ORIGINAL RESEARCH ARTICLE

A development perspective of technology-based entrepreneurship in the Middle East and North Africa

M-Said Oukil, Visiting Professor*

Department of Management and Marketing, College of Industrial Management, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia

This paper contributes to the literature on technology-based entrepreneurship with particular reference to the Middle East and North Africa (MENA) region. It highlights the importance of technology-based entrepreneurship as a strategy for industrialization and technological development. Exploratory in nature, the paper describes the general context for entrepreneurship in the evolving economies of MENA countries. Specifically it probes the positive engagement of the private sector in sustaining the drive toward technological entrepreneurship in the region. Using the scheme developed by the Organization for Economic Cooperation and Development (OECD) of classifying industries according to their degree complexity and knowledge intensity, the paper suggests another way of looking at the issue of technological development. To overcome difficulties of gathering primary data, the analysis draws on secondary data from the business Web site, bloomburg.com. The results indicate that entrepreneurship and technological developments are attracting increasing attention in the region, but that the necessary supportive educational measures are either absent or weak. The evidence is that the private sector is as active as the public sector in the processes of industrialization and technological development. Detailed studies of individual firms, sectors, and countries in the MENA region are needed to examine the role of dynamic entrepreneurs in technological take-off. Decision-makers are called upon to boost public and private innovation initiatives, and to place an appropriate emphasis on entrepreneurship learning for all. This paper sheds some light on the efforts of the private sector in MENA countries to close the technological gap with other developed and newly developing countries.

Keywords: *technological entrepreneurship*; *technological innovation*; *development*; *industrialization*; *private sector*; *MENA countries*

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The countries of the Middle East and North Africa (MENA), which aspire to higher growth and technological development, are quite interesting. On the one hand, their governments are aware that it is essential that they should escape from the 'rentier state' syndrome by diversifying. This is critical since oil and fuels are a substantial proportion of total government exports and represent as much as 76% of exports for the United Arab Emirates, 83% for Oman, 90% for Saudi Arabia, 92% for Yemen, 93% for Kuwait, and 97% for Algeria (World Bank, 2010). On the other hand, even though their people, including managers, are described having a culture that makes them disinclined to engage in adventurous business (Ali, 1993; Rice, 2003), talents and innovative capabilities exist as indicated by some examples in Appendix 1. Technology acceptance is also widely spread, particularly among the young and educated generations (Lowry, 2004). This paper examines the role of the private sector in enhancing development in the MENA region through industrial investment and high impact entrepreneurship. Traditionally, the region comprises the following countries: Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and United Arab Emirates.

The two main questions this paper addresses are: (1) What are indications of progress in technology-based entrepreneurship development in the MENA region? and (2) What necessary educational arrangements are there to support such development?

Over the past few years, the major oil-producing countries in the region (Algeria, Bahrain, Kuwait, Libya, Oman, Qatar, Saudi Arabia, and United Arab Emirates)

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have accumulated huge financial reserves due to sharp increases in oil prices. This has made them relatively very rich and increased their total investments over the period 1995–2006 to 82 billion dollars (http://www.iaigc.net).

Private capital is also in real surplus in the region as a whole (Ayar & Oukil, 2006), but has generally been invested in commercial operations in real estate, stocks, trade, and services focusing on tourism, either locally or international. This tendency is also revealed by the recent and growing shift in middle class investment away from oil and gas in favor of services and consumer-oriented businesses (GIH, 2008). At present, manufacturing represents a tiny minority of all exports, amounting to only 0.86% in the case of Jordan and 0.02% in the case of Algeria, which are the highest and lowest in the region, respectively (World Bank, 2010, p. 12).

What the above situation suggests is that Arab private business is more oriented toward zero or low risk and non-productive activities. In other words, it implies that MENA entrepreneurs avoid investing in industrial activities, where risks are great and the use of scientific and technological knowledge and innovation is usually dominant. However, things seem to have started to change, modifying the region's industrial and technological development perspectives. Both external and internal pressures have been pushing MENA countries to liberalize their economies and allow for more competition and diversification. Consequently, a number of local private companies or small and medium enterprises have been created and help strengthen the local industrial and technological base. Appendix 2 provides selected examples of private companies from each country of the MENA region and their involvement in industrial development.

