# Science, Technology and Security in the Middle East

https://www.e-ir.info/2019/05/23/science-technology-and-security-in-the-middle-east/

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Science and technology enhance the capabilities of states and societies to obtain and transform resources necessary for their development and advancement. On the other hand, lack of scientific knowledge and access to technology not only affects a country's level of development but also jeopardises its national security. In an anarchic international system, security interdependence implies that the security of a state is closely tied to the security of the other states and especially its neighbours. Since national securities are interdependent, the security or insecurity of a state may have a considerable impact not only on the security of its immediate neighbours but also on the security of the whole region in which it is geographically embedded (regional security).

Technology, as a factor affecting national security, is closely related to population growth. The greater the population growth and the greater the pace of the technological development of a country, the greater the likelihood its activities and interests beyond its borders will expand. The greater the demographic growth and the less rapid the technological development of a country, the greater the likelihood it will face significant socio-economic problems and instability (Choucri 2002, 98). In other words, unevenness in the interactive growth and development within and across the societies contributes to unevenness in the size, development, and capabilities of such societies, to differential capabilities among them, and to competitions, conflicts, and violence (Choucri 1984).

As an engine of growth, the potential of technology is still largely untapped in the Middle East where states not only lack adequate skilled labour and capital, but also use these factors less efficiently. Therefore, the purpose of this chapter is to investigate the impact of science and technology on national and regional security in the Middle East. In doing so, the chapter is divided into six sections. The first section discusses the relationship between technology and development, while the second section explores the relevance of science and technology to security. Drawing on a historical analysis, the third section examines the reasons science and technology have not, so far, played an effective role in the development of Middle Eastern states and societies. The next section identifies and discusses the instruments and patterns of technological development in the contemporary Middle East. The last section of the paper offers a sectoral analysis of the relationship between science and technology, on the one hand, and security (national and regional) in the Middle East on the other.

## The Technology-Development Relationship

The commonly held view is that technology and development are strongly linked with development driven by technology and technology serving as a key indicator of national development. In reality, however, technological change is often highly problematic with respect to its socio-economic and environmental implications as it may exacerbate inequality, uneven development, ecological degradation, and/or social exclusion (Murphy 2017, 1). A critical understanding of the drivers, dynamics, implications, and geographically uneven distributions of technology and technological change is thus an important component of development studies and practice (Murphy 2017, 1).

Generally speaking, technology is the branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment, drawing upon such subjects as industrial arts,

engineering, sciences, and applied sciences. In this sense, technology is embedded deeply in social, cultural, economic, and political systems. Due to its spatial diffusion, technology has uneven geographies of use, significance, and impact (Murphy 2017, 1).

With respect to development, technology is seen as an essential driver and determinant of socioeconomic, cultural, environmental, and political change. Economically, technology can increase national productivity through improvements to the efficiency of production and logistics, while encouraging and enhancing innovation and knowledge creation. Alternatively, technology can exacerbate socioeconomic differences and create uneven development within and between countries and regions. Culturally, technology has a profound effect on the norms and identities that help to constitute particular social groups. Environmentally, technology can contribute in significant ways to greener and more sustainable societies or exacerbate ecological degradation through intensified or expanded impacts locally and globally. Politically, technology can have democratising effects (e.g. the Facebook revolutions in the Middle East) or it can facilitate enhanced forms of repression or surveillance by state authorities (Hanska 2016, 32).

