CHAPTER 5

Using human capabilities: towards a knowledge society

Chapters 3 and 4 dealt with building human capabilities in Arab countries. This chapter and the next take the analysis a stage further to consider key areas for using human capabilities in the service of human development and welfare. This chapter focuses on utilizing capabilities in two areas that have assumed increasingly critical importance in today's knowledge-intensive world: scientific research and technological development (R&D) and information and communication technology (ICT). It considers Arab countries' progress to date in both of these areas to be relatively weak. With respect to R&D, it discusses the limited nature of R&D output and its use in Arab countries, noting some of the problems these countries face (the cost of technological development, combined with the absence of strong social demand, a large market or important societal actors interested in promoting such development, coupled with weak links between the productive sector and the education systems). It then puts forward a series of proposals for building effective R&D systems, based on a more conducive environment for their development, and an agenda for priority action. Turning to ICT, similar weaknesses are observed. For example, compared with other developing regions, the Arab region comes last with respect to web sites and Internet users, the two indices relevant to the level of information development and representative of society's involvement in ICT. It notes a range of other problems and proposes elements of an ICT strategy for overcoming them and substantially enhancing both quality and access.

STATUS OF SCIENTIFIC RESEARCH AND TECHNOLOGICAL DEVELOPMENT (R&D)

Effective systems for scientific research and technological development (R&D) are both products and drivers of education systems, especially higher education. The latter is the main source of the knowledge workers who are employed by the former, while strong R&D can, in turn, promote education/learning, especially with respect to advanced knowledge in the higher-education sector. As chapter 4 has shown, Arab higher education is urgently in need of upgrading, and its current shortcomings are reflected in weaknesses in Arab R&D. The status of R&D in the Arab world has been characterized in a variety of ways (Zahlan, A., in Arabic, 1999). Among its most important features are the following:

- In the Arab world, there is a strong correlation between the crisis in the process of development on the one hand and inappropriate technology policies on the other. A very large investment in gross fixed-capital formation of some $3,000 billion over the past 20 years has had poor returns in per capita income despite massive increases in the numbers of school and university graduates.
- Arab countries have some of the lowest levels of research funding in the world, according to the 1998 World Science Report of the United Nations Educational, Scientific and Cultural Organization (UNESCO). R&D expenditure as a percentage of GDP was a mere 0.4 for the Arab world in 1996, compared to 1.26 in 1995 for Cuba, 2.35 in 1994 for Israel and 2.9 for Japan.
- The establishment of national science and technology (S&T) systems in Arab countries is crucial for development and security. However, countries have typically acquired

Arab countries have some of the lowest levels of research funding in the world.

technology via turnkey contracting and continued reliance on foreign consulting and contracting firms, thus perpetuating technological and economic dependency, limiting employment opportunities and raising the cost of technology acquisition.

Output indicators

Science and technology output is quantifiable and measurable in terms of number of scientific papers per unit of population. The average output of the Arab world per million inhabitants is roughly 2 per cent of that of an industrialized country. While Arab scientific output more than doubled from 11 papers per million in 1985 to 26 papers per million in 1995, China's output increased elevenfold from one paper per million inhabitants in 1981 to 11 papers per million in 1995. The Republic of Korea increased its output from 6 to 144 papers per million inhabitants over the same period. India's output, by contrast, barely changed over the period 1981-1995: its output increased from 17 publications per million inhabitants in 1981 to 19 per million in 1995.

In 1981, China was producing half the output of the Arab world; by 1987, its output had equalled that of Arab countries; it now produces double their output. In 1981, the Republic of Korea was producing 10 per cent of the output of the Arab world; in 1995, it almost equalled its output. On a per capita basis, the output of the Arab world is within the range of the top R&D-producing group in the developing world: Brazil, China, and India.

Many of the significant technology-rich industries in the Arab world have been parachuted in as "black boxes".

BOX 5.1
Science as a Western phenomenon and the history of Arab science
(abridged from the Arabic version)

That classical science is in essence European whose origin can be traced to Greek philosophy and science was promoted by the Orientalist movement of the eighteenth century, starting from a eurocentric conception of the world and, contrary to the tradition in the history of philosophy and science, maintained intact during the last two centuries.

Although reasons have been advanced to justify the exclusion of "Eastern science" from the chronology of the scientific mind and these have been subject to criticism in this century, particularly in the last 20 years, the eurocentric conceptualization is the strongest element of this ideology.

Is time not ripe yet to abandon all anthropocentric characterizations of classical science as well as "miracles", be they Greek or Arab, so that an objective history of science can be written without resort to false axioms that barely hide anthropocentric motives?

Source: R. Rached, The History of Arab Mathematics: between Algebra and Arithmetic (in Arabic), Centre for Arab Unity Studies, Beirut, April, 1989.

The quality of scientific capabilities is measured by the number of citations received, based on the idea that the more often a scientific paper is referred to, the higher its quality and importance. Table 5.1 shows the number of papers cited per million inhabitants for selected countries. The Arab countries not mentioned in the table had no frequently cited publications. The right-hand column of the table suggests that the Arab countries included are within the range of other developing world countries but evidently lag far behind industrialized countries.

Making use of output: connectivity, external linkages, technological development

Connectivity, outsourcing, subcontracting

Benefiting from research and technological output depends critically on a robust system of national and international linkages among practitioners. Brazil, China and the Republic of Korea have established system linkages and policies in order to benefit from their national knowledge base. They have adopted technology policies that have enabled them to sustain a high rate of growth combined with a high rate of technology acquisition. By contrast, the connectivity of Arab scientists within the Arab world is poor at the national and regional levels. The connectivity of individual Arab scientists with international science is better simply because international relations in science provide the means for cooperation.

As noted earlier, many of the significant technology-rich industries in the Arab world have been parachuted in as "black boxes" via international consulting and engineering development organizations (CEDOs). However, these installations are not linked to local or regional CEDOs and R&D organizations. Until such connectivity is established, such installations cannot contribute to the scientific and technological development of the Arab world.

During the past 30 years, there has been a massive transformation of industrial firms in OECD countries; outsourcing and subcontracting have contributed to breaking down the vertically integrated firm. Integration has instead taken the form of joining a global web

of technological expertise; meanwhile, outsourcing has promoted the transfer of technology to Asian and Latin American subcontractors along with the transfer of employment from high-cost to low-cost countries. A number of Asian countries in particular have successfully secured a considerable share of subcontracting from major transnational corporations. This contributed to the formation of the celebrated Asian Tigers and others, such as Indonesia, Malaysia and Thailand. Few Arab countries have benefited from the globalization of outsourcing.

TABLE 5.1
Active research scientists, frequently cited articles and frequently cited papers per million inhabitants, 1987

Country	Research Scientists	Articles with 40+ citations	Number of frequently cited papers per million people
United States	466,211	10,481	42.99
Switzerland	17,028	523	79.90
Australia	24,963	280	17.23
Israel	11,617	169	38.63
Republic of Korea	2,255	5	0.12
India	29,509	31	0.04
China	15,558	31	0.03
Egypt	3,782	1	0.02
Saudi Arabia	1,915	1	0.07
Algeria	362	1	0.01
Kuwait	884	1	0.53

Challenges for Arab countries

This unfortunate state of affairs reflects the absence of well-developed national science and technology systems in Arab countries. Without such systems, including the necessary institutional and system infrastructure, domestic performance and external economic relations stand to suffer considerably. One reason why inter-Arab trade is so low (by some estimates as little as six per cent of Arab countries' total trade) may be the lack of capabilities of the science and technology system. However, opportunities exist for remedying this situation. Because of the widespread availability of knowledge, latecomer countries (including Arab countries) have the opportunity to leapfrog over earlier stages of research and technological development; they do not need to re-invent the wheel and repeat the mistakes of early researchers. Catching up can involve learning to adapt old technologies to the current state of science, based on creative R&D, imagination and ingenuity. Doing so would help to redress the problem noted earlier of poor returns on past investments in human resources, R&D and gross fixed-capital formation—which is a function of poorly developed connectivity and currently weak science and technology systems.

