CHAPTER 6

Telecommunications Technology Transfers

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INTRODUCTION

The countries of the Middle East realize the importance of modern, efficient telecommunications systems to their future development and security. Middle Eastern leaders consider telecommunications as important a part of their infrastructure as roads and ports. This is reflected in several of the 5-year plans and budgets of Middle Eastern nations. Kuwait, in particular, wants to become a regional and international financial center and has developed telecommunications capabilities necessary to reach this goal. The centrality of telecommunications to development planning is also reflected in cooperative regional efforts such as Arabsat, a regional satellite communications system.

There is today great disparity in telecommunications systems in the Middle East. Some countries, like Kuwait and Saudi Arabia, have extremely modern, efficient systems; others like Egypt have comparatively dated equipment and systems which are much less reliable.

With the notable exception of Algeria (and in a few cases, Egypt), the countries under study have opted for the most advanced telecommunications systems available-whether microwave transmission networks, satellite communications, or automatic electronic switching. Kuwait and Saudi Arabia in particular have used their financial resources to purchase state-of-the-art technology. This has allowed them to "leapfrog" conventional technology, becoming testbeds for some technology so new that it is not installed anywhere else in the world. Iran and Iraq found some of the most sophisticated systems as best suited to their needs. Algeria, in contrast, opted for more conventional technologies in order to lessen dependence on foreign expertise and to promote indigenous equipment manufacture.

Middle Eastern countries, through their PTT's (post, telephone and telegraph) ministries have made major investments in telecommunications infrastructure during the past decade. In many cases, subscribers have only recently begun to feel the impact of telecommunications, yet the experience has generated a set of rising expectations and further demand for sophisticated equipment and services among business and industry, government agencies, the military services, and residential users. A number of factors have contributed to this growing demand for telecommunications, among them the perceived novelty of the improvements, prestige associated with telecommunications as a sign of modernity, and the utility of improved communications in achieving other development goals.

The rapid expansion of national and regional telecommunications systems in the Middle East has made the region a major new market for equipment sales, operation and maintenance, consulting services, and training. This continuing transfer of technologies has increased the capabilities of these countries to expand their commercial and industrial bases; to improve domestic communications; and to explore possibilities for regional and international cooperation. On the other hand, continuing dependence on foreign suppliers, and the use and control of the systems, are sometimes controversial issues associated with these technology transfers.

This chapter first examines the present status of the telecommunications systems in each of the six study countries and in the region. Perspectives of recipient and supplier countries and firms are then discussed. U.S. suppliers have won sales of all types of telecommunications equipment and services in countries such as Saudi Arabia and prerevo-

lutionary Iran, but overall, U.S. firms have not been a dominant force in telecommunications trade in the region. In the world telecommunication market, U.S. firms have lost ground to Japanese suppliers during the past decade. In assessing competition among suppliers and implications for U.S. policy, special attention is paid to the role of supplier government fimincing in competition for sales of telecommunication technology.

TELECOMMUNICATIONS IN THE MIDDLE EAST

TELECOMMUNICATIONS SYSTEMS

Telecommunications systems generally include: 1) telephone and telex equipment, 2) transmission equipment, 3) mobile radio, 4) video and radio broadcasting equipment, and 5) data communications equipment. During the past decade, telephone and telex have been the major imports of the Middle East, making up well over 50 percent of total imports of telecommunications equipment and services for most countries. Transmission equipment imports have been the second largest, valued at 20 percent of total telecommunications imports in some cases. The following section briefly explains the application of the major telecommunications technologies in each of these categories.

Telephone and Telex Equipment

A standard telephone set consists of an apparatus that includes a telephone transmitter, receiver, and switchhook. Other types of telephone equipment used onsite by a subscriber are coin telephones, answering machines, intercoms, call restrictor devices, and station accounting systems. A telex is a direct-dial telegraph service wherein subscribers can communicate directly through circuits of the public telegraph network. Teleprinters (instruments with a typewriter keyboard and printer) send and receive messages through the system.

Both telephone and telex use switching mechanisms to interconnect the circuits of the equipment. Manual switching requires a switchboard staffed by an operator, while automatic switching can be performed electromechanically or electronically. Electromechanical switching uses analog technology, wherein mechanical (dialing) and voice signals are transformed into a continuous signal of varying frequency and used to activate the switches. Electronic switching uses electronic devices to connect circuits and usually involves computer-controlled (software) circuitry. It can operate using analog or digital technology (see box A).

Digital technology converts dialing and voice signals into discrete electrical pulses that form computer-understandable streams of information. Because it uses the power of a computer, digital switching technology can offer additional subscriber services such as abbreviated dialing, call transfer, conferencing, speed calling, call cost readouts, and reliable billing. Technically, digital technology is an improvement over analog equipment because it results in less deterioration of the transmitted signal, higher speed, and simultaneous transmission of multiple calls. At the same time, because digital technology is more sophisticated, use by local personnel in developing countries may be more difficult. Indeed, software engineers for digital systems are in short supply worldwide, not just in developing countries.[1]

Almost all of the world's telephone plants evolved using analog transmission; most of them will remain so for years to come because of the billions of dollars invested. However, it is probable that if telecommunications companies were to start anew, telecommunications channels would be almost entirely digital, with the possible exception of the local "loops" be-

[1]Information provided by Continental Page, December 1983

Box A.—Analog v. Digital Transmission

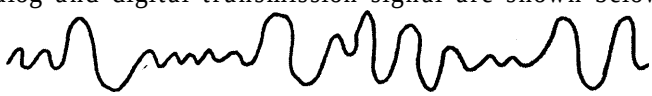
There are **two basic ways in which** information **of any type can be** transmitted over telecommunication media: analog or digital.

Analog transmission entails transmittal of a continuous signal in a continuous range of frequencies. Sound consists of a continuous spread of frequencies from about 30 to 15,000 Hz (Hertz, **or cycles per second), or at most 20,000 Hz for persons with excellent hearing. (Sound** cannot be **heard by humans below 30 or above 20,000 Hz.) Although it is technically possible to** transmit across this large range over the telephone wires, the telephone **companies, conscious of costs,** transmit **a range of frequencies that may vary only from about 300 to 3,000** Hz, a range wide **enough to make a person's voice recognizable and intelligible. When telephone signals travel** over **lengthy channels, they are packed together, or multiplexed, so that one channel can carry as many** such signals as possible. The multiplexed signals have different frequencies so that they do not interfere with one another, but they are still transmitted in an analog form.

Digital transmission means that a stream of on/off pulses is sent, such as occurs in computer circuits. These pulses are referred to as **bits.** It is possible today to transmit at extremely high bit rates such as 4,800, 9,600, and 56,000 bits per second.

An analog and digital transmission signal are shown below:

analog:



digital:

A transmission path can be designed to carry either type of transmission: this applies to all types of transmission paths, whether wire pairs, high-capacity coaxial cables, microwave radio links, satellite, waveguides, or fiber optics. Any type of information can be transmitted in either an analog or digital form. For example, the telephone channel is generally an analog channel, but computer data can be sent over the telephone lines by using **a modem** (modulator/demodulator), which converts the digital data into a continuous (analog) range of frequencies. In a similar man**ner,** any analog signal can be converted to digital signals for transmission. Codecs are circuits that convert signals such as speech and television into a bit stream and convert such bit streams back into the original signal.

SOURCE: **Adapted** from James Martin, Future *Developments in Telecommunications*(Englewood **Cliffs, N.J.: Prentice Hall, Inc.,**1977), ch. 4.

tween a subscriber and the nearest switching office. Some developing countries, such as Kuwait and Saudi Arabia, are installing pulse code-modulated (PCM) systems in which voice and other analog signals are converted into a stream of bits that look like computer data.

The economic factors favoring digital over analog transmission stem from two aspects of these technologies. First, it is becoming possible to build channels of high bandwidth, those with high information-carrying capacity. Thus, many existing wire-pair channels, which represent an enormous financial investment, could be made to carry much more traffic. Second, whenever the signal is amplified in analog transmission, the noise and distortion is amplified with it. As the signal passes through its many amplifying stations, *noise* is amplified and cumulative. With digital transmission, however, each repeater station regenerates the pulses and new clean pulses

are reconstructed and then sent to the next repeater. Thus, the digital pulse train is more impervious than the analog to distortion in the signal.

Several factors are thus pushing the economic calculus in favor of digital transmission:

1. the trend to much higher bandwidth facilities;
2. the decreasing cost of logic circuitry, which is used in coding and decoding the digital signals and in multiplexing and switching them;
3. the increase in capacity that results from use of digital repeaters at frequent intervals on a line;
4. improvements in codec design, enabling speech to be encoded into a smaller number of bits;[2] and
5. the rapidly increasing need to transmit digital data on the networks.

Facsimile systems transmit information on a written page by scanning the page electronically and more rapidly than one character at a time. Their benefits include more rapid transmission of written material than via telex, the elimination of typographical errors, and the possibility of transmitting graphics. Facsimile machines are gaining popularity in the Middle East, where difficulties have been encountered in transferring Arabic script to electronic keyboards. Current choices in facsimile systems involve low-, medium-, or high-speed models and analog or digital equipment.

Transmission Equipment

Transmission equipment enables transmission of information within the exchange area and on short- or long-distance hauls. The transmission can involve physical connections between two points ("wire"), or transmission which occurs through a space ("wireless"). It can involve analog technology that enables only one telephone conversation per circuit, or digital technology that enables many telephone conversations to be transmitted simultaneously on one circuit. The advantages of digital over analog technology include higher reliability, better reception, and the transmission of voice, data, text, and video over the same circuit.

Transmission lines include wire and cable for trunk lines that connect subscribers between two central offices or switching exchanges. Also included are coaxial cables which are transmission lines consisting of a small copper wire insulated from another conductor of larger diameter (usually a copper braid). Coaxial cable is often more desirable than wireless transmission equipment in that it is more secure for transmitting sensitive information and it provides high-quality service unaffected by changing weather conditions. Other transmission lines include wiring within the exchange and cable laid underwater (submarine cable).

High-frequency radio (other than mobile) involves wireless transmission and is often used for military applications. Microwave uses high-frequency, highly directional radio signals (above 890 megacycles per second) to transmit multiple communications channels (broadcast or video circuits between two points that have relay stations). The quality of transmission is comparable to that of coaxial cable. Repeater or relay stations receive signals through antennas, amplify them, and retransmit the signals to the next station.

Two types of microwave systems are available, line-of-sight and over-the-horizon. Line-of-sight systems permit transmission in relay links of about 30 to 35 miles on average, although single links of 100 miles may be possible if ground terrain permits. Transmission can extend to distances of 3,000 to 4,000 miles with many links. In comparison to cable transmission, attractive features of line-of-sight systems are high and flexible channel capacity, easy expansion of capacity, shorter installation time, and better adaptation to difficult terrain. Over-the-horizon systems often use tropospheric scatter technology to span longer distances (up to 700 miles) without relay links. Signals are diffracted in the atmosphere. Be-

[2] See **Box** A for definition of cock. Bits are binary digits which can take on one of two values, typically written as ''O or '' 1.

cause of the long distances, these systems are useful for transmitting across large bodies of water. They require very large antennas and very high-powered transmitters and thus tend to be costly and sometimes unreliable.

Fiber optics are composed of fine glass fibers that transmit information by converting digital electrical impulses into light beams. The information is carried through the fibers, which physically connect sender and receiver. These fibers are smaller and lighter than conventional copper wires and can carry much more information than a typical metal cable using digital signals. A single optical fiber, for example, may carry thousands of telephone calls. Optical fibers can carry a mix of signals simultaneously—telephone, cable television, radio, video, and data. They can also transmit signals four times farther than metal cables without repeaters to amplify the signal.

The fibers are manufactured with glass of high silica content and few impurities. The raw materials used in making glass fibers, unlike copper, are among the world's most plentiful substances.[3] They also do not conduct electricity and are not subject to electromagnetic interference, which means less "noise" in data communications. Fiber optic transmission is difficult to intercept or interfere with and is adaptable to hazardous conditions, making it useful in many military applications. This technology is, however, still comparatively experimental for long-haul distances and costs are higher than for other transmission methods.

There are three types of multiplexer, which enable the simultaneous transmission of several channels on a single circuit. There are three types. Frequency division multiplex transmits two or more signals on a common path by using different frequency bands for each signal. Those with large capacity can carry, for instance, one television channel and 600 to 900 telephone channels on a single microwave carrier. Time division multiplex transmits two or more signals on a common path by using different time intervals for different signals. This technique is less expensive to implement than frequency division multiplex, but is not compatible with frequency division multiplex systems and is not suitable for a large number of channels. Finally, pulse code modulation obtains a number of channels over a single path by modulating each channel on a different frequency and demodulating it at the receiving point.

Satellite transmission uses a satellite placed in geostationary orbit[4] to communicate telephone, radio and television, and data signals. The satellite operates essentially as a microwave relay in the sky, receiving microwave signals and retransmitting them to Earth. The Earth station is a dish-type antenna that receives and transmits.

Mobile Radio

Mobile radio involves radio service between a fixed station and one or more mobile stations. Land mobile radio includes conventional mobile radio and mobile telephone (mobile stations hooked into a central public telephone switching network). The new cellular type of mobile telephone system allows a higher user

[3] James Martin, *Future Developments in Telecommunications* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1977).

[4] A geostationary orbit is that of an object traveling about the Earth's equator at a speed matching the Earth's rotation, thereby maintaining a constant relation to certain points on the Earth.

Photo credit: Harris Corp.

Earth Station, Riyadh, Saudi Arabia

density in a geographic locale but requires sophisticated computer control. Paging systems are small frequency-modulated (FM) one-way radio receivers which page individuals. Many pagers can occupy a channel if receiving only data messages rather than voice. Current choices include tone only or tone and voice paging. Marine radio involves radio transmission between two units at sea or between sea and land, and air-ground communications involve radio transmission between aircraft and the ground for navigation and communications purposes.

Video and Radio Broadcasting Equipment

Closed circuit television (CCTV) includes cameras, monitors, receivers, control consoles, scan converters, and lines interconnecting the system with the receivers. Radio broadcast transmitters and studio equipment include amplitude-modulated (AM) and FM transmitters, antennas, lines, consoles, and recording and playback equipment. Television broadcast transmitters include very high frequency (VHF) and ulta-high frequency (UHF) transmitters, antennas, Lines, consoles, recording and playback equipment, cameras, and mobile vans.[5]

Data Communications Equipment

Data communications equipment connects computers to the telephone network. Up to 4,800 bits per second of data can be transmitted on regular voice telephone lines. Modified lines enable faster data transmission. This equipment includes concentrators, modems, multiplexer, and data communications switching.

MANPOWER REQUIREMENTS

From the perspective of Middle Eastern countries importing telecommunications technologies, a central concern is with manpower requirements for operating and maintaining equipment. Contracts for supply of equipment almost always include requirements that the supplier maintain the equipment for some years. As the discussion that follows shows, some of the most advanced telecommunications technologies require less maintenance than traditional equipment. Telephone operations (the center of these systems) remain, however, labor-intensive.

Because skilled manpower shortages are a major factor constraining effective absorption of telecommunications technologies in many of the countries under study, it is important to note that modem analog telephone systems are more people-intensive than digital electronic systems. As a rule of thumb, approximately 150 employees are required for every 10,000 lines of analog equipment, compared with 135 to 145 employees for digital lines. The skill mix also differs, with more college-trained technical personnel and computer and programing specialists required for digital systems.

An advantage of electronic switching systems (ESS) compared to electromechanical switching systems (EMSS) is that EMSS requires 10 to 20 inside plant personnel per 10,000 lines in order to maintain (continually oil and adjust) the switches. The work force consists primarily of semiskilled laborers. In the electronic system, only one inside plant person per 10,000 lines is needed; the system is almost unattended. The central operation and maintenance center has a computer monitor that keeps track of the system. If a fault occurs in a line, it is registered and reported on teletype. The system identifies the faulty printed circuit card, and a skilled worker (who has a supply of all needed types of circuit cards) is then sent to replace the card. The repair is thus a card-changing procedure, not a "work-bench" operation. The faulty card is returned to the manufacturer for repair or disposal.

Servicing and maintaining telecommunications equipment is a major issue in the Middle East, and particularly in Saudi Arabia and Kuwait. Saudi nationals are generally not

[5] "Very high frequency" refers to a band of radio frequencies between 30 and 300 megahertz. "Ultra-high frequency" refers to a band of radio frequencies between 300 and 3,000 megahertz.

trained in maintenance functions; these tasks are left to foreign nationals. In Kuwait, the Japanese consortium that installed and conducted initial servicing on the telephone systems was called back after 3 years of local maintenance; the local maintenance reportedly left the system in need of major overhauls.'

All of the major suppliers provide extensive training programs. U.S. firms that were interviewed, however, noted that nationals often lack motivation and that supplier personnel normally are required to perform maintenance. With foreign contractors involved in servicing and maintenance, the installed equipment reportedly functions well. Analysis of contracts in the six nations under study indicates that much of the equipment purchased since the early 1970's is still serviced by foreign suppliers.

The harsh physical environment of the Middle East further hampers maintenance of telecommunications equipment. Digital systems require air conditioning and special modules to protect equipment from dust and sand. Where required, these elements are always included by suppliers as part of the equipment package. These special applications further complicate maintenance procedures and normally prolong dependence on the supplier.

These problems associated with maintenance clarify the preference of Middle Eastern leaders for some of the more advanced technologies. Digital switching, for instance, is less expensive to maintain then analog switching. Similarly, microwave relays can often last thousands of hours between repairs, while cable networks require almost daily maintenance.

Manpower requirements in telecommunications are geared heavily toward clerical and craft workers. As a point of reference, in the United States the telephone subsector of communications clerical workers comprise 45 percent of the total work force, and craft workers 33 percent.[7]

Photo credit U S Agency for International Development

Telephone equipment provided to Egypt under the U S Commodity Import Program

Telephone operations tend to be very labor-intensive. The more advanced the telecommunications technology, the higher the proportion of professional, technical, and managerial personnel required and the fewer total workers required. The skill mix also differs, with more college-trained technical personnel and computer and programing experience required for digital systems operations. Skilled manpower shortages have been a major factor constraining effective telecommunications technology absorption in the Middle East. In Egypt where unemployment has been a problem, decisions about telecommunications technologies have been made to take account of broader social goals. The result has been that operations are less efficient, judged by international standards.[8]

TELECOMMUNICATIONS SYSTEMS IN THE MIDDLE EAST

Saudi Arabia

Saudi Arabia has taken the advanced-technology route to telecommunications. Working

[7]", Japan Telecommunications Engineering and Consulting (JTEC)—Kuwait's Reluctant Partner, *Middle East Economic Digest*, Oct. 15, 1982, p 90.
[S Bureau of Labor Statistics, Bulletin #2086, April 1981

[8]For example, ARENTO in Egypt employs more personnel than are needed in order to help solve the country's high unemployment problem. The 1 98 1 statistics show that Egypt had over 1,000 employees per 10,000 lines (AT&T Long Lines, *The World's* Telephones, Morris Plains, N.J., 1982), which is six or seven times greater than the ratio deemed adequate for efficient operations,

closely with foreign firms, the country has built an extremely efficient telecommunications network.

The network was greatly expanded in the last decade, with the number of exchange lines quintupling between 1976 and 1981. In 1982 there were 789,000 telephone subscribers, or 11.2 lines per 100 inhabitants, just over the world average of 10.5 lines.[9] This coverage is quite extensive by Middle Eastern standards, given that the World Telephone Zone 9 (Middle East and Southeast Asia) average is 1.1 lines per 100 inhabitants. Much of this telephone expansion began in 1978 with the awarding of a contract to L. M. Ericsson of Sweden and Philips of the Netherlands to install 480,000 new telephone lines.

Of the six countries under study, Saudi Arabia has the second highest percentage of automatic telephone operation, with 99.4 percent being automatic switching system control (97.1 percent electronic control [ESS] and 2.3 percent electromechanical control [EMSS]). Saudi Arabia is also the only country which has private telephone operations, which encompass 12 percent of the total telephones. With regard to telephone use in the Kingdom, 70 percent are for residential use (60 percent-main, 10 percent-extension) and 30 percent are for business use (20 percent-main, 10 percent-extension).

Several large-scale projects have been completed to enhance the transmission network. The Backbone Telecommunications Project consists of 1,420 kilometers of east-west coaxial cable between Taif and Dammam via Riyadh and a 160-kilometer microwave link between Jeddah to Taif via Buhr, Mecca, and al-Hada. The work was performed by Sartelco, a Saudi Arabian-based subsidiary of Sirti (Italy), using cable from Philips.

The Intra-Kingdom Microwave Communications Project enhances long-distance transmission for telephone and television and covers 10,000 kilometers. It links Al-Ain with King Khalid City, Hofuf, Salwo, and Dawaheen, and Riyadh with Dormah and Zolam. The system was implemented by Western Electric International of the United States and includes 300 microwave towers with a 35,000 - line capacity. Microwave links have also been established between Saudi Arabia and Sudan, with a capacity of 300 telephone lines and 92 television channels. A smaller, local digital microwave system was implemented by Telettra of Italy in Riyadh to link government buildings with certain government official residences.