Literature review

The economic literature states that technology and innovation, involving scientific, technological, and organizational knowledge, can lead to the improvement in productivity that is needed to support growth and competitiveness (Freeman, 1987; Koster, 2008; Morrison, 2006; Solow, 1956; Tejinder, 2010). The shift from underdevelopment to industry-based development is linked with technological development and innovation. As late comers, developing countries have real possibilities to develop technologically, either through the import of foreign technology or through the development of local innovations. As might be expected, a combination of these approaches produces even better results, incorporating advanced, new knowledge.

Theoretically, technological development is described to be composed of four technological capabilities (Dahlma, Ross-Larson, & Westphal, 1987). It is achievable whenever public and private firms target higher productivity levels, produce world-class exports (Goh, 2005), and focus on clearly defined, innovation-driven, and entrepreneurial strategies (Freeman, 1987). However, achieving technological development does not necessarily ensure that it can be sustained. Essentially, the ability to maintain innovation and entrepreneurial development is at the core of the process. Prominent authors in this field have advocated education and various theoretical systems, frameworks, and platforms. Most relevant here are national innovation systems including innovation ecosystems, the triple helix model, and entrepreneurship development theories. The common link between all these systems, models, and theories is innovation policy, which involves not only research and development and innovative activities, but also promotion of entrepreneurship, clustering, networking, partnership, and education. In this context, technological development cannot be anything but active, involving various sectors, industries, and firms where people work, make changes, and innovate.

The positive role of national innovation systems (NIS) in enhancing technological capabilities has been particularly emphasized. Originally, Knight (1921) and Schumpeter (1934) established the foundation for thinking about innovation. Much later, Freeman (1987), Lundvall (1992), Nelson (1993), Patel and Pavitt (1994), Leydesdorff and Etzkowitz (1998), Etzkowitz and Leydesdorff (2000), among many others, have proposed and defined the NIS in terms of national and international network institutions, science and technology, research and development, the involvement of the public and private sectors, partnership, interaction, incentives, training and education, imports, and adaptation and diffusion of new technologies. By using talents and innovation capital (Abouzeedan & Busler, 2005), technological capabilities can be built up, allowing firms and economies to strengthen their engineering and economic capabilities in order to solve problems, produce goods, and provide new or better services. In such a context, the development of innovation and technology depends on complex relationships involving public and private firms, universities and research centers, and government.

The role of governments in supporting entrepreneurship development has also been illustrated. Morrison (2006), for example, cited a number of Arab countries whose governments have tried to promote entrepreneurship and succeeded to some extent. Arab countries have, in general, invested a lot in the information and communication technology (ICT) sector. This has helped organizations in the region to modernize their operations and up-grade their performance. Arab citizens have also been positively affected by new ICT devices and services and their use is widespread (Al-Gahtani, Hubona, & Wang, 2007). However, while these governments have restructured legal systems, eased the procedures for starting businesses, and enhanced science and technology education and training, entrepreneurship education has much lagged behind.

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Entrepreneurship creates long-term wealth for individuals and nations (Michael & Pearce, 2009). High impact or qualified entrepreneurship, based on technological advances as the lever for regional development and growth, is also stressed (Leitão & Baptista, 2009). In practice, this is linked to the innovation process itself. In its cyclical form, the process is initiated under competitive pressures and induced by expected monopoly profits. When learning and experience are gained, inspiration and imitation start to occur. Then there is an impetus to restart the process for further improvements and the creation of new products, methods, processes, and businesses. This is the essence of the Schumpeterian theory in which disequilibrium is considered a normal phenomenon leading to industrial and economic dynamism (Schumpeter, 1928). Innovation, in the sense of introduction of new things or doing them differently to add value, therefore benefits firms and economies and can foster technological entrepreneurship through adoption or innovation of devices, equipment, and technical procedures.