Science and technology are key drivers of development. This is because technological and scientific revolutions and innovations underpin economic advances and contribute to improvements in health systems, education, and infrastructure. Thus, developments in science and technology have profound effects on economic and social development. Apart from constituting a salient political issue, access to and application of technology are critical to a country's development. By the same token, access to high quality education, especially higher education, is essential for the creation of scientific knowledge. Science and technology are the differentiating factors among countries separating those that are able to tackle poverty effectively by growing and developing their economies, and those that are not. The level of countries' economic development depends to a large extent on their ability to grasp and apply insights from science and technology and use them creatively. To promote technological advances, developing countries need to invest in quality education for youth, continuous skills training for workers and managers, as well as to ensure that knowledge is shared as widely as possible across society. Moreover, adopting appropriate technologies leads directly to higher productivity, which is the key to growth. Creativity and technological innovation emerge naturally in societies that have large stocks and flows of knowledge. In sharp contrast, in societies with limited stocks of knowledge, creative people feel constrained and migrate to other countries thereby causing 'brain drain' to their own countries and societies. Such societies are prone to remain in poverty and dependency.

Hence, in the presence of many social, economic and defence needs and demands, access to quality education as well as the adoption and application of appropriate technologies do not only constitute a policy question but also a question of policy priorities. Moreover, both of these questions are tied to a country's political development.

**Science, Technology and Security**

It has been suggested (Stivachtis 2011, 397–422) that development and security are interrelated. Indeed, the end of the Cold War allowed the identification of development with human security (UNDP 1993, 2). For instance, the *Declaration on the Right to Development* (1986, 2) asserts that all human beings have a human right to development and that

"development is a comprehensive economic, social, cultural and political process, which aims at the constant improvement of the well-being of the entire population and of all its individuals on the basis of their active, free and meaningful participation in development and in the fair distribution of benefits resulting therefrom."

Development has been consequently subdivided into several sectors, such as political development, economic development, and socio-cultural development. In addition, development and the environment are inextricably linked (UNDP 1994, 24–40). Moreover, it has been shown (Stivachtis 2011, 414) that there is a close relationship between development sectors and security sectors in the sense that the absence or presence of development in a particular sector impacts security and *vice versa*. For example, political development is related to political security, while economic development is related to economic security. As a result, lack of political development has the potential of enhancing political insecurity. Yet, as in the case of security, problems in one development sector may affect other

development sectors and, as an extension, the corresponding security sectors. For instance, political underdevelopment may affect economic development and, therefore, a state's economic security. This means that security and development can, to a great extent, be operationalised in the same way (Mittleman 1988, 22). Yet, it has been argued (Stivachtis 2011, 415) that national security becomes inextricably connected to national development. This means that neither development can be achieved without security nor security without development.

One of the most important questions in the field of security and development studies is whether a particular security or development sector is so significant that policy priority should be given to it. The expectation is that if problems/threats in this sector are addressed this would have positive effects on the other sectors. Addressing this question, political scientists stress the political prerequisites for economic development – political order and stability – implying the presence and function of viable institutions and enforceable rules (Almond and Coleman 1960; Almond and Powell 1966). For example, whether political instability in a country may result from the inability of the national government to promote economic development and create sustainable and effective welfare mechanisms, or from its inability to manage social and political change in a period of rapid economic growth, political development appears to be fundamental.

As far as the last point is concerned, the record contradicts the conventional wisdom that the way to avoid political instability is to stimulate economic development and industrialisation (Olsen 1963). Empirical research shows that whatever the long-term benefits of modernisation, its short-term impact tends to be more instability and sometimes violence (Skocpol 1994; Feierabend *et al*. 1966). Thus, discussion about development has emphasised political development, meaning the need to establish institutions capable of managing socio-political tensions and preventing their escalation into violence that may threaten the security of the state and its citizens.

However, since developing states have widely divergent social, economic, and political attributes, this diversity implies the absence of a unique policy formula that could apply without distinction to any developing state. Development enhances state power and capabilities and enhances national security. On the other hand, security provides the fertile ground for development while any threats to security ultimately affect development. Underdevelopment, on the other hand, increases the vulnerability of the state thereby enhancing its insecurity. Science and technology are key drivers of development and therefore central not only to a country's socio-economic development, but also its national security.