Connectivity remains critical. Effective R&D/S&T systems are complex, knowledge-intensive webs of organizations and institutions. In fulfilling one of their key functions—to produce, diffuse and convert knowledge into useful and desired outputs—the quality and efficiency of the connections that link the various components of the system are as critical as the components themselves. The successful pursuit of activities in these fields involves individual scientists, teams of experts, national and regional institutions and international organizations. The nature of the connections between the various components varies from one field to another, but each successful community displays a variety of linkages, which are mutually reinforcing and have complementary roles.

International and regional connectivities

Science and technology are global activities. An enormous amount of international cooperation is required to sustain them. Globalization reached science and technology long before it reached the political and economic spheres. Scientific cooperation is dictated by the universal nature of science. International cooperation between scientists and technologists takes many forms. In the case of Arab countries, there are strong practical incentives for R&D/S&T cooperation. For example, as discussed in chapter 3, most of the Arab world lies in an arid zone where water is scarce; this gives countries a common interest in issues relating to water use (including both conservation and tapping unconventional resources), water management, and water-efficient agriculture. Likewise, several Arab countries are oil and gas producers, which provides common technological challenges and opportunities for sharing experiences. Arab countries also share a number of problems, e.g., in health and the application of codes and standards. Hitherto, however, Arab countries have been unable to benefit

Arab countries have the opportunity to leapfrog over earlier stages of research and technological development.

BOX 5.2

Level of technological achievement in Arab countries

Technological development is rather weak in the Arab countries. This is evidenced by the relative position of Arab countries on the UNDP technology achievement index (TAI) (HDR, 2001), which referred to the late 1990s.

The TAI could be calculated for only five Arab countries: Algeria, Egypt, Sudan, Syrian Arab Republic and Tunisia, another indication of the poverty of data on knowledge acquisition in Arab countries.

None of these were classified as "leaders", a category that included countries such as Israel and the Republic of Korea. Sudan was classified as "marginalized", while the other four Arab countries were classified as "dynamic adopters", in the same category as Brazil.

In spite of significant internal variability and compared to leaders in the world, Arab countries in general clearly lag behind in technology creation (measured by patents granted to residents) and diffusion of recent innovations (measured by the share of high- and medium-technology exports in total goods exports). On the other hand, Arab countries fared relatively better on diffusion of old innovations (measured by telephone lines relative to population).

from their commonalities because they lack institutional R&D/S&T connectivity, in ironic contrast to the significant level of collaboration between Arab scientists and their colleagues in non-Arab countries.

The dilemma of poor technological development

In spite of important achievements in specific areas (e.g., aspects of extracting and processing oil in Kuwait; water desalination in Saudi Arabia; the design of sugar production lines in Egypt; and some successes in military manufacturing in Egypt, Iraq and the Syrian Arab Republic), technological development is remarkably weak in the Arab countries (box 5.2). A critical factor explaining this weakness is that technological development is a costly process, requiring a sufficiently extensive, dynamic productive base to create a strong social demand for technological development as well as a market large enough to justify its cost. Lacking these prerequisites, Arab countries have a dearth of important societal actors, whether in government or the private sector, who have a sufficiently strong interest in promoting technological development. It is instructive to note that the exception to this rule is in the military sector, where there was sufficient demand from the state, especially in Egypt and Iraq, and willingness to bear the cost. Unfortunately, however, these efforts have not spread to civilian applications.

Stimulating R&D requires a focused effort to create an enabling social, academic, commercial and regulatory environment .

TOWARDA EFFECTIVE R&D SYSTEMS

Building effective national R&D systems requires broad-based attitudinal change, involving a clear policy commitment from national authorities, wide public respect for science and knowledge and a keen desire on the part of society to keep up with scientific progress. Organizationally, the development of successful long-term R&D policies requires cooperation between R&D institutions, universities, and industry. Components of the R&D continuum need to be fostered concurrently. These components include educational systems; institutions dealing with basic, applied and interdisciplinary research; information services; funding institutions; professional societies; consulting firms; technical support systems; procurement services; and the public at large. Such cooperation fosters critical synergies and promotes the harmonization of complementary approaches, theories, analyses and applications. The evolving role of universities is especially important in R&D strategies. Theoretical research will certainly continue to be their primary responsibility, but without strong participation in applied research activities, they cannot truly contribute to the progress of analytical methods or to the enrichment of theories.

An enabling environment for R&D

Stimulating R&D requires a focused effort to create an enabling social, academic, commercial and regulatory environment to support research and technological development. The key drivers of change in these four spheres are discussed below.

Social environment

The attitude of society and individuals towards creativity, innovation and change deeply influences scientific progress. This attitude can be changed through policies that modify the rules of the social game and provide incentives for embracing change and reform. Among the most effective incentives for changing attitudes is the provision of real opportunities for social recognition, reward and advancement for those who work in the areas

of knowledge and innovation. In many societies around the world, local and national competitions, peer reviews, government medals or other forms of recognition of merit, well-publicized research grants and other similar schemes help to elevate the successful scientist's stature, thereby providing incentives for further research and holding up appropriate models for younger generations of scientists. The entrepreneurial spirit must also be kindled in order to sustain R&D within society. However, it should be recognized that many R&D activities are long-term in nature and offer limited immediate rewards although the returns on long-term endeavours should be substantial.

The success of R&D policies also requires a dramatic change in the attitude of scientists and researchers towards their own productivity. Universities, specialized research centres, consulting firms and professional associations need to focus more on performance, efficiency and results. Higher efficiency can be achieved through a better distribution of roles, choosing research objectives that better match the real-life challenges Arab countries are facing, and stronger institutional and professional collaboration that optimizes the use of resources.

An R&D culture grows out of a social infrastructure of experimentation and entrepreneurship with solid recognition of achievement and appropriate rewards. Support for experimentation requires the allotment of facilities, time and resources for such activity in the research community and at all levels of the education system. Experimentation also depends on tolerance of failure within a society. This tolerance is a critical element of the R&D process. Hence, an Arab R&D culture must evolve that does not frown on failure but rather encourages perseverance and dedication.

Academic environment

Experimentation. Arab scientists pioneered the structured experimentation process (commonly known in Western culture as the scientific method and represented by the concept of algorithms, derived from the Arabic Al-Khwarizmi). Although this is a rudimentary, well-understood process, modern Arab curricula have devoted too little time and attention to this central pillar of research and development. Additional academic attention needs to be given to approaches to structured reasoning (deductive, inductive and statistical) that provide the tools for formulating experiments and analysing their results.

Access to information. Arab students have long had to work with outdated materials and scientific journals, reflecting inadequate university and library funding for critical periodicals. Academic institutions will need to do much more to provide access to up-to-date materials either through hardcopy library access or through the vast, instantaneous knowledge base afforded by the Internet. In this respect, digital communication has greatly alleviated the physical and monetary constraints of most academic institutions in the region.

Global collaboration and external validation. Research is an activity conducted by a global community without boundaries and the scientific research process depends vitally upon collaboration. Indeed, the Internet itself was initially developed by geographically distributed research institutions to enhance their collaboration on joint research projects. In addition, external validation of local research is critical for providing an objective measure of accomplishment. Exchange programmes, external review boards, advisory councils and joint research councils provide means for measuring and validating achievements. One particularly successful example of this process is the Indian Ph.D. qualification process, which stipulates the review of original doctoral work by external academics who are in the forefront of their respective academic fields.

