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Middle East and North Africa: Bleak Future for Technological Development

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A Research Paper

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Middle East and North Africa: Bleak Future for Technological Development

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A Research Paper

This paper was prepared by [] Office
of Near Eastern and South Asian Analysis. It was
coordinated with the Directorate of Operations.
Comments and queries are welcome and may be
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Division, NESAs, []

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**Middle East and North Africa:
Bleak Future for
Technological Development**

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Key Judgments

*Information available
as of 1 July 1987
was used in this report.*

The countries of the Middle East and North Africa will continue to rely heavily on trade, financial assistance, and trained personnel from the United States and other industrialized nations to modernize their economies and to make greater use of technology. Area leaders almost certainly will ask the United States to disseminate more technological knowledge and to relax restrictions on patent agreements. As a result of its active marketing campaigns, Japan will be a particularly stiff competitor of the United States as a supplier of technology to the region. The Middle Eastern and North African countries probably will depend less on Soviet and East European equipment and assistance, which is cheaper but less reliable and less advanced than most Western goods and services.

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Most states in the region have little chance of entering the ranks of the newly industrialized countries during this century because of limited natural resources, fundamentally flawed educational systems, and deficiencies in their labor forces. The Middle Eastern and North African countries lag the West and many developing countries in Asia and Latin America in expenditures for research and development and the number of scientists and engineers as a proportion of the population:

- The poorest countries—Lebanon, Mauritania, North Yemen, South Yemen, and Sudan—have the worst prospects for technological development.
- Saudi Arabia and Kuwait are in the best position to achieve technical advances because of their financial and hydrocarbon resources. These states, however, will have difficulty reversing their dependence on expatriate labor while pursuing technological development goals. Development in the Gulf probably will continue to depend heavily upon foreign workers. Iran and Iraq also will have moderate chances to industrialize when the war ends because of their large labor forces and substantial resource bases.
- Egypt and Jordan have moderate chances for technical successes in selected areas because of their relatively strong educational systems.

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Countries in the region have had varying degrees of success in economic modernization. For example:


- All governments have developed or imported technology to upgrade health care and other public services.

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- Scientists in Egypt and Jordan have improved agricultural production and irrigation techniques.
- Some industries have acquired computers, machine tools, and other modern equipment to streamline production processes.
- Petroleum engineers in Saudi Arabia and some of the smaller Gulf states have improved oil extraction methods and refining techniques. 

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For the most part, however, the Middle Eastern and North African countries have had difficulty assimilating relatively sophisticated equipment and new technologies:

- The conflict between modernization and traditional values will continue to be an impediment in several states. Government leaders face resistance to policies that emphasize technical education and, in some cases, confront widely held cultural values that encourage disdain for manual labor. Fundamentalist groups opposed to the spread of Western culture also impede technological development.
- Illiteracy is widespread, school curriculums are outdated, and teaching staffs are weak. Governments will seek to strengthen their technical training programs, but significant shortages of indigenous manpower in technical fields probably will persist at least through the end of the century. The region's rapid population growth probably will impede government attempts to train workers adequately, further slowing modernization and making the region more susceptible to political instability.
- Despite the shortage of skilled manpower, wage scales do not adequately reward technicians.
- Many students, scientists, and engineers contribute to a brain drain by studying and by seeking fortunes outside the region—particularly in the United States and Western Europe. The small pool of local talent is further depleted by the area's military services. 

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Given the prospects for modest economic growth over the next two years, most governments in the region probably will proceed gradually with their modernization policies. They will restart some development programs that had been postponed to curb budget deficits unless there is a prolonged recession. 

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Scope Note

For the purposes of this paper, technological development represents attempts to modernize or enter a new phase of industrialization. In North Africa and the Middle East, such technological development largely refers to what would be regarded as low technology in most of the industrialized West.¹ Examples of types of low technology include:

- Turnkey plants ranging from electricity generators to automated steel mills.
- Machine tools such as drill presses and metalworking lathes.
- Computer systems that keep track of government finances or foreign workers and visitors.
- New methods to exploit mineral wealth.
- Equipment to update the fishing industry.
- Irrigation and other methods to improve agricultural production.
- Water mapping techniques.

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This paper explores why the civilian sectors of countries in the Middle East and North Africa—excluding Israel—are having trouble absorbing and mastering technology and assesses the region's potential for overcoming obstacles to modernization. It also examines the impact of slow technological development on the region's economic and political stability and its relations with the United States. The paper does not attempt to thoroughly discuss industrialization in the region.

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Reporting on the assimilation of technology in the Middle East and North Africa is infrequent and limited in scope. It focuses primarily on specific technology transfers rather than the economic and political obstacles to—and potential for—technological development.

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¹ Countries covered in this paper include Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, North Yemen, and South Yemen.

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**Middle East and North Africa:
Bleak Future for
Technological Development** [Redacted]

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Modernization Goals and Trends

The countries of the Middle East and North Africa began to reassess their development policies after the dramatic increase in oil revenues and remittances resulting from the region's oil and construction boom in the 1970s. They developed policies calling for a greater use of technology to meet basic needs, improve living standards, promote economic growth, raise national pride, and support military objectives. As an example of the greater reliance on at least low technology, the region's imports of machinery from the OECD countries increased more than tenfold between 1972 and 1981, according to UN trade data.

[Redacted]

Even though oil revenues and remittances began to decline in the early 1980s because of the weak world oil market and the regional recession, the Middle Eastern and North African states have continued to modernize by importing, developing, and applying technological goods and methods—though at a slower rate. There is still broad agreement among policymakers and industrialists in the region on the need for a stronger technological base.

[Redacted]

We believe that Jordan is the most energetic supporter of technological development in the region even though—like most other area governments—it lacks a comprehensive plan for such development. According to a contractor study, Jordan wants to continue as a principal supplier of technically trained manpower to the Gulf Arab states and to become the technological production and service center of the entire Middle East. It plans to develop small- and medium-scale manufacturing and technical services and is contemplating innovative incentive programs to encourage the formation of consulting firms to service the technical requirements of the region—which up to now have largely been provided by Western expatriates. According to the contractor study, Amman plans to train Jordanians to give them a competitive edge over other expatriate technicians. Jordan, however, has been unsuccessful in obtaining financial support from



Figure 1. Machine tools are good examples of the types of low technology used in the Middle East and North Africa. [Redacted]

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Arab neighbors for its efforts to modernize its industrial base. [Redacted]

Saudi Arabia and the smaller Gulf states have been able to pursue capital-intensive projects in the oil industry that are well suited to their relatively small populations. Morocco, with its relatively large and rapidly growing population, has chosen some projects in agriculture that use labor more intensively. Nevertheless, complex and capital-intensive imported technology is favored in some countries with large populations or high unemployment—such as Egypt and Jordan—even though it would be wiser for the countries to focus on labor-intensive projects.

[Redacted]

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A Few Bright Spots

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The Middle Eastern and North African countries have had a few conspicuous technological successes. For example:

- All area countries are developing modern health care programs—which have helped to boost life expectancies significantly in the region—and municipal services such as sanitation.