**Science, Technology and Development in the Middle East: A Historical Account**

Over the centuries, scientific and technological advances have repeatedly enabled foreign powers to interfere with the functioning of Middle Eastern economies, as well as to undermine the security of the less advanced countries of the region. This section will discuss some of the main technology-related events that led to this situation, which continues today.

Following the rise of Islam in the seventh century, science and technology flourished in the Islamic world to a far greater extent than in the West. Muslim rulers promoted the translation of Greek philosophy and science, and then encouraged further scientific exploration in numerous fields including mathematics, astronomy, medicine, pharmacology, optics, chemistry, and physics. Much of the knowledge developed by the Muslims and transmitted to the Europeans enabled Europe to emerge from the Dark Ages into the Renaissance (Saliba 2011).

Until the sixteenth century, the Arab world was connected by a unique system of trade and transport that unified its large population scattered over vast areas of land and sea. The system sustained the economy of each Arab state, underpinned trade with Europe, and fed into the various international trading systems (Bahlan 1999, 261).

In fact, the Arabs had developed an effective transnational trading system which reached its peak in the eighth to sixteenth centuries and which was based on local technological inputs, such as skilled merchants and caravan managers, navigators with extensive geographic knowledge efficiently operated ports and trading emporia, scientifically bred camels and seaworthy dhows (Bahlan 1999, 262). Trust and mutual dependence among closely knit social groups prevailed. The socioeconomic support of the transport and trading system enhanced regional

harmony and the stability of local communities. The mechanics of the Arab trading system were so flexible that traders could move their business readily from place to place in response to changes in supply and demand, or in order to avoid ruthless rulers or areas of conflict (Bahlan 1999, 263). Since trade brought prosperity and employment, local governments sought to attract traders, and provide security and support facilities to ease the process of trade and the life of the traveller.

The Arab transport system was responsible for the large-scale circulation of people and information. This included the diffusion of agricultural products, inventions, and all types of knowledge. Thus, the trade and transport system had a powerful economic, social, and cultural impact. It also integrated the economies of Arab countries with each other and with those of Asia, the Mediterranean, and Africa.

According to Antoine Zahlan (1999), there are three main reasons Middle Eastern countries lag behind in terms of technology and scientific knowledge: their loss of trade and transportation systems, the effects of the Industrial Revolution on Arab economies, and the political and economic effects of the colonisation and neo-colonisation processes.

*The Collapse of the Arab Trade and Transport Systems*

The collapse of the Arab trade and transportation systems was induced by Portuguese technological advances in ship design, navigation, and naval warfare (Guilmartin 1974). The strategic breakthrough was the invention of transoceanic ships. These ships could carry a large number of guns and could navigate the high seas. The Arabs failed to acquire or develop the necessary technological capabilities to match Portuguese naval vessels.

The small but powerful Portuguese fleet interfered violently with trade between the Arab world, Asia, and Africa (Guilmartin 1974). The Portuguese used their superior naval force to harass and interfere with shipping, attack coastal towns, loot ships, and pillage coastal towns. Ottoman technical assistance to the cities of the Arabian peninsula ultimately saved the people of the Arab coastal towns from outright massacre by the Portuguese. For the next three centuries, the forces of the Ottoman Empire protected the region from European devastation. However, the Ottomans themselves were unable to cope with European technological challenges and their empire eventually collapsed.

Portugal's naval technology diffused to the European Atlantic states. By the early seventeenth century, the British, the Dutch, and the French had displaced the Portuguese from the Indian Ocean. Between 1620 and 1670, these three countries introduced a new innovation: the East India Company which controlled fleets, marketing systems, finances, storage space, and armies (Platt 1977). While Arab trade depended on the efforts of a very large number of traders operating in a small scale and each working on their own, the East India Company was centrally managed possessing the financial resources necessary to exercise monopolistic behaviour and thus control markets. Consequently, the East India Company quickly managed to eliminate Arab long distance trade (Platt 1977).