In essence, the role of academic institutions in furthering R&D efforts across the countries of the Arab region should focus on: (a) identifying core regional and global research needs; (b) collecting and disseminating global knowledge; (c) marshalling commercial and government resources; and (d) developing human resources for the next generation of R&D leaders.

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Commercial environment

Both long- and short-term incentives for individual researchers are commercial drivers of effective R&D. Researchers need to be supported by a solid, guaranteed career path in

addition to substantial rewards for spectacular breakthroughs.

The Arab world lags significantly in private investment in R&D, reflecting the legacy of a closed, controlled economic environment. The pressures of increased global competitiveness brought about by WTO and enhanced global communication necessitate increased private-sector investment in R&D as a key global differentiator and source of competitiveness. However, many Arab firms have limited resources and will need to pool them to develop effective R&D programmes. Arab government and academic institutions can usefully work with private companies to identify focus areas for investment by both the private and public sectors, based on core needs, competencies and existing experience.

Most R&D endeavours require long-term efforts and resources. These are difficult to sustain in a commercial world ruled by profit and loss. Private-sector effort needs to be bolstered by regulatory support for R&D, through favourable tax treatment and substantial economic rewards for pioneering achievements—which should be protected by intellectual property laws and supported by capital markets. This process will need to be spurred further by the development of risk capital through venture funds and other early-stage financing for unproven products and services. The availability of such investment resources is primarily dependent on effective regulatory/tax incentives and increased sophistication in portfolio management by individuals and financial institutions. Active capital markets are related factors.

Private-sector effort needs to be bolstered by regulatory support for R&D, through favourable tax treatment and substantial economic rewards for pioneering achievements.

Finally, guilds, unions and other professional institutions have a critical role to play by defining the agenda that matches human resources with existing market needs. These institutions will need to be increasingly engaged in defining the future of their respective professions, promoting specialization and collaboration and identifying appropriate research agendas. Furthermore, these institutions can also serve as a mechanism for building cooperative networks to support long-term initiatives beyond the scope of individual commercial entities.

Regulatory environment, legislation and financing

Government regulations, national initiatives and financial incentives can have a significant impact on the development of R&D within the region. In particular, weak national legislation on intellectual property rights can lead private firms to refrain from investing in the production of knowledge at the national level, with spill-over effects at the regional and world levels. Regulatory frameworks that protect intellectual property help to promote both the expansion of research-based knowledge and the economic growth that will help to fuel further R&D expenditures. This suggests the need for a serious review of existing legislation on intellectual property rights.

Significant attention has been devoted to the concept of intellectual property and property rights. Although protection of these rights may have a short-term detrimental impact on certain regional economies, they are critical to the development of the individual and commercial incentive structure that drives innovation in R&D. While a limited number of scientists and academics are motivated purely by the intellectual rewards of investigations and theories, many more are motivated by potential economic and social recognition for their achievements. Protection of intellectual property constitutes a significant driving force of R&D by providing a legal framework for individual recognition and for obtaining substantial returns from inventions that impact a large product set or have significant applicability across a range of platforms.

Adequate financing is essential for successful R&D policies. Arab countries cannot hope to catch up with the developed world, or even to compete with many countries in the developing world, without a substantial increase in R&D spending. Arab governments should seek to increase gradually the share of R&D in GDP from the current meagre 0.5 per cent to 1 per cent, 1.5 per cent and eventually 2 per cent within the next decade. Otherwise, they will be in danger of falling technologically further and further behind the developed countries.

While governments can encourage greater private R&D spending by significantly reducing duties, tariffs and taxes on activities di-

rectly or indirectly relating to R&D, public funding will likely be the main source of support for R&D for a long period to come. Nevertheless, the private sector needs to become aware that its contribution to R&D spending is in its own best interest as a key source of improvement of its output to meet the standards set by global markets and of adaptation to constantly evolving technologies. In addition, technology-based expansion of private firms into competitive global markets would strengthen Arab private sectors by encouraging the employment of highly qualified professionals, increasing efficiency and promoting further technological change.

Government agencies and regulatory frameworks can also play a major role in marshalling the region's resources towards the development of local, national and regional research agendas. Specialization through competency centres will need to be promoted on a regional level to ensure optimal capital use (for example, an Egyptian focus on information technologies and agricultural genetics, and a Saudi Arabian focus on materials sciences and plastics). At the same time, Arab countries stand to gain much from pooling some of their financial and human resources. An Arab science foundation should be created with the objective of attracting funds and channelling them to high-level common Arab research projects. Finally, government agencies can spur technological development through direct sponsorship. For example, more than 45 per cent of all R&D efforts in the United States over the last 20 years have been funded directly by government agencies. The European Union has followed a similar model and has established several continent-wide initiatives in strategic areas of R&D. Expenditure on R&D as a percentage of GDP in the developed world has exceeded the amounts spent within the Arab region more than sevenfold.

Mobilizing Arab minds abroad

Arab societies lose valuable human resources through the emigration of highly qualified citizens—estimated to number about one million working in countries of the Organisation for Economic Co-operation and Development by the end of the twentieth century (Zahlan, in Arabic, 1999). Moreover, it now appears, in contrast to previous estimates, that the Arab brain drain intensified in the fourth quarter of that century. This phenomenon could be addressed by a two-pronged approach.

First, the brain drain could be turned into a brain gain if Arab governments, instead of focusing on repatriation efforts, were to actively engage highly qualified expatriate Arabs in domestic R&D programmes through knowledge transfer and liaison work with regional R&D institutions. Measures to maximize the brain gain for countries of origin might include:

- reinforcing links with highly qualified Arabs working abroad by building systematic rosters, setting up efficient channels of communication, providing facilities for visits to Arab countries, and supporting Arab culture in expatriates' countries of residence;
- accessing the knowledge of highly qualified expatriates through consultations and temporary work assignments. ICT-based networks offer innovative approaches to the rapid transfer of geographically distributed knowledge and expertise;
- direct support by Arab countries to associations of highly qualified Arabs abroad.

Second, as discussed in the previous section, Arab countries could also work to counter the brain drain by creating better incentives at home for qualified scientists. This would entail enhancing their social stature and offering them rewarding careers in professional and financial terms. Historical experience shows that both trends take root in societies undergoing a renaissance involving more effective use of human capabilities. Thus human development considerations and countering the brain drain can be mutually reinforcing.

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Prioritizing an R&D agenda for the Arab region

Arab countries cannot be active across the entire spectrum of R&D. Their financial and human capabilities are modest, and their research output does not exceed one per cent of the world's total. They can, however, make significant contributions if they concentrate

BOX 5.3

Knowledge determines the wealth of nations and defines the liveable state in the age of globalization.

There is a quiet revolution occurring in the midst of the welfare state. The source of its economic wealth is shifting from physical capital to human intelligence augmented with ICT. This reverses important relationships. In the past, labour was ineffective without sophisticated physical capital. In future, physical capital will be ineffective without sophisticated labour and, labour market and migration laws permitting, labour, especially educated and skilled labour, will be able to walk out on capital at any time. States and communities will have to compete for highly educated and skilled workers. This will reverse another relationship, that between the state and a large share of its citizens. Reluctant public handouts from the welfare state may no longer suffice to persuade people to settle down, pay taxes and raise families in a given country or region. The world may be shifting from the handout-based reality of the welfare state to the rights-based reality of the liveable state.

