firms—most notably small, domestically owned or nonexporting firms—do not appreciate the value ICT strategies or applications could bring to their business. SME owners see few incentives to change business models and operating procedures when the costs of adopting ICT are significant and known while returns are uncertain. There is also a general lack of alliances between governments and business sectors that would promote B2B e-commerce.

According to the UN Commission, this slow take-up is exacerbated by several other issues:

- the small number of regional institutions using the Internet in their operations;

- a limited set of companies willing and capable of migrating to online purchase and sale transactions;

- the paucity of integrated technologies linking electronic purchase applications and back-end systems, particularly enterprise resource planning applications; and

- an absence of a legal framework to protect e-commerce (with the exceptions of Bahrain, Jordan, and the United Arab Emirates).

A prominent regional exception is the e-commerce marketplace Tejari.com, launched by Dubai World and now franchised in Jordan, Kuwait, Lebanon, Oman, Pakistan, and Saudi Arabia. However, although the trading platform recorded over US$3 billion in transactions by the close of 2006 since its founding six years earlier,[18] this represents a small percentage of intraregional trade.

Limited Internet access, as well as cultural reasons— that is, when people value holding products before purchasing—have restricted B2C e-commerce. However, as credit card penetration rates increase, online purchasing of products and services not available locally will

become more significant. Indeed, Visa International reported a sizable increase in online purchases in 2005, primarily in the Gulf and Saudi Arabia.

E-government

Middle Eastern governments are making progress offering citizens e-government services, although, as may be expected, substantial disparities reflect regional inequalities in income and ICT availability. In 2005, Egypt and the United Arab Emirates recorded some of the best world improvements in the UN e-government readiness rankings (see Table 5). The United Arab Emirates merged information and services into a single gateway, while Egypt further improved its e-government central portal. Qatar has made significant investments to enhance e-government capabilities, which likely will accelerate and expand because the government entered into a partnership in late 2006 with the Singapore InfoComm Development Authority to improve ICT in both the public and private sectors.

A number of countries have innovative e-government initiatives that could serve as regional best practices to guide the improvement of e-government services. The following examples are merely illustrative:

- Bahrain's smart card technology, as part of a broader e-government strategy, enables such activities as conducting official procedures, accessing money, and recording personal educational and health data.

- The Emirates Identity Authority was created as a federal government organization to develop and manage a modern and integrated population registry and identity management system for UAE citizens and residents. The new system will encompass several key technologies, such as smart cards, biometrics, and public key infrastructure.

- Bahrain, Egypt, and the United Arab Emirates are leading regional countries offering public information through portals and official sites.

Innovation

For innovation to spring from the spread and use of ICT technologies, a number of conditions need to be in place in the economy. In the autumn of 2006, Moutamarat, INSEAD, and PricewaterhouseCoopers surveyed executives across the Arab world about their views on innovation. These views provide insight into factors that facilitate and impede innovation; the survey points to areas that need to be addressed to make the economy benefit more from spillover effects ICT generates.

Executives were asked a number of questions about their companies' successes and challenges in innovating. The overall finding was that if businesses are to innovate to become stronger regional and global competitors,

Table 5: UN e-Government Readiness Western Asia rankings

Country	2005 Rank	2004 Rank
United Arab Emirates	42	60
Bahrain	53	46
Qatar	62	80
Jordan	68	68
Kuwait	75	100
Saudi Arabia	80	90
Egypt	99	136
Oman	112	127
Syria	132	137

Source: UN, 2005.

Middle Eastern governments must make a stronger commitment to promote innovation.

Executives stated that the most important challenge for successful innovation in the region is the lack of adequate resources (see Figure 1)—both qualified personnel (30 percent of respondents) and financial resources (17 percent). Interestingly very few executives state that internal organizational rigidities hindered innovation in their companies. Firms in the region would innovate more with improvements in market conditions—such as the provision of greater information about market practices and opportunities (11 percent), less restrictive regulatory policies (13 percent), and a lower overall level of economic risk (12 percent).

Executives were also asked to rank the countries with the highest potential for becoming the innovation hub for the region (see Figure 2). The United Arab Emirates comes up dominant in the top spot with the support of 42 percent of the respondents. The United Arab Emirates has earned this distinction because of a number of investments it has made in developing its technological and innovation capabilities. The following section provides more details on the innovation strategy of the United Arab Emirates. Other countries in the region should examine their own innovation strategies and market conditions if they wish to emulate the United Arab Emirates and take advantage of the opportunities available in transitioning to a more innovation-driven economy.

In terms of sectors, the ICT and the energy, mining, and utilities sectors are ranked as the most innovative in the Arab world by about a quarter of the respondents for each (see Figure 3). There is a lot of potential for innovation in other sectors, such as health care, retail and consumer goods, and financial services.