Saudi Arabia's domestic satellite communications network, Domsat, links 11 cities—Jeddah, Riyadh, Medina, Hayel, Abha, Borayda, Tabik, al-Bahah, Jizan, Najran and al-Jawf. Harris Corporation of the United States supplied the mobile Earth stations with 11-meter antennas to link with Intelsat satellites. As of 1979, three Earth stations for use through Intelsat were installed by Mitsubishi Electric Company of Japan—two in Riyadh and one in Taif-with a total of 569 circuits. [10]

Saudi Arabia has begun to experiment with domestic optical fiber transmission systems. A 45-kilometer, 6-fiber cable has been installed by Philips in Jeddah and Riyadh. The exchanges have a capacity to handle 1,920 telephone calls per fiber. [11]

By 1980, 1,200 public pay telephones had been installed in 23 towns and cities. By 1982, 2,000 mobile telephones had become operational, having been integrated into the exchanges installed earlier using Ericsson technology. In addition, a fully electronic, multiplex-exchange telex system was completed in 1979. Using six computers, it has a capacity of 15,000 lines and serves 100 cities and towns. It was developed by a Saudi Arabian prime contractor, Hajji Abdullah Alireza Group, in cooperation with Fredericks Electronics Corporation (U.S.).

[9] AT&T, Long Lines, *The World Telephones,* Morris Plains, N. J., 1983. See also Robert Bailey, "Telecommunications," *Middle East Economic Digest, Nov* 18, 1983, p. 14.

[10] J. Chamieh (cd.), *Saudi Arabia Yearbook* (Lebanon: The Research and Publishing House, 1981).

[11] International Trade Administration, U.S. Department of Commerce, "Market Survey: The Telecommunications and Electronic Data Communications Market in the Middle East," Washington, D. C., 1982.

There are currently 12 telex machines per 10,000 inhabitants in Saudi Arabia, which, on average, is the highest ratio in the world.[12] Facsimile terminals and other data transmission equipment are also being imported. Facsimile machines are popular in the Middle East, since they scan and transmit an entire page electronically and thus are ideal for communicating information in Arabic.

Saudi Telephone is managed by Bell Canada under contract. Bell Canada has also assisted in establishing eight repair service centers—in Riyadh, Jeddah, Dammam, Abha, Taif, Mecca, Medina, and Borayda. Ericsson has established four computerized operation and maintenance control centers at Riyadh, Jeddah, Damman, and Taif to trace faults in the system. An engineering department has been set up with recent Saudi engineering graduates, assisted by Bell Canada staff. Also, two permanent 32-room training facilities in Riyadh and Jeddah with two mobile training units have been established. Bell Canada conducts training, averaging 60 hours per student, in Arabic and English with advanced courses provided in Canada.[13]

Saudi Arabia has adopted advanced technology in all telecommunications sectors-switching, transmission networks, mobile telephones, and telex. Partly because of this, Saudi Telephone has improved productivity and reduced its manpower ratio by 10 percent to 43 employees per 1,000 working lines. During this rapid expansion period, despite continuing system enhancements and increased usage, service is reportedly satisfactory. In 1980, more than 1 million international calls per month were completed by 500,000 subscribers (annual average of 24 calls per subscriber); 58 percent of these calls were made directly by the subscriber.[14] In 1981, total international calls topped 17 million, with the most calls going to (rank ordered) the United States, Kuwait, Great Britain, and Bahrain.[15]

[12] Ibid,

[13] ,\liddJ(*East Economic Digest,* Sept. 1 8. 1981.

[14] Robert Bailey, "Saudi Arabia, Telecommunications, Electronics, and the Middle East—Special Report, *Middle East Economic* Digest, January 19%1: International Telecommunication Union (ITU), *Yearbook of Common* Carrier *Telecommunication Statistics,* Geneva, 1980.

[15] 'AT&T, op. cit., 1983.

The system in Saudi Arabia is highly responsive. Bell Canada reported that: 1) 94 percent of customers in Riyadh receive operator services within 10 seconds, 2) 75 percent of national long distance calls are answered within 10 seconds, 3) almost 80 percent of directory assistance calls are answered within 10 seconds, and 4) nearly 50 percent of calls to international operators are answered within 10 seconds. The system is also reliable: 90 percent of all calls are successful, and 98 percent of subscribers receive a dial tone within 3 seconds.[16]

During the 1970's, imports of telecommunications equipment underwent tremendous growth-from OECD countries it went from $17.4 million in 1971 to $740.6 million in 1980 (in nominal dollars)." The beginning of the Second Development Plan in 1976 ushered in a rapid increase in telecommunications imports. Also, a large influx of population in the cities between 1974 and 1980 increased demand on the existing infrastructure and spurred major telecommunications expansion projects, carried out primarily by Ericsson of Sweden and Philips of the Netherlands. During 1970 to 1980, the volume of telecommunications imports amounted to 2 percent of Saudi Arabia's total import volume and almost 4 percent of world imports of telecommunications equipment. A slight retrenchment in telecommunications import spending began in 1980, owing to an increased focus on agriculture, industry, and health sectors in the Third Development Plan and to completion of some major segments of the networks.

Three supplier countries are prominent in Saudi Arabia's telecommunications market, as shown in table 51. Table 52 shows selected telecommunications contracts awarded by Saudi Arabia. Firms from the Netherlands and Sweden together have accounted for more than half of the contracts, in terms of dollar value, in recent years. U.S. firms had a 16 percent share in 1980, which represented a major shift from the mid-1970's, when they had approximately a 30 to 48 percent share of the Saudi Arabian telecommunications market.

[16] *Saudi Arabia* Yearbook, op. cit., 1 WI.

[17] SITC #764, 7249. See table 51.

Table 51 .—Market Shares of Telecommunications Equipment Exports to Saudi Arabia From OECD Countries, 1971, 1975-80 (SITC 764 or 7249)

	Canada	United States	Japan	France	West Germany	Italy	Netherlands	United Kingdom	Sweden	Total exports (in 000 U.S. $)
1971	0.3	15.1	2.4	11.1	1,4	2.2	0.0	55.9	10.4	17,406
1975 ....., . .	0.4	21.4	8.5	2.9	8.2	7.9	0.7	18.5	14.1	92,814
1976	6.5	28.0	3.2	1.6	3,8	5.4	2.3	36.5	10.6	134,756
1977	2.8	47.9	4.7	6.3	5,2	5.3	0.6	14.8	10.8	288,246
1978	1.5	33.9	4.2	1.8	4,1	4.0	21.5	9.4	18.5	568,962
1979	1.4	17.7	4.3	2.3	2,7	4.3	31.6	13.3	19.7	883,836
1980	0.8	15.9	4.9	4.0	4,4	0.7	44.0	7.1	16.0	740,561

NOTE Market shares calculated as value of exports reported by exporter as a percentage of total telecommunications exports to recipient reported by all OECD exporters

SOURCE Compiled for OTA from Organization for Economic Cooperation and Development (OECD), *Trade of Commodities Market Summaries* Exports (1971 1975-80)

Table 52.—Selected Telecommunications Contracts in Saudi Arabia

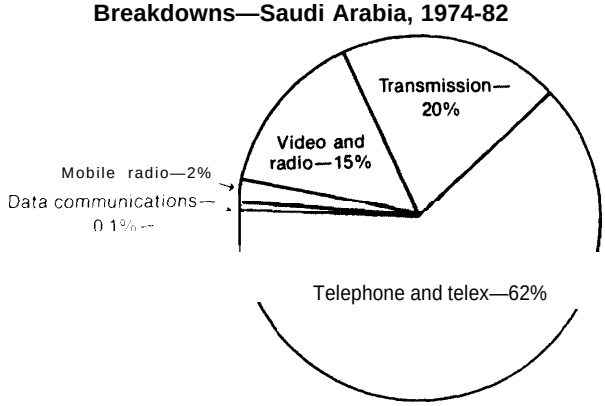
Supplier country	Year	Supplier	Description	Amount (millions of dollars)
Canada	1978	Bell Canada	Management of Saudi telephone system	1,000
Norway	1977	Teleplan	Management of telephone network expansion	185
United Kingdom.	1978	Preece, Cardew, and Rider	Design and supervision of telecommunications network	22.3
France/Saudi Arabia . . .	1982	Cegelec Contracting Co. (joint venture company)	Construction and maintenance of communication network	14.3
Italy/Saudi Arabia ., . . .	1981	Sirti/Sartelco	Installation of telecommunications system in Yanbu	65
Japan.	1982	Nippon Electric Co. (N EC)	Supply of fiber optics communications system linking Ras Tanura with Barri and Abgaig with Dhahran	16
Netherlands/Sweden/ South Korea/Norway . .	1977 (6 phases)	Philips/L. M. Ericsson/ Dong Ah/Norconsult	Increase telephone network from 200,000 lines to 1.2 million by installing world's first stored program control (SPC) system	4,400
United States	1979-82 (4 phases)	Litton Industries (Sub: Aydin Corp. and Karkar Electronics)	Improve military communications systems, provide national air defense communications network, provide digital multiplex equipment	1,720

SOURCE Compiled for OTA from selected issues of the *Middle* East *Economlc Digest*

Saudi Arabia invested between 1974 and 1982, approximately 62 percent of telecommunications expenditures for telephone and telex, 20 percent for transmission, 15 percent for video and radio, 2 percent for mobile radio, and 0.1 percent for data communications (see fig. 10). For telephone and telex (1974-82 total expenditures of $8,035 million), the largest allocations were made in the switching and total communications subsector. U.S. firms maintain slightly more than 30 percent of this market, with firms from Sweden and the Netherlands holding about 20 percent shares each. In transmission equipment sales, firms from South Korea captured 49.2 percent of the sales, due to their role in expansion of the Saudi cable network. In video and radio equipment sales, U.S. firms had a minor share of 7.6 percent, while those from France had 70 percent and dominated this market. U.S. firms had an over 90 percent share in mobile radio and data communications, but these represented only about $290 million total expenditures by Saudi Arabia from 1974 to 1982 (see fig. 11).

By far the major growth areas in Saudi telecommunications over the last decade have been in development of integrated communications systems. The Philips-Ericsson-Dong Ah-Norconsult-Bell Canada consortium has received the major share of this market and has effectively closed off the market to other suppliers. U.S. and U.K. firms have been supplying communications systems for specialized applications such as air traffic control and military and industrial communications.

Figure 10. —Apparent Telecommunications Sector Breakdowns—Saudi Arabia, 1974-82



SOURCES: Complied for OTA from Intel-Trade: Inbucon. 1980: MEED Telecommunications

Kuwait

In 1981, Kuwait's telephone exchange capacity reached 286,200 lines, a 100 percent increase over 1979. The number of lines in active use numbered 171,427, with 231,640 telephones connected to these lines. This amounts to about 15.8 telephones per 100 residents, the highest ratio among the six countries in this study. Despite this relative abundance of capacity, forecasts of population growth and business demand have lagged behind actual growth. As a result, while some exchanges have excess capacity, others cannot meet the demand. In some newly developed areas, businesses and residences reportedly must wait 2 to 3 years for a telephone, owing to shortages of lines and equipment. Almost two-thirds of all telephones are residential; the rest serve business.

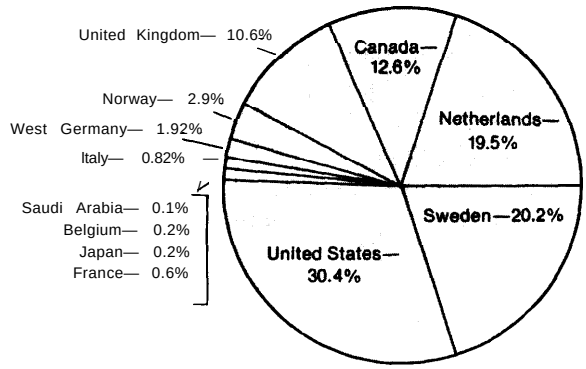
The system is 100 percent automatic: 89.9 percent EMSS and 10.1 percent ESS. All switching equipment installed between 1980 and 1982 is fully electronic digital systems. There are 16 local telephone exchanges and all telephone operations are government-run. Three Earth satellite stations are linked to both the Atlantic and Indian Ocean Intelsat networks. Domestically, a mobile telephone system is in place, with 4,019 mobile units in use as of 1981. In 1979 an electronic telex exchange of 7,500 lines was completed by Olivetti of Italy.

Kuwait had only one TV broadcasting station in 1979, but a second channel was to be available later that year. The station range includes Bahrain and parts of Iraq and Saudi Arabia. Estimates of TV receivers number 375,000, and radio receivers number 1 million.

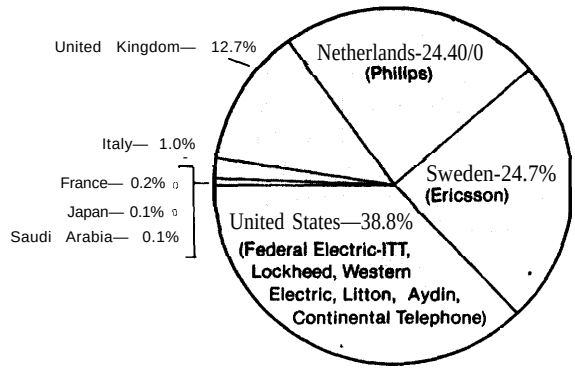
The Kuwait telecommunications system has generally been a reliable network. Recently, however, there have been localized problems. Kuwait's development began earlier than that in most neighboring countries and many difficulties can be traced to the strain imposed by explosive population growth on systems be

Figure 11 .–Apparent Market Share, Saudi Arabia, 1974-82

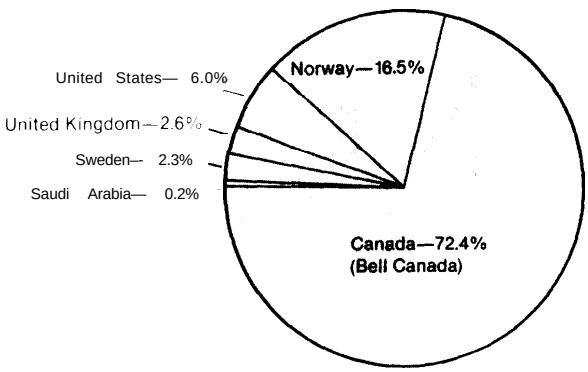
Total telephone and telex—$8,035 + million



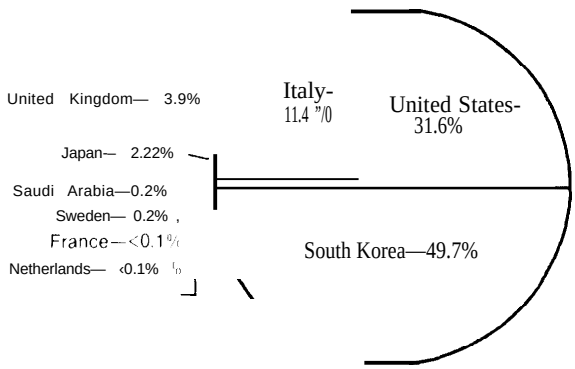
Switching equipment—$6,369 4 + million



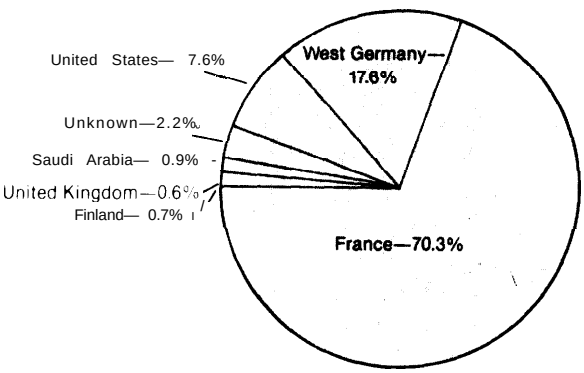
Training, maintenance, consulting— $1,3971 + million



Total transmission—$2,596.2 + million



Total video and radlo - $2,000.7 + million



Total mobile radio—$266.5 + million

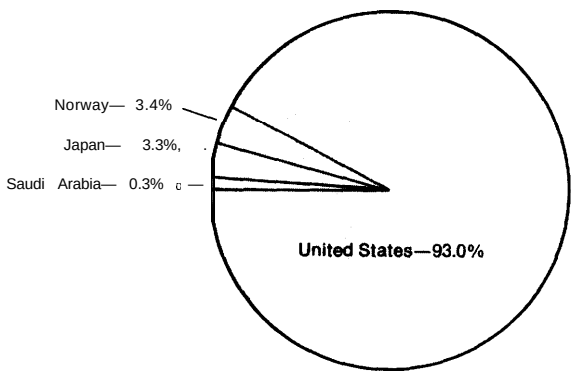
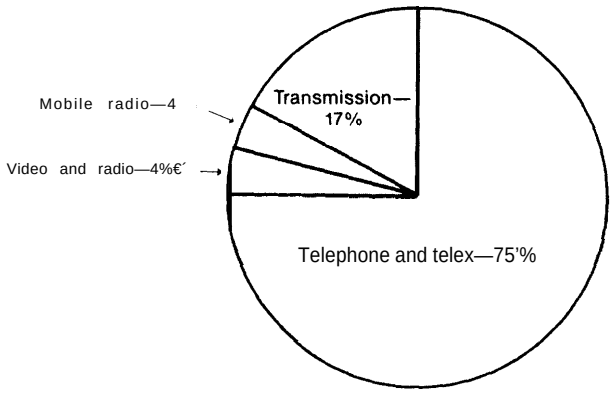


Figure 12.— Apparent Sector Breakdowns— Kuwait, 1974-82



SOURCES: Compiled for OTA from Intel-Trade: U.S. State Department cables

ginning to age. The Communications Ministry has adopted two sets of measures to deal with the problem—several contracts for rehabilitation of the cable network, and more reliance on microwave links and other technologically advanced equipment. Its major shortcoming is in keeping up with localized demand, which requires accurate planning for exchanges that require excess capacity in order to support future increased needs. One of the worst problems for Kuwait's telecommunications users has nothing to do with outmoded or overburdened equipment, but with routine loss of service due to cutting of cable by contractors working on roads and buildings. To alleviate this problem, a utility management system will be installed by a Japanese consortium at a cost of $28 million. This system will include computerized mapping of all underground utility networks in the 500-square-kilometer city.[18]

Kuwait's average of telephones per 100 inhabitants is 15.8, well above the world average of about 10.5. Moreover, usage of the system by subscribers is the highest among the countries under study—an average 20.4 international calls per subscriber during 1980. While Kuwait's telephone system is the smallest of the six countries, it provides the greatest amount of capacity to its population and is the most heavily used.

Given Kuwait's small population and geographic area, its recent development of the most extensive and most used telecommunications network among the six countries reflects its desire to become a world business and financial center. This requires an excellent communications system, especially internationally. Kuwait's extensive satellite transmission facilities and data transmission capabilities, and its recent purchases of high-technology equipment to expand its telecommunications network are evidence of the commitment to this goal.

Early expansion of oil production capacity of Kuwait in the 1950's resulted in large development expenditures throughout the late 1960's and 1970's. Expenditures in the telecommunications sector reached almost 3 percent of all Kuwaiti imports in 1970. Imports of telecommunications equipment, parts, and accessories from OECD countries rose from $7.7 million in 1971 to $90.1 million in 1980 (in nominal dollars) as shown in table 53 and represented from 0.2 percent to 0.7 percent of world telecommunications imports. Table 53 also lists the market share of telecommunications equipment exports to Kuwait from OECD countries in 1971 and 1975 through 1980.

As shown in the table, Japanese firms have controlled between one-quarter and one-third of Kuwait's telecommunications market during the 1970's. Kuwait's ties with its former colonial ruler Britain are still strong, as evidenced by a large volume of British exports in this sector to Kuwait. Over the last decade, Swedish firms have had several large contracts in telecommunications, but failed to maintain a stable foothold. Firms from West Germany and the United States have succeeded in gaining about 15 percent each of Kuwait's market. Table 54 shows selected telecommunications contracts awarded in Kuwait.

Kuwait investment in the telecommunications sector from 1974 to 1982 was approxi-

[18] "Telecoms to Reap Benefits of Investment," *Middle East Economic Digest, Special Report on Kuwait*, May 1984, pp. 29-30.