By the eighteenth century, trade routes throughout the Middle East were being reoriented toward coastal towns and European trade and transport. Whereas the Arab international trading system had been heavily land-based and internal, the new system was heavily dependent on European shipping and trade (Bahlan 1996, 264). This loss was soon followed by the progressive displacement of internal land-based long distance travel services by European shipping. No serious Arab competition arose to challenge the rapid development of European Mediterranean shipping firms (Headrick 1981).

When in 1832 the French occupied Algeria, and later Tunisia and Morocco, they sought to close all trans-Saharan routes, which were being used by resistance movements and by 'clandestine' trade (Bahlan 1999, 265). Thus by the early twentieth century, the complex and rich system of internal trans-Saharan transport had been dismantled. Two further technological developments accelerated the dismantling of regional and local trade and transport systems: the construction and operation of railway systems by foreign firms, and the construction of the Suez Canal (Headrick 1981).

By the latter part of the nineteenth century, the national systems of trade and transport had disintegrated to the level where they were replaced by totally imported systems with very little local participation (Zahlan and Zahlan 1978). The displacement of camel-based transport technology with railway and steamship technologies without the transfer of mechanical and new naval technologies meant that the Arabs lost the employment generated by operating their system of transport (Headrick 1981). Even today, Arab countries remain unable to acquire the employment derived from operating and maintaining their extensive transport systems.

The strength of the Arab and Muslim worlds was based on a common market and not on political unity. Although many Arab countries were in conflict, this did not eliminate trade and cultural exchanges between them. But as the Arabs were unable to acquire, adopt, or develop alternative technologies to contain technological challenges, which eventually led to the collapse of the transnational Arab trading system, the forces that bound the Arab communities to each other were loosened and the cohesiveness of the Arab world began to weaken.

*Industrial Revolution*

The second phase of technology dismantling was induced by the Industrial Revolution, which undermined the traditional textile industries that were firmly based in Arab countries. Steam power, machine production, chemical sciences and technology, electrification, petroleum production and refining, communication technologies, radio, electric power and engineering, and countless advances in medical science, construction technologies, city planning, and management systems all had dramatic consequences for the Arab world.

Every technological advance in Europe contributed to the continuing decline of inter-Arab cohesiveness (Zahlan and Zahaln 1997). The acquisition of Western military technologies, beginning with the Ottomans and Muhammad Ali, led to the progressive divorce of military institutions from their local environment and to their progressive integration into the military-industrial-intelligence complexes of Western powers.

New technology was imported in a dependent mode and packaged with its consultants, contractors, operators, and financiers, and without any effort being made to develop new technologies at home (Zahlan and Zahlan 1991). The cost of this dependency was enormous as were the resulting economic and political consequences of the Egyptian and Ottoman debts: the occupation of Egypt in 1882, and the collapse of the economy of the Ottoman Empire.

*Colonisation and Independence*

The third phase of technology dismantling began with the direct occupation of Arab countries when practically every single important decision was made by the emissaries of the colonial powers. Colonialism affected all aspects of life in the Middle East. The net result was the further divorce of the elites, the culture, and the economy of the region from technical matters (Zahlan 1999, 267).

The fourth phase was induced by political independence. When independence was achieved, the rulers and elites of the new states had little knowledge of contemporary developments in science and technology, which had become so central to the industrialised world in the late twentieth century. Not only did all equipment, industrial supplies, and maintenance services have to be imported, but also Arab countries depended completely on foreign consulting and contracting services (Helie 1973). The new leaders sought to develop their countries through the rapid expansion of educational systems and investment in new industries. Cultural distortions and alienation were intensified by the accelerated programs adopted at this time (Beblawi and Luciani 1987). Because they wished to accelerate the process of development, the new national elites unknowingly adopted methods that ultimately led to even greater technological dependence. As a result, foreign consulting firms conceived and designed enormous projects, foreign accounting and law firms monitored them, and an army of foreign contractors and foreign labour implemented them (Zahlan and Zahlan 1978). Although major things were built, such as power and desalination plants, hospitals, irrigation schemes, enormous dams, transport systems, and airports, locals contributed little to the process (Beblawi and Luciani 1987). However, those who mediated these contracts earned enormous commissions and well-placed people accumulated personal fortunes in the billions of dollars (Zahlan and Zahlan 1984). Meanwhile, the gap between the Arab world and industrial countries has continued to grow, and Arab economies still suffer from chronic

stagnation and low productivity.