Case studies of innovative initiatives

The instrumental role of Middle Eastern governments in stimulating technology development and innovation is documented in the following two case studies:
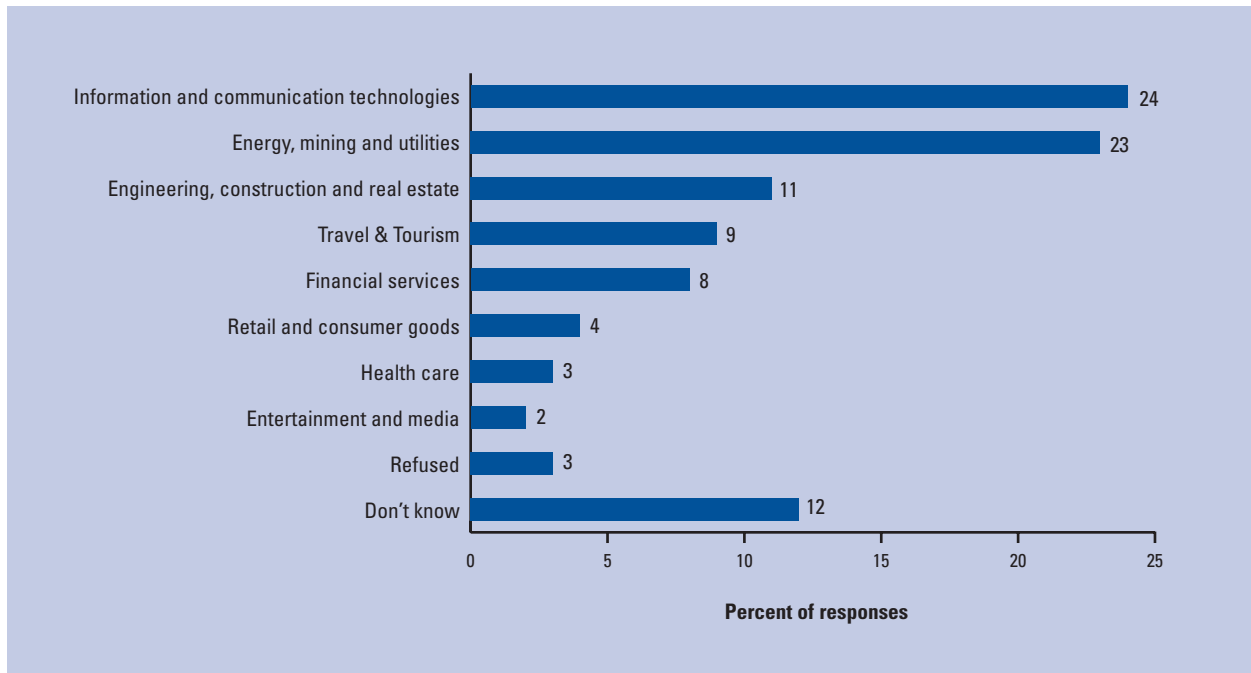
Since 2000, UAE policymakers have promoted building the Emirates into information-rich societies.

Figure 1: What are the greatest challenges to your company's ability to innovate?
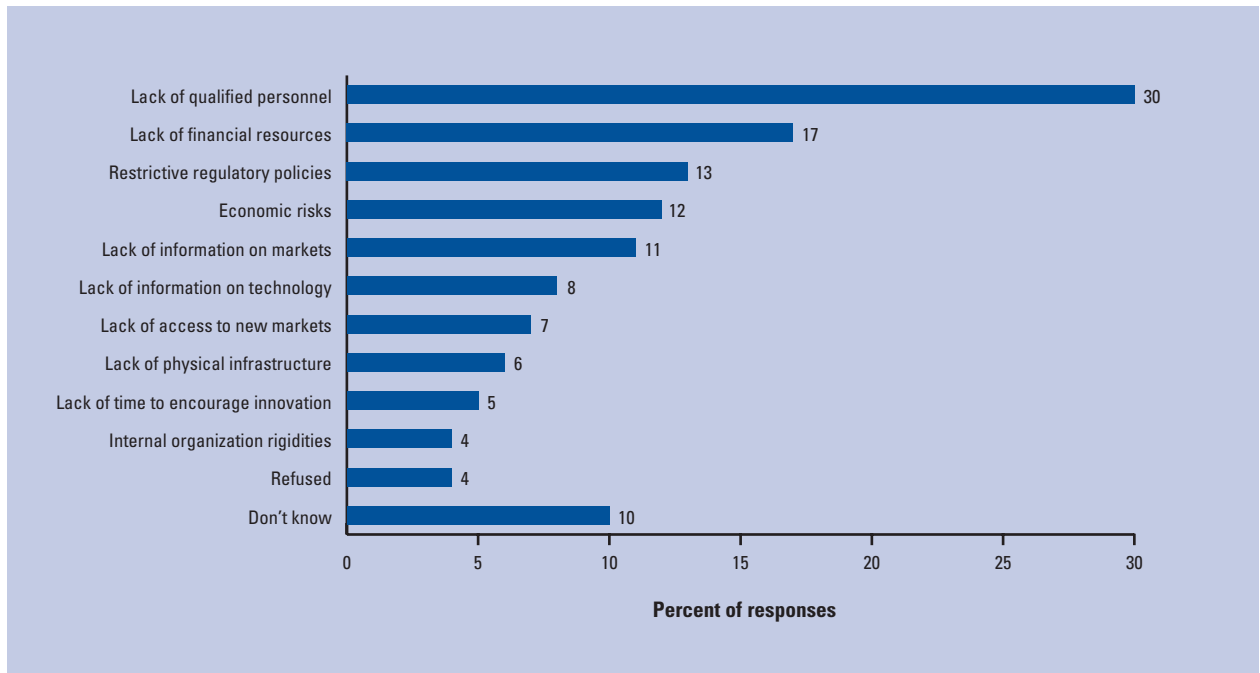
Source: Moutamarat, INSEAD, and PricewaterhouseCoopers survey.