Engaging in business generally involves risks, but for those involved in technology-based endeavors the risks may be greater. This is mainly because research and development (R&D) or innovative activities generally precede product and process development and are increasingly complex and expensive. In comparison, commercial activities and services have less weight in the disequilibrium needed to create change as in the Schumpeterian sense described above. Consisting of new products, new materials, and methods of production or organization not previously in use, innovations differ from speculative activities (Kirzner, 1985; Schumpeter, 1947). To enhance economic growth, industrialization, and technological development, the role of technological innovations, and thus technological capabilities, is important and now widely recognized (Lerner, 2010), especially in the case of small and medium size enterprises (Subrahmanya, Mathirajan, & Krishnaswamy, 2010). Estimates indicate that over 60% of all economic growth is due to technological advance rather than improvements in labor productivity (Freeman & Soete, 1997).

The argument that the concepts of entrepreneurs and innovators are separate constructs (Brannback, Carsrud, Krueger, & Elfving, 2008) suggests that an entrepreneur is not necessarily an innovator. The former may, for instance, take the risk of not being able to recover his or her capital if anything goes wrong, but the endeavor may not involve any creativity or innovation and may require little technological progress. If late industrialization is not fatal (Tan, 2008), closing the gap with developed and newly developed countries should be possible by making use of the available technological tools and devices and/or initiating proper incremental and/or major innovations. Normally, real progress can be made when technologically advanced investments are made to increase productivity and gain competitive advantage.

Technological innovation-based entrepreneurship or 'technopreneurship' is very attractive because of its expected high impact compared to ordinary trade or service-based business. Most recent empirical studies show that the more innovative a start-up activity, the more its impact on growth (Mueller, 2007). Drucker (2006) also considers that innovation and entrepreneurship go hand in hand, and where organizations or countries do not have a strong propensity for innovation, clusters of innovation or entrepreneurship could be a way forward (Khan & Ghani, 2004; Scheel, 2002). If ordinary businesses and social entrepreneurship can help in creating jobs and preserving the environment, innovation-based entrepreneurship adds the creation of wealth through the production of new, more tangible and intangible outputs. Lalkaka (2001) asserts that technological entrepreneurship is undeniably a significant source of good jobs.

In the view of Rosenberg (1982), process innovations are of particular importance, because they help in creating new and competitive manufacturing systems (Fujimoto, 2004). Specifically, they lead to improved production processes and consequently to new outputs, higher productivity, better quality, lower costs, and increased flexibility (Tirupati, 2008). Here, the old debate of heavy versus light industrialization ceases to be important as technology, science, and creativity become central. A country or a firm could thus be said to be making progress when it invests in more creative, technologically, and scientifically developed industries. By way of illustration, this paper considers established private industrial investments in MENA countries to show their contribution to growth and technological development. Producing all sorts of industrial goods locally can sustain growth and development.

Worldwide, the dynamics of growth and development are uneven. Some countries and regions are more innovative, technologically developed, and entrepreneurial and, thus, more developed than others (De-Groot, Naskapi, & Stough, 2004; Verspagen, 2007). This is generally explained by differences in strategies, economic structure, infrastructures, environments, and culture (Morrison, 2006; Tan, 2008; Zgheib, 2004). Where favorable attitudes, forward thinking and initiatives, venturing, and clustering prevail, expectations are generally positive (Ali, 1993; El Namaki, 1992; Porter, 1990; Rice, 2003). Well-designed policies and blended education also play a critical role (Dubini, 2002; Zhang & Duysters, 2010).

Research methodology

As mentioned above, technological development is a process involving four types of capabilities, although

not all need to occur at the same time. These are investment, production, engineering, and innovation (Dahlman, Ross-Larson, & Westphal, 1987). Reaching the stage of innovation indicates that countries or enterprises possess innovation capabilities and become capable of producing new things with value-added leading to higher productivity levels. In the view of the present author, technological development can also be indicated by the upgrading of such capabilities, by shifting from low-technology to high-technology or science-based industries. In this paper, industries are as classified by the OECD's (2005) method, according to the degree of sophistication and knowledge content. High-technology industries include pharmaceuticals; aircraft and spacecraft; medical, precision, and optimal instruments; radio, television, and communication equipment; and office, accounting, and computing machinery. Low-technology involves electrical machinery and apparatus; motor vehicles, trailers, and semi-trailers; railroad and transport equipment; chemical and chemical products; and machinery and equipment. A simple but useful interpretation of this classification is that while the existence of low-technology industries means that countries have reached a certain level of industrialization, the development of high-technology industries and science-based industries indicates their move toward higher or more advanced levels. For example, shifting from producing goods using old engineering processes to those using semi-electronic or even fully electronic processes would indicate that progress has been made, creating greater competitiveness.