Table 53.—Market Shares of Telecommunications Equipment Exports to Kuwait From OECD Countries, 1971, 1975-80 (SITC 764 or 7249)

	United States	Japan	Belgium	France	West Germany	Italy	Netherlands	United Kingdom	Sweden	Switzerland	Total exports (in 000 U.S. $)
1971	4.3	38.5	4.9	0.8	4.8	0.0	0.6	15.6	10.9	1.5	7,700
1975	11.8	15.7	2.4	12.5	7,3	4.6	0.4	10.6	30.4	2.2	16,742
1976	26.8	20.0	0.5	18.2	10.1	3.0	0.1	6.1	10.8	0.5	52,701
1977	20.2	22.0	0.4	4.8	3.3	4.2	0.1	21.3	16.8	4.8	55,315
1978	5.8	23.1	1.2	3.8	5.8	1.0	0.6	28.4	17.9	9.1	68,506
1979	5.6	35.6	0.7	2.2	10.3	0.7	0.9	11.7	28.6	1.4	68,534
1980	14.3	26.8	0.5	1.7	15.5	0.8	3.2	23.1	10.8	0.5	90,084

NOTE Market shares calculated as value of exports reported by exporter as a percentage of total telecommunications exports to recipient reported by all OECD exporters

SOURCE Compiled for OTA from OECD, *Trade of Commmodities Market Summaries* Exports (1971, 1975-80)

Table 54.—Selected Telecommunications Contracts in Kuwait

Supplier country	Year	Supplier	Description	Amount (millions of dollars)
France	1980	CIT-Alcatel and Cables de Lyon	Coaxial cable linking Kuwait and Safwan, Iraq	5.0
United Kingdom	1981	Pye Ltd.	Complete communications system for Kuwait police	10.8
United Kingdom	1980	Pye Telecommunications	Telecommunications network maintenance	5.9
Sweden	1979	L. M. Ericsson	Telephone exchange extension; AXE type equipment	15.0
Kuwait	1980	Abdel-Aziz Abdel-Mohsin al-Rashid	Underground cable installation	7.0
Kuwait	1981	Kuwait Prefabricated Buildings Company	International telephone network extensions—Salmiya Exchange	7.5
Japan	1980	Nippon Electric Co.	Satellite ground station installation; repairs on NEC station completed in 1966	4.4
Japan	1980	Japanese Telecommunications Consulting and Engineering	Telephone network consultancy for management improvement, planning of repairs, preparation of specifications for international tenders, provision of training	7.4
Japan	1981	NEC	Install one central microwave station and six auxiliary ones. Design is by Kuwait Ministry of Communications	13.0
United States	1979	Ampex international	Supply of mobile television unit with auxiliary equipment	1.5

SOURCE Compiled for OTA from selected issues of the *Middle East Economic Digest*

mately 75 percent in telephone and telex, 17 percent in transmission, and 4 percent each in mobile radio and video and radio (see fig. 12). As figure 13 shows, in contrast to the situation in Saudi Arabia, Swedish firms have been dominant suppliers of telecommunication equipment in a number of categories.

Egypt

The number of telephone lines in Egypt in 1981 was estimated at 375,000 lines for between 400,000 and 500,000 telephones.[19] Approximately one-half of the telephones are residential and one-half commercial, yielding about 1.2 lines per 100 inhabitants, a very low ratio. Telephone service availability varies widely by geographical location, as large urban areas have a telephone density of 4.35 per 100 population while other areas have a density of 0.36 per 100 population.[20] In 1978 the waiting list of subscriber applications numbered 200,000 with only 48 percent of registered demand being met.[21] The telephone system is operated by the government and is 89.2 percent automatic.

By all reports, in recent years Egypt telephone system has been generally antiquated (some parts dating back to 1929) and in poor repair. A 1978 master plan developed by Continental Telephone International of the United States recommended major rehabilitation of and extensions to the Egyptian system, upon which the government acted by awarding a major contract to a European consortium in 1980. Small exchanges in remote villages often consist of manual switchboards. These contrast with the larger, multiexchange, crossbar automatic switching equipment used in Cairo and Alexandria.

In 1979 an Alexandria exchange was renovated by CIT-Alcatel (France); their E-10 digital electronic exchange equipment supplied 10,000 lines. Ericsson of Sweden supplied 20,000 lines at Al-Mazha in Cairo in 1979. Extensive cable and microwave linkages (supplied by Raytheon of the United States) connect the smallest exchanges to Cairo, where most of the international traffic flows. Other international switchboards exist in Alexandria and Port Said. International calls are handled by two submarine cables with 480- and 230-channel capacities or via an Earth satellite station linked to the Intelsat Atlantic Ocean network.

For training purposes, CIT-Alcatel has installed an E-10 model exchange in the Arab Republic of Egypt National Telecommunications Organization (ARENTO) training center. Continental Telephone and Arthur D. Little are both being funded by the U.S. Agency for International Development (USAID) under-its $200 million loan and grant program to ARENTO to supply managerial and technical advice.

Two telex exchanges operate in Cairo and Alexandria, and mobile telephone service has been established in the Cairo area. In addition, special microwave transmitters, using tropospheric scatter technology, have been established to facilitate communications between cities, oil terminals, gas plants, and offshore oil complexes.[22]

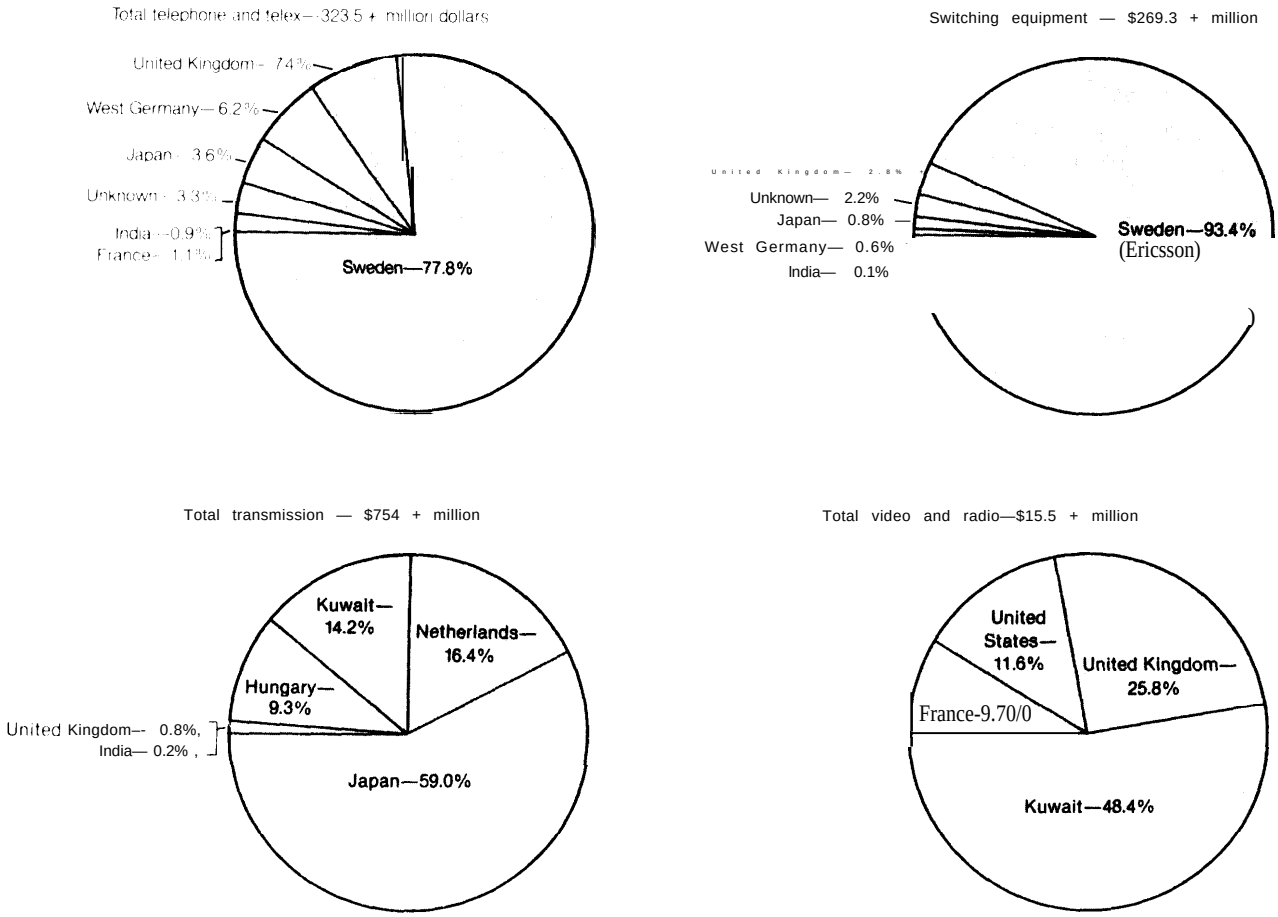
[19] U.S. Department of Commerce, "Marketing in Egypt, " *Overseas Business Report*, 81-31, *1981*.

[20] AT&T, op. cit., 1983.

[21] R. J. Saunders, J. J. Warford, and B. Wellenius, Telecom*munications and Economic Development*, JHU Press, published for The World Bank, July 1983.

[22] *'Tropospheric scatter technology involves use of radio frequency waves reflected off the troposphere and received at a distant station on Earth.

Figure 13.—Apparent Market Share—Kuwait, 1974.82



Radio and television broadcasting is well developed. A network of 24 radio transmitters have the capability of reaching the entire population. Fourteen transmitters have shortwave range and the 10 others are mediumwave. Between 6.6 million and 6.8 million radio receivers exist, according to 1979 estimates. Twenty-eight television transmission stations, some with color capability, reach 1.3 million receivers and 7 million people.[23]

The 1978 Continental Telephone study assessed the efficiency of the Egyptian communications network. Study participants found that only 23.9 percent of all calls dialed in Cairo were completed, emergency telephone numbers were frequently inoperable, and 50 percent of all service vehicles could not be used, owing to lack of spare parts. Moreover, the report concluded, Egypt's current problems could be attributed, in part, to the many different types of equipment in the system supplied by many different firms. Maintenance and interoperability problems could arise in the future, the report warned, if similar procurement strategies are followed in rehabilitating and expanding the system.

Attempts have been made recently in the Egyptian telecommunications sector to make its administration more efficient and cost effective. Outside consultants in the late 1970's stated that some of the major problems plaguing the Egyptian telecommunications opera-

[23] *Overseas Business Report*, op. cit., 81-31, 1981.

tions stemmed from the inclusion of telecommunications in the public sector. As a result, 1) realistic rates and tariffs could not be set for telecommunications service or equipment installation, 2) employees could not be easily hired and fired, and 3) all money went into and came out of a central revenue fund, allowing for no fiscal autonomy. The consultants recommended that telecommunications be made an autonomous public entity, much like Egypt Air or the Suez Canal Authority.

Egypt's response was to pass law No. 153 in 1981, which established the National Organization for Wire and Wireless Telecommunication, whose shares are 100 percent owned by the government. The organization still reports to the Ministry of Communication but is otherwise autonomous. Although it is still too early to gauge the long-term effects of this change, tariffs and installation charges have recently risen to more realistic levels, and the new organization can retain its own earnings. [24]

Redundant labor will continue to be a problem, however; attrition has not eased the burden. The problem will become more severe when the electromechanical switches in the Egyptian system are converted to electronic switches, displacing many semiskilled workers.[25] For many reasons, major layoffs of these personnel are not expected.

By far, Egypt's telephone system is the least extensive of the six countries in this study. It reaches just over 1 of every 100 inhabitants. As for system usage, 1977 statistics show low international usage (an average of 1.1 international calls per subscriber in 1977) but high domestic use (an average of 50.0 national calls per subscriber that year).[26]

Imports of telecommunications equipment, parts, and accessories from OECD countries went from $11.9 million in 1971 to $180.4 million in 1980 (nominal dollars).[27] Telecommunications equipment comprised about one percent of the Egyptian budget and from 0.2 to 0.9 percent of world imports in telecommunications during these years.

As shown in table 55, France's position in the Egyptian telecommunications market has continued to grow. CIT-Alcatel and Thomson-CSF are major French firms, along with West German and Austrian companies, doing business in Egypt. Thomson-CSF won a major $1.8 billion contract to overhaul and expand the Egyptian telephone network. Great Britain and Sweden have also held sizable and fairly stable market shares.

The share held by U.S. firms has expanded substantially over the last decade, from 2.6 percent in 1971 to 17.9 percent in 1980. This was due partly to Egypt improved relations with the United States. USAID grant and loan programs to rehabilitate the Cairo telephone system have provided major opportunities for introducing U.S. telecommunications firms into the Egyptian market.

Telephone and telex was the major area of investment in the telecommunications sector by Egypt from 1974 to 1982, accounting for 83.5 percent of total telecommunications expenditures. Transmission accounted for 11.7 percent, while video and radio, and mobile radio accounted for 4.5 percent and 0.2 percent, respectively. Of the over $2,300 million spent on telephone and telex, France had a 36 percent share; West Germany, 26 percent; Austria, 26 percent; Sweden, 5.5 percent; and the United States, 5 percent. Of the $324 million total spent by Egypt from 1974 to 1982 on transmission, U.S. firms dominated, with a 48 percent share. Those from West Germany had a 28 percent share; Japan, 10 percent; and Great Britain, 9 percent. The major shares of the video and radio expenditures of $123 million from 1974-82 went to firms from Great

[24] Communication with industry expert, January 1984.

[25] AID intends to replace 170,000 lines presently with electromechanical switching to electronic switching. Ten to twenty inside-plant personnel per 10,000 lines are required to maintain old EMSS systems, while the new ESS systems require only one per 10,000 lines.

[26] ITU, op. cit., 1980.

[27] OECD *Trade of Commodities: Market Summaries, Exports*, 1971, 1975-80, See table 55.

Table 55.— Market Shares of Telecommunications Equipment Exports to Egypt From OECD Countries, 1971, 1975-80 (SITC 764 or 7249)

	United States	Japan	France	West Germany	Italy	Netherlands	United Kingdom	Sweden	Switzerland	Total exports (in 000 U S $)
1971	2.6	2.0	16	25.9	3,0	0.2	13.0	43.6	1.2	11,886
1975	2.7	17.8	26.3	8,5	0.7	0.4	15.2	21.9	22	59,479
1 9 7 6	4.2	9.5	25,6	9.3	3.7	0.8	30.4	13.5	13	70.377
1977 . . .	14.4	2,5	23.7	10.0	0.6	0.5	31.6	12.9	1.8	97,262
1978	16.8	5.3	26,0	10.8	3,7	1,0	14.9	14.4	1.2	141,882
1979 . . . . ,	14.4	9.3	36,3	8.6	3.2	1.0	11.2	12.1	0.4	183.286
1980 ., ... ,	17.9	8.5	31.2	4.4	3.9	4,3	14.7	10.7	0.6	180.440

NOTE: Market shares calculated as value of exports reported by exporter as a percentage of total telecommunications exports to recipient reported by all OECD exporters

SOURCE Compiled for OTA from OECD *Trade of Commodities Market Summaries* Exports (1971, 1975-80)

Britain (47 percent), Japan (29 percent), the United States (17 percent), and France (6 percent).

Algeria

The number of telephone lines in Algeria is approximately 606,000. The telephone system is government-run and involves only 63.1 percent automatic switching. About two-thirds of registered telephone demand has been met.[28] Twelve satellite ground stations have been in existence since 1979 for domestic telephone, telex, and television transmissions, connecting 14 Saharan towns with major population centers. An international Earth satellite station connects Algeria to the Atlantic Ocean Intelsat network. All major towns are connected to Algiers by telex, and several have their own international telex linkages.[29]

Television and radio broadcast centers are located in Algiers, Oran, and Constantine. Radio transmissions operate on medium and short wave, covering territory well beyond Algeria's borders. Microwave linkages with France ensure reception of European television broadcasts. By 1982, there were over 2 million radio receivers and 350,000 television receivers in the country.

Despite the rather limited coverage of the telephone system—3.3 telephone lines per 100 inhabitants—domestic usage by subscribers is relatively high, with an average of 31.2 domestic calls per subscriber in 1979. To deal with geographic difficulties in network transmission, Algeria opted for advanced satellite systems for part of its domestic operations. Algeria's telephone service is, however, frequently unreliable and slow, with long-distance service usually surpassing local service.

Algerian imports of telecommunications equipment, parts, and accessories peaked in 1976 at about $140 million. The 1976 figure represented slightly less than 3 percent of Algeria's total imports. In recent years these imports have made up about 1.5 percent of the total. Algeria represented from 0.3 (1970) to 1.7 (1976) percent of world imports of telecommunications equipment, parts, and accessories from 1970 to 1979.

During the 1970's, Algeria's national plans emphasized investment in heavy industry and development of natural gas resources. Associated development of a satisfactory telecommunications infrastructure was critical to achieving these investment goals. Algeria's extensive use of satellite technology for much of its domestic transmission network has facilitated communication linkages to the major population centers from natural gas fields, mining areas, and industrial production complexes across vast areas of sparsely populated desert.

Table 56 presents the market shares of telecommunications equipment exports to Algeria from OECD countries in 1971 and 1975-80. France has historically been a large supplier to Algeria. By 1980, French firms held 28 percent market share, much reduced from their 79 percent share in 1971. Algeria has attempted to diversify its technology purchases for political reasons and to improve its position in negotiating prices for its liquefied natural gas.[30]

U.S. firms have maintained their market share in the Algerian telecommunications area. This share has, however, fluctuated noticeably. Some observers believe that Algeria's support for the Palestinian movement and its nonalignment policy may serve to stimulate diversification of suppliers, rather than extensive purchases from U.S. firms.

Telephone and telex represented 68 percent of the Algerian telecommunications market from 1974 to 1982; transmission, 30 percent; and video and radio, 2 percent. Total telephone and telex expenditures during this period were approximately $456 million, with Spain winning 70 percent of this, Sweden winning a 27 percent share, and the United States, 2.5 per-

-'U.S. Department of Commerce, "Marketing in Algeria," *Overseas Business Report*, 82-07, 1982; AT&T, op. cit., 1983.

[29]H. Nelson (cd,), *Algeria: .4 Country Study* (Washington, 1). (',: The American University, 1979).

[30]Martin Roth and Michael Frost, " Algeria W'elcomes Japanese Export Drive, *Middle East Economic Digest,* Aug. 28, 1981, pp. 4-5,

Table 56.— Market Shares of Telecommunications Equipment Exports to Algeria From OECD Countries, 1971, 1975-80 (SITC 764 or 7249)

	United States	Japan	Belgium	Denmark	France	West Germany	Italy	United Kingdom	Spain	Sweden	Switzerland	Total exports (in 000 U.S. $)
1971	0.8	0.3	0.2	0.0	790	74	2.3	59	11	00	28	13.338
1975	5.4	3.0	03	0.3	377	15.4	1.0	43	145	161	17	120.062
1976	3.0	4,2	0.5	0.2	26.0	94	14	40	170	329	11	138.301
1977	9.2	8.7	27	0.3	228	100	2.3	6.6	131	227	1.6	94,908
1978	8.9	11.9	0.9	3.3	156	215	2.0	68	95	168	11	101.048
1979	8.2	3.1	11	2.3	180	223	1.5	5.8	200	73	8.7	128.918
1980	4.8	2.6	5.6	3.4	278	17.4	15	12.7	75	76	6.1	100.068

NOTE Market shares calculated as value of exports reported by exporter as a percentage of total telecommunications exports to recipient reported by all OECD exporters
SOURCE Compiled for OTA from OECD *Trade of Commodities Market Summaries* Exports (1971 1975-80)

cent. Of the total transmission expenditures of $200 million from 1974 to 1982, Japan had a 53 percent share; France, 39 percent; and the United States, 6 percent.

Iraq

Statistics on Iraqi telecommunications are largely unavailable. The number of telephones in Iraq numbered approximately 320,000 in 1977, which amounts to 2.6 telephones per 100 inhabitants. Existing facilities include crossbar automatic telephone switching equipment with new exchanges installed in Baghdad, Nineveh, and Tamim, and microwave networks between major cities. Two Earth satellite stations exist at Dubail for use in international communications; they were built by Telspace, a subsidiary of CIT-Alcatel, of France.[31] A telex system located in Baghdad had 1,462 lines in 1980, but a contract has been awarded to triple this number. The number of radio receivers in the country is estimated at 2 million.

Based on rather scarce information, it appears that rapid progress was being made prior to the war with Iran to build the capacity of the Iraqi system. Major upsurges in government spending, begun in the mid-1970's, resulted in a near doubling of the number of telephones. Iraq has chosen crossbar switching and advanced digital systems, although usage in Iraq is still low—among the lowest of the six nations in this study.

Large-scale importation of telecommunications equipment by Iraq did not begin until 1975, when expenditures on OECD imports reached $65.5 million. Imports of telecommunications equipment, parts, and accessories from all suppliers represented over 3 percent of Iraq's total imports and over 1.1 percent of the total world imports of telecommunications equipment for these years.[32] Shrinking oil exports, beginning in 1982, and the prolonged war with Iran have, however, dampened further civilian expansion in the telecommunications area.

Table 57 lists the market shares of telecommunications equipment exports to Iraq from OECD countries in 1971 and 1975-80. With more than a 49 percent market share in 1980, France was dominant. Since the mid-1970's, Iraq has sought a leadership role among the Third World nonaligned nations and reduced its technology trade with the Soviet bloc countries. As a result, Japan, Britain, and the Netherlands made minor inroads into the market. U.S. firms won less than a 1 percent market share. Table 58 includes data on representative recent telecommunications contracts awarded by Iraq.