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The Long Road to Self-Sufficiency in Military Technology

The majority of countries in the Middle East and North Africa have relied in varying degrees on foreign military technical personnel. Host governments have accepted foreign military technicians as a necessary short-term inconvenience on the road to military independence. Influenced by nationalism, a desire for independence in national security matters, or the fear of covert intelligence collection, nearly all now are seeking to reduce the size and scope of foreign military contingents within their borders. For many countries in the region, however, the prospects for achieving this goal are poor:

- *Since the end of the 1982 war in Lebanon, all branches of the Syrian military have depended heavily on foreign military personnel—particularly Soviet and East European advisers and technicians—for assistance in operating and maintaining their advanced Soviet weapon systems.*
- *Both North Yemen and South Yemen rely heavily on the services of Soviet military advisers for maintenance and operational support. More than two-thirds of Sanaa's military equipment is from the USSR. Its efforts to obtain arms and advisers from Western and Arab sources have been frustrated by the lack of cash.*
- *Jordan has made great strides in maintaining its modern weapons, but it still depends on foreign technical advisers to help operate highly complex components. Because US arms will remain in the inventory for years, US technical assistance in the upkeep of such weapons as the I-HAWK missile will play a vital role in maintaining Jordan's military effectiveness. The United States also provides technical training for hundreds of Jordanian soldiers and airmen annually.*
- *The Arab Gulf states are heavily dependent on expatriate personnel to keep sophisticated weaponry functioning. Although Saudi Arabia and Oman have embarked on campaigns to reduce the number of foreign military personnel, we believe these*

efforts will meet with only limited success because local forces lack the technical skills and often the motivation to perform functions done by expatriates. Reliance on expatriates probably will increase over the next few years as additional sophisticated weapons are delivered. [redacted]

The Middle Eastern and North African states have far to go before they are self-sufficient in arms production. Only a few countries in the region—most notably Egypt and Jordan—manufacture small arms, rifles, ammunition, or artillery shells. Egypt has gone beyond such activities to refurbishing aging Soviet equipment in its arsenal and manufacturing missiles and anti-aircraft guns. To contribute to regional security and stability, the Arab League established the Arab Industrial Organization (AIO) in 1980 to boost the region's arms industries, to increase military trade between Egypt and other countries in the region, and to contribute to regional security and stability. The AIO, however, has done little to foster greater military cooperation among Arab League members or to increase arms production by any of them, especially since Saudi Arabia blocked its contributions to the AIO after Egypt signed the Camp David accords. [redacted]

Arab countries depend almost exclusively on foreign assistance to produce sophisticated military equipment and parts. Saudi Arabia, Egypt, and Morocco participate in offset or coproduction agreements with the United States and West European countries. Such arrangements allow developing countries to import military equipment as well as the technology and training needed to manufacture selected components of this equipment locally. Saudi Arabia's "Project Peace Shield," for example, entails offsets from US contractors of at least \$1.2 billion. Some of the funds will go toward military applications, such as establishing a center to maintain and repair aircraft and projects to make electrical and telecommunications equipment. [redacted]

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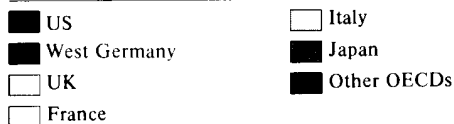
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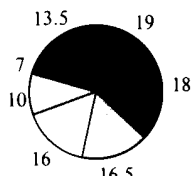
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Figure 2
OECD^a Machinery^b Exports

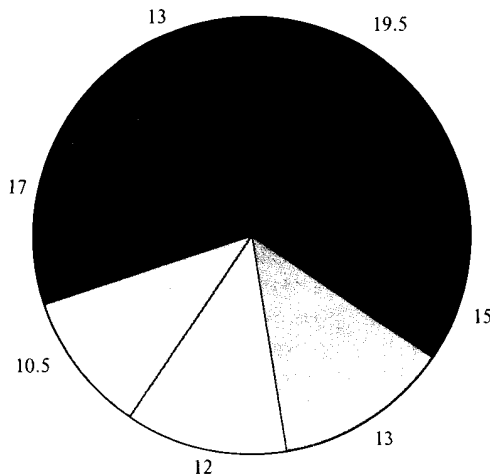
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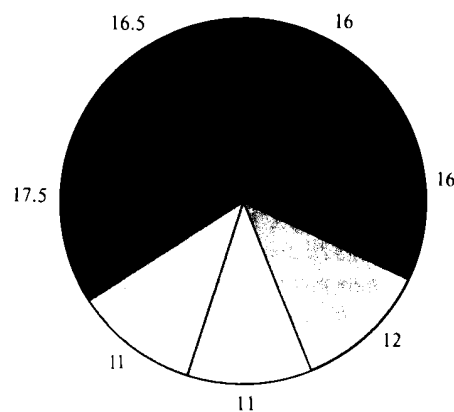
1972 = \$2.8 Million



1981 = \$30.1 Billion



1985 = \$21 Billion



^a Except Iceland, New Zealand, Portugal, and Turkey.

^b We have used the category machinery to cover the region's imports of low-technology goods. The category includes all types of engines, farm equipment, heavy industrial machinery, business machines and computers, electrical equipment, forklifts, pumps, scientific instruments, and spare parts for machinery.

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- Local manpower has been trained to operate and maintain most civilian aircraft and to manage the air traffic control systems used by local airlines, five of which consistently rank, according to *World Air Transport Statistics*, among the world's top 50 airlines in terms of passengers carried, freight tons carried, and distances flown.
- Saudi Arabia and Kuwait operate complex petrochemical projects that contribute significantly to government revenues.
- Egypt, whose efforts in research and development are the strongest in the Arab world, has several relatively good laboratories devoted to medical and agricultural research—which the government has proclaimed "Centers of Excellence." Egypt's dependence on the Nile has also spawned some of the

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Leadership Goals

Most leaders in the region have tried to win public support for technological development. In practice, however, they generally have failed to reach their modernization goals. The following examples illustrate how government officials in the Middle East and North Africa have tried to set the stage for technological development:

- Egypt's President Mubarak believes that society's attitude toward scientific research needs to be changed and has linked economic growth to keeping up with technological advances, according to press reports. During a meeting with several hundred scientists and engineers in 1987, Mubarak urged them to continue their efforts to improve the living standards of Egyptians, according to the US Embassy in Cairo. He stated that he intends to remove obstacles to scientific research in Egypt and to draw up a new plan for technological development. M. F. Abd al-Hady, president of Egypt's Academy for Scientific Research and Technology, believes that the new plan will stress the need for closer ties between Egypt's research and development community and industry as well as the need to find new funding sources for research and development—such as government agencies and private-sector companies that derive practical benefits from scientific developments, according to the US Embassy in Cairo.
- According to press reporting, Hashemi-Rafsanjani, speaker of Iran's parliament, addressed educators in 1983 on the subject of science and technology:

"Weakening the universities' scientific dimension is a mistake . . . Our society has not yet paid attention to science from the viewpoint of Islam . . . We should serve in this arena for the sake of the revolution and of Islam, for the propagation of science . . . and for the salvation of young people who have come to learn." We believe that Hashemi-Rafsanjani continues to want to bolster scientific and technical education to support Iran's economic and political goals.

- Jordan's Crown Prince Hassan believes that Jordan must create additional employment opportunities through developing technology manufacturing—such as computer software—and regional service industries. Instead of investing large sums in additional infrastructure and industrial projects to increase productivity, Hassan prefers to concentrate on education and training and attracting foreign investment in technical fields. According to the US Embassy in Amman, the Crown Prince says that Jordan looks to Singapore as a model for its economic development. Jordan also has been influenced in its development effort by British precedents, creating its own Royal Scientific Society. The Society, however, conducts little scientific research. It focuses mainly on economic and social issues facing Jordan, consulting with government ministries and private agencies on planning issues, and undertaking feasibility studies on development projects.

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best water technicians in the world, according to US Government officials.

- Jordan has introduced computers and data processing tools to its educational system.

Shortcomings and Failures

Most countries in the region have been unable to fulfill their technological development goals. They are in the early stages of industrial development and have

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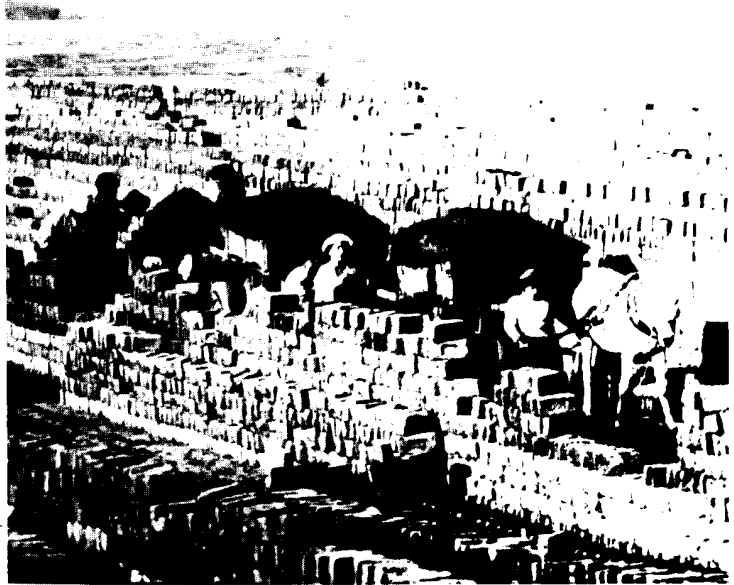


Figure 3. Primitive construction methods in Egypt ...