**Components and Instruments of Technology Systems**

The major instruments of national technological development are university education systems, research and development (R&D), national consulting and contracting firms, relevant economic and financial institutions to support technological development, and science policy (Zahlan 1996, 269).

There has been a significant and dramatic expansion of the proportion of people in the Middle East who have completed four or more years of higher education. The number of universities has also increased including a significant number of foreign universities (Kjerfve 2014). Yet, the quality of higher education in the Middle East is among the lowest in the world. Only two or three Arab universities are in the list of the top 500 universities in the world and none is in the top 200. Employers in the region complain that university graduates lack the skills needed to work in the global marketplace. Many are not well-trained in science, mathematics, engineering, and other technical subjects where the jobs are. Furthermore, these graduates lack the 'soft skills', including creativity and teamwork, partly because their training has emphasised memorisation and rote learning (Devarajan 2016).

Much of the emphasis of Arab foreign education has been in science and engineering (Qasem 1998). Doctoral-level knowledge-producing education, however, is still highly underdeveloped in the region and, therefore, specialisation is pursued abroad (Dini *et al*. 2015).

Arab universities have been the leading centres for both basic and applied research in science and technology. The number of professors in Arab universities has increased with the majority of them associated with science and technology (Zahlan 2012). The number of research and development centres also increased with half of them engaging in research in agriculture, nutrition, water and irrigation, marine sciences, and the biological science. The rest focus on oil and petrochemicals, ecology, basic sciences and computer science (Lightfoot 2018). Research activity in Arab countries is thus highly focused on applied subjects, with a priority in medicine and agriculture. Despite the valiant efforts of a number of scientists, basic research is on such a small scale that it is virtually non-existent (Zahlan 2012).

R&D organisations play a major role in successful planning, design, and operation of economic installations. However, because the consulting and contracting services utilised in establishing industrial plants are generally imported on a turnkey basis, the demand for local R&D services is still limited (Sehnaoui 2017). Technological dependence severely constrains the development of the requisite R&D capabilities to support and service the various economic sectors (Zahlan 2014).

Arab science and technology-related human resources are more than adequate and could, in principle, constitute an integrative social factor. But in the absence of rational and appropriate science policies and adequate financial resources, the potential of this human resource is dissipated (Zahlan 2012). The reason for such a low figure is the lack of resources and the absence of demand for services by nationals: both the public and private sectors depend nearly exclusively on foreign firms for technical services (Zahlan 2014).

Arab countries are near the top of the Developing World level of activity, but far below the levels of industrial countries. Thus, although the output may be comparable, the application of scientific findings is more constrained than in other large developing countries where there are no political or economic barriers to the circulation of ideas and expertise (Segal 2018).

The Arab world provides a large market for technology products and services. This can be seen from the large number of identical contracts for the same technology that are awarded repeatedly over short periods of time in a number of technological fields. Such a market provides excellent opportunities for technology transfer because technology is best acquired as part of the repeated undertaking of similar projects (Zahlan 2012). The absence of adequate financial and insurance services to support national consulting and contracting firms, combined with the absence of adequate technology policies, are the main reasons for the slow pace at which technology trickles into the

region (Zahlan 1984). Contracts with foreign consulting and contracting firms are in agricultural development, construction, transport systems, industry, educational technologies, aviation, communication, and so on. (Emery*et al*. 1986; Zahlan and Zahlan 1991).