By telecommunications sector, telephone and telex have taken the major share of Iraqi expenditures (58 percent). Transmission has taken a 19 percent share; video and radio, 17 percent; and mobile radio, 6 percent. Of the total $1,170 million spent on telephone and telex between 1974 and 1982, Japan garnered 62 percent of the market; France, 13 percent; Yugoslavia, 11 percent; and Sweden, 2 percent.

Of the total transmission expenditures of $380 million during this time period, 45 percent went to Sweden, 25 percent to Japan, 11 percent to Italy, 7 percent to Great Britain, 6 percent to France, and 5 percent to unspecified suppliers. Swedish firms were particularly strong in wire and cable and land mobile radio, while Japan and Italy were both strong in microwave systems. Total video and radio expenditures from 1974-82 were over $340 million, with France having a 54 percent market share; Japan, 27 percent; and Switzerland, 8 percent. Japan was dominant in television (with 75 percent) and France was dominant in radio (84 percent). Total mobile radio accounted for $115 million in this time period; Sweden had 93 percent of the market and Japan and Great Britain had minor shares.

Iran

By 1979, Iran had 1,234,000 main telephone lines (95.8 percent automatic–92 percent EMSS, 3.8 percent ESS), which is approxi-

[31] "Telecommunications, I'electronics, and the Middle East—Special Report," *Middle East Economic Digest,* January 1981.
[32] *U.N. Yearbook of International Trade Statistics,* op. cit., 1982.

Table 57.—Market Shares of Telecommunications Equipment Exports to Iraq From OECD Countries, 1971, 1975-80 (SITC 764 or 7249)

	United States	Japan	Belgium	France	West Germany	Italy	Netherlands	United Kingdom	Sweden	Switzerland	Total exports (in 000 U.S. $)
1971	3.8	4.6	2.8	26.3	0.8	1.9	0.2	24.9	32.7	0.3	4,797
1975	2.4	26.9	1.6	19.4	7.7	3,3	0.4	22.7	6.7	5.2	65,513
1976	7.6	21.3	2.4	14.3	11.6	2.6	0.1	31.8	3.7	1.3	70,686
1977	2.0	9.9	0.8	51.5	4.6	0.6	0.1	22.6	3.6	1.5	76,131
1978	0.5	14.0	0.3	42.3	2,7	0.2	11.8	20.4	1.8	4.2	185,410
1979	0.4	13.4	1.0	43.4	4.1	0.7	14.1	9.6	4.8	6.3	193,784
1980	0.8	8.2	0.3	49.4	2.3	1.8	7.8	16.7	6.1	1.1	254,860

NOTE Market shares calculated as value of exports reported by exporter as a percentage of total telecommunicatlons exports to recipient reported by all OECD exporters

SOURCE Compiled for OTA from OECD Trade of *Commodities Market Summaries* Exports (1971, 1975-80)

Table 58.—Selected Telecommunications Contracts in Iraq

Supplier country	Year	Supplier	Description	Amount (millions of dollars)
France	1981	Thomson-CSF	Provide 27 microwave telephone exchanges	152.0
France	1980	Thomson-CSF	Turnkey construction of telephone network	144.5
West Germany	1977	Siemens	Reinstallation and expansion of telephone exchange	0.6
Hungary	1977	Elektroimpex	Supply 2,500 color television sets	1.0
Italy	1982	Telettra	Set up two microwave systems	42.0
Japan	1979	Nippon Electric Co. and Mitsui Co.	Construct four computerized telecommunication and video control systems	19.1
Japan	1981	Sumitomo Construction Co.	Supply and install telecommunications facility	64.5
Japan	1979	Furukawa Electric Co.	Supply 17 telephone networks in Baghdad and surrounding areas, providing an additional 200,000 telephone lines	59.3
The Netherlands	1981	Philips	Install telephone network	11.1
Sweden	1981	SRA Communications	Install mobile telephone system	82.2
Sweden	1981	L. M. Ericsson	Supply and install telephone cables	166.7
United Kingdom	1980	Cable & Wireless	Expand international exchange lines	3.9
Soviet Union	1981	NA	Construct telecommunications center	3.3
Yugoslavia	1980	Energoinvest	Construct two transmission lines	21.0

NA—not applicable

SOURCE Compiled for OTA from selected issues of the *Middle East Economic Digesf*

mately 3.4 lines per 100 inhabitants. Iran's system is completely government-run. Eighty-one percent of the lines are residential, and about one-half of them are located in Teheran. The 1979 waiting list for subscribers amounted to 750,000, meaning that only 62 percent of registered demand had been met. Data from 1976 indicate that 8.9 million national calls were made that year compared with 1.1 million international telephone calls.[33]

The major long-distance transmission networks in Iran employ microwave systems rather than multichannel cables, owing to the country's difficult terrain and other technical advantages of microwave systems. As of 1977, this microwave network consisted of four segments: 1) the CENTRO cross-country network, which traverses 2,300 kilometers and has 45 relay stations, beginning at Tabriz and serving Porn, Kashan, Isfahan, Nain, Yazd, Kerman, Barn, and Zahedan; 2) the Teheran-Assadabad large-capacity network; 3) the Isfahan-Shiraz network linked to Teheran; and 4) a nationwide microwave network encompassing six major routes, covering 3,560 kilometers, and having a capacity of 960 telephone channels. In addition, a ground satellite station is located at Assadabad near Hamadan to facilitate international traffic.

There are direct dial facilities to 27 foreign countries and 74 operator-assisted switchboards at the international telephone exchange. To deal with its vast geographic area, dispersed population, and rough terrain, Iran opted for microwave transmission in the rnid-1960's and continued to expand this network nationwide. Despite rapid growth in exchange capacity during the 1970's, the number of lines per 100 inhabitants (3.4) is well below the world average of 10.5. Moreover, usage statistics by subscribers as of 1976 were among the lowest of the six countries in this study– an average of 1.6 international calls and 13 domestic calls per subscriber in 1976.

In 1979, Iran had over 2,980 telex lines and automatic computerized telex centers in several cities. One hundred and fifty cities were equipped with modern teletype and teleprinter systems, which replaced the old telegraph network. Under the Shah, three television channels and four radio networks were operated. Estimates of radio receiver ownership in 1976 were 4.3 million households; of television receivers, 1.6 million households. [34]

Iran developed its telecommunications infrastructure earlier than the other countries covered in this study. In its Fourth Development Plan (1968-72), Iran focused extensive investment funds on building its nationwide microwave networks, meeting existing demand for communication services and anticipating requirements for the future, During this period, between 3 and 6 percent of all Iranian imports involved telecommunications equipment, and Iran became a major world market for such items, acquiring 4.5 percent of world imports of telecommunications equipment in 1971. However, in 1972 and 1973, owing to a worsening balance of payments and capital shortage problems, investments in this sector declined.

The rapid oil price increases of 1973 and 1974 at the beginning of Iran's Fifth Development plan resulted in a major revision, doubling investment allocations. Expenditures on telecommunications projects again increased, reaching a peak in 1976 of $330.5 million. Budget deficits caused by lower oil revenues in 1975 and 1976 resulted in a leveling off of spending by the end of the plan period. Figures on telecommunications imports since the 1979 revolution are not available but, based on OECD export figures, such imports probably fell in the early 1980's to about one-quarter of the 1978 trade total.

During the 1970's, firms from the United States and West Germany shared the Iranian telecommunications market almost equally, about 25 percent each, as shown in table 59. The positions of firms from Japan, Italy, and the United Kingdom fluctuated rather widely from year to year but maintained an aver-

[33] ITU, op. cit., 1980.

[34] M. Tehranian, "Communications Dependence and Dualism in Iran, *Intermediary,* vol, 10, No. 3, 1982, pp. 40-44.

Table 59.—Market Shares of Telecommunications Equipment Exports to Iran From OECD Countries, 1971, 1975-80 (SITC 764 or 7249)

	Canada	United States	Japan	Belgium	France	West Germany	Italy	Netherlands	United Kingdom	Switzerland	Total exports (in 000 U.S $)
1971	6.5	15.2	219	1.2	3.9	22.1	19.7	0.3	5.6	25	91,859
1975	4.3	23.8	13,9	2.1	7.8	26.8	9.2	0.4	80	10	207,965
1 9 7 6	6.9	38.0	77	04	5.7	247	7.4	0.2	63	1.2	330.461
1977	4.6	27.0	9.0	08	11.8	244	98	05	9.5	0.7	252.898
1978 . . .	0.9	226	127	07	7.5	21.1	91	94	13.2	18	315,323
1979	0.0	219	7.2	0.2	4.9	29.8	187	104	5.0	13	139.420
1 9 8 0	0.0	0.0	173	0.2	2.0	32.6	32.7	14	9.5	21	75,069

NOTE Market shares Calculated as value of exports reported by exporter as a percentage of total telecommunications exports to recipient reported by all OECD exporters

SOURCE Compiled for OTA frem *OECD* Trade of Commodities Market Summaries. Exports (1971, 1975-80)

age of only about 10 percent of the market each.

Market shares, as could be expected, have shifted since Iran's revolution. With the United States effectively out of the picture, Japan and Italy have been the beneficiaries, assuming 17.3 and 32.7 percent of the market, respectively, in 1980. West Germany strengthened its position to 32.6 percent of OECD telecommunications exports to Iran by 1980.

Telecommunications sector breakdowns in Iran between 1974 and 1982 were approximately 70 percent for telephone and telex, 27 percent for transmission, and 3 percent for video and radio. Supplier market share in each of these sectors has changed dramatically since the revolution. As a historic reference point, telephone and telex shares in 1974 were United States, 74 percent; Japan, 13 percent; Sweden, 6 percent; and the United Kingdom, 7 percent. U.S. firms had an 85 percent share of transmission equipment exports to Iran. For video and radio, France had a 77 percent share, the United Kingdom had 14 percent, and the United States had 8 percent.

Regional Telecommunications Development

The Middle East has focused attention on improving telecommunications among neighboring Arab countries. Several regional projects are under way, many having received their impetus from a telecommunications development plan for the Middle East drawn up by the International Telecommunication Union (ITU) in 1978.[35]

The largest regional project being planned is Arabsat which promises to bring significant benefits to countries of the region through improved communications. The system as planned will provide the capability for expanded and more efficient communications not only among countries in the Middle East, but also between them and other parts of the world. Therefore, on the one hand: the technology may be used to promote free flows of information. On the other hand, the benefits of the system will depend upon who controls it and how it is used. In light of the different approaches these countries have taken to television broadcasting and their different political stances, they will be challenged to produce joint broadcasts. Furthermore, decisions taken by leaders in each country about what types of broadcasts should be shown could limit information available to local viewers. Thus, the advanced technology embodied in Arabsat's planned system could be used to expand or restrict information flows, depending on how the broadcasting is handled.

The first Arabsat satellite is now scheduled for launch in November 1984 on a European Space Agency (ESA) Ariane launcher. The second was scheduled for launch by NASA's shuttle STS-25 Atlantis in May 1985.[36] A third will be kept as a spare. Each satellite will have an operational lifetime of 7 years.[37] The main ground control station will be in Riyadh, and an auxiliary station maybe located near Tunis.

The concept of Arabsat grew out of a 1953 Arab League agreement to develop effective telecommunications links throughout the Middle East region. This agreement led to the creation of the Arab Telecommunications Union (ATU) in 1958 and its affiliated Arab Satellite Communications Organization (ASCO). ASCO is made up of five permanent

[35] The ITU is a specialized agency of the United Nations, comprising varitJus fora which plan and administer the details of international telecommunications.

[36] "'' Space Shuttle Payloads and Experirnents, " S1'S Missions, 1 through 81, Rockwell International, December 1983. This will be the first flight for Atlantis.

[37] '' Arabsat: A Giant Step for the Middle East, " *Middle East Economic Digest*, oct. 15, 1982, p. 84: "Ford Aerospace to Build Arabsat, " *Aviation Week and Space Technology*, June 1, 1981, p. 24; *Middle East Economic Digest, Special Report — Telecommunications*, October 1983. p. 8; Ali Al-Mashat, ''I)ata Communications Services in the Arabsat System,'' paper presented at the 2nd Gulf Computer Conference—Dubai, Dec. 14-15, 1982. To illustrate the potential that the system presents for controlling information, Arabsat has reportedly considered encrypting television broadcasts so as to ensure that they can be received only by appropriate members and that signals cannot be intercepted. See ''Arabsat Satellite's Control Signals Will Be Encrypted " *Aviation Week and Space Technology*, May 21, 1984, pp. 1 76-177.

members (Saudi Arabia, Libya, Iraq, Kuwait, Qatar) and four members elected by the general assembly for 2-year terms. The general assembly consists of the member countries' Posts and Telecommunications ministers and is the governing body of the organization. In 1969, the Arab States Broadcasting Union (ASBU) was formed.

In 1972 several of the governments of the Middle East asked the United Nations Development Program (UNDP) for assistance in setting up a telecommunications network in the Middle East and the Mediterranean. The UNDP asked the ITU to study technical aspects of such a plan. In the first 5-year phase of the study, ITU drew up a master telecommunications plan for the region, compiled from detailed local surveys. It focused on creating and improving satellite, land, and submarine telecommunications links among the several countries (28 sponsoring governments approved the master plan in 1978—Iran, however, was not one of them). ITU estimated that the expenditures for just the international portions of the work would reach $3,000 million by 1990. Egypt, Iraq, Kuwait, Lebanon, Oman, Saudi Arabia, and the United Arab Emirates (UAE) will contribute 35 to 40 percent of the cost; UNDP will contribute a similar share, and the rest will come from non-Arab Mediterranean States.

In the second 5-year phase, ITU conducted subregional feasibility studies with an emphasis on improving communications in the Red Sea area by using microwave and submarine cables. The third phase will look at the ground network and the training of Arab nationals in telecommunications and broadcast engineering and management.[38] The master plan also suggested diversifying the telecommunications routing so as to increase reliability. Plans are also being made for an intra-Gulf coaxial cable linking the UAE, Qatar, Bahrain, and Saudi Arabia, with a later extension to Kuwait.

In 1976, Comsat, of the United States, was given a $100 million contract to provide technical consulting for the Arabsat program. Political issues delayed the program. The contracts for building the three satellites were awarded in May 1981 to Ford Aerospace (United States) and Aerospatiale (France). The final U.S. export license approval was not granted to Ford Aerospace until February 1982. Aerospatiale was reportedly named as the prime contractor because Ford was on the Arab boycott list. However, Ford received 59 percent of the total contract value ($79 of $134 million) and has the largest share of the work. Ford provides the antennas, propulsion units, power converters, communications subsystems, and altitude control systems.

Another $40 billion telecommunications master plan—MEDARABTEL–formulated by ITU and funded by the U.N. Development Program and participating countries, is now being implemented. In June 1982, Telettra (Italy) and Thomson-CSF (France) obtained an $18 million contract based on this plan for a microwave link between Saudi Arabia, North and South Yemen, Djibouti, and Somalia. The plan also includes extended telecommunications links with Europe and national and international transmission routes for radio and television broadcasting.

Other regional projects under way or planned in the Middle East include: 1) international sea navigation satellites; 2) trans-Gulf cable links; 3) an intercontinental submarine cable between Saudi Arabia, Singapore, Indonesia, and Sri Lanka, costing about $500 million; 4) a coaxial cable link between Algeria, Tunisia, Morocco, and Libya; 5) a coaxial cable link between Kuwait and Iraq in which CIT-Alcatel of France and BICC Telecommunications of Great Britain are involved; and 6) a telephone network being built by Philips of the Netherlands along a l,200-kilometer highway linking Syria, Jordan, and Kuwait via Baghdad.

There are few discernible trends yet in technology trade for projects awarded for regional work. Arabsat, the ITU plan, and MEDARABTEL

[38] *Middle East Economic Digest,* Oct. 15, 1982; *Times of London,* Feb. 2, 1981.

should create a great deal of business in expanding transmission networks, including Earth stations, submarine and coaxial cables, and microwave systems.

Stress has been laid on expansion of the transmission network. By far the largest subsector of expansion has been satellite systems, with U.S. firms holding 76.5 percent of the market and French firms the remaining shares. In microwave systems, the Italian firm Telettra captured a 65.4 percent share. France's Thomson holds 34.6 percent of that market. Overall, in the transmission sector, which represented $283 million in expenditures from 1974 to 1982, the principal actors have been U.S. firms with 63.2 percent of the market, followed by French firms, with 23.9 percent."

PERSPECTIVES OF RECIPIENT COUNTRIES AND FIRMS

Saudi Arabia

The rapid expansion of the Saudi telecommunications network has resulted in one of the most modern systems in the world. The Posts, Telegraphs, and Telecommunications Ministry (PTT) has not been averse to introducing advanced technologies-they have installed the world's first nationwide stored program control telephone system, used electronic digital switching, employed microwave and satellite transmission extensively, and experimented with fiber optic transmission. Given the size of the projects, the rapidity of implementation, and the sufficient funding of the program, it is likely that the firms, as well as the technologies involved will gain increased credibility in the international market.

The highest levels of expenditure in the most recent Saudi Arabian 5-year plan are for municipalities, electricity, education, civil aviation, health, roads, and desalinization. Telecommunications allocations are next on the list, representing about 3.7 percent of total expenditures, or $8.7 billion. Most of this amount is set aside for finishing ongoing projects, such as the Telephone Expansion Program and the Intra-Kingdom Microwave Project.

The telecommunications budget for the 5-year plan and the first three yearly budgets are presented in table 60. Expenditures have fluctuated on a yearly basis since the beginning of the plan and appear to be ahead of schedule. Between 1980 and 1982 alone, over $6.8 billion was allocated in yearly budgets. While the value of contract awards in telecommunications throughout the Middle East fell from 13.9 percent in 1982 to 4.2 percent in 1983, Saudi Arabia increased its purchases in this sector from $570 million in 1982 to $1,726 million in 1983.[40]

Demand for telecommunications equipment in Saudi Arabia is expected to continue to rise during the next 5 to 10 years as the telecommunications modernization program is completed. Government ministries and public corporations have accounted for about 85 percent of the purchases of equipment and services; of this, 80 percent is purchased by the PTT and the Ministry of Information. Other ministries are building new headquarters and have a need for large private automatic branch exchange (PABX) systems.

To conduct business with the Saudi Arabian government, a local agent and office is required. Joint ventures with Saudi interests are also encouraged. In evaluating responses to tenders, Saudi ministries reportedly give preference to 100 percent Saudi-owned firms over 51 percent Saudi-owned joint ventures. These firms are, in turn, favored over agent-represented foreign companies. In business, Saudi Arabian customs reportedly emphasize trust and personal contact as the basis for consummating business deals.

The largest purchaser in the private sector is ARAMCO, which operates an independent 27,000-line phone network, but demands will increase from other purchasers as hotels, uni-

4'1'1, *op.* cit., 19~2

[40]MEED Consultants, *Middle East Contracts: Directory and Analysis*, 1983 Second Half (London: Middle East Economic Digest, 1984).

Table 60.—Saudi Arabian Telecommunications Budgets As Compared to Total Budgets (in millions of U.S. dollars)

	1980-84 Plan	1979-80	1980-81	1981-82	1982-83
Total budget	$237,100	$48,500	$71,418	$86,868	'$91 .357
Telecommunications. . . .	$ 8,700	$ 1,429	$ 2,574	$ 2,154	$ 2,080
Video and Radio ., .,	NA	NA	NA	$ 459	$ 461
Percent of total ...	3.7	2 9	3.6	3.0	2.8

SOURCE J Shaw and D Long Saudi Arabian Modernization The Impact of Change on Stability *The Washington Papers* New York Praeger 1982); Edmund O'Sullivan Saudi Budget Shifts Emphasis From Infrastructure to Human Resources Middle *East Economic Digest* Apr. 30 1982, pp 1618

versities, airports, office buildings, and industrial facilities are completed.

Minimum requirements for all equipment are the norms recommended by the ITU's CCITT and CCIR.[41] U.S. modifications to these standards appear to be acceptable.[42] Private equipment connected to the public system must be approved by the PTT'. For broadcasting equipment, important long-term supplier decisions are made when particular contracts are awarded, since European and American systems are often not compatible. Often, the detailed requirements for specific projects are drawn up by foreign consultants to the PTT. This is true in Saudi Arabia, where Arthur D. Little, Norconsult, Swedetel, ITU, and Preece, Cardew, and Rider have worked on the plans and requirements for large telecommunications programs and then served on the bid evaluation committees.[43]

The telecommunications subsector likely to receive the greatest attention over the next decade is that of telephone and telex. With goals to once again double phone capacity and to increase telex capability, large projects are likely to be awarded. Established suppliers who have won the confidence of Saudi Arabian officials and who have long experience in the market are in the best competitive positions. This means that Ericsson and Philips in the switching and user equipment area and Cable and Wireless for telex may benefit particularly from the projected expansion.

Growth in capacity often reveals hidden demand. So it is with subscriber usage of the expanded telephone system in Saudi Arabia. In 1977, with only 200,000 subscribers, the average number of international messages per subscriber was 5.8 calls. In 1980, with 700,000 lines in operation, each subscriber initiated over 24 international calls.