The liveable state will have to accommodate the values and interests of highly educated and skilled workers. It is likely to pursue a higher quality of life. The state will be characterized by low inflation; effective financial systems; easily accessible, competitive local markets attached to global markets; low transaction costs for businesses; and independent, efficient judiciaries that protect the rule of law, including private-property rights and sanctity of contracts. Systems for the creation and adoption of technology, for the free exchange of ideas and knowledge also fit in this mix. Highly educated and skilled workers are likely to favour human rights and freedoms protected by the rule of law and to demand open access to the public sphere, political participation and a public expenditure programme that efficiently buys the public goods that they want. Strong public opinion will bestow legitimacy only on administrations that are service-oriented, responsive, efficient, transparent and accountable. Facilities for affordable access to health care, lifelong education and ICT may become a standard. So may tolerance, peaceful coexistence, social cohesion and a clean environment.

The importance that liveable states attach to human solidarity will determine the scope and breadth of the social safety net. Therefore, while equality of opportunities is bound to increase with education and the prevalence of ICT, equality of outcomes is likely to continue to remain an open question.

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their efforts on a prioritized core agenda of activities that maximizes the benefits to their societies. While a specific list of such activities cannot be determined a priori, some general prioritizing principles can be defined, as follows:

- *Build a small number of specialized centres of excellence.* The model here is that of the development of highly focused centres of competence that have dramatically surpassed others comparable in both scientific and commercial excellence. These include Silicon Valley, United States, in computer hardware and applications; Murano, Italy, in shaping, colouring and forming glass; Seoul, Republic of Korea, in micro-mill development for steel and its alloys; Bangalore, India, in software engineering and development; and Switzerland, in its focus on miniature mechanical structures (including watches, sensors and sophisticated automotive components).
- *Focus on fields in which distinctive capabilities exist.* Arab countries should focus on fields in which they are capable of reaching world-class scientific standards, in which they already have experience, and which are critical for their economies, such as water desalination, solar energy, petrochemical and phosphate industries, computer software, data processing and genetic biology. Arab countries have reliable accomplishments in these fields—for example, water desalination in the Gulf States, computer programming in Egypt and Jordan, the phosphate industry in Morocco and Tunisia, or the petrochemical industry in Saudi Arabia. Building on experiences, cumulative knowledge and tested practices is an essential foundation for an effective R&D system.
- *Promote global competitiveness.* Reduced tariffs brought on by WTO will significantly reduce the economic protection of many local industries. Thus, superior products and services on a global rather than a regional, national or local scale will increasingly drive effective competition. The market for R&D efforts in the Arab region should go beyond the regional context and be evaluated in the context of global competitiveness.
- *Focus on human-resource-intensive rather than capital-intensive R&D.* The region's competitive advantage lies primarily in the availability of high-quality human resources. Conversely, the region is lacking in access to cheap capital, primarily as a result of a poor property-rights regime. This situation requires an increased focus on R&D endeavours that require limited capital outlay but significant brainpower. These are the so-called "knowledge sciences". The most obvious candidate is information technology, but other fundamental research subjects such as mathematics, theoretical and device physics, and economics can also be pursued with limited capital.
- *Learn from the global R&D community.* Various other government and regional institutions are engaged in extensive R&D promotion. Significant lessons can be learned from these institutions, e.g., Europe's Esprit programme, the Defense Advanced Research Projects Agency (DARPA) in the United States, and the United Nations International Telecommunication Union (ITU). Arab insti-

The market for R&D efforts in the Arab world... should be evaluated in the context of global competitiveness.

tutions must engage these and other international entities and seek to contribute to and excel in them.

The second half of this chapter focuses on a topic intimately connected with R&D/S&T systems: information and communication technology (ICT).

ICT AND THE DIGITAL DIVIDE

Aspects of the digital divide: information, knowledge, technology

Information and communication technology (ICT), a product of R&D and an increasingly important factor in the knowledge economy of the twenty-first century, can be both a unifying and a divisive force. Its divisive aspect has come to be known as the "digital divide", which refers to the differences between those who have digital access to knowledge and those who lack it. The term, coined in the United States, is based on statistical surveys that relate the possession of ICT resources by individuals, schools and libraries to variables such as income level, age, ethnicity, education, gender and rural-urban residence. The inception of the term in the United States had an impact on its definition, measurement and ensuing recommendations. The concept is now widely used in comparisons involving various countries, provinces, groups and regions.

Reactions vary concerning the digital divide. In the final analysis, its existence is undeniable, but it is not an entirely technological issue. Technology has always been, and will continue to be, a social product. ICT is emphatic testimony to this fact. Inasmuch as the digital divide calls for technological solutions, it calls for societal innovation, or post-technological innovation, so to speak (box 5.5). The digital divide is thus linked to the whole cycle of knowledge acquisition.

Clearly, there is a basic difference between information and knowledge. Information, even in abundance, does not add up to knowledge. Historically, the world complained about too little information; today, the complaint is about over-information, or information overload, which presents problems of its own. The tremendous amount of information available on the Internet is overwhelming unless it is organized, sifted and filtered through the use of appropriate tools to extract concepts and knowledge that are useful in problem-solving.[1] Moreover, valuable knowledge is still surrounded by a host of technical, legal and administrative barriers.

True knowledge is what empowers people to cope with a fast-changing, complicated world. It is knowledge about life, and knowledge as a way of life. Therefore, the concept of knowledge should go beyond scientific knowledge and embrace the full triad of knowledge about science, humanities and art. Indeed, the latest cultural trend in the information industry is to promote the latter two types of knowledge. This is a matter that should be taken into account in developing Arab human resources, as must a parallel issue: knowledge for whom?

Technology has always been, and will continue to be, a social product.

This having been said, to understand the various aspects of the digital divide, the phenomenon should be discussed along two axes (figure 5.1).

The horizontal axis represents the full cycle of knowledge acquisition, which consists of five stages: accessing information, organizing information, extracting knowledge, applying knowledge and generating new knowledge. The vertical axis represents the components of the information industry: the content, processing and distribution of information. Of these three, content is the most important.

The common definition of the digital divide, and of ways to close it, focuses on the shaded area indicated by (1) in the figure. However, the focus of attention should be shifted to the shaded area designated by (2). A change in the perception of the digital divide is essential because it affects the choice of infrastructure and the way in which required human resources are developed.

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Many studies have been carried out on the reasons for the hampered flow of knowledge in Arab countries. At this point, a key factor to grasp is that knowledge in the age of information is closely related to, and dependent on,

[1] A good example is that all the data relevant to the human genome project are published on the Internet. However, there is a huge gap between the availability of this mass of biological data and the extraction of knowledge from it in order to discover the causes of a certain disease and create new medications.

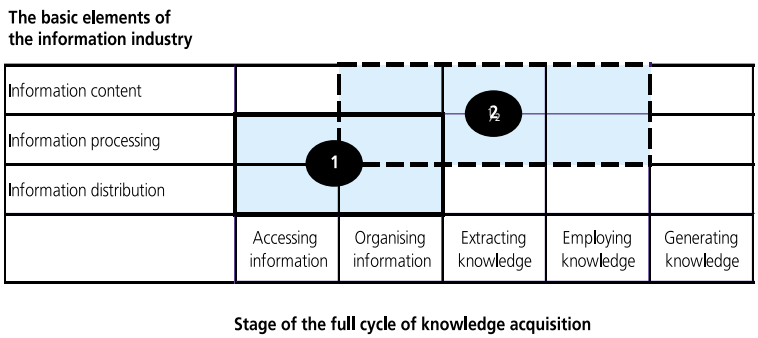
BOX 5.4

Social innovation: going against the grain

Social innovation, with regard to technological application, is a matter of finding solutions that are creative, different from those in current use, and even heading in the opposite direction from common ICT practice in advanced countries. For example:

- From the Internet to the mass media, not the reverse. The Internet is being used extensively as a form of mass media. The common practice is for the content of the mass media (press, radio, television) to be placed on the Internet, but the opposite is also possible. The Sri Lankan radio station has been successfully taking information from the Internet and broadcasting it to its listeners, for example. A specialized team in the radio station scans the Internet on behalf of the local population, looking for information that may be of interest to them. The station receives questions from the public on any topic and airs the answers after conducting an Internet search. The local radio service has thus brought the Worldwide Web home to people who cannot explore Internet sites themselves. This successful experiment has attracted much attention from development organizations and international forums.
- The cyber café as a centre for added intelligence, not for entertainment and e-mail. Cyber cafés are usually used for distance correspondence, chatting or electronic games. The Republic of Korea has succeeded in spreading the use of the Internet by establishing a great number (20,000) of Internet cafés. Most of these cafés focus on the use of the Internet for recreational purposes and as a means of escaping social traditions concerning relations between the sexes. These cafés could be used as added intelligence centres, providing information services to local individuals and institutions. The personnel of the cyber cafés could look for the information on behalf of their customers, sift through the load of information, and summarize the results. These cafés could then be linked together and with popular cultural centres, youth clubs and local government decision-making centres in order to promote communication and transparency. Such cafés could thus become a popular nucleus for electronic government.
- Arabic language-processing systems as a model for processing the English language. The systems designed to process the English language electronically dominate the methods of processing other human languages. These systems have proven ineffective when used for Arabic for a simple reason: the computation of the Arabic language, compared with English, is much more complicated on each level of the language matrix: the letter, word, phrase, and text. Arabization efforts were at first confined to incorporating Arabic into systems designed for English. This is an illogical approach because it aims to incorporate the complicated into the simple. It prompted some Arab researchers to design a computerized model using the Arabic language as a superset, supplanting English. It has been proved that this model can be easily adjusted to handle English. This is a rare opportunity to apply advanced technology and artificial intelligence in the computation of the Arabic language in a manner that can be applied to other languages.

Figure 5-1
Dimensions of the digital divide



technology. In other words, the functions of generating and using information are dependent on the prevalent state of technology. Hence, technological limitations may mean that state-run Arab R&D institutions may not be able to play their full role in generating knowledge. Meanwhile, the manufacturing and services sectors in Arab countries still lack the technological maturity and the R&D departments that are capable of generating new knowledge.

Despite these impediments, several positive factors could result in the doubling of the ability of Arab countries to generate new knowledge in the information age:

- Information, by its very nature, is renewable. ICT will accelerate the rate of this renewal, thus increasing the opportunity for Arab countries to catch up in the course of the advancement of knowledge.
- The products of information are closely related to the market. This gives workers a growing role in designing, developing, selecting and marketing these products. Therefore, many local innovators will have the chance to contribute to the process of technological development.
- Modern information techniques have underlined the importance of the humanities, a discipline in search of a new methodology that transcends that of natural sciences. Arab scientists have a chance to take part in bringing about this shift in knowledge because the humanities are actually expected to inspire natural sciences in terms of future methodology (Ali, N., 2001:20).

The digital divide between the Arab region and other developing regions

Numerous studies have examined the digital divide between various parts of the world, measuring it through a barrage of statistical indices, including the number of stationary telephone lines, personal computers (PCs), web sites and Internet users and their ratio to the total population. As expected, the Arab world ranks low on some of these indicators. For example, Arabs represent 5 per cent of the world population but only 0.5 per cent of Internet users (Dewachi, 2000).

Figure 5.2 provides graphic comparisons

between Arab countries and other parts of the developing world. The Arab region does not score too badly with respect to telephone lines and personal computers per thousand people, but it ranks last with respect to web sites and Internet users, the two indices that are more relevant to the level of information development and representative of society's involvement in ICT.

How the factors involved in the development of informatics interact and their weight in either expanding the digital divide or narrowing it are region-specific. This is true not only in the developing world but also in more advanced regions. For example, despite the similarities between the United States and European Union countries, many in Europe objected to the evolution of the European Union into an information society along the lines of the United States model (Bangemann, 1994). The latter is based on the establishment of a network of information superhighways, with priority given to technological and economic aspects while cultural and social ones are ignored. If Europeans have such concerns, what approach should be taken by the Arab region, where economic, social, and cultural disparities are much more pronounced? Current Arab policies for the most part have adopted a model based on copying and imitation. However, Arab countries need a different model to take them into the information society. The pressures of catching up with the information bandwagon should not eclipse the fact that Arab countries need an innovative vision that fits their special circumstances.

Some of the reasons for the wide digital divide separating Arab countries from the advanced world include the following:

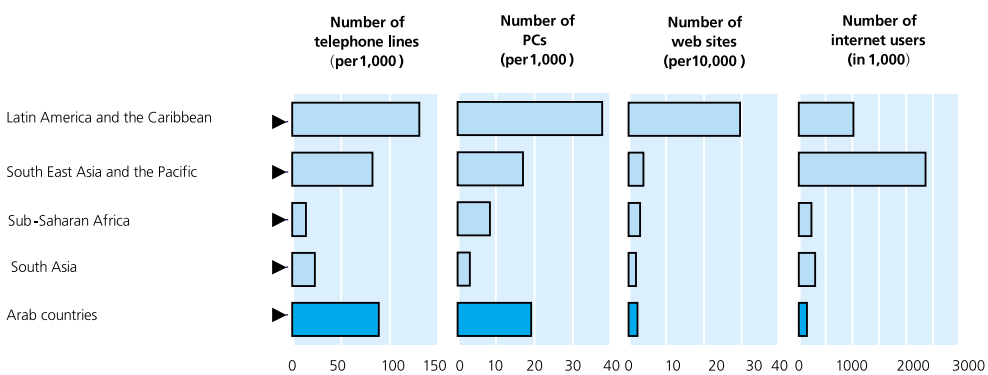
- ICT, by its nature, is highly susceptible to monopoly and merger because of the means of central control it provides, together with the easy manoeuvring of symbolic assets and the easy flow of the products of informatics that it offers.
- Transition to the knowledge economy has reinforced the role of profits in the knowledge-production process, leading, in turn, to a rise in the cost of obtaining information resources.
- Building infrastructure for the information superhighways is costly.
- A growing brain drain, both actual (emigration) and virtual (through the Internet), is depriving the Arab world of its top ICT specialists, who are being aggressively sought by foreign companies. This situation, if allowed to continue, could lead to the exclusion of Arab countries from the field of R&D.
- The fast pace of change in ICT increases the important of technological planning. However, could lead to technocrats taking control of strategic development decisions. These technocrats often ignore the social and cultural aspects of ICT planning. Very few Arab experts combine ICT knowledge with awareness of its social and cultural implications.
- A situation is evolving with ICT that is reminiscent of the severe imbalance in the distribution of wavebands between advanced and developing countries with regard to telecommunications. Cyberspace is becoming a crowded place and powerful players are taking up much of the room, with their web sites dominating most regions, cities, and groups.

Despite all the impediments that have led to the widening of the digital divide between

Arab countries need a different model to take them into the information society.

Cyberspace is becoming a crowded place and powerful players are taking up much of the room.

Figure 5-2
Indicators of the digital divide among Arab countries and developing world regions



Source: Development Indicators, World Development Report, World Bank, 2001.

Arab countries and the advanced world, there is one factor that should be exploited to the utmost: the ongoing cultural and social orientation of the information industry. This is particularly true with regard to the Arabic language.

The digital divide among Arab countries

Figure 5.3 presents indicators of the digital divide in Arab countries according to the countries' HDI rankings. It shows extreme disparities among Arab countries regarding informatics. There is a strong correlation between the digital divide and the level of HDI if the three categories of the latter (high, medium, low) are considered. However, the correlation becomes weaker within each category because the variables affecting human development differ from those affecting informatics.

Aside from economic factors, the main reasons for the digital divide among Arab countries are:

- absence of national information policies;
- weakness of the role of Arab League agencies and other regional organizations;
- lack of interest of Arab financial institutions in information projects, where feasibility studies are normally undertaken on a purely economic basis without taking societal returns into account;
- the required considerable increase in education budgets, particularly after the expansion of ICT use in education.