Since the national markets for sophisticated technological services of each Arab state are small, any serious effort to transfer technology has to involve substantial Arab economic cooperation. There has been no significant effort to date to implement inter-Arab cooperation in technology. Moreover, the subject of technology transfer to the Arab world has become synonymous with trade (Emery *et al*. 1986; Ilgen and Pempel 1987). In this type of analysis, Arabs are not seen as participant in a process of technological development. The main focus of this approach is on the suppliers of technology rather than the consumers. In addition, emphasis is often placed on the competition among the various industrial powers for the lucrative Arab markets; the behaviour of the Arab trading parties tends to be of minor interest. This is mainly due to the fact that much of the planning and decision-making is done by foreign institutions. The leading Arab development institutions, as well as the Arab governments utilise foreign consulting firms almost exclusively (Zahlan 2014).

In the presence of foreign skills and know-how, the construction of petrochemical plants, refineries, and water desalination plants is well within the capabilities of Arab organisations. Arab firms lack neither the technical expertise, nor the natural, financial, or human resources to undertake such projects. What is missing is a variety of other inputs, such as financial, legal and technical support services that Arab governments do not make available to their national organisations.

Finally, the weakness of Arab science and technology systems in conjunction with the absence of effective science policies in the Arab world have made the economic integration of technological activity very difficult (Zahlan and Zahlan 1980). The inability to formulate and adopt sensible technology policies has contributed to the continuing disintegration of Arab society and culture (Beblawi and Luciani 1987, 27). Unemployment, alienation, marginalisation, and the intensification of civil unrest and violence are all direct or indirect indicators of the absence of an integrated science policy and of the impact of that absence on the economic life of the Arab world (Bizri 2017).

**Science, Technology and Security Sectors**

In the military sector, the referent object of security is mainly the state. Military action usually threatens the state's physical base (territory and population) and institutions (Buzan 1991, 116–117). The relevance of science and technology to military security is highlighted by the need of states to produce weapons systems necessary for national defence. It is not by accident that due to current conflicts in the region, the major focus of many Middle Eastern states is access to military-related technologies. States that have the necessary technology to produce their own weapons systems find themselves in a better position than those that have to import weapons. This is not only for economic reasons (i.e. impact on trade balance) but also because they can be less politically dependent on weapon supply countries.

When it comes to achieving military self-reliance in the Middle East, technology transfer and the expansion of local production for international export are common objectives of regional countries (Singer 2009). Indeed, in their contacts with the major Western producers of military equipment, some Middle Eastern states have made it clear that 'If Western providers of military equipment want to work with local Arab companies, they will have to transfer their technical knowledge to the ones that are part of a rising indigenous defence sector' (Mouchantaf 2018). However, some analysts are sceptical of this attitude because regional states lack the capability to absorb military technology not only due to the shortage of nationals in the defence industry but also because of the limited access to science, engineering, and mathematics graduates (Mouchantaf 2018).

In the political sector, the referent object of security can be the government or the citizens. Threats may arise as a result of peoples' dissatisfaction with governmental policies or from the attempts of governments to exercise tight control over their citizens in their effort to maintain power. Surveillance and other control-related technologies in the hands of governments, such as control over the mass media and press show the relevance of technology to political security. On the other hand, the recent Arab uprisings demonstrated that communication technologies, such as the

internet (Facebook) and cell phones can be effectively used to organise and coordinate popular resistance to the government (Berman 2017).

Specifically, although text messaging was used extensively in the Arab Spring, it had a limited effect and did not lead to direct political change (Brown 2012). As a tool, it helped individuals to communicate and coordinate, but this impact was indirect. Satellite TV also had more subtle and varying effects. What made the big difference was the use of cell phones, which provided a ubiquitous image and video capture device (Ellis 2011). Anyone possessing a cell phone could document and transmit footage instantly. Without camera-phones, the only actors capable of documenting the 2011 uprisings would have been professional journalists whose coverage is usually lacking in dynamic situations such as the Arab Spring. Cell phone technology also helped to include citizens who were watching events unfold, as they were seeing video and images captured by regular citizens. This mobilised individuals who felt like they too could take part in the protests and have a political voice. Social media and the Internet also had a significant impact on the outcome of the Arab uprisings as they offered the protestors a space to express and develop political viewpoints unhindered by regimes. This is because social networking sites like Facebook have structural features that promote participation and mobilisation (Hanska 2016, 29–30).