Figure 2: Which Arab country has the greatest potential for becoming the innovation hub for the region?
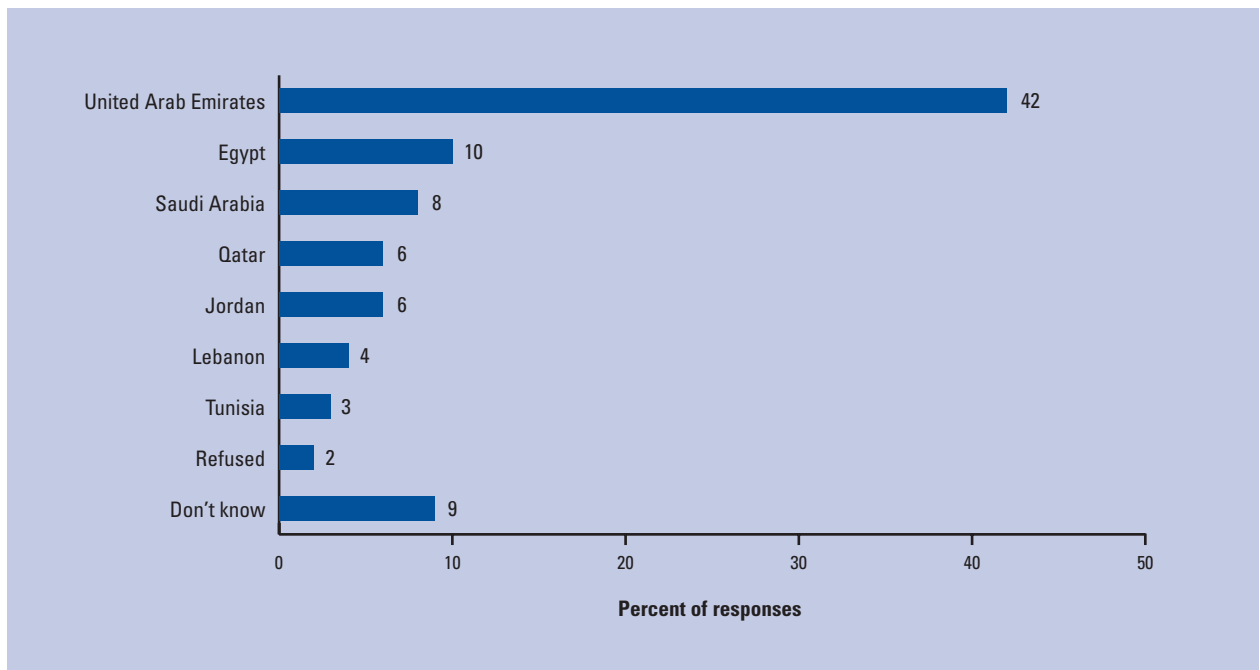
Source: Moutamarat, INSEAD, and PricewaterhouseCoopers survey.

Figure 3: Which industry sector has the highest level of innovation in the Arab world?

Industry sector	Percent of responses
Information and communication technologies	24
Energy, mining and utilities	23
Engineering, construction and real estate	11
Travel & Tourism	9
Financial services	8
Retail and consumer goods	4
Health care	3
Entertainment and media	2
Refused	3
Don't know	12

Source: Moutamarat, INSEAD, and PricewaterhouseCoopers survey.

The UAE case study discussed below describes some of the innovation- and ICT-based initiatives they have pursued to realize their intentions.

In the second case study, Jordan, lacking natural resources, has elected to reinvent its educational system through innovative education initiatives. Investing in education was deemed the most appropriate mechanism to improve employment opportunities for the country's large, youthful population; at the same time, lack of human capital has been identified as the key obstacle to innovating in the region. Jordan, seeking to become an information-work economy, has created a number of cutting-edge ICT-based educational programs through public-private-partnerships that are now exported to other countries.

Case study 1: Innovative policies:
The United Arab Emirates success story

The United Arab Emirates has combined innovative government policies and the forces of petro-dollars to redefine its economic landscape. The country's per capita income is on par with those of leading Western European nations (US$28,581 in 2005). Certain observable parameters indicate that the country has a great potential for becoming a top-notch knowledge-based economy stimulated and energized by a host of innovative initiatives and programs; public- and private-sector entities in the United Arab Emirates have started their journey of focusing on innovation as a driver for further

development and growth. Supportive market mechanisms and policies are fueling the innovation wheel. Currently the country enjoys high levels of broadband Internet penetration, particularly in Dubai (64 percent) and a high mobile telephony penetration rate (close to 100 percent). The country is significant today as a business, technology, education and health-care hub in the region.[19]

The recent Moutamarat-INSEAD-PricewaterhouseCoopers survey on innovation places the United Arab Emirates as the forerunner in the region, rating it as the country most likely to become the region's innovation hub. The survey respondents rated it four times more likely than its closest rival, Egypt, to become the dominating innovation influence in the Arab world. One might argue here that the United Arab Emirates has reached a high-tech frontier and that innovation, one of the pillars of competitiveness, is, if not the only driver, certainly among the self-sustaining drivers of growth and development.

Responding to the rapidly growing importance of the United Arab Emirates and riding the wave of innovation in this market, many global corporations are establishing "innovation centers" in that country. One such facility was established by Bayer MaterialScience AG in November, 2006—this is the first development center for high-quality polymer materials in the region to have access to a wide range of options for technical service, the development of new applications, and training for customers and employees. The United Arab Emirates,

like many other Arab countries, is concentrating on developing its innovative capacity and providing possible solutions—such as raising awareness of the need to develop an innovative capacity—to many of the hurdles associated with these bold initiatives. The area is witnessing a surge of public- and private-sector cooperation and partnerships to deal with these issues.

Unlike any other country in the Gulf, the United Arab Emirates has worked very hard on its technology initiatives. This is manifested in a maturing IT market, which has been estimated to be worth US$1.46 billion as of the end of 2005 and is expected to top the US$2.2 billion mark in 2008.[20] Dubai has been in the lime light for the past six years, but, unsurprisingly, Abu Dhabi, the nation's capital, is currently emerging as the biggest technology spender in the country, with total IT spending in 2005 valued at US$769 million (46.89 percent of the market).[21] With regard to the latest advancements related to technology applications in the country, new developments have evolved rapidly, from imaging and archiving solutions to enterprise portal and content management systems. The United Arab Emirates is becoming more advanced very quickly as it is driven by the desires of both private businesses and the government toward a digital- or knowledge-based economy.

The first of the technology-intensive innovation initiatives in the United Arab Emirates was Dubai Media City (DMC), launched in November 2000. Next to DMC are Dubai Internet City (DIC) and Knowledge Village. The major goal of the multibillion dollar DMC, DIC, and Knowledge Village complex is to create a cluster of innovation comprising educators, incubators, logistic companies, multimedia businesses, telecommunications companies, remote service providers, software developers, and venture capitalists in one place.

DIC is the region's first technology-innovation zone and is viewed by decision makers in this country as an economic driver not only of Dubai's economy, but also of the United Arab Emirates as a whole. Today hundreds of high-tech firms are housed in DIC. DMC houses more than 550 media companies, including global giants, along with regional companies and new startups. Companies in this high-tech corridor employ more than 7,000 knowledge workers from all around the world.