Reaching advanced levels by building solid technological and innovative capabilities requires the use of human capital, further industrialization, and substantial educational efforts. The best use of human capital, linked with adequate funding for research and development, have been advocated as supports for development (Baldwin & Gellatly, 2006; Mohnen, Palm, Loeff, & Tiwari, 2008; Rosa, Rose, & Mohnen, 2006). Effective deployment of human capital in management is crucial (Dakhli & De Clercq, 2004; Marques, Simon & Caranana, 2006; Mezher, El-Saouda, Nasrallah, & Al-Ajam, 2008; OECD, 2000; Sanyang & Huang, 2009; Wang & Zang, 2005) and provides opportunities to sustain technological development. Talented individuals and skilled entrepreneurs who are fully engaged will not wish to emigrate, but will use existing knowledge, produce new knowledge, and create new local businesses. The more advanced or innovative companies they create, the greater is their contribution to the economy and to society. In practice, the outcome is particularly valuable when it results in competitive advantage. Where there is a shortage of knowledge or ideas, recourse to clustering and networking has merits (Geenhuizen, Watanabe, Jauhari, & Masurel, 2009). Brain gain, or the return of graduates from abroad, can support the buildup of national innovation capacity as can systems based on local aspirations.

Industrialization, in the sense of exploiting the available local resources, can enhance growth and development. In the MENA region, growth has historically started within the public sector and with the reproduction or imitation of existing foreign products. As elsewhere, industrialization has not only been used as an engine of growth but also as a way to reduce gaps with the rest of the world (Szirmai, 2009). Changes in policies including legislation, opening partnership with foreign firms, and establishing business incubators (Aubert, 2004; Klonowski, 2007; MacCormack, 2007; Marshall, 2004; Wu, Gu, & Zhang, 2008) have all played an important role and allowed private productive industries to emerge and economic activities to expand. To narrow the technological gap with the industrialized world, the continuous development of technologies, including communication and information technologies, offers MENA countries the opportunity to produce and distribute goods and services more efficiently than in the past.

Aiming to enhance productivity, competitiveness, and technological development, a number of countries have drawn policies to encourage start-ups, paying particular attention to technopreneurship. This has been not only through regulations and capital venture but also promotion of innovation and entrepreneurship education. Striking examples are Singapore, Korea, Taiwan, Malaysia, India, and China. In MENA countries, promoting entrepreneurship and technopreneurship could also be part of industrialization and development. To this end, the dynamic function of entrepreneurship, associated with science, technology, and innovation, is much needed in the region to strengthen its competitiveness. According to Porter (1998), the absence of productivity arising from innovation and technology is fatal, and it is productivity that gives sense to competitiveness at both the micro and the macro levels. At the macro level, recent research highlights important differences between countries as indicated by a competitive growth index (Blanke, Paua, & Sala-I-Martin, 2004). Countries can be divided into groups of either innovators or mere adopters. When countries do not innovate, their growth and competitiveness are vulnerable.

Results and discussion

The relatively late emergence of Arab entrepreneurship can be explained by two groups of factors. Objective factors include pre-entry flaws, the precarious position of entrants, lack of tools for survival, and lack of knowledge about how to exit (El-Namaki, 2008). Subjective factors include conservatism, culture, and education (Almaney, 1981; Hills & Harold, 1986; Schuster & Copeland, 1996; Scott & Twomey, 1988; Zgheib, 2004). If change is needed and sought, it could come from investment, but investment

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in education. In the world of business that would mean investment in innovation and entrepreneurship education.