Success in closing the digital divide within the region will be critical for success in narrowing the divide between Arab countries and the rest of the world. This suggests that countries might consider forming an Arab information bloc.

The digital divide within each country

There are no studies or statistics that address the various aspects of the digital divide within individual Arab countries. Given the interplay of social and technological factors, however, such a divide certainly exists. The impact of social factors on ICT will vary from country to country, but education levels and age composition of the population are likely to be central determinants of the digital divide. Other factors significantly influencing the digital divide within countries include:

- language. Most of the information currently on the Internet is in English, a language that most of the population do not know well;
- absence of remedial education and rehabilitative adult-education programmes;
- cultural aspects, particularly with respect to gender. It is still common in many Arab countries to limit women's employment to certain areas despite the fact that ICT and the Internet, on the whole, provide opportunities for Arab women by giving them access to work from home.

The influence of language deserves special attention.

The linguistic divide

Linguistically, the world of ICT is at a watershed.

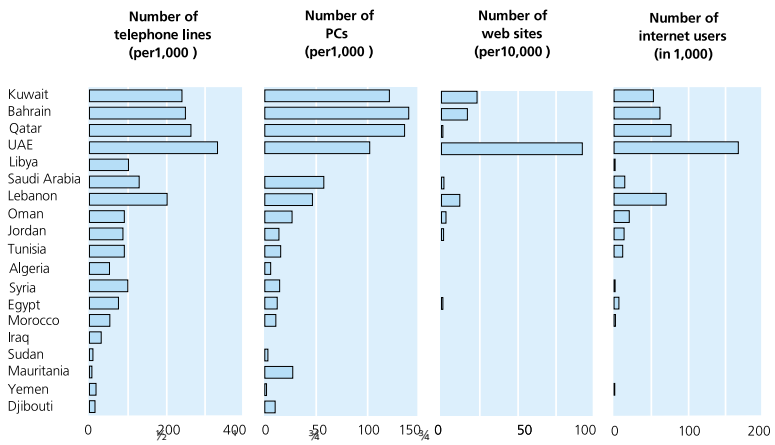
Language plays a crucial role in the information society. It is central to culture and culture is central to the information society. Language has a particularly key role in certain ICT areas, especially with regard to artificial intelligence. More generally, language is a recurring topic in the debate over globalization, especially now that the Internet has made its political, cultural and economic importance universally clear. Concern over the future of linguistic diversity in the information age is evident from the currency of such terms as "language divide", "extinction of languages", "linguistic racism", and "language wars". Some people have become pessimistic enough to list language among the victims of the information age,[2] along with other entries on the list of victims such as cultural diversity, local values and national sovereignty. Conversely, some see in the Internet a chance to revive languages, protect languages spoken by minorities, stimulate linguistic communication across cultures and promote language creativity and the arts related to it.

Linguistically, the world of ICT is at a watershed. It can maintain linguistic diversity, a choice that entails difficult communication and hinders the flow of information and knowledge, or it can turn to a standard unified language, most likely English. The Director-General of UNESCO has described this latter

[2] A book was recently published entitled The Death of Language.

possibility as a great catastrophe. Arabic, meanwhile, has its own watershed. It can become a means for Arab countries to catch up with the information train, or it can lead to a wider linguistic divide between the Arabs and the rest of the world at various levels, including linguistic studies, lexicology, language education, the professional use of language, the documentation of language and language computation.

Figure 5-3
Indicators of the digital divide among Arab countries, by HDI rank



Main features of the current Arab information environment

Policies, legislation and organization

The absence of national information policies. All Arab countries lack information policies that delineate targets and priorities, coordinate the various sectors and formulate strategic alternatives with regard to the creation of infrastructure and the development of human and information resources. The organizational and legislative frameworks for production and services institutions in various fields of information and communication are also lacking. Nevertheless, over the past few years, political leaderships in Egypt, Jordan, the Syrian Arab Republic and the United Arab Emirates have shown interest in the information industry. This has led to the formulation of national plans to promote infrastructure, encourage foreign and local investment, provide Internet services to schools, and establish free zones for ICT technology, such as the Dubai Internet City (box 5.5), the Smart Village in Egypt and the Silicon Hills in Jordan.

The absence of a pan-Arab information policy. In view of the absence of national information policies, the absence of a pan-Arab information policy is hardly surprising. Arab attempts at integration in the field of information have been confined to the sectoral level. A series of strategies has been designed by the Arab League Educational, Cultural and Scientific Organization, an organization that has paid particular attention to informatics relating to education, culture and the media. However, these efforts have never found their way into national policies relating to information, culture, media and education. In most Arab countries, these sectors are mainly monopolized by governments, and the political sensitivity assigned to them hinders Arab coordination in the field of informatics.

As a result of the absence of a strong, effective policy at the national and regional level, the field of informatics in Arab countries suffers from the following impediments:

- prevalence of an isolationist sectoral outlook and the absence of coordination between sectors. This sectoral outlook conflicts with the current tendency to merge the information, media and culture sectors;
- uncoordinated procurement of communication systems, which impedes the unification and linking of Arab countries. Incompatible mobile phone systems, to give one example, mean that users may not be able to use their phone sets in the roaming mode. Recently, the need to coordinate decisions concerning the procurement of communication systems became all too evident; now such coordination seems likely once the old, incompatible systems have been phased out.

A monopolistic, or semi-monopolistic, pattern still dominates the area of conventional telecommunications.

Restructuring of the telecommunications sector

Since 1995, most Arab countries have been restructuring their telecommunications sectors, substantially motivated by the introduction of mobile phones and Internet services. The restructuring is usually implemented in three phases: corporatizing state-run communications agencies; privatizing the agencies; and deregulating the sector and allowing free competition. Despite these efforts, restructuring is slow and a monopolistic, or semi-monopolistic, pattern still dominates the area of conven-

tional telecommunications (figure 5.4).

Restructuring is taking place in the absence of both an economic model for the telecommunications corporate sector and a clear division of labour between various types of ownership (state, public, cooperative, private). Countries will need to guard against the risk that restructuring could permit the emergence of the untrammelled profit motive and the potential for monopoly to undercut the provision of affordable and equitable service.

Content is the most important component of the information industry, but Arab policy-makers have not yet taken this fact to heart.

More generally, rapid changes in ICT require prompt legislative action, something for which few Arab legislatures are equipped. This has led to the appearance of an organizational or legislative gap whose problematic nature is compounded by the fact that those who are in charge of legislation and organization lack knowledge of the technical aspects of ICT and must rely on the help of technical specialists, who tend to make recommendations on purely technological and economic grounds without taking into account the social and cultural aspects of informatics. Also, legislative efforts to date have focused on the telecommunications sector, with little attention to legislative questions relating to the convergence of telecommunications, information and content.

BOX 5.5

The Dubai Internet City

Dubai announced plans to set up its Internet City in October 1999. Less than a year later, the city was ready to host local, regional and international ICT companies.

The Dubai Internet City has gained a reputation, among Arab information free zones, for its advantages in terms of:

- availability of quality infrastructure. The Emirate of Dubai seeks to establish a sophisticated communication network covering all of Dubai: the schools, homes, shops, offices, hotels and restaurants;
- support given to the project at the highest political levels;
- success in attracting leading international companies to set up regional offices there;
- location in one of the regions most known for its use of ICT (figure5.3): the United Arab Emirates, Bahrain and Qatar;
- linkages with the Media City and the Wahat al-Fikr (oasis of the intellect) project in other cultural areas. This strategy is linked with the trend to merge information and media on the one hand, and ICT and culture on the other;
- assignment of the management of Dubai Internet City to a group of young people of the Emirate of Dubai who have superb qualifications as well as experience in ICT and business administration;
- presence of the annual GITEX fair in Dubai, indisputably the most important Arab event in ICT;
- provision of services that go beyond infrastructure to include R&D in the field of informatics. The City is planning to set up several units for R&D in advanced fields of informatics;
- its character as a microcosm of globalization: a mosaic of nationalities, languages, values, products and services.