Another mover and shaker in the high-tech corridor is Knowledge Village; this project is designed to create a wired community to help build the region's talent pool and advance its move to the knowledge economy. Knowledge Village is located in the Dubai Technology and Media Free Zone with DIC and DMC. By being in the high-tech corridor, Knowledge Village offers its partners the prospect of forging partnerships with the business community and creating a vibrant learning and innovation environment. Currently, Knowledge Village has more than 70 educational and research institutions as partners.

Also worth mentioning is Dubai Silicon Oasis (DSO), which is intended to be one of the world's leading high-technology parks for the semiconductor and microelectronics industry. DSO is an innovation-driven technology community, housing microelectronics- and optoelectronics-related enterprises, a state-of-the-art microelectronics innovation center (MIC), fabrication plants, research and development centers, and specialized academic institutions and residential areas.

The government of the United Arab Emirates has been a key driver in the innovations within the country. The Dubai e-government initiative is an integral component of Dubai Vision 2010, which aims to establish Dubai as a knowledge-based economy by leveraging tourism, IT, media, trade, and services as pivotal industries in an effort to move away from dependence on oil-related products. The Dubai e-government initiative aims to improve and innovate in government services by using technology as a key enabler for a customer-centric approach to providing government services. To achieve these goals, the Dubai e-government has developed and implemented a number of projects that were successfully completed in the past four years (2002–06). Examples of these projects are *ePay*, *askDubai*, *mDubai*, *eIntegrate*, *eHost and eHost*, *eJob*, *eSurvey*, and *eCitizens*.

Many Dubai government departments have reached the fifth stage of e-government evolution—seamless integration. A case in point is the eService, which was recently launched between Tejari and the Department of Economic Development (in January 2006); all 50,000 organizations licensed by the department now have automatic access to Tejari LINK—the service that enables online market-making for businesses of all sizes and is facilitated through a quick and affordable one-time registration on the Tejari trading community. This initiative specifically supports SMEs, which are growing at a fast pace. Through Tejari LINK these organizations automatically receive a designated website to ensure a significant Web presence for each company. In addition, they are added to a national online directory, join a message center to facilitate trading leads, and receive space for electronic product showrooms and e-exhibition functionality. Another feather in the cap of Tejari is the creation of specialized subcommunity portals that cater to specific community clusters or industry segments. One such portal is the one created for the more than 5,000 companies located in the Jebel Ali Free Zone Authority (JAFZA), which enables the free zone companies to send and receive trade leads, create online company profiles and product showrooms, and find suitable trading partners through Tejari Exchange.[22]

Case study 2: Innovative classrooms:
The Jordan Education Initiative

Jordan is a small desert country that lacks the oil and natural gas resources found in the Persian Gulf; yet, like its foreign policy, Jordan's education philosophy has been

developed with an eye to the country's unique position in the region. English is taught in all Jordanian public schools, and the country has marketed itself as a safe and open place for foreign college students. Jordan invests a higher percentage of its gross domestic product in education than any other country in the Arab world.[24]

With a high level of unemployment (estimated between 15 and 20 percent), a young population (34 percent are under 14 years of age, and there is a median age of 23 years), and a low per capita income (US$4,700 in 2005), the political leadership in Jordan is convinced that the real wealth is in young people. It has therefore championed innovation in the educational system in the country through the use of technology. Through the Jordan Education Initiative (JEI), the country's main objectives are to enable its students to compete globally in the knowledge economy, train teachers and administrators to use technology in the classroom, and guide students through critical thinking and analysis. Today, the JEI is being replicated in Rajasthan, India (launched in November 2005), the Palestinian territories, Bahrain, and most recently Egypt (launched in May 2006), as well as in other countries.

The JEI runs parallel to and shares dependencies with two existing national programs in Jordan: (1) the Education Reform for the Knowledge Economy (ERfKE) program, a reform program supported by World Bank; and (2) the National Broadband Learning and Research Network, a nationwide high-speed broadband network connecting all of Jordan's public schools, universities, community colleges, and community access centers, which reached 1.5 million learners by the end of 2006.

The JEI initiative was officially launched in June 2003 by the World Economic Forum's IT and telecommunications industry governors to transform public education through technology in Jordan. In addition to the Forum, which sponsored the JEI, the initiative has over 45 organizations that include 25 international private-sector partners, especially in the ICT sector; 17 local establishments; and 11 government agencies and NGOs. It has four major objectives:

- Improve the delivery of education in Jordan through public-private partnerships.

- Unleash the innovation of teachers and students through the effective and efficient use of ICT.

- Build the capacity of the local ICT industry.

- Create a model of reform that can be used in other developing and emerging countries.

Two distinctive features set this initiative apart from others. First, it is an ambitious blueprint that uses technology as a catalyst to innovate in the educational system and accelerate Jordan's development into a knowledge economy. Second, it is an application of ICT through a public-private partnership. These partnership arrangements have been win-win situations for the JEI and the country in general. Public schools have benefited tremendously from what the private sector has contributed in terms of skills, innovation, project management, technical expertise, and so on. With the assistance of substantial investments from companies—(financial, in kind, and expert-based) such as Cisco, Computer Associates, Dell, DHL, IBM, France Telecom, Microsoft, Intel, and many others—tremendous improvements were provided to e-Contents, especially in mathematics, science, and English as a foreign language (EFL). As of November 2006, 35 partners had been engaged in deploying the technical infrastructure to 100 Discovery Schools; helping in designing, developing, and/or rolling out five e-Content curricula (in math, Arabic, English, ICT, and science). In February 2006, Math e-Content, which had been piloted in the previous year, was rolled out online to all Discovery Schools. Currently, the initiative is piloting an ICT e-curriculum that will apply technology to subjects such as music, language, and science, rather than teaching technology for its own sake. In terms of the initiative impact, and as of November 2006, 85,000 students, teachers, and principals benefited from the initiative in one form or another.