Younger generations with science and engineering training and higher levels of local and/or foreign education have new perspectives on business and have started to reverse traditional business trends. 'In a survey of 1.4 million Arab youth, 94% surveyed were interested in working for themselves. In Kuwait, 28% of youth are planning on starting their own business in the next 12 months, and 32% in Saudi Arabia' (Aramex.com).

The level of technology has become an indicator of advancement and living standards (Faris, El Hawari, & Ihsan, 2009). In the MENA region, increasing numbers of private firms and businesses invest in advanced manufacturing and high-tech industries (Oukil, 2007). The data in Table 1 indicate the public and private efforts in the industrialization process, suggesting good prospects for MENA's industrial and technopreneurship development including the knowledge intensive industries sector.

Table 1 was constructed using secondary data from the Bloomberg online Web site accessed in May 2010 (http://investing.businessweek.com/research/common/symbollookup/symbollookup.asp?region=MidEastAfr&letterIn=A&searchType=coname&lookuptype=public&x=23&y=8). A systematic and intensive search made it possible to gather information about various industries and technologies established in the MENA countries. In the course of this search, country details were identified together with details of the main types of established industries. As can be seen in the table, various types of industries employing both low and high levels of technology can be found across the MENA region. What is also interesting is the involvement of the private sector, which is highly significant. Private enterprise is very active in all sectors except for nanotechnology and biotechnology, with the possibility that this picture may change in the future. The prevalence of private industry, ranging from low to high-tech and including science-based industry and software as key creative and knowledge intensive elements of industry (Harabi, 2009), suggests once again that technological development in MENA countries is effectively under way with entrepreneurs playing an important role.

There is evidence that Mena countries have attained important levels in their industrialization and growth processes. More importantly, there is at least some evidence that industries are quite diverse with different levels of technological complexity. Efforts are not only in the public sector, but the private sector has also been playing a more and more important role. The private sector is not exclusively devoted to trade as it was in the past.

If growth and development are not to be simple processes limited to the import or transfer of technology and creation of firms or businesses, entrepreneurial development in all its aspects is needed. In particular, relevant education is necessary not only to provide knowledge, skills, and awareness but also to build human and innovation capital. The shortage of engineering and management capabilities cannot be overcome except through learning and practice.

Education is therefore a determinant of success in starting businesses (Naude, Gries, Wood, & Meintjies, 2008). One important difference between Arab countries and those in the rest of the world, which have achieved higher growth rates, is the emphasis on entrepreneurship

Table 1. Public and private technology development through industrialization efforts in the MENA region

	Country reference number													Sector	
Industry and technology	1	2	3	4	5	6	7	8	9	10	11	12	13	Public	Private
Aerospace industry	✓		✓	✓		✓				✓			✓	✓	✓
Car manufacturing	✓	✓	✓	✓			✓	✓		✓		✓	✓	✓	✓
Capital goods	✓													✓	✓
Chemical	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓
IC technologies	✓	✓	✓	✓		✓			✓	✓		✓	✓	✓	✓
Micro-electronics	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
Pharmaceutical industry	✓		✓	✓		✓		✓		✓	✓	✓	✓	✓	✓
Software industries	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓	✓
Nanotechnology	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Biotechnology	✓		✓	✓						✓		✓	✓	✓	

Source: http://investing.businessweek.com/research/common/symbollookup/symbollookup.asp?lookuptype=private&region=all&letterIn=O.

1 = Algeria, 2 = Bahrain, 3 = Egypt, 4 = Jordan, 5 = Kuwait, 6 = Lebanon, 7 = Libya, 8 = Morocco, 9 = Oman, 10 = Qatar, 11 = Saudi Arabia, 12 = Tunisia, 13 = United Arab Emirates.

and technopreneurship education. In the developed and newly developing countries, the issue is formally institutionalized and relevant programs are offered at various levels and time periods, for example, in universities, colleges, and centers and throughout the academic year including the summer. Non-degree training is also offered for individuals who do not have a strong educational background.