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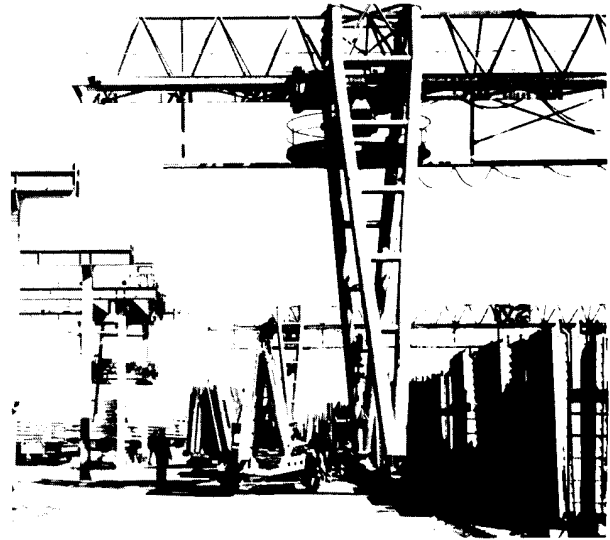
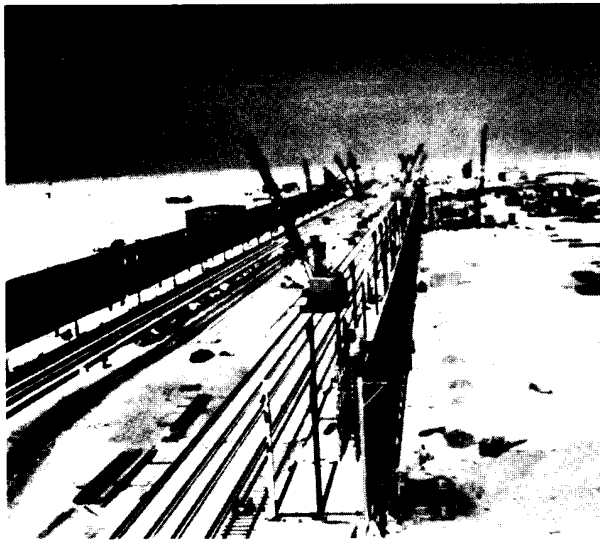


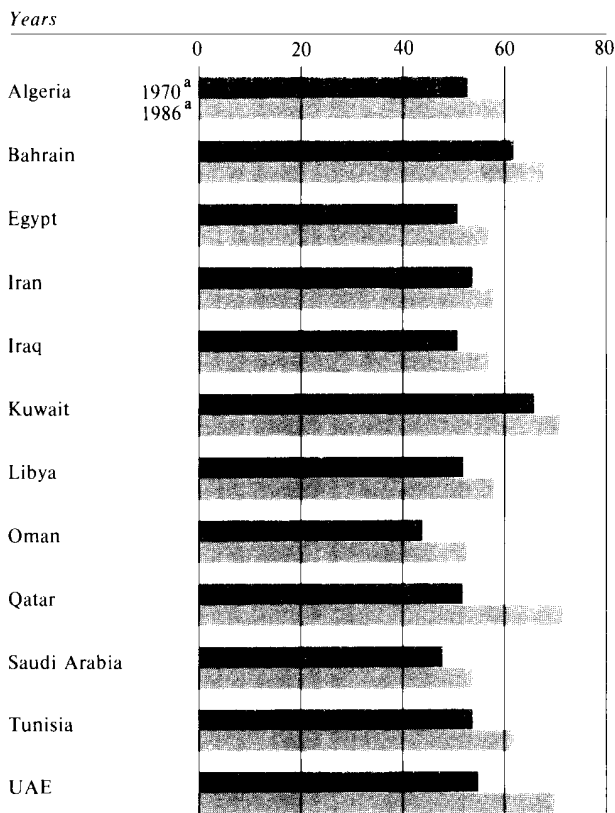
Figure 4. ... versus more sophisticated methods in Libya.

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Figure 5
Middle East and North Africa: Improvements in
Life Expectancy, 1970 and 1986



^a Estimates based on available data.

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done little to stimulate innovation or invention. Despite government declarations encouraging the indigenous development of technology, most governments have failed to provide sufficient financing—the most critical measure of potential technological development—especially during periods of shrinking resources. According to UNESCO statistics, Arab states spend only an average of about 0.3 percent of GNP on research and development as compared to an average of 0.4 percent in non-Arab African countries,

Israel: The Exception to the Rule

In contrast with other countries in the Middle East and North Africa, Israel has been successful in building a technological and industrial base. High-technology industry makes an important contribution to Israel's economy, even though many of the country's high-technology industries are caught in a recession because of declining exports, scarce domestic investment funds, and the government's austerity program.

Israel has long touted the development of a high-technology industrial base as the long-run panacea for its foreign payments deficits and stagnant economic growth. It has sought to educate a scientifically and technically skilled work force to give it the comparative advantage needed to compete in specialized high-technology overseas markets. Israel has eight academic centers that churn out a steady stream of graduates to fill scientific and technical vacancies. Emphasizing the important role the professional work force plays in high-technology development, nine of every 1,000 workers employed in manufacturing are engineers or scientists, according to the Israeli press. Among the industrialized countries, only Japan exceeds this ratio.

0.5 percent in Latin America, 1.2 percent in Asia, 2.5 percent in the United States and Japan, and 3 percent in Israel.

Another measure of potential technological development is the proportion of scientists and engineers in the population. According to UNESCO statistics and our own estimates, Arab countries have about 250 scientists and engineers per million people, compared to about 100 per million in non-Arab African states, 300 per million in Latin America, about 350 per million in Asia, almost 3,000 per million in the United States, and over 5,000 per million in the Soviet Union. Arab researchers are concentrated in the agricultural and biological sciences.

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Industry provides almost no support for research and development in most countries in the Middle East and North Africa—a contrast to the pattern in most industrialized nations with free market economies. In Arab countries, universities dominate research and development. Egypt’s universities, for example, sponsor between 70 and 90 percent of Egypt’s research and development, according to US Embassy officials in Cairo. This leads to an emphasis on esoteric research and gives short shrift to practical applications of technology. According to US Embassy officials, when area governments have become involved in research, they have spent resources predominantly on low-grade, trial-and-error types of technical experiments that produce marginal economic and scientific results. Very little applied research is performed.

[redacted]

Technologically advanced “white elephants” are common throughout the area. They result from poor planning and a failure to adapt technology to local conditions. According to US Embassy officials, national pride gets in the way of eliminating wasteful projects. Examples include:

- A chemical fertilizer plant in Egypt that is so inefficient that it would cost less to shut the plant down and continue paying employees’ salaries than to keep the plant operating.
- A phosphoric acid plant in Morocco that produces far below capacity and does not have enough qualified foremen and middle-level managers.
- A multimillion-dollar subway system that Egypt is building in downtown Cairo to alleviate traffic problems, but which probably will deposit thousands more people into an already congested urban center.
- Jordan and Saudi Arabia use advanced agricultural techniques to produce food crops but at the cost of gross economic inefficiencies. For example, Jordan has used hydroponic technology to grow \$40 watermelons, according to a contractor study. [redacted]

Governments in the region frequently import technology from the West without transferring or developing the know-how to re-create the technologies themselves. Several countries in the region have established

turnkey plants, in which construction typically is guided by a foreign company and few local people are trained to run the plant once it is completed. Examples of such turnkey projects include:

- The Shubra electricity plant in Egypt.
- Some oil refineries and petrochemical plants in Saudi Arabia and the smaller Gulf states.
- Water desalination plants throughout the region.