Rewards to private-sector entities are in the form of strengthening their reputation and polishing their image within society, yielding a long-term return on social capital and social investment. For the private sector in particular, an effective educational system is critical for economic growth and social development, in building a skilled labor force, and improving productivity. But the ultimate winner in this educational public-private partnership initiative is the group of students and teachers, especially in public schools, who are having their schools fully wired and equipped and their human resources fully trained and skilled.

Another major objective of the JEI initiative is to help the country build a model of education reform and innovation that can be exported to and/or replicated in other developing countries. Currently, the JEI is viewed as a success story and has helped spur off other education initiatives around the world, such as the Rajasthan Education Initiative (begun in November 2005) and the Egyptian Education Initiative (May 2006), among others. Based on the success of the JEI initiative, among other factors, the World Economic Forum is launching a new project—Partnership for Education— with UNESCO, under the auspices of the Forum's Global Education Initiative (GEI).

Notwithstanding the discernible accomplishments of this initiative, unfortunately the JEI still lacks a set of formal performance evaluation criteria for impact assessment in terms of ensuring access, improving quality, and providing the right teaching. Another challenge that has to be addressed is capacity building and cultural change

management, both at the micro and macro levels. The role of the private sector does not stop at offering financial and technical support; it really has a role to play in defining the standards of education and in offering internship and training programs.

Policy recommendations to promote innovation

As Middle Eastern policymakers consider how to position and prepare their countries for the future, it is especially important that they consider the process to assess and implement innovations. Technology is evolving at ever more rapid rates and decisions cannot be deferred in the hope that a new more powerful or cheaper technology will make decisions easier. The history of post-war development is a progression of ever more versatile technologies arriving in ever faster waves. If the developed world had waited for the next set of technology inventions to improve investment cost-benefit ratios, the developed economies would not stand where they do today.

Estimating cost-benefit ratios of technology and innovations is not a science. The potential for improving economic, social, and educational prospects hinge upon myriad governmental and business decisions, as well as on cultural issues. US companies, as a group, have gained more from technology investments in terms of productivity and innovation than European companies. However, this is an average generalization. Numerous European and Asian companies are world leaders, applying technology to boost innovation levels and, ultimately, performance. They have applied technologies to their unique requirements, and at the same time adapted and changed their business practices in a restless process of assessment and innovative renewal.

There is extensive sharing of information, regional initiatives, and collaborative alliances in the developed world. Fast-changing technology introduces novel applications for new and established markets. It is beyond a single major company or government's capabilities to hazard substantial investments alone, and no sector sees more joint ventures or alliances than ICT. Monopolistic practices are frequently incompatible with keeping pace with, let alone anticipating, chameleon technology evolutions.

This pace of change introduces two major challenges for Middle Eastern policymakers: managing the changes innovative technology development requires, and entering into regional and public-private partnerships to defray risks and maximize technology's potential for supporting innovation and improving the economic prospects of all citizens.

It is hoped the following recommendations to stimulate innovation will help policy leaders review strategies and practices most suitable for their country, recognizing that each Middle Eastern country has different economic priorities, cultures, and social dynamics. These differences should not obscure the potential to exchange useful information, best practices, and explore launching public-private and regional initiatives.

Encourage innovation in small- and medium-sized enterprises

SMEs comprise the greatest number of service companies and they employ the largest total numbers of employees in the region. Because of their aggregate prominence, technology take-up among SMEs could bring substantial economic benefits to Middle Eastern countries, provided SMEs can adapt and innovate in their business practices to capture productivity improvements. Unfortunately, SMEs face formidable hurdles in adopting technology and innovating in business practices. Many SME owners and managers assess technology in terms of immediate cost rather than as an investment for innovation, to gain more customers, reduce long-term costs, and improve performance. These attitudes will be difficult to change, but they must evolve if the Middle East is to enjoy the potential economic and social gains stimulated by technological progress.

However, in defense of conservative Middle Eastern SME owners and managers, it should be noted they are far from alone in hesitating to use technology beyond basic administrative and accounting functions. Many European SMEs have also been slow to integrate technology into their businesses.[24] If substantial numbers of Middle Eastern SMEs are to adopt technology more aggressively, governments must make patient and persistent efforts to change long-settled business methods. In particular, governments should consider the initiatives listed below.

Education

There simply are not enough ICT professionals available whom SME managers can hire full-time to supervise a company's technology program. Educational investments are required to provide training and attract students to new ICT career choices. Higher funding to support teachers' professional development is also needed. For those students who do not choose an ICT career, schools should improve general technology literacy by offering basic business-related technology training and skills as part of the standard curriculum.

SME software and providers

Many SME applications are not optimized, in terms of language or functions, for Middle Eastern SMEs. The paucity of digital Arabic content and software presents an ideal opening for Middle Eastern countries to sponsor national plans to promote an Arabic software industry.

The timing is particularly auspicious with the planned inauguration in 2007 of the Saudi-German full-featured Arabic search engine, Sawafi. Software, ranging from tools and packaged software to tailored applications and multimedia tools, is a high-growth industry that can be launched and supported with relatively low capital

and financing expenditures.[25] Moreover, measures to support and encourage Arabic software development will rebound to the greater benefit of Middle Eastern technology evolution because the software industry will require IPR and patent protection, as well as supporting e-commerce legislation. Furthermore, as more computers are installed in increasing numbers of schools and universities, there will be greater demand for more Arabic content and software to advance e-education initiatives, both at schools and at home. National software and content development programs can also open another venue for regional cooperation. Last, and most importantly, a robust local software industry can help reverse the "Arab brain drain" by offering attractive careers in the Middle East.

ICT-related financial incentives

Research and development (R&D) in technology-related services and innovative business practices should enjoy R&D tax credits, especially as services command such a large amount of Middle Eastern economic activity. While these R&D tax credits would also benefit large companies, they would encourage SMEs to experiment with introducing new business practices using technology and innovative processes. Tax credits could also be introduced for businesses to purchase computers and software.