While there appears to be relatively high usage by current subscribers, the physical capacity of the network commissioned may exceed the expected demand through 1990 by about 500,000 lines. Saudi Arabia is, however, building now in anticipation of future demand, given projected rates of urbanization and industrial growth.

One indicator of the ability to absorb telecommunications technology is the number of employees per 10,000 phone lines. For a particular quality of service, the fewer persons required the more efficient the operations. In 1980, the total number of employees was given as 12,571, or 284 per 10,000 lines; an estimate for 1981 showed an improvement with 189 per 10,000 lines.[44] By comparison, AT&T used 102 employees per 10,000 lines in 1982.[45] These figures also compare favorably to the estimate of 140 employees per 10,000 digital lines for inside and outside plant operations.

Although the figures describe a Saudi system in transition, they show increasing efficiency by employees in operating and maintaining the equipment. The numbers are supported by other information on Saudi Telephone (Sauditel). While 62 percent of Sauditel

[41] The International Consultative Committee for Telegraph and Telephone (CCITT) and the International Consulting Committee for Radio (CCIR) are two of the ITU's largely autonomous permanent organizations.

[42] Intel-Trade, May 15, 1979.

[43] U.S. Embassy, Riyadh, Market Research *of Telecommunications Equipment,* February 1980.

[44] D. Fargo, "World Telecoms Tell Their Plans for Growth, " *Telephone.}',* Sept. 24, 1979, pp. 88-111.

[45] AT&T, Statistical *Report,* AT&T, Basking Ridge, N. J., 1981.

employees were nationals in 1981, the proportion of Canadian supervisors was being reduced. The employment goal for the company is 80 percent Saudi nationals.[46] Nationals hold all public interface positions and many managerial roles. Saudi Arabian personnel aim to take over parts of the training program themselves.

Saudi nationals, once trained, reportedly have good ability to operate telecommunications equipment. While some with prior education in the United States are already oriented to Western technology, those who are products of the Saudi Arabian educational system have reportedly sometimes faced difficulties in moving from rote learning to programs centered around understanding causes and effects of operations.

Planned growth in telecommunications capacity takes into account anticipated growth in demand in conjunction with Saudi Arabia's rapidly growing population.[47] At the same time, the country has been experiencing a large influx of population into the cities since 1974. The average population growth rate in urban areas was 7.6 percent annually between 1970 and 1980. In comparison to the overall national rate of growth, this urbanization effect is extreme and may present future problems in that certain exchanges may be overcrowded while others are underutilized.

With an estimated 70 percent of its 2.5 million work force being foreign, Saudi Arabia set a goal of reducing the growth of the foreign work force. Projections indicate that the overall labor force may continue to grow through the year 2000.[48] Shortages exist within the managerial, professional, technical, and skilled labor categories, which all affect the labor situation in the telecommunications sector. Estimates suggest that non-Saudi labor encompasses more than one-half of the work force in these categories, vital to effective absorption of telecommunications technologies."

Computer training programs have been established at Sauditel's data center and by the National Guard. Telecommunications and broadcasting training institutes have also been conducting programs in Riyadh and Jeddah since 1971. However, these programs have not attracted the number of trainees originally envisioned and have reportedly experienced high dropout rates.[50]

Most contracts for telecommunications equipment currently include training (in Eng-

[46] 'Industrial Studies and Development ('enter, *A Guide to Industrial Development in Saudi Arabia*, Riyadh, 1 977.
[47] *Middle East Economic Digest—Special Report on Saudi Arabia*, July 198 1: ITA, op. cit., 1982.

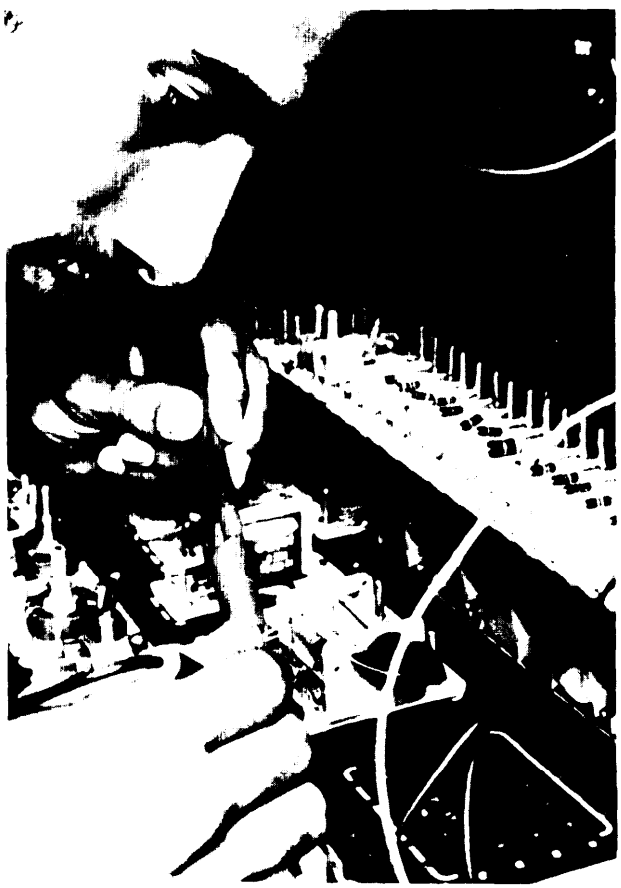


Photo credit: Aramco World Magazine

At ARAMCO'S Ras Tanura Industrial Training Shop, a student tests electronic circuitry

[48] "Riyadh ('ailing–12ast and F; fficiently," *Middle East Economic Digest, Special Report on Saudi Arabia*, July 19h 1, p. 27.
[49] See ch. 4 for a discussion of various estimates of Saudi population,
[50] "'Saudi Arabia—The Manpower Controversy," *Middle East Economic Digest*, Apr. 24, 1981, pp. 40-41,

lish and Arabic), operations, and maintenance provisions. The training goal is often to bring nationals to a level of operational proficiency rather than preparing them to take over all aspects of maintenance, which is usually handled through joint ventures. This has been the case with the Intra-Kingdom Microwave Project, where Western Electric training in management and operations and maintenance was accomplished by Western Electric personnel for the first 12 months after installation and by Sartelco personnel (an Italian-Saudi joint venture) subsequently. Maintenance work is delegated to foreign contractors; thus dependence on suppliers continues. As discussed in the Saudi Arabian project profiles (included in app. 6A), U.S. firms bidding on the telephone expansion contract in 1978 had high cost estimates for operation and maintenance. These estimates may have been instrumental in loss of the contract.

Saudi Arabia encourages foreign investment that results in domestic assembly plants and manufacturing facilities for import substitution. To date, there have been limited attempts at local manufacture in the telecommunications field. The Saudi Cable Company, a joint venture with Philips, plans a major expansion. Telephone Industries Co., Ltd., a joint venture with Ericsson, was established in 1976 to manufacture telephone equipment, apparatus and cable. It was licensed by Ericsson to produce cable, 50,000 lines of automatic exchange equipment, 40,000 lines of PABX systems, and 12,000 phone sets per year. By 1979, however, production had not begun. In addition, a Finnish company established a factory to produce TV tubes in 1977. Without plans for extensive local development of a telecommunications equipment manufacturing industry, Saudi Arabia will remain dependent on foreign sources.

Increased usage by the residential, business, and government sectors has revealed a pent-up demand for telecommunications equipment and services. One particular application of CCTV has had a major impact on education in the Kingdom. By custom, women have been segregated from men at all levels in the educational system. This has also extended to the required use of female instructors to teach female students. Because there have been shortages of female instructors, educational opportunities for women have been stymied. However, the introduction of CCTV into the classroom has enabled male instructors to teach women.

As the telecommunications network reached the small towns and villages in the Kingdom, it has provided local businessmen and traders with easy access to the national economy. The network thus has increased local employment, and brought increased prosperity to the outlying regions. Increases in telecommunications capabilities have also enabled the construction of refineries, industry, and exploration sites in remote areas of the country.

Expansion of both the civilian and military telecommunications networks in the Kingdom also has had national security implications. The government has acted to integrate these networks and thus improve its command and control capabilities. Litton Industries, of the United States, is participating in this project to integrate the networks.

While Saudi Arabia's telecommunications infrastructure has grown rapidly, capacity to absorb technology effectively has increased at a slower pace. Accounts of Sauditel accomplishments are impressive. Nevertheless, manpower shortages in managerial and skilled technical areas present continuing problems, despite efforts to establish training programs. Absence of a domestic telecommunications industry means that Saudi Arabia will be dependent on foreign suppliers into the foreseeable future. On the other hand, there is no doubt that Saudi Arabia can operate and maintain an efficient telecommunications system, because the country can afford to pay for operations and maintenance assistance.

Kuwait

Kuwait has aspirations to be an important regional and international financial center. A

"The Economist Intelligence Unit, *Quarterly Economic Review*, London, April 1981.

reliable and advanced telecommunications network is a prerequisite. Kuwait's extensive international investments and foreign assistance programs also require modern telecommunications facilities. In addition, Kuwait Petroleum Company (KPC) has plans to establish itself as a major integrated international oil company. Such an operation requires extensive international communications to support management, production, and distribution. Advanced technology transfers will also enable the Kuwaiti government and business to establish links with databanks overseas.

The Ministry of Communications projects a doubling of telecommunications capacity between 1980 and 1985, as follows:[52]

	1980	1985	1990
Telephone capacity	269,000	381,000-500,000	1,100,000
Telephone subscribers	160,000	345,000	900,000
Telex capacity	6.000	15,000	na
Telex subscribers	2,400	5,500	7,500

A major goal is to rehabilitate the telephone system. Major repair expenses are being incurred for telephone cables; $1.38 billion has been allocated to replace damaged underground telephone cables with waterproof ones. Kuwait has imposed large fines on contractors who damage these cables during construction, but the fines have not resulted in an elimination of this problem.

Actual construction expenditures for telecommunications grew as follows:

1978	$ 72.2 million
1979	80.6 million
1980	79.1 million
1981	105.7 million
1982	152.4 million

During 1982-83, allocations by the PTT fell slightly from $212.9 million in 1981-82 to $201.6 million." The Ministry of Communications is the major consumer of telecommunications equipment. Other major government purchasers are the Ministries of Defense and Public Health. Sales are by tender and are always carried out through a local agent.

[52]Kuwait Ministry of Communications, "Present and Future Telecommunications in Kuwait," March 1981.

[53]The Economist Intelligence Unit, *Quarterly Economic Review*, London, March 1982.

Mid-range electronic PABX equipment (10 to 100 lines) can be only sold to the Communications Ministry, which then provides it to private users. Smaller and larger private exchanges can be sold directly to end-users. Most other equipment is marketed directly to private companies and individuals, such as the KPC, shipping agents, newspapers, and banks.

Kuwait continues to import the latest and most advanced telecommunications systems. Europe and Japan have come to dominate many key segments of this market, where American firms have lost bids owing to their higher prices.

The number of local telephone exchanges is expected to double over the next decade, as will the number of international trunk lines. Sophisticated subscriber equipment, including autodialing, and electronic PABX's, are popular among businesses. Over the next decade, Kuwait is planning to spend $1.5 billion on expansion of special telecommunications networks at ports and transportation centers and along highways.

In the transmission field, demand for satellite technology has been generated by the data transmission requirements of banks and financial institutions. Additional microwave linkages and uses for fiber optics will probably be identified over the next 10 years. Since there are no plans to develop a domestic telecommunications equipment manufacturing industry, Kuwait will continue to be dependent on imports into the foreseeable future.

In 1981, there were 347 telecommunications employees per 10,000 lines in Kuwait.[54] This compares with an estimated 140 employees usually required to operate and maintain digital equipment. It is also significantly higher than the employee-to-line ratio in Saudi Arabia and Iran.

Based on data reported by the ITU (1980), Kuwait annual expenditures for maintenance and repair have been erratic. Through 1973,

[54]AT&T Long Lines, op. cit., 1982

the costs were low–$3,000 to $6,000 per 1,000 main lines per year. The costs in 1974 and 1975 were very high in comparison-$75,000 per 1,000 main lines. Expenditures since then declined, but rose slightly again recently.

These costs may be related to two factors. First, the use of many types of equipment and many suppliers during initial implementation of the telecommunications network is making it difficult to maintain sufficient inventories of spare parts and obtain replacements. Second, there have been problems in equipment maintenance. Overall, while there appears to be high demand for a variety of telecommunications services, the capacity of local Kuwaitis to operate and maintain the network efficiently has been limited.

With a high rate of population growth and a large expatriate population, Kuwait's demand on international trunk lines is likely to be high. Due to the large population shifts and changing needs of subscribers, it has been difficult to predict and match demand and exchange capacity. The waiting list for telephone subscribers has been large, fluctuating between one and five percent of the total population.

Kuwait faces manpower shortages that limit technology absorption in the short term. In the 1975 census, there were a total of 298,415 people classified as economically active. Of these, only 29 percent were Kuwaiti nationals. This situation has created a strong dependence on foreign contractors.

For example, a Japanese consortium of Nippon Telegraph and Telephone and Kokusai Denshin Denwa (KDD) planned, designed, and installed the telephone system between 1965 and 1975. Three years after the system was turned over to Kuwait, the Japanese were asked back to renovate, maintain, and operate the system, which had reportedly deteriorated. The new Japanese consortium, Japan Telecommunications Engineering and Consulting (JTEC), that accepted the job rejected a contract renewal offer. Citing payment withholdings and difficult working conditions, JTEC allowed another foreign contractor to take over the role of operator, maintainer, trainer, and consultant for the Kuwaiti PTT.[55]

The Kuwait Telecommunication Training Institute was established in 1966 to train nationals in maintenance, operation and supervision of telecommunications systems. Courses cover a broad range of subjects, including English, switching and transmission technologies, broadcasting and training methods. In response to rapid expansion of telecommunications services in Kuwait and limited numbers of Kuwaitis interested in the training, enrollment was recently expanded to a small number of non-Kuwaitis.[56]

In the construction field, Kuwaiti firms are apparently becoming large and capable, winning many civil works contracts. Except for Kuwaiti trading companies that procure telecommunications equipment from foreign suppliers for the government, local firms are often not capable of fully absorbing the advanced technology installed.

Egypt

As its telecommunications facility is modernized and as Beirut has been the site of prolonged civil war, Cairo is likely to emerge as a major regional commercial center. Already, it is serving as a cultural center in the Arab world, exporting television and radio programs from its large broadcast studios.

Radio and microwave transmission facilities have improved communications for Egyptian oil companies between headquarters, oil wells, and refineries. Improved and more reliable transmission will probably create a new computer and data-processing industry, producing a demand for indigenous computer programmers. The increased investment in the telecommunications network may help slow the outflow of technically trained and experienced workers from Egypt to elsewhere in the Arab world.

"''Japan Telecommunications Engineering and Consulting (JTEC)– Kuwait Reluctant Partner, " Middle *East Economic Digest,* Oct. 15, 1982, p, 90.

"Telecommunications Training Institute, *Prospectus– Telecommunications Training Institute,* TTI, Safat, Kuwait, 1983.

Satellite links also have enabled more reliable and timely communications between the Foreign Ministry and Egyptian embassies abroad. Moreover, Egypt has been a major purchaser of military communications equipment from France and other suppliers. The British, for instance, have a joint venture in Egypt to manufacture military radio products.

The 1978 master plan for telecommunications developed by Continental Telephone International has apparently been adopted as Egypt's official 20-year plan. That plan and the initial budget figures for the 1980-84 development plan in the transport and communications sector allocated $2.4 billion to project investments over a 5-year period.[57]

The basic goals are to: 1) increase the number of telephone lines from 700,000 to 1.6 million by 1985, 3.0 million by 1990, and 4.5 million by 2000; 2) attain a telephone line density of 3.7 per 100 inhabitants by 1985; 3) install 12,000 new telex lines by 1985 and 26,000 by 1990; 4) install new and replacement coaxial cable linkages between major cities, submarine cable between Egypt and Saudi Arabia, and microwave linkages between Upper and Lower Egypt and to the Sinai; and 5) establish new broadcasting stations and towers and renovate or replace existing equipment.

Eighty percent of all contracts in this field are with the public sector—ARENTO (Arab Republic of Egypt National Telecommunications Organization), ministries, or 11 other public-sector organizations. In the public sector, agents are required to represent foreign firms, financing is essential, and political clout is reportedly useful.

The private sector, in comparison, has greater access to funds and can buy directly from suppliers. In fact, one source indicates that the key factor in making a successful sale to the government is the availability of favorable financing; the technology chosen is a direct result of the best financial package.[58] Decisions of convenience rather than technological planning may have resulted in the purchase of a large variety of equipment types that must now be made compatible.

The standard for electrical current in Egypt is 220 volts, which benefits European suppliers over American firms. There is no formal statement concerning telecommunications standards; ARENTO and its contractors have developed them as the need arose."

The estimated cost for the 4.5 million new telephone lines by the year 2000 is $17.4 billion. Feasibility of the telecommunications plan largely rests on the availability of financing from suppliers, donor countries, and international organizations. Even if the projected 700,000 new telephone lines are successfully completed by 1985, there will still be an estimated shortfall of 400,000 lines. This pent-up demand helps explain the likely focus of requirements over the next 10 years. Telephone and telex equipment will be the largest sector for expansion, mostly in switching and subscriber equipment. While most of the current exchanges are of the crossbar type, fully electronic digital equipment is expected to be used increasingly.

There is a shortage of telex capacity in Cairo as a result of increases in the number of businesses opening offices there. ARENTO is planning to spend $17.2 million to install additional telex exchanges, telex traffic is expected to quadruple by the year 2000, placing further strain on capacity.

The transmission network is in great need of renovation and replacement. The major market will be in coaxial cable and carrier trunks. Enhancements to microwave systems and high-frequency radio are secondary markets. In addition, as digital transmission takes over there will be a developing market for Time Division Multiplex (TDM) equipment.

ARENTO is forced to employ more personnel than needed in order to help alleviate the country's high unemployment. This has led to underemployment, problems in supervision,

[57] Charles Richards, 'Egypt Embarks on Crash Modernization Program, *Middle East Economic Digest*, Oct. 15, 1982, p. 87.

[58] U. S. Department of Commerce. ('communications *Equipment in the Arab Republic of Egypt*, Washington, D.C., 1980.

[59] Ibid.

and a resulting poor quality of workmanship and service.

Annual expenditures for maintenance and repair of the telephone service slowly escalated from a 1970 level of $62,651 per 1,000 main lines to $81,580 per 1,000 main lines in 1976 (in constant 1979 dollars). This gradual response to an apparently rapid deterioration of the network was a major contributor to poor service. In 1977, major increases to the maintenance and repair budget–reaching $146,961 per 1,000 main lines--signalled the beginning of of the "quick fix" approach to restoring quality service.[60]

The major domestic source of telecommunications equipment is the Telephone Apparatus Company, which is government-owned. Previously a joint venture with Ericsson and now under license to that company, this facility produces 35,000 lines of crossbar exchanges, 7,000 lines of PABX systems, and 35,000 phone sets per year. Annual sales in 1978-79 were $12.9 million. The factory appears to be well managed. It produces many of the technical components and is not merely a subassembly operation. However, because it is a state-owned factory, pay is on a low, government scale, and good technical staff are reportedly lost to private enterprise. Egypt also has a radio and TV production plant. The labor force at this facility totals 200 and is trained in manufacturing, management, quality assurance, and design.

Among Middle Eastern countries, Egypt has a comparatively large population and a fairly high percentage of its population aged 20-24 enrolled in higher education-15 percent in 1978. In 1978-79, there were 11,117 graduates and 72,306 students enrolled in engineering, science, technology, and electronic curricula in Egyptian universities. These numbers increased rapidly during the 1970's, which suggests that a growing base of technically qualified manpower will be emerging shortly. One problem will be to keep them employed within Egypt.

[60] ITU, op. cit., 1980.

Egyptian fitters and technicians are reportedly capable. But at the same time, these skilled laborers go abroad, depriving Egypt of experienced technicians. As a result, there is a lack of experienced skilled workers to operate and maintain the telecommunications network. Much of the existing network is maintained by foreign contractors.

Under USAID funding, Continental Telephone and Arthur D. Little are providing extensive training in craft skills such as telephone installation and cable splicing. They are also attempting to transfer broader technical knowledge to the more advanced employees. Training sessions are held at ARENTO's Telecommunication Training and Research Institute in Cairo. The training, which is provided in both English and Arabic, includes formal classroom as well as on-the-job learning experience.

Thomson-CSF is commissioned to train Egyptian technical staff to take over operation of the enhanced network within a 3-year period. Apart from this training, the Ministry of Interior has established a separate institute of telecommunications training. This ministry is responsible for fire, police, security, emergency services, and traffic functions-and thus has very special communications needs. Training at all levels—from technician upward and from telex machine repair to microwave circuitry design-is conducted.