We believe that turnkey plants often represent hollow advances because they bypass key intermediate technical stages and do not alleviate surplus labor problems. According to some development planners, the construction of turnkey industrial plants is more akin to conspicuous consumption than to investment in productive capacity. [redacted]

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The Middle Eastern and North African states have become dependent on industrialized nations to provide spare parts—for instance, printed circuit boards, diodes, and resistors—for their technologies. Some countries, such as Iran, Iraq, and Syria, are having problems acquiring spare parts for their newly acquired technologies because of reduced revenues and trade restrictions. [redacted]

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[redacted] even if firms acquire all the spare parts they need, it is difficult for some technologies—such as telecommunications equipment—to be utilized successfully because of the harsh climate, with the prolonged exposure of equipment to dust, sand, and heat. [redacted]

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Agricultural development has not progressed as rapidly in the Middle East and North Africa as it has in other parts of the less developed world. Despite the

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A Case Study in Modernization

An examination of the Egyptian textile industry provides examples of the range of industrial development in the Middle East and North Africa. Most firms are technologically underdeveloped, have poor managers, and lose money year after year. A few are well run and are equipped with the most modern equipment available. [redacted]

A typical textile firm in Egypt has poor working conditions, according to the US Embassy in Cairo. Spinning and weaving equipment is outmoded, the floors are coated with thread and pieces of fabric, and the walls are covered with dirt. Children, some of them apparently under the legal working age of 12, gather pieces of fabric from the floor. Management complains about the low productivity of textile workers. Most workers moonlight at several other jobs in order to supplement their incomes. One manager has advertised for textile engineers for weeks at a time without receiving any inquiries. Part of the problem is low wages. A beginning engineer at the firm earns only about \$115 per month. Most university engineering graduates would rather try to work abroad than accept a job at that salary. [redacted]

Some companies, however, achieve rare successes. A textile firm located in Alexandria bases its success on high-quality management techniques and automated weaving equipment. [redacted]

[redacted] The prime motivation is incentive pay for quality and productivity, as well



A knitting machine in a textile factory can replace four to eight workers. [redacted]

as management concern for the well-being of workers. The firm's management claims that the average wage at the company is \$430 per month—a high wage for a factory worker, by Egyptian standards. Working conditions are good. Shop floors are clean; machinery is well maintained; and the company maintains a club that is open to workers as well as management and provides an outdoor park for the use of workers and their families. [redacted]

influx of large amounts of capital into the region over the past decade, area countries have shown limited ability to develop and sustain effective and profitable agricultural systems.¹ Food imports have increased rapidly throughout the region, rising in value by about

650 percent between 1973 and 1985—from about \$4 billion to just under \$30 billion, according to academic research and the US Department of Agriculture. The region's food production has not kept up with its rapid population growth. In Libya, for example, food production in 1985 increased 31 percent over the average for the period 1976-78, according to US

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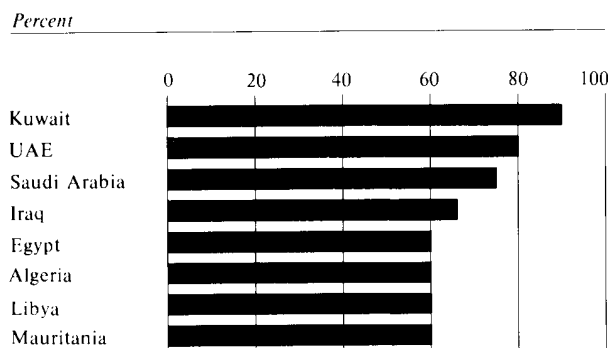
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Figure 6
Food Imports as a Share of Total Consumption in Selected Countries, 1986



attempts by the West to gain influence and control over the region. Moreover, creativity and independence are generally regarded as negative traits in most Middle Eastern societies, and the high value placed on conformity almost certainly has an adverse impact on technological development. In many instances, traditional populations have to be convinced of the usefulness of technology before they will even experiment with it:

- An American academic believes that many Arabs do not accept technology as important because they either derive little direct benefit from it or do not understand its application.
- According to a contractor study, most societies in the region are fundamentally tribal in structure and inclination and resist absorbing modern concepts of organization and technical operations.

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Department of Agriculture data, but the population increased by 42 percent. Overall, per capita Middle Eastern and North African food production in 1985 was 96 percent of the level for 1976-78, according to US Department of Agriculture data. [redacted]

[redacted]

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Obstacles to Successful Technological Development

The selection, adaptation, and diffusion of up-to-date technology are key elements in stimulating economic growth. But the nations of the Middle East and North Africa must overcome a number of obstacles before technology can be effectively used. [redacted]

The widespread aversion among the native populations of Saudi Arabia and the other wealthy Arab states of the Persian Gulf to performing technical work also inhibits technological development. The rapid economic development of these oil-rich states over the past 30 years, coupled with this aversion, has been responsible for the mass import of foreign workers to perform jobs that require semiskilled or skilled labor. Gulf Arab governments have faced serious problems encouraging their young people to pursue technical and vocational training that requires hands-on work. Virtually no middle-class parents want their children to perform what they regard as menial labor. Technical education carries the stigma of being the last resort of those who are academically less astute. [redacted]

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Culture

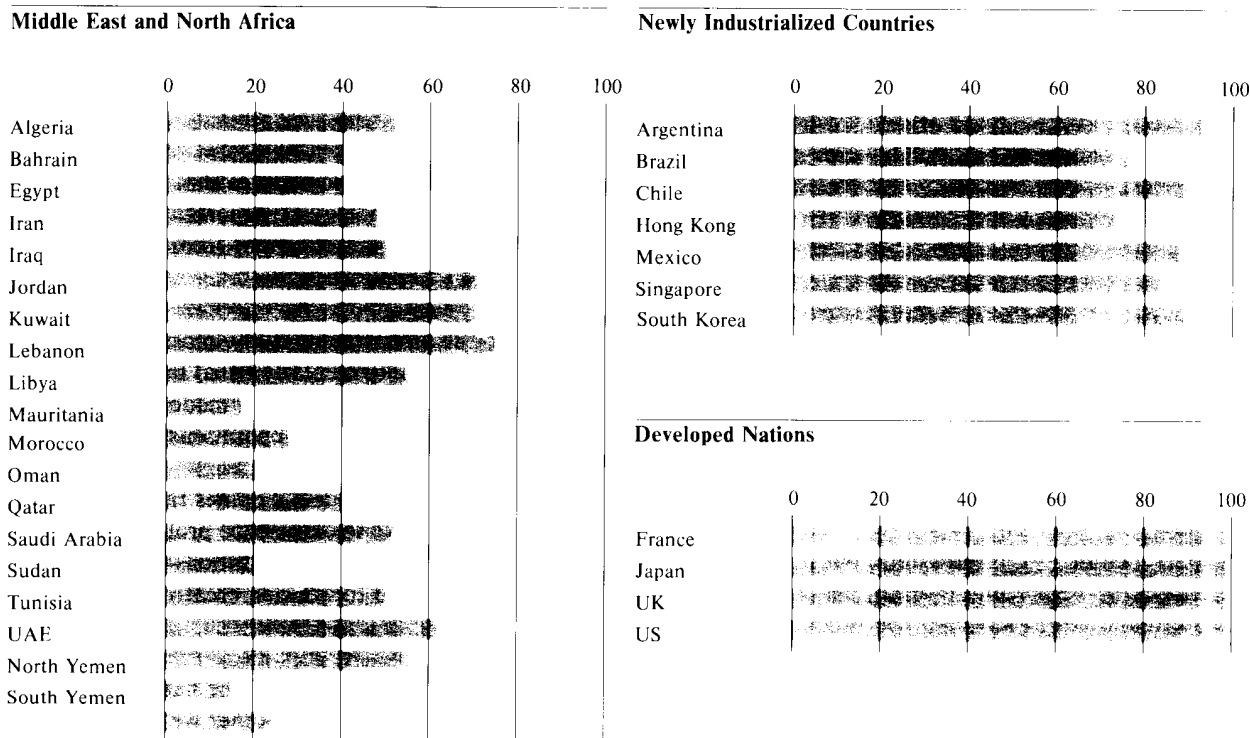
We believe that cultural factors play a major role in inhibiting popular acceptance of technology in North Africa and the Middle East—particularly among the rural and lower classes, which perceive inherent conflicts between technology and traditional values and practices. The more traditional segments of the region's societies usually consider basic skills, hard work, and self-reliance to be the only necessary tools for everyday life. Modern gadgets and innovations generally are viewed as unreliable and confusing or as