Public awareness

The government should invest in publicity campaigns and organize technology resource centers in business districts to inform and educate SME owners about the innovative potential of new technologies. Financial incentives to encourage SME owners to assess technology options could be offered, for example, by issuing consultancy vouchers.

Introduce innovative financing approaches

Over the past decade, Middle Eastern countries have financed technology infrastructure (with the exception of mobile communications) principally from two sources: government budgetary allocations, primarily through revenues generated by the telecommunications monopolies, and donor and international financial institution programs. However, the scale of investments required to improve technology infrastructure capacity and performance is beyond the ability of these traditional methods in many countries. Even those countries enjoying a surge in oil revenues should consider new financing techniques, because they face so many competing and pressing socioeconomic needs. Technology presents many potential openings to attract investors, unlike such public priorities as improving health care, literacy, and roads. Notable ways to encourage private and foreign investment, especially recommended by the World Bank, include:[26]

Competitive subsidies

Competitive bidding to award cash subsidies to technology providers can stimulate private investment by lowering up-front risk. Subsidies help public finances remain within budget because they are not open-ended commitments or based on percentage formulas. Technology providers must meet performance goals to receive payment, which encourages compliance. Moreover, subsidies can be targeted to social or economic priorities, such as improving Internet access in rural areas.

Aggregate demand

Pooling government departments' and agencies' technology purchasing needs and soliciting competitive tenders can stimulate the private sector to invest in new infrastructure and services. For example, governmental cross-departmental commitments to purchase broadband capacity can limit the commercial risk of installing new networks while reducing the overall cost to the government. However, if demand aggregation is to succeed, departments must coordinate their plans and requirements. Unless officials at the highest administrative levels give forceful direction to support interdepartmental technology purchasing, administrative rivalries will likely scuttle joint departmental tenders.

Private funding guarantees

Governments can develop loan guarantee schemes, as have been applied in Europe, to encourage private lenders to finance technology investments. However, as Middle Eastern debt markets tend to favor funding working capital, this approach may appeal more to foreign lenders and financial intermediaries than to domestic businesses.

Lower administrative obstacles to encourage investments

Middle Eastern states are not alone among developing countries in shouldering a legacy of extensive bureaucracies and administrative procedures. Although some Middle Eastern countries have made significant recent progress in improving the business environment for entrepreneurs, conditions are far from ideal. There is not a single entrepreneur in any country who does not complain about red tape, but Middle Eastern administrative burdens can especially hinder innovative ventures, which, by nature, must adapt at relatively short notice. Perhaps technology can serve as a useful wedge to help governments negotiate administrative reforms.

Public-private partnerships

Regional and national cultural, social, and traditional values strongly influence investment priorities and methods. The Middle East has few successful public-private partnerships, or, for that matter, public-public regional initiatives to date. However, there are signs of change. Over the past several years, Egypt, Jordan, and the United Arab Emirates have encouraged investments

and partnerships in technology projects. Egypt has convinced international companies, such as Microsoft and Cisco Systems, as well as national companies, to participate in multimillion dollar investments. Jordan has forged partnerships between its software development sector and international companies to increase software exports to developed countries.

The large scale and cost of infrastructure investments, the specific technologies, and their implications for future development are all sound reasons for Middle Eastern countries to explore new financing, partnerships, and regional initiatives to share resources and expertise. Public-private partnerships are well suited to long-term technology investments where risk is higher than other opportunities that typically attract private Middle Eastern investors, such as real estate or commercial trading. However, such partnerships require new sets of negotiating and oversight skills for governments to be able to participate effectively. Because the Middle Eastern technology sector is in the early stages of development, foreign companies must participate to transfer knowledge and expertise. Until a full set of IPR and patent protection laws are promulgated and enforcement is raised to the standards of developed countries, attracting foreign partners will be difficult and time-consuming.

Innovate by sharing best practices

The Middle East is home to several innovative initiatives that could serve as models for best regional practices, and possibly extend to other forms of cooperation and mutually beneficial endeavors. For example, Egypt, Jordan, Saudi Arabia, and Syria have recently introduced programs to promote family-owned computers through different types of government-supported financing plans. Foreign technology manufacturers, such as Hewlett Packard and Acer, are beginning to invest in the region, constructing new plants in Saudi Arabia. Innovation parks, clusters, and free trade zones, encouraged and fostered by different types of financial and regulatory incentives, have appeared throughout the Middle East. Information about, and access to governmental programs have been priorities for many countries, and e-government programs hold great promise for advancing the sharing of best practices.

However, as a general rule and in contrast to Asia, where National Information Technology Councils share information and experiences, regional sharing of knowledge is not common among Middle Eastern countries. For example, although the League of Arab States identified 19 projects well suited for regional cooperation in 2001—such as establishing technology indicators, developing an Arab regulatory framework, creating a center for digital documentation and archiving heritage, developing access nodes to connect Arab internet networks, and translating and Arabizing ICT terminology—progress has been slow.

Recognizing the importance of regional cooperation, in 2003 the United Nations Development Programme announced an initiative, Information & Communities Technologies for Development in the Arab Region (ICTDAR) to assist all Arab countries improve their ICT capabilities. As previously mentioned, the International Telecommunication Union, Arab Regional Office has also launched an inter-Arab Internet connection project.

A promising route to encourage innovative regional projects would commence by developing formal institutional channels to share information about best practices. As these contacts built mutual confidence, more elaborate projects requiring resource commitments could then be planned and considered. Identifying regional projects that respect a member country's national culture and priorities has not been an issue. Rather, summoning the political will to explore ways that regional cooperation can advance each country's development agenda remains a concern. Sharing best practices in innovation offers Middle Eastern countries a useful and noncommittal path toward regional cooperation.