Although skilled manpower shortages represent one major constraint to absorption, it may be possible to overcome this problem in the short term by retaining in-country skilled technicians who are emerging from the universities and training programs. The most difficult constraint to absorption, however, is the availability of sufficient capital to pursue the planned development of the telecommunications network.

Algeria

The planned expansion of the telephone and telex networks has enabled Algerian national planners to begin to address the needs of other industries. The growth of LNG production,

liquefaction plants, and export markets will require increased domestic coordination and international linkages through telecommunications. Planners are also encouraging small-to-medium private enterprise and decentralizing industry from Algiers and the coastal plain; both efforts will entail better telecommunications facilities.

The expansion of the telecommunications network is likely to integrate the rural areas with the political and social mainstream of the nation. At the same time, the urban population explosion and planned increase in housing construction will put greater demands on the capacity of the telecommunications network.

The 1980-84 Algerian development plan allocates $2.5 billion, or 2.5 percent of total allocations, to telecommunications. Overall, one-quarter of the funds are devoted to complete projects currently under way, and the remainder to new projects. The breakdown of projected investment is (in millions of U.S. $):[61]

Switching	$ 757.7
Transmission	453.0
Buildings	363.2
Network plant	342.3
Improving quality of service	68.9
Support equipment	48.0
Other services	54.3
Radio and TV	400.0
Total	$2,487.4

As occurred with previous development plans, it has been impossible to spend the allocated plan funds within the expected time frame, owing to manpower shortages, construction delays, and insufficient installation capability.

Very little, if any, telecommunications equipment or services are purchased by private industry in Algeria. National ministries and state-owned companies do all the tendering, selection, and procurement, even for private concerns. The Posts, Telegraphs, and Telexcommunications Ministry (PTT) is responsible for about 75 percent of purchases for the public networks; the Radio and Television Agency procures radio and video equipment; Sonatite, a state company, obtains equipment for private end-users (PABX's and phone sets); and mobile radio equipment is purchased by each ministry and national company individually. Standards for Algerian equipment are based on French, and therefore, ITU norms.

The Algerians are committed to conventional technologies—analog transmission and crossbar switching produced locally. Thus, Algeria's approach is quite different from that taken by Saudi Arabia and Kuwait, and more similiar to that of Egypt. Price is usually the most important criterion in awarding a telecommunications contract. In fact, most ministries and network companies are mandated by law to grant contracts only to the lowest bidder. Technical competence of the contractor and the reliability of equipment, as demonstrated by installations elsewhere, are also important decision factors. Since the Algerians have also been trying to rid themselves of an overdependence on French imports, non-French suppliers have been in a good position.

The largest expansion will probably be in switching and transmission, especially in light of plans to increase line density in urban areas and expansion to rural areas. Firms from Sweden, Spain, and France are likely to be predominant in the switching and subscriber equipment areas. Japan is likely to become dominant in the transmission area, since it supplied cable and microwave networks and is a front runner in supply of additional Earth stations.

A substantial amount of telecommunications equipment is currently being produced locally. While these plants may have been designed to produce the equipment from start to finish, most are assembling components still imported from Spain or the United States. Moreover, these plants are not yet up to full-capacity production and probably will not be until late in this decade. Therefore, there is still

[61] Michael Frost, "Algeria: Telecommunications Expansion Underway," *Middle East Economic Digest*, Apr. 24, 1981, p. 6; Konsulterna, "The Market for Communications Equipment and Systems- Algeria, U.S. Department of Commerce, August 1981.

an import market for crossbar and subscriber equipment, cable, and TV and radio receivers.

There are three major local sources of telecommunications equipment production. The factory built by Standard Electrica-ITT (Spain) at Tlemcen in 1975 was designed to produce 100,000 lines of public telephone crossbar switching equipment, 20,000 lines of PABX switches, and 140,000 phone sets per year. The plant is only today beginning to reach this capacity level, because of employee turnover and the difficulty in training employees. Currently, the factory is assembling components imported from Standard Electrica in Spain; but it was originally designed to enable complete local manufacture.

Two cable factories have a capacity of 10,000 tons per year of multipair pressurized cable. Production can be shifted to jelly filled cable as well. The national company in charge of these factories is contemplating microwave and multiplex production later in the decade.

Another facility, built by General Telephone & Electronics (GTE) (U. S.) under a 1976 contract, is a TV and electrical production plant that is still being supplied by GTE. It has the capacity to produce 130,000 TV sets and 400,000 radio receivers annually. At capacity levels, the plant was designed to have a staff of 4,000 Algerians.

By 1990, it is likely that local production will be able to handle a substantial portion of the demand. By one estimate, local manufacture will be able to meet 55 percent of domestic switching needs and 90 percent of the multipair cable requirements.[62]

The telecommunications network is extensively used by subscribers. In 1979, each subscriber made an average of 31.2 domestic calls. This compares favorably with an average of 13.0 domestic calls in Iran and 15.5 in Iraq.

Algeria has a high average net growth rate of population—2.9 percent per year. Estimated at 18.9 million in 1980, its population by 1990 should grow to 25.2 million. This places a continuing pressure on the telecommunications network capacity. For example, the waiting list for telephone subscribers has grown at an average annual rate of 41.8 percent over the past decade. The current push to provide more capacity will narrow the gap between supply and demand, but if Algeria fails to continue to expand the phone system beyond the 1985 goals, the result may be a low density of 3 phone lines per 100 inhabitants in 1990.

Another pressure on the network is the very rapid population growth of urban areas-almost twice the projected overall growth rate at 5.7 percent per year. Capacity in already crowded urban exchanges will have to be expanded at a much faster pace than in rural areas.

One goal of the current plan is to decrease the extent of foreign assistance required in manufacturing and installing additional capacity. To that end, the three local manufacturing plants have been designed to be self-sufficient. National companies are also taking charge of installing exchanges and transmission equipment. However, attracting, training, and maintaining sufficient manpower has been a problem in both production and installation, resulting in the need for continued foreign technical assistance into the foreseeable future.

Although technology transfer is a national goal, the capacity of local personnel to carry out this goal has been questioned by some U.S. firms that have worked in Algeria. It is their opinion that while some Algerian trainees are conscientious in learning how to operate and maintain their segment of the telecommunications network, a large proportion is unmotivated to do so and unable to handle the technology efficiently even after extensive training. Moreover, attempts to develop higher-level training in telecommunications technology with the university in Algiers and the establishment of technical training schools were unsuccessful, owing to government funding cuts.

[62]Konsulterna, ibid.

Exacerbating this manpower problem, the modern analog telecommunications technology being installed in Algeria is more labor-intensive than digital technology. Given a conservative rule of thumb of 150 inside and outside plant personnel per 10,000 analog lines, Algeria will require a minimum of 15,000 telephone employees operating and maintaining a l-million-line network by 1990. Judging from manpower requirements for telecommunications systems elsewhere, approximately 9 percent of the employees will need college degrees in engineering and management. Eighteen percent will have to be technical school graduates in electronics to serve as technicians in switching centers. Sixty-six percent will need some electrical repair training to serve as outside plant installers and repairers. The remaining 7 percent will have to be literate to serve as operators and clerks.

Of the six countries in this study, Algeria has the lowest percentage of the relevant age group enrolled in higher education (4 percent) or in secondary school (31 percent). These statistics, plus the large proportion of the economically active population working abroad in France, suggest that Algeria may face the constraint of insufficient skilled manpower to fully absorb the telecommunications technology it is purchasing. As a result, Algeria will probably have to depend significantly on foreign technical help beyond 1990.

If current trends and plans for development and export of liquid natural gas materialize, the necessary capital for telecommunications efforts should be available. However, there is insufficient high-level management and technical personnel to operate the telecommunications factories and the growing network. Training efforts for technician-level telecommunications personnel must compete with requirements of other industrial establishments for available manpower. These training efforts are, however, critical to more effective utilization of telecommunications technologies.

Iraq

Iraq's telecommunications network has brought with it efforts to expand the technically trained work force, but in the short term increased dependence on foreign technical support has resulted, Moreover, in purchasing advanced computer-based technology, Iraq may limit maintenance problems now, but expand foreign dependence later, if sophisticated training is not pursued. Iraq's motivation to expand its telecommunications networks is also, in part, to serve its requirements for improved military preparedness. At present, with oil revenues reduced and the war with Iran continuing, projects in the telecommunications field are putting an increased strain on Iraq's balance of trade.

Iraq planned 525 new projects to develop the telecommunications infrastructure in the current 5-year plan. Among the goals were:[63]

1. Increase telephone capacity to 1 million phone lines by 1985 and to 1.8 million by 1990.
2. Increase phone density to between 7 and 10 phones per 100 inhabitants by 1985.
3. Increase the number of telex subscribers to 6,000 by 1985 and to 10,000-18,000 by 1990.

There is an absence of information on specific objectives in the telecommunications area and no cost breakdowns of planned development in Iraq's 5-year plan. As a standard for comparison, the previous 5-year plan allocated $1 billion to telecommunications programs. It was estimated that almost one-half of these funds were used to establish military communications networks.

Major government contracts are usually put out to tender for international competition. Sales in telecommunications equipment and

[63] Intel-Trade, Mar. 30, 1979: ITU, op. cit., 1978, MEED Consultants, op. cit., p. 7.

services are often made to ministries directly or to state trading organizations. Local representation for foreign firms is often useful in enhancing sales.

Over the long term, Iraq intends to expand its telecommunications network in both rural and urban areas, using the latest digital transmission systems. An east-west microwave system has been contemplated to support international trade of food and agricultural products. Other areas likely eventually to see increased demand are PABX systems, mobile radio telephone networks and data communications networks, for state organizations.

West European firms from France, Great Britain, and Sweden already dominate in many sectors. Japanese companies tend to be predominant in switching and wireless networks. It is likely that they will continue their major presence in the Iraqi telecommunications market. The Eastern bloc-Hungary and the Soviet Union—have made only minor inroads in this market. U.S. firms, likewise, have had a very limited presence.

International usage has been high and this has strained the capacity of the network. International communications traffic had grown at 30 percent annually. This was probably a consequence of the growth in business and exports as well as the large number of foreign workers in Iraq.

There are several factories devoted to electronics and telecommunications equipment. A semiprivate company has the capacity to produce 50,000 telephone sets annually. A public-sector factory producing telephone wire was scheduled to be commissioned in the early 1980's. A contract was signed in mid-1981 with Thomson-CSF (France) to establish an electronics manufacturing facility, and consideration was being given to developing indigenous production of TV and radio receivers. However, given startup times for new facilities and current capacity limited to component assembly, dependence on foreign telecommunications equipment imports is expected to continue at a high level.

Although figures on Iraq's manpower situation are not available, large numbers of foreign workers have built factories and infrastructure and operated and maintained Iraq's telecommunications system.[64] In part, Iraq sees purchase of advanced technology as one way of offsetting its deficiency of skilled manpower. Most contracts for equipment stipulate that operation and maintenance of that equipment by foreign contractors must include training that supports indigenous absorption goals.

Iraq's plans for expansion of the telecommunications system have been delayed by the war with Iran. By far the largest share ($6.4 billion of $7.2 billion) of contracts awarded in 1983 were in the defense sector. Although authoritative information is not available, it appears that Iraq's telecommunication expansion has been concentrated primarily in the military sector in recent months.

Iran

Expansion of television broadcasting (reaching more than 65 percent of the population) and other mass communication vehicles has been a major instrument of political mobilization in Iran, used to discredit the Shah and then to legitimize the new regime.[65] Telecommunications have also been used by the Islamic regime to build support. The regime's priorities suggest that future investments in telecommunications will be focused primarily on consolidating military positions and ensuring readiness.

Early in 1982, a 20-year development plan was approved and in September 1982 a new 5-year plan was implemented in Iran. In these documents, the regime stated its wish to avoid the degree of dependence on foreign suppliers that the country experienced under the Shah. The principal objective of the current plan is economic self-sufficiency. Staple items and

[64] "Jonathan Crusoe, "Iraq's Spending Slowdown Disappoints Contractors, " Middle *East Economic Digest,* Feb. 19, 1982, p. 10.

[65] Tehranian, op. cit., 1982.

strategic and intermediate goods must be produced domestically.

The PTT Ministry has selected sectors that will receive enhanced telecommunications networks. In order of priority they are: 1) security and defense forces, 2) "voice and vision broadcasting," 3) government institutions, 4) productive and agricultural sectors, 5) villages, 6) trade and commerce, and 7) households.[66] In addition, goals have been established to develop telecommunications facilities for all villages of 1,000 persons or more by 1987 and all smaller villages by 1997. Some expansion and repair work is apparently proceeding. Approximately 43,000 new telephone lines are planned for installation in Teheran, Gilan province, and Rasht.

Reportedly, $8.3 million has been spent through June 1982 on reconstruction and renovation of telecommunications facilities and microwave equipment. The telecommunications budget for 1982-83 was set at $27.2 million. Moreover, an amendment to the 1982-83 budget included $112 million for completion of several projects. In comparison, planned investments in telecommunications under the Shah amounted to $380 million (1978-83), $546 million (1983-88), and $913 million (1988-93). Given the sketchy information available on current plans and budgets, it is difficult to assess the likelihood that the goals will be vigorously pursued.

Based on 1981 figures, Iran had a fairly low ratio of telecommunications employees (255) per 10,000 lines. This suggests a rather efficient operation. [67]

Prior to the overthrow of the Shah, two domestic manufacturing plants were producing telecommunications equipment, primarily telephone sets. One factory was a joint venture with Siemens, and the other was under a licensing agreement from another German firm. It is unknown whether these plants are still in operation. Iran thus developed a limited level of self-sufficiency in equipment production.

Reported shortages of telecommunications equipment and spare parts in Iran since the revolution have encouraged expansion of local production and importation of materials from friendly countries. Although some requirements are being satisfied by domestic sources of supply, the domestic cable manufacturing facility reportedly has had difficulties meeting demand.[68] Given Iran's desire for greater self-sufficiency, it is likely that it will attempt to increase indigenous production of telecommunications equipment and will probably draw upon West German, Italian, and Japanese expertise to expand its capability.

Iran's population is growing at an average annual net rate of 2.3 percent. Extrapolating to 1990, Iran's population maybe 48.7 million. If previous trends continue, population growth in urban areas will increase at a rate of over 4 percent annually. These factors will serve to put more stress on the capacity of the existing system. As an indicator of this push on demand, waiting list statistics for telephone lines have increased exponentially between 1971 and 1979—from 133,559 persons (0.5 percent of the 1971 population) to 750,000 persons (2.1 percent of the 1979 population)."

Iran made strides in addressing the problem of shortages of skilled labor in the 1970's. Statistics demonstrate that between 1969 and 1974, the number of engineering students receiving higher education in Iran more than doubled. In addition, the contract with American Bell International, Inc., focused in part on developing full self-sufficiency in telecommunications training by 1985.[70] Iranian trainees who went through the Bell training program exhibited a clear ability to master hardware operation because the training was practical, technical, and hands-on. Maintenance and administrative training were more difficult for trainees to grasp. Several Iranians who finished the courses successfully became instructors for their colleagues.

[66] *Akhbar {* Iranian newspaper-English translation), Sept. 27. 1982; Oct. 9, 1982.
[67] AT&T Long Lines, op. cit., 1982.
[68] ITA, op. cit., 1982.
[69] ITU, op. cit., 1980.
[70] *['Telecommunications,* August 1979.

On the negative side, some of the Bell training courses experienced a dropout rate of close to 50 percent. Moreover, many of the management skills viewed as essential to efficient operations were found to be too Western-bound and culturally alien. These topics included team approaches to problem solving, communications skills, and recordkeeping skills.

Like Iraq, Iran's telecommunications expansion depends on the course of the war. In 1983, however, Iran reportedly awarded $20 million in contracts in this sector, in comparison to $1.5 million reported for Iraq.[71]

Several common themes have emerged in the analysis of these six nations that serve to enhance or constrain indigenous capabilities to absorb telecommunications technology. These are described below.

Factors that Facilitate Absorption

National Objectives to Reduce Dependence on Foreign Suppliers.–-Almost all of the countries in this study maintain as a formal national goal reducing dependence on foreign suppliers. Algeria, Saudi Arabia and Iran have set conscious goals to increase self-sufficiency in industrial production and in telecommunications in particular. These objectives have been generally implemented through major training programs. This was true with the American Bell training contract in Iran before the revolution and the Bell Canada training contract in Saudi Arabia.

In some cases–Saudi Arabia, Kuwait, and Iraq, in particular-these goals are critical for reducing the presence of large foreign work forces in-country. Saudi Arabia has established goals to enable rapid transfer of technical operations to the indigenous labor force. This has involved major investments in training of administrative and management methods and technical skills. Saudi Arabia has emphasized programs to improve productivity among trained nationals as a way of reducing the resident foreign work force.

[71] MEED Consultants, op. cit., 1984.

National Security.– Iraq and Iran have expressed special interest in application of telecommunications technology to improve military readiness. Moreover, each of the six countries has made large investments in sophisticated military communications systems over the past 10 years. Undoubtedly, these acquisitions and the training of nationals in the military services to operate and maintain the equipment have contributed to improvements in civilian capabilities to absorb the technology.

National Objectives to Build Infrastructure. –Each of these countries has taken the opportunity, afforded by the rapid increase in oil revenues during the 1970's, to rebuild a decaying infrastructure or to develop a base. They realize that without modern transportation and communication networks, electric power grids and other basic utilities, and a network of health, education, and social services they will not be able to build and develop the productive sectors of their economies. In this context, telecommunications systems have been seen as essential parts of the national infrastructure. Countries such as Saudi Arabia have seriously supported these commitments, backed them with sufficient funds, and avoided bureaucratic constraints.

Indigenous Production.—Domestic production of telecommunications equipment reduces foreign imports required. While production in each of these countries is limited and often consists of only component assembly plants, it provides a stable base of training in technical skills. Domestic manufacturing has taken various forms. Local firms have in some instances operated under license to a major supplier, participated in joint venture with a Western firm, or been involved in technical cooperation with a foreign corporation. In some cases, Algeria and Egypt for instance, domestic plants have the capacity to manufacture the components.

At the same time, because these Middle Eastern countries invest very little in technical research and development, they are often constrained by the technology they originally

select for manufacture. Hence, most domestic production in the Middle East involves electromechanical analog switching and rotary telephone instruments. Ironically, private industry and business that can afford more sophisticated equipment may import electronic digital PABX's and push button phones from foreign suppliers, bypassing domestic producers entirely, as occurred in Egypt.

Decision To Stay With Conventional Technology.—Another factor that enhances the capacity to absorb technology is continuity in programs, needed to ensure compatibility of technology. If a country has made a clear decision to adopt established technology as the standard nationwide and does not sway from that decision by importing experimental equipment, absorption will be enhanced. By using one type of technology, training is simplified and focused. Algeria, for example, has chosen to stay with conventional electromechanical equipment because it is a known quantity, has been proven to be effective, and is easier to master for trainees with limited electrical background.

Synergy With Other Industries.–Absorption of technology is fostered by a continuing demand for improved services from a growing user community. The growth of domestic and export industries in these countries, and an increase in housing construction, have synergistic effects on the growth of telecommunications networks and on the indigenous capacity to operate and maintain them.

Factors That Constrain Absorption

Manpower Shortages.—Saudi Arabia and Kuwait presently have work forces that lack

Photo credit *Saudi* Arabian Ministry *of* Information

Taif Earth station

the technical and management skills necessary to operate and maintain effective telecommunications networks. Algeria, Egypt, and Iran, on the other hand, produce technicians but they are attracted by higher salaries to work in the Gulf States. This drain of skilled labor constrains absorptive capacity.

Skilled technicians and engineers who remain in their native country are in such short supply that the telecommunications industry must compete with other industries for their talents. Since the telecommunications networks in these countries are owned by the government, workers are often paid on a government scale, and job offers from private industry are likely to be more attractive. Moreover, the high dropout rates and problems in recruitment indicate that motivation among trainees in these countries is often low.

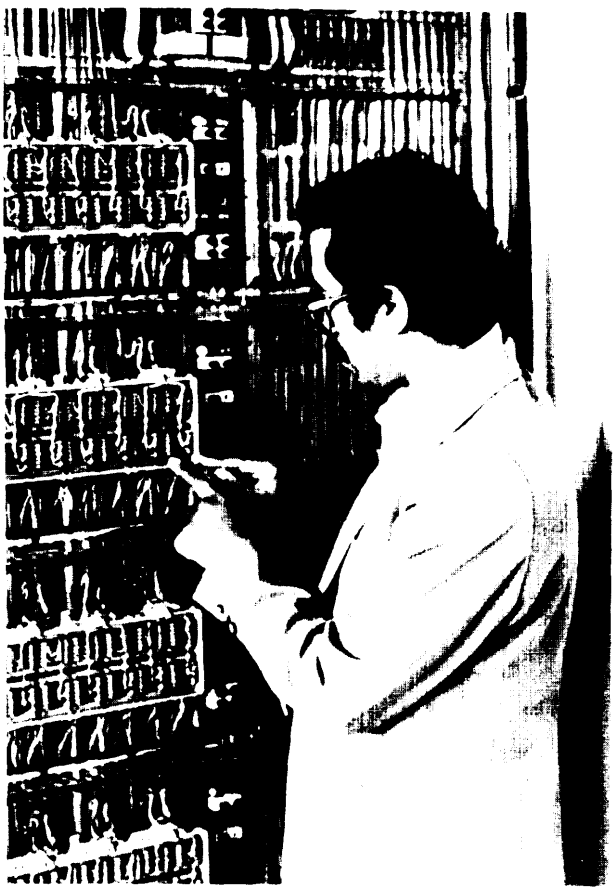


Photo credit: Aramco World Magazine

Saudi technician Inspects computerized telephone network Saudi Arabia was the first country in the world to install a nationwide stored program control telephone system

Several cultural factors also constrain absorption. In Saudi Arabia, for instance, cultural aversion to manual labor has limited maintenance training of nationals and focused attention on operations. In Iran, Bell trainers found that while apprentices were able to gain technical mastery of telecommunications equipment rapidly, administrative, management, and maintenance methods were, for them, abstract and foreign.