The element of content

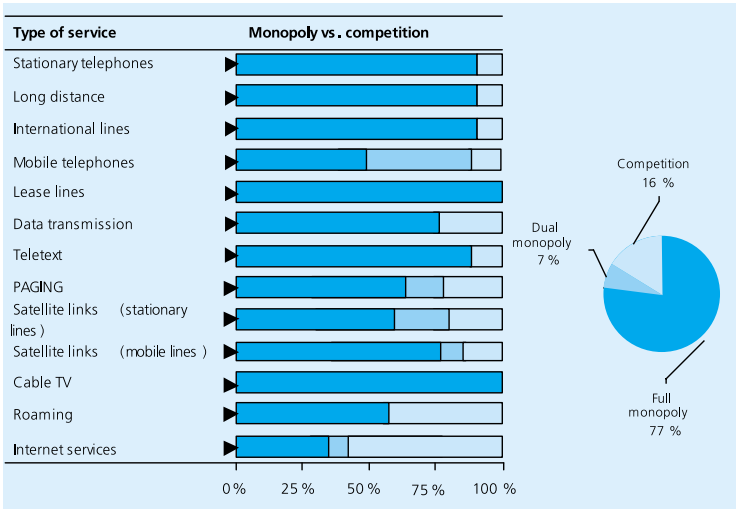
Content is the most important component of the information industry, but Arab policy-makers have not yet taken this fact to heart; as just noted, their focus is mainly on telecommunications infrastructure. Some studies have already pointed to the poor use of information resources in decision-making. Meanwhile, the meagre use of scientific and technological information has been linked to the low level of R&D activities in general. Even when questions of content are broached, its quality and sources are not linked to cultural trends in the information industry, nor is the distinction made between the type of content relevant to the information industry and that needed in decision-making and R&D.

The position of Arab countries is also unsatisfactory with respect to cultural heritage and creativity. In the case of heritage, Arab countries lack the means of controlling their old and new information assets, including scripts, documents, films, voice and video recordings, music and songs. Most of these resources have not been digitized. As for new creative content, Arab countries suffer a serious shortage in its production. The rate of film production has dropped from hundreds to scores. Most of the material transmitted on Arab TV channels is imported. Similarly, Arab news agencies with some recent exceptions, import most of their reports from the four major news agencies, almost becoming subagencies. There are no reliable figures on the production of books, but many indicators suggest a severe shortage of writing; a large share of the market consists of religious books and educational publications that are limited in their creative content.

The figures for translated books are also discouraging. The Arab world translates about 330 books annually, one fifth of the number that Greece translates. The cumulative total of translated books since the Caliph Maa'moun's time (the ninth century) is about 100,000, almost the average that Spain translates in one year (Galal, S., 1999). Meanwhile, there are some encouraging initiatives involving the publication of the content of Arab magazines and newspapers on the Internet and their distribution on CD-ROMs.

However, if Arab states have been reluctantly ceding their monopoly over the telecommunications sector, they are still clinging to their monopoly over the content of information. Efforts to introduce elements of electronic government (Dubai, Jordan) are usually confined to administrative affairs and the provision of government services to the public. There are no attempts to use the Internet as a means of achieving a higher level of political transparency or enhancing democratic performance. The Internet has not yet been used as a way to transcend the official media and serve all social classes.

Figure 5-4
Extent of monopoly in telecommunications in Arab countries



Source: ITU, Regional Office for Arab States, October 2000.

Using ICT in education and training

Egypt, Jordan, Saudi Arabia and the United Arab Emirates have formulated ambitious plans to introduce computers at various stages of education. There are additional plans to introduce Internet services in a communications laboratory in each school. These plans face several obstacles, however, including insufficient training of teachers; a severe shortage of educational software in Arabic; inability of curricula to cope with the diversity of education and learning methods (distance learning, learning through participation, collaborative learning); and inability of school administrations to manage modern educational technology.

On the other hand, the existence of several government and non-governmental centres for ICT that have proved their competence means that these obstacles to using ICT in educational contexts could in principle be overcome without resorting to foreign expertise for the use of ICT in education.

There are no real opportunities for using ICT to train adults in the workplace. Most Arab workplaces lack a technological environment conducive to ICT training. The language barrier is also a deterrent for the great majority since learning and training via the Internet require some knowledge of English.

Software development for ICT

It is customary to classify software on two levels: operating and productivity-enhancing software and application software. Operational and productivity-enhancing software include operating systems governing the operation of the computer, data networks, programming languages and productivity-enhancing programmes, such as word processing and databases. Successful attempts have been made to Arabize the operating and word-processing systems, but these efforts were terminated owing to fierce competition by transnational companies and the absence of standardization. It is now hard for the Arab world to compete in this field.

Numerous studies have indicated the importance of work on the computation of Arabic and the Arabization of ICT. One recent study by the Economic and Social Commission for Western Asia (ESCWA) examined the importance of Arabization, its prospects, priorities and relation to the knowledge economy. Several Arab countries have established specialized ICT centres and institutes, including the Electronics Research Centre, affiliated with the National Research Centre in Egypt, founded in 1963; the Regional Institute for Communication and Information Studies in Tunisia, founded in 1986; and the Higher Institute for Applied Sciences and Technology, affiliated with the Syrian National Research Centre.

These centres have made significant contributions to the computation of written and voiced Arabic language, electronic translation, educational software, multimedia, encryption, security systems and the design of national information networks and geographic and administrative information systems. The

The Internet has not yet been used as a way to transcend the official media and serve all social classes.

Egyptian Centre has carried out several studies in microelectronics and robotics. However, these centres have not succeeded in establishing a joint research programme, sharing resources, or coordinating research programmes to avoid duplication despite all the opportunities the Internet provides in this respect. Very few attempts have been made to use the opportunities for cooperation presented by international cooperation agreements.

Application software includes educational, administrative and financial software, information services and databases. A considerable number of companies specialize in multimedia and electronic publishing; these are mostly software development companies and a few educational and media publishing houses. One of the most popular application programmes relates to religious heritage, reflecting the importance of the cultural factor. Information services in the Arab world are rather modest, owing to the lack of resources and personnel and weak demand.

(ICT) access patterns coincide with social divides, i.e., wealth, education, age, gender and urbanization.

Promoting access to ICT

The acquisition, (including extraction and collection), manipulation, analysis and dissemination of information will powerfully drive economic prosperity in Arab countries as elsewhere within the coming decades. The world economy is increasingly based on information-intensive services that yield higher value added than traditional manufacturing enterprises. However, it is critical that the indispensable tools of information technology--the computer terminal, associated software and the Internet--be accessible to as wide a variety of individuals within Arab society as possible. Through free-form participation, these tools can engage the minds of many budding scientists and researchers throughout the region not only in the field of information technology but in all fields of research. ICT is by far the most important enabler and equalizer of technology access available today.

Many users in the Arab world today complain of the shortage of Arab content and information resources on the Internet. Remedying this situation would have many benefits, including helping to build an increased sense of community and participation on-line, through, e.g., content embodying symbolic heritage, including texts, music, films and databases, as well as new creations by writers, thinkers, artists, and composers. Some would suggest increased Internet expenditure, control and direction from institutional and government entities to ensure that culturally relevant content is produced, as a way of helping to avert a cultural onslaught from abroad. Such initiatives should be largely unnecessary: increased accessibility of, and participation in, the medium will naturally enrich the Internet with Arab information and culture. The more Arab journalists, writers, poets, engineers, scientists, doctors and philosophers are introduced to the medium, the more such people will publish their own content, making cyberspace a richer place for Arab and non-Arab users alike. However, getting the most value from this upsurge of information will require enabling commercial and regulatory frameworks. The potential value is great and the economic rewards are significant, as shown in table 5.2.