Invite private-sector innovation by opening markets

Recent liberalizations in the Middle Eastern mobile telephone markets have proven the power of competition to introduce new innovative services, lower prices, and stimulate demand. However, main telephone lines remain a monopoly in many countries. Governments should introduce competition to stimulate much-needed private-sector investment and innovations.

Opening monopoly main telephone lines to competition is only the start to crafting a new regulatory regime better suited for stimulating innovation. For examples, novel fixed wireless technologies and advanced digital processing techniques could spread Internet connectivity at far more affordable costs to much more of the population. The developed world is in the midst of devising new regulatory approaches for some of these new transmission technologies by replacing individual operator licensing with shared and license-exempt use. Because state-of-the-art digital processing techniques let operators share spectrum without interference, they promise to reduce regulatory burdens and encourage competing vendors to deliver more services to the public and business at more affordable rates.[27]

Share regulatory and legislative information

Regulatory issues are complex in the fast-moving world of technological innovation. Regulators in the developed world regularly share information and analysis to develop policies and monitor developments. Middle Eastern governments should endorse this model of international cooperation. The recently formed Arab Regulators Network is a promising new regional initiative; it has advocated exchanging information and possibly merging pilot projects across the entire Arab region.

A viable and enforced legal regime must be in place for the Middle East to accelerate technology development and e-commerce. Governments should share legal research and analysis to speed promulgating laws and regulations to:

- protect personal data and information privacy;

- protect Internet-related intellectual property, publishing rights, and software applications;

- accelerate signing, ratification, and joining international agreements relating to IPR, including the Patent Cooperation Treaty and the Patent Law Treaty; and

- accelerate the introduction of e-commerce legislation.

Monitor and measure development and innovation within and across countries

Middle Eastern strategies differ in many respects, but all share a need to devote more resources to collecting timely data to monitor innovation and development progress. Without reliable data, governments cannot accurately assess progress and refine plans. The UN, the World Bank, the International Telecommunication Union, and regional organizations have embarked on a major project—Partnership on Measuring ICT for Development—to convince all countries to collect a small set of relevant data to render analysis much more accurate and up to date. Middle Eastern countries should strive to track and compile these basic statistics because they will greatly aid monitoring and improving their technology and innovation strategies.

Encourage entrepreneurial opportunities such as offshore call centers

The global offshore call market—currently valued at between US$40 billion and US$50 billion—is growing rapidly at around 30 percent annually. India has dominated the market, serving US and UK clients, but now continental European companies are seeking to outsource call centers; such centers require multilingual capabilities beyond English. They also prefer call centers that fit more closely, geographically and culturally, with their home base.

Middle Eastern call centers that cater to this new market are now appearing. In 2005, A.T. Kearney's annual ranking of global services locations placed Egypt as 12th, followed by Jordan at 14th and the United Arab Emirates at 20th.[28] The strong commercial potential of these locations is best suggested by noting that the 2004 survey included none of these countries.

Egypt has encouraged the development of call centers through the support of the Information Technology Industry Development Agency, formed in 2004. This agency, which includes a public-private task force, helps local and foreign investors secure tax breaks and organize call centers in free trade zones, notably Smart Village in a Cairo suburb. Smart Village is the first of several planned innovation clusters the agency intends to establish. Furthermore, to improve the cost competitiveness of Egyptian call centers, the government has plans to grant the first two licenses for international Voice over IP (VoIP) services. VoIP licenses are an exception in the Middle East as most countries restrict VoIP to protect their main telephone line monopoly revenue.

Egyptian support of its nascent call center industry exhibits a number of characteristics important to stimulating innovation: a special agency with public-private participants to oversee developing call centers, tax and other financial incentives to attract domestic and foreign investors, innovation clusters to encourage a favorable environment for technology companies, and flexibility to liberalize telecom regulations to introduce new communication technologies.

Conclusion

Since 2000 most Middle Eastern countries have made substantial progress designing strategies to integrate and weave the new strands of the information society into traditional social, economic, and cultural patterns. These strategies have begun to yield results. Most countries have seen a surge of mobile telephone use. Increases in Internet access considerably outpaced world average growth. Some countries have enthusiastically embraced e-government initiatives to deepen communications with citizens and deliver government services. The pioneering Tejari e-marketplace has demonstrated e-commerce's ability to accelerate trading and business activity. The promise of the Internet and computers to improve the lives of less-advantaged citizens has been acknowledged by policymakers as several countries seek to disseminate computers widely through PC financing and distribution programs.

If policymakers are to leverage these encouraging developments into innovation and faster progress, they should refine the process to prioritize, implement, and monitor initiatives. The process will also be substantially more robust, innovative, and versatile if more initiatives can include new models of public-private partnerships and regional associations. For in the Middle East, policy will likely play a greater role than technology in setting the pace for how innovation evolves. This is because access to technology is not the bottleneck in many parts of the Middle East, but creating the overall environmental conditions for innovation to thrive remains an ongoing challenge, even in the more developed economies of the region.

A top policy priority should be to develop ways to encourage SMEs to invest in technology and innovative business processes, because the wider economic and social benefits could be substantial. Nurturing and

supporting the formation of an Arab software industry is a most necessary parallel policy initiative to help SMEs maximize the ways technology could potentially stimulate innovative and more productive business activities.

The considerable scale and range of investments required to raise Middle Eastern technology and innovation performance suggests policymakers should now explore new financing methods to build infrastructure and innovation capabilities. These techniques, drawing upon competitive principles and private-sector participation, will challenge conventional attitudes toward the state's role in the economy, but they hold the promise of unlocking much-needed new funding sources.

Novel technologies inevitably bring change, unsettling at times, as economies and societies adapt. This is especially true for many conservative Middle Eastern countries. However, this conservatism can become an ally to innovation if policymakers reduce risk by sharing best practices, encouraging information exchanges, and creating regional innovation ventures.

Notes

1 *General purpose technologies* are innovations that potentially affect a wide range of industries in the economy.