Capital Availability.—Each of these countries, except for Egypt, has been able to invest significant amounts of national revenues in development or renovation of telecommunications infrastructures. Only Egypt has been constrained by lack of available investment funds and has relied extensively on economic assistance for funding.

If a country can afford to pay for the importation and installation of telecommunications equipment and can afford to have foreign labor operate and maintain that technology, it may choose to continue that dependent relationship while investing its limited local manpower in other sectors of the economy.

Population Growth.–Another factor that constrains telecommunications capacity is the rapid growth of population in these Middle Eastern countries, especially in urban areas. This growth continually strains capacity, resulting in difficulties in maintaining a high quality of service.

Inconsistent or Changing Public Policy. –Consistency in public policy is important in achieving high levels of technology absorption, especially when the government is the owner of the technology and the major source of development funds. Some countries such as Algeria and Kuwait have reduced telecommunications and technical training budgets despite stated national objectives, as revenues declined or as political priorities changed. As a consequence, efforts to develop a skilled manpower base to operate and maintain the technology have been disrupted or delayed.

In Egypt, public-sector organizations have been mobilized to assist in solving the chronic unemployment problem. In response, the state-operated telecommunications authority employs almost ten times the number of workers required to operate and maintain the equipment. This has resulted in underemployment for some, the placement of unqualified workers in other functions, overall supervision problems, and a poor quality of service. In this case, one national goal—to improve the telecommunications infrastructure-has been balanced against other policy goals of reducing unemployment.

PERSPECTIVES OF SUPPLIER COUNTRIES AND FIRMS

The world telecommunications market is growing rapidly. According to some experts, sales of telecommunications equipment worldwide may double during the decade of the 1980's to $366 billion during the period.[72] Total sales amounted to $188.2 billion during the period 1970 to 1980. Sales in 1983 alone were about $59 billion. A significant portion of these sales will surely be in the Middle East. A plan adopted by the ITU to overhaul the public systems of 28 Middle Eastern and Mediterranean basin countries called for $30 billion (1978 dollars) in investments.[73]

Major supplier firms have several objectives in common in pursuing telecommunications transfers to the Middle East: 1) marketing in countries with a recognized need, technological requirements, and ample budget; 2) finding new markets once their own domestic markets have been saturated; and 3) building a solid reputation that can open foreign markets for other telecommunications goods and services. Major supplier countries also have interests in recycling petrodollars to equalize trade balances, opening markets for other types of exports, and in providing technical assistance to foster friendly relations with recipients.

More than 2,300 U.S. and foreign companies manufacture telecommunications equipment.[74] The number increases further if one adds suppliers of telecommunications support services—consulting, training, technical operations management, and maintenance. Competition among these suppliers is intense, considering that there are only about 100 major customers for public networks worldwide-i. e., the national PTTs.

This section focuses on the competitive position of U.S. and other supplier firms in this market-what the U.S. share of the market has been, how U.S. firms rank within the six national markets covered in this study, and how they fare within each technology sector. Finally, critical factors that have influenced competitive success in the Middle Eastern telecommunications market are identified.

United States

Observers disagree about why U.S. firms have not been more successful in sales of telecommunications equipment and technical services in the Middle East. On the one hand, businessmen see the efforts of the U.S. Government as insufficient and not on par with those of other governments, particularly with regard to export financing packages. On the other hand, many observers agree that U.S. sales in the Egyptian market stem directly from AID loans supporting telecommunications system expansion (see app. A, Egyptian project profile) .75 Some also feel that, until recently, U.S. firms were not anxious to tailor technology to foreign markets since the domestic U.S. telecommunications market is so large.

The American Businessmen's Group in Riyadh has taken the position that the U.S. Government has not provided the means to help U.S. firms bear the large financing demands

[72] A. Kamman, "World Telecom Market: Size and Potential," *Telephony*, Oct. 22, 1979, pp. 116-121; *Business Week*, Oct. 24, 1983; *Business Week*, Feb. 1, 1982.

[73] "Harnessing the Telecom Revolution," *Middle East Economic Digest, Special Report—Telecommunications*, October 1983, p. 2.

[74] AT&T Annual Report, 1981.

[75] Interviews with representatives of U.S suppliers. March 1983.

involved in doing business in the Middle East. Small and medium-sized companies find it difficult to arrange adequate financing, and companies, large and small, cannot offer complete financing packages as comprehensive as that offered by the Siemens consortium in Egypt. Through the Export-Import Bank, the U.S. Government makes loans to foreign purchasers of U.S. goods. However, corporations want the bank to do more by providing such things as bank letters of guarantee, guarantees for tender and performance, and advance payment bonds. The Overseas Private Investment Corporation (OPIC) provides political risk insurance and guarantees to U.S. firms investing directly in less-developed countries, but the countries in which OPIC operates are limited by maximum gross national product (GNP) requirements.

The U.S. Government has, however, several established programs in the Middle East that particularly assist U.S. suppliers of telecommunications equipment. In Saudi Arabia, the U.S. Army Corps of Engineers is a consultant to the Ministries of Defense and Aviation in the design and contracting of military construction work. The Corps writes specifications, preapproves bidders, and evaluates proposals for the Saudis. In its construction jobs, there is usually a telecommunications component. The Corps plays a nonpartisan role in bid evaluations, and non-U.S. firms may be chosen as subcontractors.

USAID has contributed $242 million in loans and grants to Egypt since 1977, all tied to purchases from American telecommunications suppliers. AT&T, Ford Aerospace, Simplex, Continental Telephone, and Arthur D. Little have been the principal recipients. AID-funded contracts have included microwave equipment, traffic control equipment, TV broadcasting systems, navigation control networks, telephone cables, switching systems, and radar surveillance and remote-sensing equipment.

Thus, while U.S. Government personnel do not normally seek out export opportunities or carry on negotiations for sales of telecommunications equipment and services, as do other supplier governments,[76] government-supported programs such as AID's in Egypt have been important mechanisms for sales. (As discussed in ch. 11, there has been considerable debate among AID officials and U.S. policymakers concerning the appropriateness of these programs.)

The United States Telecommunications Training Institute (USTTI) was established in 1982 with U.S. Government support. The purpose is for private U.S. firms to share advances in telecommunications technology with developing countries. The establishment of the USTTI also reflected the recognition that most equipment and service supplying countries use training as a vehicle for entering markets in developing countries.

Training is performed in the United States by the corporate sponsors on their own equipment. Nearly 20 U.S. corporations have contributed over $2.5 million to the program in its first year including both capital and in-kind donations of technical personnel and equipment. In addition, the World Bank, the ITU, and other multilateral organizations have provided scholarships to help pay transportation and living expenses of the trainees.

In the past year, 14 percent of the trainees were from the Middle and Far East, with five from Saudi Arabia, one from Kuwait and one from Egypt. Some have suggested that the USTTI should collaborate with firms in sending personnel abroad to conduct training in developing countries. This would be an important learning experience not only for the foreign trainees, but also for the U.S. firms who seek entry into foreign markets. Others suggest that the training offered by the organization should stress lower level technical skill development to a greater extent.

The major U.S. telecommunications firms with dealings in the Middle East have been AT&T International, Continental Page, Inc., and General Telephone and Electronics (GTE).

[76] "Interviews with representatives of U.S. suppliers; November and December 1982.

France

Over the past decade, France has developed policies to promote the development of the nation's telecommunications industry. The government also encourages firms to target half of the equipment they produce for export markets. It has also assisted manufacturers in standardizing equipment to facilitate integration and export to other countries.

France is eager to maintain a strong export position in the Middle East to cover its imports of Middle Eastern oil, particularly oil from Saudi Arabia. In early 1982, France signed a liquefied natural gas (LNG) agreement with Algeria that included an accord to supply $2 billion worth of French goods and services, including telecommunications, to Algeria. French banks have also extended credits for export of telecommunications goods and services to Egypt.

In addition to export credits, the French government provides support to telecommunications exports through the DGT (Direction Generale des Telecommunications), the telecommunications branch of the French PTT. DGT plays a diplomatic and consultative role, maintaining contacts with foreign telecommunications administrations and international bodies such as the ITU. DGT also provides information and consulting services."

The major French telecommunications firms doing business in the Middle East have been Thomson-CSF and CIT-Alcatel.[78]

[77]*Middle East Economic Digest, Special Report on Saudi Arabia,* July 1981; *Telecommunications,* March 1980.

[78]"Some restructuring of the French telecommunications industry is now occurring in order to increase exports and keep France competitive internationally. Thomson-Brandt will transform its telecommunications interests. currently held by its subsidiary Thomson-C SF, into a new holding company called Thomson Telecommunications, under CGE's (Compagnie General d'Electricite) management. By 1987, CGE plans to merge its subsidiary, CIT-Alcatel, with Thomson Telecommunications, thus effectivelybecoming France monopoly telecommunications producer. (*N.Y. Times,* Sept. *21,* 1983; *Financial Times,* Sept. 16, 19WI. *See* also "Telecom Giants to Join Forces." *Middle East Economic Digest—Special Report on France,* April 19H4! pp. 4-5.

Great Britain

The British government in 1980 supported a high percentage (39 percent) of exports with official financing.[79] British firms have, however, lost ground as worldwide exporters of telecommunications equipment, and the government has not developed a strongly targeted policy similar to that of France.[80] Direct government support (including financing) for this industry thus appears to have been less extensive than in France or Japan.

In part, British telecommunications exports may have suffered, because British manufacturers have over-engineered and over-designed equipment to meet the standards of the government-operated domestic phone system.[81] As a result, their products have been uncompetitive, overpriced, and unsuitable for foreign markets.

In an attempt to turn this situation around, British Telecom, the government-owned phone authority, is cooperating with local industry to develop and market System X, a family of digital, microelectronic, and stored program control telephone exchanges. This system is intended to boost sales overseas and improve the reputation of British telecommunications technology. In addition, British embassy personnel in Saudi Arabia are reported to be effective in maintaining influential contacts with the Saudi PTT and arranging marketing meetings for British firms.[82]

Major British telecommunications firms involved in Middle Eastern markets are Cable and Wireless, Standard Telephone and Cable, Ltd., and Plessey Telecommunications and Office Systems, Ltd.

West Germany

West Germany has provided export credits to several countries in the Middle East. The

[79]Robin Day Glenn, *Financing of United States Exports of Telecommunications Equipment,* The International Law Institute. Georgetown University Law Center Monograph, Washington, DC., 1982, p. 23.

[80]Ibid., p. 11,

[81]*Telephony,* Sept. lo, 1982.

[82]*Financial Times,* Jan. 6, 1981.

Siemens-led consortium was probably awarded the $1.8 billion Egyptian telephone expansion contract because of the financial package in which the West German government participated through export credits and soft loans. Export credits have also been granted for exports to Iraq.[83]

Domestically, the German government provides funding to local manufacturers for research and development (R&D). In 1979, for instance, the government committed approximately 3 percent of its total R&D budget to defray costs incurred by the electronics industry.[84] Siemens is the major West German firm involved in Middle Eastern telecommunications.

Sweden

Sweden has a well-organized government system for promoting sales overseas, although private companies compete with the government for business. Televerket (TVT) is a state= owned public utility that provides telecommunications services (telegraph, telex, telephone, data communications, radio communications) domestically and overseas. TVT has several manufacturing facilities, a consulting organization (Swedetel) that works primarily in developing countries, and a subsidiary (Swedcom) that installs, operates, and maintains telecommunications equipment in foreign countries. Another subsidiary, Teleinvest, acts as an export agent to assist in financing and export of telecommunications equipment manufactured in Sweden. In addition, the government provides some credit assistance for large projects in developing countries through Svensk Export Kredit.

Swedish government entities sometimes collaborate with private companies in selling products overseas. TVT and Ericsson are equal owners of a company called Ellemtel, which was set up to design and develop telecommunications equipment. Ellemtel developed the AXE exchange, for example. Private companies can call on Teleinvest to assist in financing and exporting products.

In 1978, faced with trade deficits largely caused by rising oil imports, Sweden initiated an export drive aimed at Middle Eastern countries. Banks increased their support to companies exporting to the Middle East, and the government organized trade missions for 100 Swedish companies. The Philips/Ericsson project in Saudi Arabia was reportedly won partly because two Swedish banks were approved as guarantors by the Saudi Arabian Monetary Agency.[85]

Canada

Bell Canada is one of the world's oldest telecommunications organizations, having started as a telephone company in 1883. It has since become Canada's principal supplier of telecommunications services, employing 57,000. In 1983, Bell Canada Enterprises was established as the parent company of a family of firms that includes Bell Canada as the operating telephone company, Northern Telecom as a manufacturing subsidiary, Bell-Northern Research as a telecommunications research and development organization and Bell Canada International (BCI).

BCI was formed in 1976 in response to strong overseas demand for consultancy services. It has performed telecommunications projects of all sizes throughout the world including the five-year Saudi management contract awarded in 1978, which at that time was the largest ($860 million) communications contract of its kind in history. Under this contract, Bell Canada would organize, operate, and maintain the expanding telephone system and train Saudis to take over the operation themselves. This contract was superseded in 1983 by a $1,297 million 3-year contract to provide the Kingdom with operations and maintenance service for its telecommunications expansion program. Bell Canada has carried out other work in Saudi Arabia including one contract for ARAMCO which has involved

[83] John Whelan, "West Germans Win on High-Tech," *Middle East Economic Digest,* Jan. 29, 1982, pp. 10-11.
[84] *Telecommunications,* October 1980.
[85] *Telecomn]unications,* February *1982.*

provision of advice on management methods and setting up a private communications network. They reportedly won these contracts because of their proven operating track record and extensive training experience.

The next biggest Middle Eastern market for BCI is Iraq, which has become the largest customer for the supply, installation, and maintenance of Northern Telecom equipment. BCI first entered Iraq in 1976 when it installed an advanced Northern Telecom exchange on a turnkey basis—Iraq now has 60 of these exchanges.[86]

Netherlands

The Dutch have escalated their efforts to obtain a larger share of the telecommunications market in the Middle East. Their major company is N.V. Philips. Prior to 1978, Dutch exports of telecommunications equipment to the region were low. However, between 1979 and 1980 the Dutch government took several steps that improved their firms' competitive positions.

The Netherlands had encouraged cash outflows to stabilize the Dutch guilder. As a result, Dutch banks expanded their foreign interests and have been in a better position to assist companies with financing. Dutch government aid to developing countries, which represents about one percent of gross national product, also plays a role in influencing sales to the Middle East. As part of the Philips/Ericsson telephone contract in Saudi Arabia, the Dutch government provided a guarantee for financing.

Japan

Telecommunications operations in Japan have been handled under Nippon Telephone and Telegraph (NTT), a public corporation which is being reorganized. However, Kokusai Denshin Denwa (KDD) and private companies are important suppliers internationally. Although NTT has not been allowed to manufacture its own equipment, it helps Japanese manufacturers by advancing them part of the purchase price. This reduces costs and often enables them to underbid the competition.

The Japanese government has offered credits to some countries (Algeria for one) to purchase Japanese telecommunications equipment. In addition, the government sponsors high-technology research. NTT supports basic research in telecommunications—very large-scale integration (VLSI), optical fibers, and digital networks–and participating firms gain access to research results.

Japan has entered the Middle East telecommunications market only in the past 10 years. Many Japanese companies have become very competitive. In the early 1970's, exports represented only about 8 percent of Japan's telecommunications sales; in recent years they have made up nearly 20 percent.

Major Japanese firms active in Middle Eastern telecommunications markets are Nippon Electric Company (NEC), Fujitsu, Ltd., and Hitachi. Ltd.

U.S. Competitive Position

There has been volatility in the patterns of telecommunications exports of the major supplier nations. The increasing popularity of digital technology and the aggressiveness with which some suppliers have promoted product development have had important effects. Too, aggressiveness in designing effective marketing strategies and enlisting government support for these efforts have also been evident. Market shares of major suppliers in 1980 and net changes in worldwide market shares over the past decade are presented below.[87]

	Market Share		Share *Point Difference*
	1971	*1980*	*1971-80*
Japan	13.6	21.4	*+ 7,8*
United States	18.7	15.6	3 . 1
West Germany	14.7	12.6	2.1
Netherlands	7.4	7.2	--0.2
United Kingdom	11.1	7.0	-4.1
France	5.4	6.5	+l.1
Sweden	7.2	5.6	- 1.6

[86] "Bell Maintalns Momentum in Saudi Arabia," Middle East *Economic Digest Special Report on Canada*, May 1984, p. I 1, see al so H R Red mond, "Dynamics of Technology Transfer: ('anada's Work It) Saudi Arabia," *Telephony*, Aug. 24, 1981, pp. 30-32.

[87] *U.N. Yearbook of International Trade Statistics*, 1980

Major shifts in market shares over the past 10 years consist of:

- A major increase in Japan's share, exceeding those of the United States and West Germany.
- A decline in U.S. and West German shares.
- A major decline in Britain's shares.
- A slight improvement in France's position.

Even small changes in share points are substantial when translated into dollars, since the size of the world market itself grew extensively over this period.

Japanese firms have benefited in the world market from the structure of Japan domestic telecommunications market, the depreciation of the yen, and a major industrial shift to high technology industries. The French have marketed their advanced technology aggressively and have made major inroads in the sale of military equipment worldwide. On the other hand, the West Germans and British were late in developing digital telecommunications equipment to meet world demand.

Focusing more specifically on the six Middle Eastern countries in this study, the following suppliers have been dominant in the national markets for telecommunications equipment and services. based on contract activities between 1974 and 1982:

Algeria	1. Spain 2. Sweden 3. Japan
Egypt	1. France 2. Germany 3. Austria
Iran	1. United States (until 1979)
Iraq	1. Japan 2. Sweden 3. France
Kuwait	1. Sweden
Saudi Arabia	1. United States 2. Sweden 3. Netherlands 4. France

U.S. firms were predominant in Iran prior to 1979, but their work then came to a halt. The only other national market in which U.S. firms have had firm control is Saudi Arabia. This situation is likely to continue. U.S. firms have also won large numbers of Arabsat contracts.

The positions of U.S. firms can be clarified further by analyzing market dominance at the technology sector level within each country. The sectors in the Middle East in which U.S. firms were strong competitors between 1974 and 1982 are shown in table 61.

In Algeria, U.S. firms had strong positions in two relatively small technology sectors—satellite and multiplex. In Egypt, the U.S. firms dominated or were strongly competitive in a variety of small sectors. The picture in Iran is very different; prior to the revolution, U.S. firms monopolized all of the key technology sectors except for video and radio broadcasting. In Iraq, the United States had virtually no presence, and penetration of the Kuwaiti market was minimal. Saudi Arabia is the one national market in which U.S. firms were predominant or strong competitors in all of the major technology sectors. U.S. firms also dominated in the regional Arabsat project.

It is difficult to discern any pattern in these data to suggest that U.S. suppliers are especially competitive in certain telecommunications technology sectors, except that U.S. firms have been dominant in satellite systems, both in satellite components and Earth stations. The ability to win contracts in Middle Eastern markets is determined by many factors, some of which are discussed below.

U.S. Supplier Advantages

Overall, U.S. suppliers have had a high technical reputation. U.S. technology has been viewed as being high in quality and dependable and reliable. Moreover, the reputation of U.S. telecommunications technicians and engineers is attested to by contracts from many national PTT ministries to provide consulting services to support planning, operations, and maintenance functions. After-sales service by

Table 61. —U.S. Competitive Position in Telecommunications Markets in the Middle East Between *1974* and 1982

	Dominant position	Strong competitor	Sector-size	(millions)	Total market
Algeria	Satellite	—	$ 11 2	$	6669
	Multiplex		1.8		
Egypt	Cable		230.4		2,8000
	Microwave		72.5		
		Television	677		
	Consulting		351		
	HF Radio		9.2		
Iran (1974-79)	Switching		1,900,0		2,8000
	Cable		689.9		
	Telex		180		
	Satellite		6.0		
Iraq .,	None	None			2,000.0
Kuwait	—	Television	7 0		4310
Saudi Arabia	Switching		6,400.0		12.9000
	Microwave		1,000.0		
		Radio	3964		
	Mobile		257.5		
		Satellite	685		
	Other telephone		19.2		
		CCTV	18.9		
	Data Communication		18.6		
	Multiplex		4.2		
Regional	Satellite	—	234.0		2943

SOURCE Office of Technology Assessment

U.S. firms was also highly regarded and viewed as dependable. U.S. manufacturers were also considered major suppliers of advanced technologies in emerging fields, such as data communications and office automation systems. In the six nations covered by this study, however, these high-technology areas were less important in trade than telephone and telex sectors.