On the other hand, the Arab Spring demonstrated that it is quite dangerous to be friends with regime critics on Facebook. For example, the Syrian Electronic Army (SEA) was established to wage online war against Assad opponents. As a result, SEA has attacked domestic sites as well as international targets, such as the Associated Press Twitter account (Ellis 2011).

Technology, however, has a long history of being used in revolutionary movements in the Middle East. For example, during the Iranian revolution, Ayatollah Khomeini produced and distributed tapes of sermons denouncing the Shah, helping to grow dissent in the country. Parallels can also be drawn with the Cedar Revolution of 2005 in Lebanon, where protests occurred after the Lebanese Prime Minister was killed. Citizens demanded an investigation and the withdrawal of Syrian troops from the country (Ellis 2011).

A final aspect of the impact of the internet on the Middle East conflicts involves the utilisation of social media for jihadist recruitment. The phenomenon is particularly relevant in cases of so-called self-radicalisation where individuals succumb to the lure of extremist propaganda, produced in Middle East sites. Pulled into ISIS circles, some cyber recruits carry out violent acts as ‘lone wolves’, while others travel to the Middle East in order to fight for the caliphate.

In the societal sector, the referent object of security is collective identities, such as religious or national identities (Buzan 1991, 122–123). As in the political sector, surveillance and other control-related technologies can serve as instruments of power in the hands of governments that aim at controlling particular religious and ethnic groups. This is the reason societal threats can be difficult to disentangle from political ones. On the other hand, targeted social groups may use communication technologies to raise support for their cause or invite external involvement for protection purposes.

In the economic sector, national security issues can emerge involving linkages between economic capability on the one hand, and military capability, power, and socio-political stability on the other (Buzan 1991, 126). Due to its connection to economic development, science and technology become central to economic considerations (Chambers 2015; Ahmed 2018). Moreover, a state’s military capability rests, at least partly on the possession of an industrial base capable of supporting the armed forces. The absence or the economic decline of basic industries can, therefore, raise questions about the ability of the state to support independent military production (Buzan and Sen 1990). For example, the desire of several Middle Eastern states to maintain or acquire production capability in key militarily related industries has inserted a national security requirement into the management of the national economy. On the other hand, the pursuit of military research and development has prevented some Middle Eastern states from investing in their civil economy.

Yet, when technology cannot support economic development, economic threats may also enhance domestic instability. The link between economic and political stability generates a set of questions about development, which

can easily be seen as national security issues. For example, some Middle Eastern states that are not efficient producers find themselves locked into a cycle of poverty and underdevelopment from which there is no obvious escape. Hence, the governments of those states find themselves having to choose between investing in new technologies and knowledge creation at the expense of lowering the already very low living standards.

Information and Communication Technologies (ICT) constitute one of the fastest growing sectors in the Middle East. Nevertheless, most of the countries in the Middle East have shown no signs of impending information revolutions (IRs). The proliferation and ever-more-sophisticated employment of ICTs are critically dependent upon economic factors, as well as the nature of the government and its role in ICT development. Except for Israel and Turkey, every other country in the region is deficient in necessary economic factors or government participation (Burkhart 2003). Thus, it has been argued that despite having high mobile penetration rates, the Middle East lags behind other areas in terms of technological advancement and regional states need to improve technology education and the regulatory framework (Saadi 2017). Moreover, governments need to address information-related security vulnerabilities that threaten the operation of both the private and public sectors and impact national economies.