2 See ITU (2006).

3 One widely used definition of *Middle East* is the airline industry's IATA standards, which lists Afghanistan, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Palestinian territories (West Bank and Gaza strip), Oman, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, United Arab Emirates, and Yemen (Wikipedia, Middle East, http://en.wikipedia.org/wiki/Middle_East). The subset, *Western Asia*, comprises Bahrain, Egypt, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, and the United Arab Emirates.

4 See World Economic Forum and INSEAD (2005, 2007) for details.

5 See *World IT Report* (2003), available at www.worlditreport.com.

6 See UN-ESCWA (2005, p. 21).

7 See NAP for the Arab States, International Telecommunication Union, Arab Regional Office. Available at www.ituarabic.org/IPS-IDN/Documents/Doc08-%20NAP%20FOR%20THE%20ARAB%20STATES.ppt.

8 See UN-ESCWA (2005, p. 34).

9 See UN-ESCWA (2005, p. 34).

10 See UN-ESCWA (2005, p. 30).

11 See UN-ESCWA (2005, pp. 10–15).

12 See BSA/IDC (2005a, b); *Middle East and Africa Report*, available at www.bsa.org/idcstudy/.

13 See UN-ESCWA (2005, p. 15).

14 See Mrad (2005).

15 See ABC Newsonline (2006).

16 See UN-ESCWA (2005, p. 61).

17 See Poortman (2005).

18 Tejari executive conversation with one of the authors.

19 See Madar (November 2006).

20 See Zawya.com (accessed December 13, 2006).

21 See Zawya.com (accessed December 13, 2006).

22 Mr Hijazi described this portal to one of the authors on November 30, 2006.

23 See Zoepf (2006).

24 See EU ICT Task Force (2006).

25 For a detailed analysis of Arab software industry potential, see Mrad (2005).

26 See Wellenius (2006).

27 See *The Economist* (2004).

28 See A. T. Kearney (2005).

References

ABC Newsonline. 2006. "Search Engine to Target Arabic Speakers." April 26. Available at www.abc.net.au/news/newsitems/200604/s1624108.htm.

A. T. Kearney. 2005. Global Services Location Index 2005. Available at www.atkearney.com/shared_res/pdf/GSLI_Figures.pdf.

BSA/IDC (Business Software Alliance/International Data Corporation). 2005a. *Expanding the Frontiers of our Digital Future: Reducing Software Piracy to Accelerate Global IT Benefits*. White Paper, December. Available at http://www.bsa.org/idcstudy/.

———. 2005b. *Middle East and Africa Report*. Available at http://www.bsa.org/idcstudy/.

The Economist. 2004. "A Brief History of Wi-Fi." June 10.

Economist Intelligence Unit. 2006. The 2006 e-readiness rankings, a white paper from the Economist Intelligence Unit, London. Available at www.eiu.com/site_info.asp?info_name=eiu_2006_e_readiness_rankings.

EU ICT Task Force. 2006. *Fostering the Competitiveness of Europe's ICT Industry*. EU ICT Task Force Report. November. Available at http://ec.europa.eu/enterprise/ict/policy/doc/icttf_report.pdf .

ITU (International Telecommunication Union). 2006. *World Telecommunication/ICT Development Report 2006: Measuring ICT for Social and Economic Development*. Geneva : International Telecommunication Union.

Mokyr, J. 1990. *The Lever of Riches: Technological Creativity and Economic Progress*. New York: Oxford University Press.

Mrad, F. 2005. "Meeting Arab Socio-economic Development through ICT." Presentation at the School of Computer Science, Carnegie Mellon. Available at www.cs.cmu.edu/~cfr/talks/2005-Feb-4.ppt.

Poortman, C. Speech to World Economic Forum in the Middle East on Infrastructure Challenges, May 20, 2005.

Trajtenberg, M. 2006. "Innovation Policy for Development: An Overview." Foerder Institute for Economic Research Working Paper 6-06. Tel Aviv: Foerder Institute for Economic Research.

UN (United Nations). 2005. *Global E-Government Readiness Report 2005*. New York: United Nations.

United Nations ICT Task Force. 2005. *Measuring ICT: The Global Status of ICT Indicators, Partnership on Measuring ICT for Development*. New York: The United Nations Information and Communication Technologies Task Force.

UN-ESCWA (United Nations Economic and Social Commission for Western Asia). 2005. *Regional Profile of the Information Society in Western Asia*. United Nations Economic and Social Commission for Western Asia, October 31. New York: United Nations. Available at www.escwa.org.lb/information/publications/edit/upload/ictd-05-6.pdf.

Wellenius, B. 2006. "Extending Communication and Information Services: Principles and Practical Solutions." In *Information and Communications for Development: Global Trends and Policies*, ed. P. Guislain, C. Zhen-Wei Qiang, B. Lanvin, M. Minges, and E. Swanson, pp. 41–55. Washington, DC: World Bank.

World Bank. 2006. *Information and Communications for Development: Global Trends and Policies*. Washington, DC: World Bank.

World Economic Forum. 2005. *The Global Competitiveness Report 2005–2006: Policies Underpinning Rising Prosperity*, ed. A. Lopez-Claros, M. Porter, and K. Schwab. Hampshire: Palgrave Macmillan.

———. 2006. *Global Competitiveness Report 2006–2007: Creating an Improved Business Environment*, ed. A. Lopez-Claros, M. Porter, X. Sala-i-Martin, and K. Schwab. Hampshire: Palgrave Macmillan.

World Economic Forum and INSEAD. 2005. *The Global Information Technology Report 2005–2006: Leveraging ICT for Development*, ed. S. Dutta, I. Mia, and A. Lopez-Claros. Hampshire: Palgrave Macmillan.

———. 2007. *The Global Information Technolgy Report 2006–2007: Connecting to the Networked Economy*, ed. S. Dutta and I. Mia. Hampshire: Palgrave Macmillan.

Zoepf, K. 2006. "Jordan's Ambitious Plan: A Country with Few Natural Resources Hopes to Build its Intellectual Capital by Expanding its Higher-Education System." *Chronicle of Higher Education*. 53 (7): A39.