The shortage of Middle Eastern and North African nationals with technical skills is compounded by cultural prohibitions—and government restrictions in

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Figure 7
Literacy Rates in the Middle East and North Africa, Newly Industrialized
Countries, and Developed Nations, Selected Countries, 1986



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Saudi Arabia, the smaller Gulf states, and Iran—on women’s participation in the labor force. Women in Iraq, Lebanon, and Morocco have the greatest freedom to work, but only about 15 to 20 percent of working-age females in these countries participate in the work force.² We believe the inclusion of more women in the work force would improve productivity, especially because women would be more willing than

men to remain in their home country after graduation from college, according to a contractor study. A larger number of Middle Eastern and North African women are seeking entry into the labor force than a decade ago, according to a contractor study. The Saudi Government is allowing limited female employment in new fields, such as computer operations and programing. Isolated successes in allowing women to

² This figure does not include jobs in areas such as agriculture and household services.

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participate more actively in the labor force probably will continue, but we doubt that Saudi leaders will permit a widespread challenge to traditional cultural values by allowing large numbers of women to enter the work force in the foreseeable future. [redacted]

Education

For the most part, Middle Eastern and North African educational systems have not adequately prepared their populations to absorb modern technologies. Literacy rates range from 15 percent in North Yemen to 75 percent in Lebanon, compared to 75 to 94 percent in newly industrialized countries such as Argentina and South Korea, according to CIA statistics. Literacy among women and the poor averages less than 15 percent [redacted]

[redacted] Only half of the children in the region between the ages of five and 15 attend school. School enrollment reaches about 90 percent in the cities but often does not exceed 15 percent in rural areas, [redacted]

Some improvements in the region's educational systems have enhanced economic potential. Many more elementary and secondary schools have been built within the last decade, and university enrollments are doubling about every five years. A widening gap, however, has developed over the last decade between the relatively uneducated and the highly educated, leaving a relatively small pool of people able or inclined to take positions in the broad middle range of technical and administrative jobs. By the end of the 1970s, expatriates occupied about 90 percent of these middle-level positions in Saudi Arabia and the smaller Gulf states. [redacted]

Many of these positions remained unfilled in other countries, such as Egypt and Sudan, which sent large numbers of skilled workers to the Gulf. [redacted]

Governments in the region have tried to promote technical or vocational education in order to adapt to the demands of imported technology. Several countries have updated their university systems to offer more courses in engineering and medical sciences. Others offer scholarships abroad to study technical subjects unavailable at home. Some Jordanian schools have introduced children to various types of machinery and mechanical devices, teaching them assembly

procedures. In the wealthier Gulf states schools introduce computers at an early age. Governments throughout the region are trying to counsel good students to go into nontraditional fields to acquire "industrial" skills (electrical engineering, machine repair) and "management" skills (bookkeeping, communications). [redacted]

Despite these attempts at improvement, many employers believe that current educational standards are woefully inadequate and they choose to retrain the graduates they hire, according to business journals. In some cases, the educational systems are little more than outmoded extensions of those of the former colonial powers and sustain curriculums largely irrelevant to current social and economic demands:

- University systems rely heavily on rote memorization and parroting knowledge during examinations.
- Many students in Jordan complain that by graduation they have not become good beginning engineers or computer programmers but have learned only how to pass examinations.
- Syrian high schools and universities offer only elementary courses in specialized areas such as electronics and computers.
- Many students with an aptitude for science choose other fields because of limited opportunities for hands-on experience and the lack of qualified staffs in technical schools. [redacted]

The higher cost of technical institutes has slowed efforts to expand enrollment in them. Per-student costs in vocational and technical schools are 1.5 times greater than in general schools, according to a contractor study. Most graduates are prepared to operate only outdated machines because schools cannot afford new equipment. The contractor reports that students in computer science at Damascus University must make do with a purely theoretical education because they never see a computer. [redacted]

Language barriers also hamper technical education. We do not believe that critical subjects such as telecommunications, information technology, medicine, and computer technology can be taught adequately in the universities unless more literature

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Figure 8. Several expensive technical institutes have been built throughout the region—such as this one in Tunisia.



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Figure 9. Often, however, the equipment used in workshops is outdated, and the schools have difficulty attracting talented students.



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appears in Arabic or unless more students and professors use English in the classroom. Universities in Egypt, Libya, Morocco, and the Gulf restrict classroom use of English—the language in which most scientific textbooks are written—in order to limit Western influences.

Although governments in the region have increased their attention to technical and vocational training, many young people still lack interest in these career options. less than 30 percent of university students in the Middle East and North Africa major in scientific fields. Even technical school graduates are not committed to the

idea of performing skilled labor as a career. Some students say that it is “something one does while waiting to see if something better comes along,”

We believe that there is a growing public opposition to government policies emphasizing technical education in several countries. Elite groups in Jordan attacked such an educational emphasis, according to a contractor study. Students in several countries—particularly Jordan, Saudi Arabia, Kuwait, and the United Arab Emirates—continue to resist pursuing technical

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Jordanian Attitudes Toward Technical Work

A recent survey of Jordanian technical school graduates and employers—conducted for the World Bank—indicates the low esteem with which such graduates view themselves, the inappropriate work attitudes they bring to the job, and the inadequacies of the training they received:

- *Seventy-five percent of technical school graduates aspire to a university-level liberal arts education and view their present circumstances as temporary.*
 - *Only 20 percent of the graduates want to achieve a high degree of competency in their chosen vocational or technical education field.*
 - *Over 60 percent of the graduates indicate that their education did not sufficiently prepare them for their first job.*
 - *Eighty percent of the graduates had only average or below-average scholastic performance. (Trainees can drop out of the program by themselves but are never failed because of inadequate performance.)*
 - *Two-thirds of the employers of graduates note that technical schools are not imparting responsible attitudes toward work or high skill standards to their students.*
-

careers and believe that a university degree will provide entry into a white-collar job even if such jobs are becoming difficult to secure.

Islamic Fundamentalism

In our judgment, most Islamic fundamentalists throughout the Middle East and North Africa believe that Western technology—which is often accompanied by unwanted cultural and social innovations—undermines Islamic religious and cultural values. According to a contractor study, some fundamentalists criticize modernization because it is based on secular scientific knowledge rather than on religious canon. Others denounce what they perceive as the moral decay caused by modernization and believe that the economy suffers because Muslims imitate un-Islamic Western models. They demand that the government abandon Western-style education in favor of traditional Islamic instruction, with its emphasis on

religious education. So far, public protest against imported industrial technology has been rare. Fundamentalists have focused more on trying to ban other Western introductions, such as video clubs and movies.

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We believe that a few fundamentalists—those who have had more exposure to the benefits of modernization and technology, and who are located mostly in Iran—do not share the view that most Western advances must be rejected. They believe that some modern elements—such as Western medical technology, computers, and communications systems—can be incorporated into society without disturbing Muslim values. They believe that importing technology is acceptable if Islamic values are upheld.