With respect to institutions, agencies, and associations dealing with business creation and related issues, Table 2 provides information about the efforts made in the region, noting that the most important aspect of agencies promoting innovation is their efficiency and not necessarily their mere existence however modernized. Problems such as bureaucracy, corruption, and lack of transparency are often reported (SMEDEC, 2005).

Table 2. Leading institutions enhancing entrepreneurship in main MENA countries

Country	Concerned institution	Year of establishment
Algeria	Agence Nationale de Soutien a l'Emploi des Jeunes	1996[1]
Bahrain	Arab Regional Centre of Entrepreneurship	2003[2]
	Investment Training and Bahrain Training Institute	1992
Egypt	Egyptian Incubator Association	1995[3]
Kuwait	Kuwait Finance House	1977[4]
Jordan	Queen Rania Centre for Entrepreneurship	2004[5]
Lebanon	Berytech	1995[6]
Morocco	National Agency for the Promotion of SMEs	2002[7]
Oman	Fund for the Development of Youth Projects	1998[8]
Qatar	Qatar Development Bank	1997[9]
Saudi Arabia	Saudi Entrepreneurship Development Institute	2002[10]
Tunisia	Centre of Young Entrepreneurs	1998[11]
United Arab Emirate	Dubai Enterprise Center	1996[12]

[1]ANSEJ (http://www.ansej.org.dz/AccueilDG.aspx)
[2]ARCEIT (http://www.arceit.org and http://www.bti.com.bh)
[3]EIA (http://www.escwa.un.org/ntpi/egypt.asp)
[4]KFH (http://www.kfh.com/en/about/index.aspx)
[5]QRCE (http://blog.qrce.org/)
[6]Berytech (http://www.berytech.org/)
[7]ANPME (http://www.anpme.ma/)
[8]FDYP (http://www.ameinfo.com/146757.html)
[9]QDB (http://www.qdb.com.qa/)
[10]SEDI (http://www.sedi.org.sa/index.php?p=5)
[11]CDJ (http://www.centre-of-young-entrepreneurs-cdj-tunisia/)
[12]DEC (http://www.decuae.ae/Website%20v5_files/Page437.htm)

Entrepreneurs need more than luck and informal business experience, even if those things do have a role in their success. For one thing, entrepreneurship education provides trainees with knowledge and skills that are useful for conducting modern business. Awareness and direct involvement will also provide better chances of implementation and success. Jeffrey and Spinelli (2007) 'recognize that there is no substitute for actually starting a company, but believe that it is possible to expose students to many of the vital issues and immerse them in key learning experiences'.

In MENA countries, entrepreneurship education is at an early stage, and relevant course offerings are very recent and limited to a very few universities. These are in Jordan, Oman, and the United Arab Emirates where, remarkably, the subject of entrepreneurship is obligatory (Theil, 2007) and the western incubation model is successful (Madichie, 2010). In the rest of the region, what limited teaching of entrepreneurship there is covers management of small and medium enterprises and feasibility analysis for projects. Such courses are generally provided for students of economics and business. In comparison, students with engineering or science profiles are offered little or no opportunity to take such courses or train in depth and within an entrepreneurial framework. Teaching them about the innovation process, how to raise capital, protect intellectual property, act entrepreneurially, and create an organizational culture that promotes innovative thinking are crucial. Corresponding awareness, skills, knowledge, and competencies should however be acquired and strengthened for business and non-business students.

Finally, worth mentioning is that important initiatives have been launched, including formal business plan competitions. Distinctive examples are 'InJaz al-Arab' (Lebanon, Kuwait, Egypt), the Youth Entrepreneurs Association (Jordan), 'Intilaq' (United Arab Emirates), and 'Badir' (Saudi Arabia). However, as innovation suffers from a lack of both finance and qualified personnel (AII, 2006; GEM, 2007), there is an urgent need to devote special attention to building an innovation culture and incubating infrastructure, particularly among university graduates and researchers.

Conclusion

Entrepreneurship-driven innovation is a major driver in modern economies. Hence, technology-based entrepreneurship and technological innovation become not only very attractive but also important and useful for their impact on industrialization, growth, competitiveness, and technological development. In this paper it has been argued that another way of considering technological development is through shifts from low-tech to high-

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tech and science-based activities. In MENA countries, technological development is effectively under way, and entrepreneurship is being more actively promoted in a number of those countries.