In the environmental sector, science and technology become extremely relevant due to the need to have an efficient use of natural resources and to protect the environment. The overall aridity of the Middle East has motivated some of the richer countries to search for technological solutions to their water requirements. Through sustained investment in research, they have become experts in water desalination, water recycling, and solar energy. The region's oil-poor countries, however, cannot afford such advanced technologies and remain dependent on more traditional water resources. Yet, the need to secure access to water has led to the utilisation of construction-related technology to create water dams. Unfortunately, while these dams regulate the water flow to cropland, generate vital electricity, and supply potable water, they also introduce environmental problems that have cast a shadow on their overall success. Since the region's major rivers no longer flood to produce natural fertilisers, farmers downstream are forced to use massive amounts of artificial fertilisers, which in turn pollute the regional rivers.

**Conclusion**

The technological dependence of Arab countries has enhanced their vulnerability to outside interference and reduced their internal, national integration. National integration depends on economic exchanges within society. Dependent technology policies reduce such exchanges. Instead, economic exchanges take place with foreign countries without involving the national population. The counterpart of weak internal cohesiveness is a high degree of dependence on imports. In general the extent of Arab dependence on imports for all necessities of life is striking.

On the positive side, Middle Eastern countries possess enormous human, strategic, and natural resources, which, if efficiently managed and put to effective use, could induce a rapid economic change. But those resources cannot be put to socioeconomic use because of the underdeveloped state of their national and regional institutions. In other words, socioeconomic development is difficult to achieve in the absence of an adequate level of political development. This situation is a direct consequence of the strength and stability of the prevailing rentier political economy (Beblawi and Luciani 1987). Therefore, Middle East governments need to strengthen their political, legal, and institutional systems, adopt a performance-oriented political economy, and introduce an appropriate science and technology policy.

Today, Arab countries face three major challenges: population pressures, global increase of oil and gas sources, and declining Arab labour productivity. Mounting population pressures will decrease the resources available for undertaking economic reforms. By the year 2050, an expected increase of some 400 million inhabitants will bring the total population to some 700 million. Half of these will be below the age of 18. This young population could be an important force for positive and creative change if provided with proper education and training. The absence of appropriate technology policies, however, could transform this abundant and youthful population into a disruptive and destabilising force. To this, one may add the fact that the expanding number of gas and oil sources worldwide have combined to reduce Arab income and increase the cost of imports. In addition, increasing labour productivity in the newly industrialising countries is reducing the attractiveness of Arab countries for foreign direct investment. Most of the subcontracting to the Arab states now is for low-value-added and low-technology activities. In other words,

internal and external factors are not favourable to promoting technological development in the Middle East. However, it is imperative.

The future of any country is contingent on its capacity to produce the goods and services in demand. The major tool in achieving this goal is science and technology. The Middle East has remained outside this competition because Arab states have not sought to acquire the requisite political economy. However, people in the region retain the capacity to alter their future. Thus, a positive response to global technological challenges would require the adoption of a successful program of technology transfer in order to narrow or close the technology gap. Technology transfer takes place over a substantial period of time and is a cumulative and systemic process. Transfer, however, involves changes in a country's political culture, the legal system, the economy, social organisation, and management.

To promote technological advances, Middle Eastern governments should invest in quality education for youth, continuous skills training for workers and managers, and should ensure that knowledge is shared as widely as possible across society. Yet, particular attention should be given to improving the investment climate, which is crucial, as are the right incentive structures, to guide the allocation of resources, and to encourage research and development. Successful countries have grown their ability to innovate by investing public funding to help finance research and development in critical areas.

The benefits to flow from technological revolution in an increasingly connected and knowledge-intensive world will be seized by those countries that are sensitive and responsive to the rapidly changing environment and nimble enough to take advantage of the opportunities. Those who succeed will make substantial advances in reducing poverty and inequality. Those who do not, will face enormous internal insecurity and will transform themselves into a threat for their neighbours and the region in which they are embedded.

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