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The introduction of technology into Kuwait over the last decade has spawned conflicting attitudes, according to a public opinion poll administered by the US Information Agency in 1986. Three-quarters of the respondents—especially young, educated males—believe that Kuwait needs all the modern technology it is getting and that more technology brings a better quality of life. At the same time, however, many Kuwaitis hold negative views of the influence of Western popular culture, which they associate with modernization. Over 70 percent of the respondents view Western music and videotapes as morally corrupt rather than reflecting a better standard of living. Older and less-educated respondents were most concerned about Western influences.

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Brain Drain

We believe that the lack of incentives for scientists and engineers to remain in their own countries will continue to impede the development of science and technology in the Middle East and North Africa. Countries in the region annually lose hundreds of talented youths—most of whom have gone abroad for technical education—mainly to the United States and Western Europe. An expert on the brain drain phenomenon estimates that over 250,000 Arab professionals live in the United States, Europe, and Latin America because of poor salaries and living conditions, political discontent, or lack of job opportunities

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at home. Many professionals in fields such as medicine, engineering, or teaching also have emigrated, mainly to the richer Arab oil states. [redacted]

Policies to control the outflow vary. For example:

- Iran continues to send students abroad to study but would like to reduce the flow in order to have more control over the Islamic aspects of their education, according to Iranian press reports. Iran's President Ali Khamenei has suggested publicly that Iran invite foreign professors to teach science and other subjects to offset the domestic shortage of university educators and to stem the emigration of talented students.
- The Syrian Government has attempted to combat the brain drain by demanding that graduates who have been financed by the state work in Syria for several years after graduation or repay their loans and grants. Iraq has followed a similar policy.
- Sudan would like to send more agricultural specialists to the United States for advanced training, according to US State Department officials, but it almost certainly will lose more skilled workers if it pursues this policy.
- According to the US Embassies in Cairo and Amman, Egyptian and Jordanian officials support a limited brain drain because it serves as a safety valve for domestic unemployment and underemployment, and it brings in remittances—an important source of foreign exchange for both countries. [redacted]

Military Siphon

The military sector—particularly in Egypt, Iran, Iraq, Libya, Saudi Arabia, and Syria—absorbs the most experienced technical manpower and has seriously curbed the ability of the civilian economy to meet production targets. Although there are not enough qualified nationals to maintain and operate sophisticated military equipment in some instances, the quality of most armed forces personnel—pilots, engineers, electronic technicians—generally is better than that found in the civilian population, according to a contractor study. The military services in Syria and Saudi Arabia, for instance, attract better personnel by

maintaining their own technical training facilities and by providing salaries and other incentives that surpass those at civilian institutions, according to a contractor study. This disparity contributes to the shortage of competent technical manpower in civilian sectors such as industry, construction, telecommunications, and transportation. [redacted]

Competing Demands for Scarce Financial Resources

The regional decline in real economic activity of 2 percent in 1985 and 4 to 5 percent in 1986 reduced the abilities of countries in the area to maintain plans for acquisition and development of technology. Some budget items have suffered, even though most Middle Eastern and North African states have continued to allocate resources for health care, sanitation, communications, public transportation, and housing. Several governments in the Gulf states, for example, have postponed or scrapped projects to construct schools and training centers. Iran has reduced the number and amount of educational scholarships for study abroad because of the recession and budget cuts. Economic reforms such as privatization and diversification are foundering because businessmen and governments do not have sufficient capital to promote new projects. [redacted]

Burgeoning populations are straining government welfare systems and forcing leaders to pay more attention to social services and consumer subsidies that can have an immediate impact on political and social stability. As a result, long-term stability could be jeopardized if funds for modernization plans and technology imports fall lower on the list of priorities. Syria, Jordan, and the Gulf states face some of the most serious limitations to technological advancement because of high population growth. Although some

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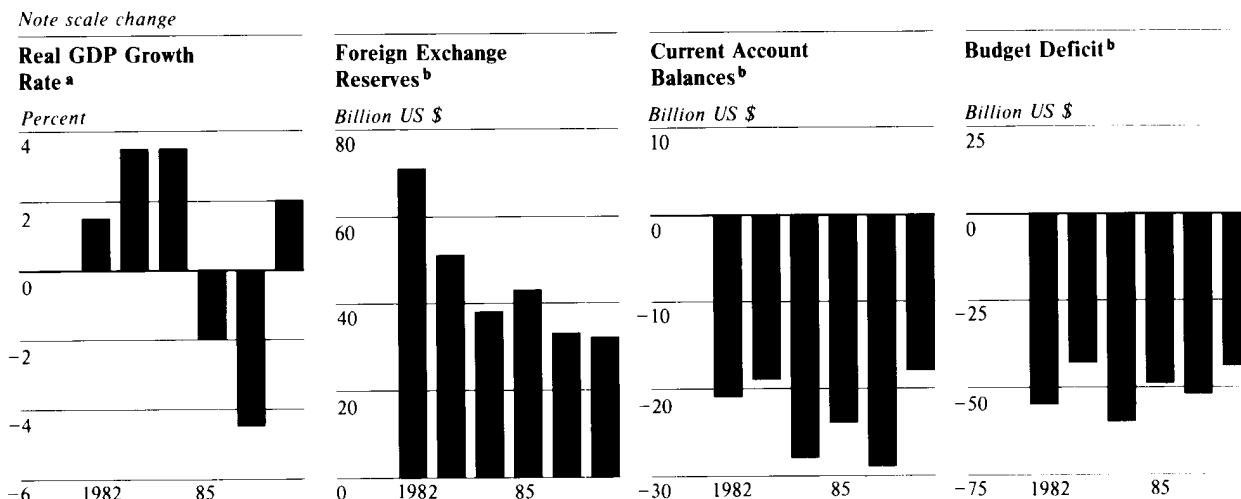
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Figure 10
Middle East and North Africa: Economic Indicators, 1982-87



Note: Data for 1986 and 1987 are projected.

^a Weighted average, estimated.

^b Estimated.

313445 8.87

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shortsighted Egyptian officials suggest that “excess labor can work in agriculture,” US Embassy officials in Cairo believe that population growth is one of Egypt’s most pressing problems. [redacted]

Low Wages

Besides the lack of prestige associated with working in technical and vocational fields, workers are disenchanted because wages and working conditions do not meet expectations. Government development policies are inconsistent because they support salary and wage practices that do not correspond to what the government recognizes as critical shortages in technical manpower. Many unproductive administrators with college educations or nondegree entrepreneurs with small shops make better livings than skilled industrial workers. Some firms in Egypt are having trouble attracting engineers because wages are too low, according to US Embassy reporting. [redacted]

We believe that modernization policies in the Middle East and North Africa will continue to suffer unless area governments restructure wage scales or allow

free-market forces to work to reward technical skills. In some cases, even this approach may not be successful. The Jordanian Government’s attempts to restructure wages have not corrected structural problems in the labor market. Jordanians seem to be indifferent to the new higher wage levels for skilled and semiskilled work, according to a contractor study. [redacted]

Impact of Technology on Labor Markets

There is a downside to promoting a more efficient infrastructure using capital-intensive and labor-saving technology. Fewer workers are required, but they must be more highly skilled. Most countries in the region already have serious difficulty in trying to lower unemployment, raise worker productivity, and train their work forces adequately. [redacted]

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Figure 11. Algeria: Students learn to operate telecommunications equipment. [redacted]

There is a serious shortage of qualified nationals at the middle and lower levels of industry in most area countries. Most civil service trainees are inadequately prepared to use advanced technology and methods in key areas such as accounting, statistics, communications, and computer operations. According to the World Bank and the ministries of labor throughout the region, there are severe shortages of managers, engineers, doctors, and computer programmers and there are large surpluses of graduates in fields such as Arabic language and literature, sociology, and law. [redacted]

We believe that chronic, structural unemployment is a growing problem in most countries—except for technical jobs, where employment opportunities are abundant—and could contribute to political unrest. Urban unemployment is compounded as many rural residents move to the cities, hoping for higher wages and a more rewarding life. Where capital-intensive and labor-saving technology is successfully introduced, we believe that unemployment problems could become more severe. In many cases, management is proud of its new Western equipment and does not appear concerned that the introduction of more capital-intensive machinery has spawned an attrition policy of not hiring new employees to replace those who retire or quit. We believe—on the basis of interviews of officials in the US Embassies in Jordan, Egypt, and

Unemployment Among Nationals, and Population Growth in Selected Countries, 1986

Percent

	Unemployment	Annual Population Growth
Algeria	30 ^a	3.2
Egypt	10	2.8
Jordan	10	3.3
Kuwait	3	3.5
Morocco	30 ^a	2.4
Saudi Arabia	3	3.2
Syria	10	3.7
Tunisia	30 ^a	2.3

^a Includes underemployment. People eligible to work are considered underemployed if, for example, they do not have full-time jobs or if they do nonessential jobs or services (for example, selling gum on the street, washing windows of cars stopped in busy traffic).