Research on innovation and entrepreneurship in the Arab world in general, and the MENA countries in particular, is much needed. The very few publications on the subject are general, descriptive, or exploratory. The absence of data is a serious obstacle to carrying out detailed statistical analyses with a view to reaching definite conclusions. While there is a risk that current data sources are biased or inaccurate, the secondary source used here was taken as the only available way or accessible source of shedding some light on the issue. The results indicate that efforts are formally and purposefully being made to inject positive technological and entrepreneurial ingredients into the development process of the region.

While the prospects therefore seem to be positive for the MENA countries in their efforts to reach higher levels of technological development in the future, clearer emphasis should be placed on entrepreneurship education with particular attention to researchers and young people with technical and scientific profiles. Decision makers should focus on human resources more than on simple creation of greater numbers of businesses, at the same time being more sensitive to technological innovation projects put forward by local people and expatriates. It is to be hoped that this paper will capture the attention of relevant public authorities, managers, and entrepreneurs, and help them to understand the specific role of technological innovation and act accordingly for a better future for the region.

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***M-Said Oukil**
Department of Management and Marketing
College of Industrial Management
King Fahd University of Petroleum and Minerals
P.O. Box 1867
KFUPM
Dhahran – 31261
Saudi Arabia
Email: oukil@kfupm.edu.sa

Appendix 1. Patents granted to 13 MENA countries by US Patent Office (01/01/1977–12/31/2009)

Country	Number of patents	% to total
Saudi Arabia	324	40.75
Kuwait	126	15.84
Egypt	97	12.20
UAE	77	9.68
Lebanon	58	7.29
Morocco	42	5.28
Jordan	24	3.01
Tunisia	18	2.26
Oman	8	1.006
Qatar	8	1.006
Algeria	5	0.628
Bahrain	5	0.628
Yemen	3	0.377
Total	795	100%

http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_all.htm

Appendix 2. Examples of private industrial and technology companies in 13 MENA countries (alphabetic order)

Country	Firm	Industry
Algeria	Al Dar Al Arabia Pharmaceutical/Manuf.	Pharmaceutical/Biotechnology
	Alfatron Electronic Industries Spa.	Electronic equipment
	Alstron Algerie Spa.	Electrical equipment
Bahrain	Arab Shipbuilding and Repair Yard Co.	Heavy machinery
Egypt	Advanced Computer Technology	Software & tech services
	Amereya Pharmaceutical Co.	Pharmaceutical/Biotechnology
	Arab Cables Co.	Electrical equipment
Jordan	Al Asalah Electro Mechanics Co.	Electronic equipment
	Al-Anfal Fertilizer Industry Co.	Chemicals
	Alnejma Bulk Pharmaceutical Co.	Pharmaceutical/Biotechnology.
Kuwait	Arab Bild Industrial Resources Co.	Chemicals
	Al Bahar United Co.	Computers
Lebanon	Alliances Jewelleries, Pvt Ltd.	Textiles
	Arabia GIS SAL.	Software & tech services
Libya	Akakus Catering Co.	Energy
	Allibiya Co.	Chemicals
Morocco	Agapolymer.	Chemicals
	Alcoa Fixations Maroc.	Metals & mining
Oman	Al Anwar bank Co. SAOG	Metals & mining
	Al Intaj Sulphochemical Indus. Co.	Chemicals
Qatar	Afrina Trading and Construction	Engineering
Saudi Arabia	Advanced Electronics Co. Ltd.	Electronic equipment
	AES Arabia Ltd.	Heavy machinery
	Alsalam Aircraft Co.	Aerospace/Defense
Tunisia	Afrique Travaux Sarl.	Engineering
	Almed Sa	Heavy machinery
United Arab Emirates	Advanced Military Maintenance	Aerospace/Defense
	Al Badie Group	Heavy machinery
	Gulf Automobile Industry Corp.	Car manufacturing

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