Current barriers to access

The position of the Arab region vis-à-vis ICT is characterized by several features prevailing in other parts of the developing world, including:

- a marked concentration of ICT in a few countries;
- access patterns that coincide with social divides, i.e., wealth, education, age, gender and urbanization;
- large deficits in connectivity, capability and content;
- weak linkages in infrastructure and a mismatch between ICT and the production system.

However, Arab countries face some additional problems, including:

- the increasing importance of the linguistic dimension in ICT, especially after the spread of the Internet;
- the culture surrounding the use of information in general. In some countries, the benefits of an open information culture of direct exchanges among citizens, between citizens and government, and internationally have not yet reached a critical mass;

- e-government, e-commerce and decision support systems are either non-existent or in their infancy.

Making ICT available to all

Policies and organization. The Arab world needs an effective information policy. This policy should:

- have a multisectoral outlook. In particular, it should be sensitive to the increasing tendency to merge the sectors of communication, media and information;
- acknowledge the importance of the integration of Arab information in Arabic, especially with regard to the sharing of resources;
- emphasize that ICT is a tool for communicating knowledge and take into account that the computation of the Arabic language is a basic starting point for this approach;
- acknowledge the role of content in its broad sense;
- give priority to the use of ICT in education, training and public health as well as to the creation of a viable infrastructure for an Arab cultural industry.

Strategic planning agencies should be created for information development. These agencies should have units specialized in monitoring the technological development of ICT and evaluating technological programmes, products and producers. This should be coupled with the training of specialists in societal adaptation policies relevant to ICT.

Telecommunications infrastructure. Policies for the restructuring of the telecommunications sector need to guarantee deregulation and open up competition to encourage local and foreign investors to contribute to infrastructure development. At the same time, a measure of government regulation should be maintained to guarantee a minimum level of public telecommunications services for people with limited income and those residing in rural and distant areas. In addition:

- Innovative alternatives should be explored with the aim of reducing the cost of building infrastructure. For example, it is possible to establish a multi-tiered telecommunications system (with regard to speed) while maintaining connectivity and compatibility among system levels. It is also possible to create inexpensive and quick-to-build wireless communications or wireless local loops (LLPs) for local use.
- Specialists in departments of planning and organization should be trained in matters concerning the restructuring of the telecommunications sector and in examining various economic models for privatizing and liberalizing it.
- Arab countries should coordinate their telecommunications systems in order to guarantee their compatibility and connectivity.
- Telecommunications service charges should be adjusted to ensure access regardless of financial ability.

TABLE 5.2
Information industry in the United States and the European Union, 1994 (in billions of dollars)

Information-industry sector	European Union	United States
Content of information	186 (34%)	255 (45%)
Distribution of information	165 (30%)	160 (28%)
Processing of information	193 (36%)	151 (27%)
Total	544 (100%)	566 (100%)

Source: UNESCO, Information Annual Report for 1998.

A spirit of participation. Participation in, and a sense of societal responsibility for, the process of information development and policy, planning, implementation and follow-up should be developed. This requires a clear definition of goals and full commitment by the political leadership and the government. NGOs should be encouraged and trained to use the Internet in polling opinions, rallying support and coordinating positions so that their web sites become alternative channels of expression to State-loyal official media. The purpose is to empower these organizations to become popular fact-finding bodies, able to present their views and uncover instances of social dysfunction, corruption and failure of development efforts.

Development of human resources. A full study should be made of the process of introducing computers into Arab schools in order to identify areas of success and failure. In particular, national plans should aim to develop specialized personnel for training as computer teachers. Training in the use of ICT as an educational tool should involve a blend of educational and methodological principles, the theory of knowledge and technical aspects.

ICT is a tool for communicating knowledge... the computation of the Arabic language is a basic starting point.

Efforts should be made to develop Arabic-language software for general education, adult training and upgrading of professional skills. Programmes for adult training should be linked with the actual needs of the labour market and should be coordinated with the introduction of ICT in the workplace.

The Internet should be used to the maximum extent possible in the training of women in order to attract Arab women to participate in the development process. Emphasis should be placed on the social and development sides of communication, not simply the technical.

The number of technological support centres should be increased. The Egyptian experience of creating a group of such centres in the provinces, with UNDP funding, is useful in this regard. The Technology Access Communication Centre (TACC) is providing training in electronic trade, office management, and other skills to Egyptians with limited means, adults, and small and medium-sized businesses.

Developers and implementers should realize the importance of innovation in the age of information.

The skills of social innovation should be fostered. Developers and implementers should realize the importance of innovation in the age of information and encourage their personnel to adapt technology applications to local needs. Information awareness can be spread through the media in a subtle approach that links ICT with day-to-day life.

The element of content. Content should be considered a major component in the modern information industry. Laws should be passed to protect national archives, including unclassified documents produced by national and pan-Arab institutions. Heritage assets, including text, pictures, films, music and radio and TV recordings, should be digitized. Developers and users should be informed of the available Arab sources of content and the importance of these sources in providing attractive multi-media products and services. A model that might inspire this effort is the INFO2000 programme of the European Union.

R&D for ICT. Priority should be given to research that addresses the ICT trends discussed earlier in this chapter and that advances the computation of the Arabic language. A network of specialized research institutes should be created to tackle the processing of the Arabic language and the new branches of ICT. These centres could be hosted in existing Arab research institutions. Opportunities for cooperation with the European Union in ICT research should be exploited, especially with regard to automatic translation, management of information resources, and the digitalization of cultural heritage.

This chapter has discussed using human capabilities in Arab countries in order to move towards a knowledge society, a keystone of human development. Chapter 6 continues the focus on the use of human capabilities in three

BOX 5.6

Imam Ali bin abi Taleb: (556-619 A.D.) knowledge and work

- No vessel is limitless, except for the vessel of knowledge, which forever expands.
- If God were to humiliate a human being, He would deny him knowledge
- No wealth equals the mind, no poverty equals ignorance, no heritage equals culture, and no support is greater than advice.
- Wisdom is the believer's quest, to be sought everywhere, even among the deceitful.
- A person is worth what he excels at.
- No wealth can profit you more than the mind, no isolation can be more desolate than conceit, no policy can be wiser than prudence, no generosity can be better than decency, no heritage can be more bountiful than culture, no guidance can be truer than inspiration, no enterprise can be more successful than goodness, and no honour can surpass knowledge.
- Knowledge is superior to wealth. Knowledge guards you, whereas you guard wealth. Wealth decreases with expenditure, whereas knowledge multiplies with dissemination. A good material deed vanishes as the material resources behind it vanish, whereas to knowledge we are indebted forever. Thanks to knowledge, you command people's respect during your lifetime, and kind memory after your death. Knowledge rules over wealth. Those who treasure wealth perish while they are still alive, whereas scholars live forever; they only disappear in physical image, but in hearts, their memories are enshrined.
- Knowledge is the twin of action. He who is knowledgeable must act. Knowledge calls upon action; if answered, it will stay; otherwise, it will depart.

Source: Ali bin abi Taleb, Nahj Al-Balagha, Interpreted by Imam Muhammad Abdu, Vol. 1, Dar-Al-Balagha, Beirut, 2nd edition, 1985.

areas that are equally central to both the process and the goals of the human development effort: restoring economic growth, promoting full employment, and attacking poverty in Arab countries.