[redacted]

Morocco—that the work forces in several increasingly capital-intensive industries such as textiles, petrochemicals, and telecommunications have been decreasing steadily over the last two to three years. [redacted]

Many university-educated Egyptians, especially those without the personal connections so often needed to find a job in Egypt, either cannot find jobs in their field or take blue-collar jobs that pay more, such as driving taxis. Urban unemployment is growing as large public-sector plants reduce their work forces, and we believe the private sector will not be able to create jobs fast enough to keep pace with the expanding work force. [redacted]

Although much of the Jordanian population is well educated and supports government efforts to modernize and provide technical jobs, some lesser educated Jordanians fear that technological advances will eliminate their jobs, [redacted] [redacted] Where positions have become obsolete following the installation of new technologies or updated

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equipment, displaced Jordanians frequently have been kept on the payroll and assigned other duties, such as security. Broad government modernization plans call for retraining displaced employees to operate new equipment, but no programs have been established so far, [redacted]

that Iraq and Iran will have moderate chances for industrializing when the war ends because of their significant natural resource bases and large populations. Egypt and Jordan have good chances to achieve isolated technical successes in fields such as agriculture and water management because of their relatively strong educational systems. [redacted]

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Prospects

In the long run we expect that modernization will proceed slowly in the Middle East and North Africa because of cultural and economic constraints that are difficult to surmount. We believe that the general population in the region will continue to be ill prepared to handle the technology that the public and private sectors plan to acquire over the next decade. Area governments probably will establish more technical schools and training centers in order to try to fulfill modernization plans, but persistent negative attitudes toward technical education will work against the success of these plans. [redacted]

Islamic fundamentalism will complicate regional modernization plans. We believe that the conflict between modernization and Islamic fundamentalism will be most acute in states—such as Saudi Arabia and the United Arab Emirates—that have been isolated from Western influences and whose wealth has sparked rapid expansion of technological development. Despite concern for the growing political power of fundamentalism, governments in the region will continue to acquire Western technology that helps improve the standard of living while attempting to limit the penetration of Western cultural values. Most government leaders probably are prepared to risk the fundamentalists' ire by continuing to turn to Western nations to provide support in meeting critical needs in such areas as health care, sanitation, communications, public transportation, and housing construction. [redacted]

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Technology acquisition and development almost certainly will not push economic development forward in the Middle East and North Africa in the way that it has in newly industrialized countries such as Brazil and Hong Kong, because natural resources other than oil are limited and labor force deficiencies will take decades to correct. We believe that area countries will be unable to compete successfully in most commercial technology markets because of their delayed start, expensive production factors, and the difficulty of breaking into markets where trade ties are well established. We believe advanced Western technologies such as automation, biotechnology, genetic engineering, information and computer sciences, and robotics will have little immediate relevance to countries in the region. [redacted]

Modernization and the Oil Market

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We believe that the region's short-term outlook for technological development depends to a large extent upon oil prices, which are likely to average between \$15 and \$18 per barrel over the next two years. With these prices, the entire region probably will achieve growth in real GDP of about 2 percent in 1987. Area governments probably will press ahead with their modernization plans, resuming some programs that they were forced to cut over the last five years. [redacted]

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The poorest countries—Lebanon, Mauritania, North Yemen, South Yemen, and Sudan—have the least chance for technological development. Saudi Arabia and Kuwait, on the other hand, are in a good position to achieve technical advances because of their greater financial and hydrocarbon resources. These richer countries probably will continue to advance in areas such as petrochemicals and oil refining. We believe

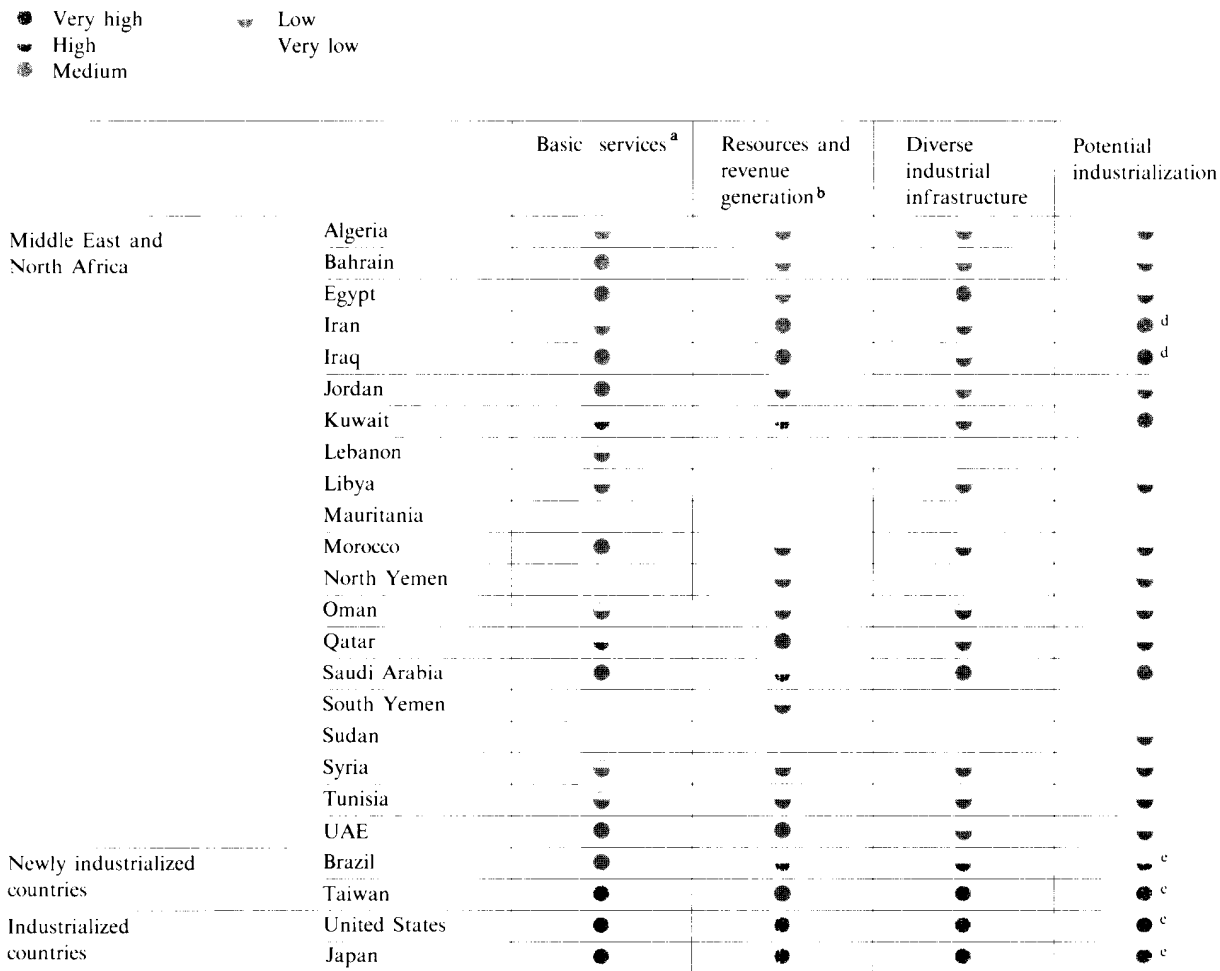
In the unlikely event that the OPEC price and production agreement collapses, a prolonged recession and increased unemployment would result. Although most area governments would try to avoid severe austerity measures by drawing down their foreign exchange reserves or increasing foreign borrowing, some technological development programs—for example, computer training and agricultural research—almost certainly would suffer. [redacted]

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Figure 12
Meeting Selected Requirements for Potential Industrialization



^a Includes health care, agricultural improvements, schools, etc., to help foster a strong work force.

^b Country can take advantage of natural and human resources to finance and provide inputs for industrialization.

^c Not the sum of the previous three columns; other factors also affect the ability to produce a broad range of products and services for consumption and export.

^d If war ends.

^e Actual industrialization.

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We believe a few governments in the region—particularly the Gulf states and Egypt—will continue to promote competition and privatization to boost economic growth. Uncertainty about the outlook for the economy and oil revenues, however, will discourage most private domestic investment in technology. [redacted]

industrialized nations—particularly Japan, France, West Germany, and the United Kingdom—to provide technical equipment and to promote educational and scientific development. Japan probably will be the most important competitor of the United States as a supplier of technology because of its active marketing campaigns in the region. In addition, many Japanese technological goods probably are less expensive than their US counterparts. We expect that Japan will sponsor technical exchanges—including sending technical specialists to the Middle East and inviting engineers to Japan—and give aid for research and development. The Middle Eastern and North African states will depend less on Soviet and East European equipment and assistance, which is cheaper but less reliable. [redacted]

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Modernization and Indigenization

Gulf state leaders probably will promote technological development and economic modernization more than indigenization of the labor force, despite their fears of the threat to social and political stability posed by large numbers of foreign workers. Saudi Arabia and the smaller Gulf states will continue to depend heavily on expatriates—particularly in critical technical areas such as computers, electronics, petrochemical production, and telecommunications. Generally, the more sophisticated the technology, the greater will be the dependence on foreign labor. [redacted]

We believe area countries will shift their imports from finished goods toward capital equipment, support systems, and technical services. The region will welcome foreign investment and technology imports in areas such as security systems, military goods, water resource management, arid land agriculture, geological studies, coastal development, and nonconventional energy sources. According to US Embassy reporting, the United States can be most useful if it focuses on programs to increase agricultural production and if it invests in private-sector initiatives for industrial development. [redacted]

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Indigenization remains a goal, but we believe the Gulf states will continue to employ expatriates at rates near recent levels unless their economies worsen substantially. Labor offices in Saudi Arabia issued more than 500,000 work permits to foreigners during 1986, and the country continues to import labor at a steady rate, according to press reports. We believe that indigenization will progress least in areas requiring technical and skilled manpower. [redacted]

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According to a contractor study, Saudi Arabia's economy may be destined to contract for its future, with entire segments the permanent preserves of foreign workers and Saudi nationals presiding over all. We believe that Gulf modernization will depend heavily upon the abilities of Saudi Arabia and the smaller Gulf states to attract large numbers of expatriate workers. Under this scenario, modernization in the labor-exporting countries of the Middle East and North Africa probably will lag because many trained workers will have left for higher paying jobs in the Gulf. [redacted]

We expect that several countries in the region will approach the United States to develop joint projects in order to assure continued access to technical expertise. Egypt would like to train more technicians and production managers in the United States—particularly as Egyptians engage in more industrial ventures with the United States. Oman has requested US assistance to tap underground water resources. [redacted]

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We believe that opportunities for US investors and technology equipment exporters will decline if the recession in the Middle East and North Africa continues. Nevertheless, area countries almost certainly will request the United States to disseminate more technological knowledge and to relax restrictions on patent agreements. US technology exports to the region have

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Implications for the United States

Even though the oil boom is over, we believe that the Middle Eastern and North African countries will continue to depend on the United States and other

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not grown as rapidly as those of its competitors over the last decade because of increased trade restrictions on items such as computers and military equipment, according to a contractor study. The Europeans and Japanese have been far more willing to make such technology available to the Middle East and North Africa. We believe that Iran, Libya, and Syria will continue to try to acquire US technology—which is not legally available to them because of US trade sanctions or bans on technology transfer—through third parties such as France, Switzerland, and Kuwait.

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Appendix

Selected Technology Interests and Acquisitions in the Middle East and North Africa ³

Algeria

- Acquired computerized equipment and technical assistance for oil refining industry.
- Is cooperating in research, manufacturing, and operation of satellite communications with India.

Bahrain

- Plans to establish a computer network for government ministries.

Egypt

- Has nuclear research center; interested in using radioactive isotopes in scientific and medical research. United States has provided 40 to 50 technicians to help with cooperative program in nuclear science.
- Government officials recently advocated that more government agencies and private companies fund scientific research, that the government emphasize adapting imported technologies to local capabilities, and that laboratories conduct more research to detect new and endemic diseases in Egypt.
- Approached Israel to learn latest irrigation techniques.
- Plans to encourage more scientists and engineers to work in areas such as energy and improvement of oil products, environmental protection, agricultural cultivation, and building materials.

[Redacted]

³ These items illustrate the range of technology items that Middle Eastern and North African states have acquired or are trying to obtain. We cannot determine with great precision who runs this equipment, but we believe that indigenous personnel operate most technical equipment in nonoil states after an initial phase where foreign supervision is required. Foreign workers probably operate most technical equipment in Saudi Arabia and the smaller Gulf states. [Redacted]

Iran

- Seeks computer spare parts—memory boards, printed circuit boards, diodes, and resistors—for mainframes in government ministries and provincial computer centers.

[Redacted]

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Iraq

- Is cooperating with West Germany to establish photovoltaic energy plant.
- Acquired battery charge production technology from West Germany.

Jordan

- Encourages US companies to share technology in order to make potash industry more efficient.
- Wants to explore alternative sources of energy and to devise new technological methods for saving existing energy.
- Seeks to improve irrigation methods.

Kuwait

- Ministry of Interior keeps track of Kuwaitis and large expatriate population by using computers to monitor arrivals and departures at airport and land borders.

Libya

[Redacted]

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- Has sought assistance from Denmark to construct iron and steel foundry.

[Redacted]

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Morocco

- King Hassan has developed a strong personal interest in computers



North Yemen

- Is developing oil sector with assistance from US firms.
- Plans to have science and technology exchanges with Pakistan.

Oman

- Sultan Qaboos hopes US assistance and technology can help to locate new sources of water, hydrocarbons, and minerals.

Qatar

- Has sought economists and administrators from Turkey, Egypt, and Pakistan to work in the oil sector in order to help market oil products.

Saudi Arabia

- Is acquiring computers to communicate flight information to defense and civil aviation officials, to modernize government ministries, and to enable Ministry of Interior to track nationals, expatriates, and Hajj pilgrims.
- Saudi firms seek distribution rights to market Japanese and Taiwanese computers and printers in Middle East.
- Depends on several US firms for machine tools—including drill presses, flanging machines, armature lathes, break drum lathes, and metalworking lathes.



Sudan

- Seeks aid from United States, Saudi Arabia, and Japan to help develop manpower training programs, modernize the public and private sectors, and sponsor development projects—such as hospitals, irrigation systems, and an electric power program.

Syria

- Has purchased turnkey communications and micro-electronics plants from the United Kingdom.
- Has sought assistance from France to train technicians to operate telephone systems.
- Is constructing sewerage treatment plants but has asked West German firms to supply and install electrical and mechanical equipment and to train personnel.
- Uses advanced surface geochemical techniques for petroleum exploration.



United Arab Emirates

- Telecommunications firm has purchased transportable satellite earth stations from the United States, which have been mounted on small trucks and are now part of a government communications system.
- Abu Dhabi National Oil Company has acquired a US “supercomputer” for oilfield reservoir engineering and management.



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