Since most new telecommunications technologies involve the use of microchips, the competitive position of the United States, which is still one of the top suppliers of these valued components worldwide, has been boosted. In fact, several foreign manufacturers of telecommunications equipment (e.g., Thomson-CSF) were dependent on the United States for these components. Until recently, U.S. telephone companies outside the Bell system bought their small electronic switchboards from GTE, ITT, or Stromberg-Carlson Corporation. More recently, however, 75 percent of such sales have been made by the Japanese firms Oki Electric Industry Co., NEC, Hitachi, and Fujitsu. This suggests that one factor contributing to U.S. market shares in the past is now less important.

In addition to civilian communications equipment, many U.S. suppliers are major manufacturers and exporters of high-technology military communications products. Military communications networks are a major technological component in command and control, military preparedness, and national security, and thus are central to the modernization of a nation's armed forces. U.S. military equipment sales have served to facilitate the sale of both military and civilian communications equipment.

As discussed earlier, U.S. government programs in Egypt and Saudi Arabia promote telecommunications technology transfers to those countries.

U.S. Supplier Disadvantages

Probably the most important difficulty experienced by U.S. suppliers of telecommunications equipment and services has been in establishing competitive prices and in arranging comprehensive financing packages. Not heavily subsidized domestically or for export, the industry must reduce its costs internally through higher productivity and lower overhead to come up with the best pricing bid.

U.S. suppliers have at times been at a disadvantage in competing against firms in Japan and Western Europe, where governments provide complete and attractive financial packages. Although U.S. Government agencies such as the Export-Import Bank and OPIC support U.S. exporters, they apparently have not had the flexibility of some foreign governments in providing long-term soft loans, extensive export credits, and bartering arrangements. For example, a West European consortium won the $1.8 billion contract for modernizing Egypt's telephone network, reportedly primarily because of the attractive financing offered with the assistance of their governments. This project is described in appendix A.

Most U.S. suppliers, catering primarily to the domestic market, design their equipment to North American standards, which are modifications of CCITT norms. Except for Saudi Arabia, the six Middle Eastern countries in this study, as well as most European nations, abide by straight CCITT norms. Some have viewed this as a problem for U.S. suppliers, but Japanese manufacturers also produce equipment for their domestic market using modified CCITT norms.

Until recently, U.S. firms did not actively market digital electronic switching technology abroad. In comparison to the product lines of digital switching leaders, such as CIT-Alcatel and Ericsson, U.S. modern analog offerings were not as sophisticated or new. Moreover, U.S. prices were high for this older technology. On the other hand, some U.S. manufacturers (GTE for instance) have been bidding on digital equipment contracts. In fact, some suppliers offer greater flexibility to customers because they do not restrict themselves to sale of their own equipment. (In certain cases, this last point may constitute an advantage.)

In addition to complaints about weak U.S. government representation of business mentioned earlier, Government regulations and taxation were said to impede the flexibility and competitiveness of U.S. suppliers. Recently, however, many of the obstacles for U.S. firms operating overseas have been moderated. Tax laws were changed in 1981 to relieve U.S. citizens working abroad of paying taxes on the first $75,000 earned. (Workers from Japan, West Germany, Great Britain, Italy, France, and Sweden do not pay taxes on salaries, bonuses, health insurance, or retirement benefits earned overseas.) In 1982, revisions were made to the Sherman Anti-Trust Act, relaxing restrictions on companies involved in foreign trade. The Export Trading Act of 1982 and the Bank Export Services Act established an office in the Department of Commerce to promote export trade associations and investment in export trading companies.[88]

U.S. firms have also complained about other laws which have not been changed, such as the antiboycott program and the Foreign Corrupt Practices Act (FCPA) of 1977. The FCPA, they say, makes little distinction between bribes and commission agent fees or foreign sales representatives' bonuses. In many Middle Eastern countries, they claim, these costs are the accepted mode of doing business.[89] Some businessmen also claim that in Algeria, where the agent system does not operate, corruption is minimal. However, OTA research did not uncover any cases where the FCPA was a major factor in lost sales. The Arab boycott of Israel influenced the nature of contract awards, as mentioned earlier, by Arabsat. U.S. firms were, however, able to participate.

In general, the following factors, ranked roughly, have been critical in marketing telecommunications technology effectively in the Middle East.

1. Low *price.* Despite their large revenue base, many of the oil-producing countries are increasingly cost-conscious. Price has often been the most important decision criterion.

"Public Law 97-290, 1982.

"'Charles Wohlstetter, chairman of Continental Telecom, Inc., says his company could not win a contract to install a phone system for Saudi Arabia because ''we were unable to pay a bribe. " U.S. law, he says has kept "American companies from providing big systems in the Middle East," *Business Week,* Oct. 24, 1983.

(See, for example, the Saudi Arabian telephone expansion project profile, appendix A.) In fact, selection of the low bidder is sometimes mandated by law. Depreciation of certain national currencies over the past few years and the ability of companies to profit from domestic subsidies have tended to make particular suppliers more attractive. [go]

2. Complete financial package. Ability to supply a complete financial package with attractive terms to the buyer is often a key determining factor in a contract award.

3. *Reputation.* Technical competence, product reliability, and the ability to point to operating installations using the supplier's equipment are key selling factors.

4. *After-sale support.* A supplier's willingness to train local personnel, provide spare parts, and operate and maintain the equipment it installs is a critical decision factor. This type of commitment is often exhibited through establishment of a local office or joint venture.

5. *Associated business deals.* By offering extra "carrots," suppliers can develop unique packages that are attractive to the buyer. For instance, in addition to the telephone modernization work in Egypt, the Siemens consortium promised to conduct efforts to improve railway signaling and rolling stock, perform a feasibility study on Egyptian coal resources, and establish a joint-venture consulting organization. Moreover, Thomson and Ericsson apparently tie civilian communications sales to military equipment transfers. On the other hand, the reported attempt by U.S. suppliers to link an Egyptian telephone project to a threat of withdrawing certain military aircraft sales, was not successful.

6. *Early program involvement.* Participation by a foreign contractor in a program's early stages—a pre-engineering or master plan phase—is often helpful in gaining the customer's confidence and in establishing an organization in-country to handle the follow-on tasks. This was true in the case of AT&T in Iran and, in part (since the Siemens consortium won the large contract), with Continental Telephone in Egypt. Being the first to introduce a new technology in a country—microwave networks, digital electronic switching, Earth stations, or mobile radio networks, for instance-has also assisted companies in gaining control of those markets.

7. *Local operations.* In each of the six countries except Algeria, it is necessary to operate through a local agent. As discussed in appendix A, the Ericsson/Philips/Bell Canada consortium was said to have been aided in its successful bid by use of Prince Fahd's son as an agent. In most countries, joint ventures with local interests are given preference in contract award evaluations. Such joint ventures, however, may involve potentially costly risks, since suppliers have less control over their investments.

8. *Political neutrality.* Political neutrality in Middle Eastern issues has apparently enhanced Japan's opportunities to export to a wide range of ideologically diverse Middle Eastern countries. In other cases, such as Saudi Arabia and Egypt, political alliances have served to promote U.S. telecommunications exports.

9. *Corporate financial soundness.* In order for a supplier to profit in conducting business in the Middle East, it must be able to withstand payment delays, as well as a host of other investment risks.

[go] As stated by John L. Moore in R.D. Glenn (op. cit., 1982). "The currency relationships are such that one could almost rule U.S. companies out of competition on price, without regard to project finance except in projects where the U.S. still has an edge on technology or mass production due to the scale of our economy, or efficiency and certainty of meeting delivery schedules. ' '

IMPLICATIONS FOR U.S. POLICY

Specific U.S. laws and policies, such as the Foreign Corrupt Practices Act, taxing of U.S. workers abroad, and antiboycott legislation, although having an influence, have not been major determinants of U.S. competitiveness in Middle Eastern telecommunications markets. Although together they do represent obstacles to U.S. suppliers, the major factors sometimes negatively affecting U.S. presence and market share have been price and financing arrangements of foreign competitors. Technical reputation, reliability of spare parts supply and after-sales service, and favorable diplomatic ties follow as secondary determinants.

U.S. foreign policies have set the context for trade. The United States has had great success in countries with favorable ties, such as Saudi Arabia, prerevolutionary Iran, and, increasingly, Egypt. U.S. supplier presence in Iraq and Algeria has been minimal, and it is nonexistent in present-day Iran.

The United States is an acknowledged leader in state-of-the-art telecommunications technologies, such as satellite systems, but these have often represented smaller dollar-volumes of sales in the Middle East. The more conventional technologies and the increasingly dominant digital systems are strong technologies for non-U.S. suppliers, technologies that are often tailored by them to export markets and can be promoted effectively against a strong dollar, particularly with advantageous financing.

Some options could be considered which could assist U.S. firms in winning sales of telecommunications equipment and services which help promote the Middle Eastern nations' development plans. They include:

1. Establishing more foreign manpower training programs in the telecommunications field, which increases expertise and familiarizes Middle Easterners with U.S. equipment. As one example, the U.S. Telecommunications Training Institute involves a number of U.S. firms working in a joint effort supported by the U.S. government.
2. Promoting mutually advantageous development assistance/contingent contract awards. This could be accomplished by explicitly linking assistance and export programs (through use of mixed credits)[91] or by expanding technical assistance programs in telecommunications involving private U.S. firms as well as government agencies. (As discussed in chapter 13, many fear that assistance goals could be distorted by explicit linkage.)
3. Promoting regional cooperation in telecommunications. This approach would only improve the positions of U.S. firms if their participation was central to cooperative technical efforts, such as in a telecommunications technology transfer center.
4. Upgrade the technical expertise of Foreign Commercial Officers 'and AID staff to deal more effectively with telecommunications-related projects.

OTA's research indicates that the comparative position of U.S. firms in Middle Eastern markets stems only in part from U.S. Government policies. With the assistance of the U.S. Government, financing, commercial representation and cooperative programs involving private-sector firms could be improved; but the marketing and technology transfer efforts

[91] In July 1984, the U.S. Export-Import Bank announced that it would provide 90 percent financing and 8 percent interest to support the U.S. firm Scientific Atlanta in its bid to sell a satellite communications network to Algeria. This step was taken in an effort to counter Japan's use of mixed credits. See Washington Post, July 11, 1984, p. D1.

of the firms themselves are key determinants of success in contract competition. Indeed, telecommunication technology transfers to Egypt and Saudi Arabia have certainly been promoted by U.S. Government policies.

CONCLUSIONS

Despite overuse of the term, there has indeed been a world telecommunications revolution in the last decade. With telecommunications deregulation in the United States and pressures to deregulate in other countries, changes in the next decade may be even greater. What was previously a necessary but not very dynamic sector, generally run by a governmental PTT, telecommunications has been transformed with computers, microchips, and satellites into a sophisticated, rapidly changing sector. Even firms in industrial countries have been pressed to keep up with recent developments in automatic exchanges, fiber optics, data transmission, digital systems, and satellite technology.

Technological advances in telecommunications come rapidly–systems can become obsolete before they are installed. Distinctions between communication, information transfer, and processed data are no longer clear, owing to improved communication links, increased computer ties, and transborder data flows.

In the Middle East, the gradual shift from conventional analog to digital electronic equipment will become even more apparent, as will a shift from large public network development to sophisticated systems and services for private end-users. Service industries involved in repair, maintenance, and supply of the telecommunications infrastructure can be expected to develop in the private sector within the recipient countries. Computer and data-processing industries are also likely to emerge. Banks and financial institutions have already been among the first to push for sophisticated telecommunications services, office automation, and data-communications features.

Despite the stated desires of the Middle Eastern nations and the well-conceived plans for domestic as well as regional communications, there is great disparity in the availability of telecommunications facilities, the reliability and efficiency of operations, and usage from country to country. Systems range from the efficient, heavily used, but possibly soon-to-be-overtaxed systems of Saudi Arabia and Kuwait; to the Egyptian system, where less than one local call in three is completed; to Iran, which recently had an average of only 13 domestic calls per subscriber per year over the 3.4 lines per 100 inhabitants. The local need is there; pent-up demand exists across all telecommunications sectors and represents excellent future markets for foreign suppliers: potential also exists for developing indigenous capabilities in equipment manufacture, installation, operation, and maintenance.

In telecommunications, several critical factors tend to facilitate technology absorption by Middle Eastern countries: they include a national resolve to build adequate infrastructure, demand for telecommunications technology from other sectors of the economy, strong national security objectives, the existence of domestic telecommunications production facilities, and decisions to stay with more conventional technology. Factors constraining absorptive capacity in telecommunications include skilled manpower shortages, rapid population growth (producing burgeoning demand), and inconsistent or changing public policies regarding telecommunications development.

U.S. firms have done relatively well in advanced telecommunications sectors in the Middle East–but these, up to now at least, represent small dollar amounts in total telecommunications expenditures in the region. U.S. suppliers have exported many types of telecommunications technologies to Saudi Arabia and pre-revolutionary Iran, but over-

all, the U.S. firms have not been a dominant force in telecommunications trade in the region. This has been due to many factors, including political relations between the U.S. and nations in the region, a strong U.S. dollar in recent years, and difficulties in arranging financing as compared to the financing offered by other suppliers. In addition, until recently, the large, "captive" U.S. domestic telecommunications market was the prime concern of U.S. equipment suppliers.

U.S. policy options for improving the positions of U.S. firms and for furthering development goals of the Middle Eastern nations include improving the technical capabilities of U.S. commercial representatives in the region, allowing more flexibility to government agencies in arranging financial assistance to exporters, promoting regional cooperation in telecommunications, and increasing cooperative technology transfer efforts involving the private sector.

APPENDIX 6A.–TELECOMMUNICATIONS PROJECT PROFILES IN SELECTED MIDDLE EASTERN COUNTRIES

SAUDI ARABIAN PROJECT DESCRIPTIONS

Telephone Expansion Program[1]

The Saudi Arabian Telephone Expansion Program, an ambitious program to expand the telephone network in Saudi Arabia from 200,000 lines to **1.2** million in a 5-year period, began in January 1978. A consortium of Ericsson (Sweden), Philips (Netherlands) and Bell Canada head the project team. There were three serious bidders considered by Saudi Arabia for this job–the Ericsson/Philips/Bell team, ITT (U.S.), and Western Electric International (U.S.). Separate cost estimates were requested from each bidder for the three segments of the contract—urban systems, rural systems, and operations and maintenance, Overall, the winning contractors offered the lowest bid, as can be seen below:

Bids (in billions of U.S. $)

	Urban	*Rural*	*Ops & Maint.*	*Total*
ITT	$1.25	$0.20	**$2.00**	$3.5
Western Electric	1.47	0.23	1.20	2.9
Philips/Ericsson/Bell	1,49	0.25	0.47	2.2

While ITT projected the lowest costs for the urban and rural systems, it estimated the highest costs by far for the operations and maintenance segment of the job. Western Electric's estimates in this regard were also almost triple that of the non-U. S. consortium. The high cost estimate for this work segment may have been instrumental in the final selection, since it portends future operations and maintenance costs for the equipment proposed by each supplier. Another factor in the bidding that probably influenced the award decision was that Philips had hired Prince Fahd's son as its agent in Saudi Arabia. In terms of financial arrangements, the Dutch firm arranged for guarantees from three banks and received a direct Dutch government guarantee. The Swedish firm was able to amass a **$277.4** million guarantee through Citibank (U. S.) and 11 other Swedish banks.

The evaluation team consisted of members of the Saudi PTT, Norconsult (Norway), Arthur D. Little (U.S.), and the International Telecommunication Union.

The total contract has grown from $2.2 billion in 1978 to over $5.0 billion, The project's scope includes installing the world's first national stored program control (SPC) telephone system. Over 795,000 new lines were to be installed and 197,000 existing lines on crossbar exchanges were to be converted to computer control, In addition, a national automatic mobile telephone system was to be installed.

Philips and Ericsson agreed to split the work and revenues equally. Essentially, each firm supplied the following equipment:

Ericsson	*Philips*
Large-capacity local exchanges	Small and medium exchanges
Rural container exchanges	Container exchanges
All-tandem trunk and international exchanges	PCM multiplex equipment
Equipment to upgrade existing crossbar exchanges	Trunk cables and most local cables
All telephone instruments, coin boxes, and mobile telephones	Building designs
Some local cable	Subscriber rural radio
All network equipment	

[1] R. Raggett, "Desert Project Blossoms," *Telephon.y,* July 28, 1980; *Intel-Trade* April 15, 1979; *World Business Weekly,* June 9, 1980; *Middie East Economic* Digest, July 1981, Feb. 19, 1982, Oct. 9, 1981, March 13, 1981, May 23, 1980, Aug. 17, 1979, Feb. 17, 1978.

Bell Canada's role involved a 5-year operations, maintenance, and training function. Given its $1 billion segment of the job, Bell Canada was to establish and control Saudi Telephone under the auspices of the Saudi PTT. Its other functions included installing and maintaining subscriber lines, indicating new network installation priorities, assisting in the test and acceptance procedures, training, subscriber billing, developing phone directories, and building construction.

The consortium drew on 200 subcontractors to supply equipment and services. Principal among them was Dong Ah Company (South Korea), whose functions were to construct, install, and provide initial maintenance for the outside plant and buildings, Norconsult and A. D. Little provided consulting services.

The contract was based on a pre-engineering study conducted by A. D. Little in 1974-75. Its report recommended that the Saudis update existing crossbar exchanges with digital equipment, expand the phone network, and increase the number of main phone stations by 476,000 digital lines.

After the initial contract was signed, Philips and Ericsson formed a Saudi joint venture to manage the supply and installation of equipment and coordination of other subcontractors. One of the first tasks was to provide living quarters for the employees. Three fixed-location villages were constructed beginning in 1978 near Riyadh, Jeddah, and Dammam for 1,500 employees and their families at a cost of $48 million. Compounds for 230 unmarried employees were also developed in Riyadh and Jeddah. In addition, mobile camps for installation engineers in remote areas were established. Although the Dutch and Swedish employee population was the largest, 43 other nationalities were represented, including many British. Dong Ah brought in more than 6,000 Koreans and Indonesians. The crew was characterized by a very low absentee rate and high contract renewal rate.

To meet the very tight schedules, a massive logistics effort had to be planned and executed to transport equipment to the required sites. Over 200,000 cubic meters of supplies were shipped from Europe by air and sea and then stored in Jeddah and Dammam until distributed by truck. To avoid on-site delays, exchanges were pre-assembled in Europe before shipping. A minicomputer was also shipped to the consortium's on-site headquarters to help plan, project, inventory, and control the complex production schedule. Detailed monthly progress reports were generated in English and Arabic for discussion with the PTT, consultants, and subcontractors.

Other obstacles also emerged as the project progressed. Local and municipal government officials had to give their consent to where the trenches were dug and where buildings could be located. Only Muslim staff were allowed into the holy cities of Mecca and Medina. Subscriber hookups were often delayed because Muslim custom prevented telephone technicians from entering homes when a male member of the household was not present. Moreover, the two consultants, A.D. Little and Norconsult, modified priorities over the course of the contract, given new developments in technology. Their recommendations resulted in the use of fiber optic technology in Riyadh. At the same time, the project team had a goal of keeping the systems within the operational capabilities of Saudi personnel, despite the advanced technology that was employed.

Training occurs in Europe, Canada, and on-site. While few trainees have any technical background, they undergo an intensive program that covers the outside plant and the inside plant (operations, system maintenance, and technician levels). Trainees get 2-3 months of field experience between course segments. There has been some difficulty in finding sufficient numbers of trainees; highly qualified engineers are often attracted to private companies. There has also been a high dropout rate.

So far, the system has experienced minimal downtime and is highly responsive in providing customer services. There is also a high usage rate among new subscribers, helped along by low phone rental charges and low rates for calls.

Intra-Kingdom Microwave Program[1]

Western Electric International Inc. (now a part of AT&T International) was awarded this $408 million project in June 1977 by the Saudi PTT, based on a tender released in September 1976. The job entailed the engineering, furnishing, installation, operation, and maintenance functions for 12 months, and the training of local personnel for a 6,200-mile, 46-route, 300-site microwave communications project, The system was built to provide 35,000 long-distance telephone circuits, as well as telex, television, and data transmission channels. In addition, a 405-phone emergency roadside sys-

[1]K. Jackson, "Linking up with the Future, " *Telephony*, Aug. 27, 1979; *Saudi Arabia Yearbook 1980-81: Middle East Economic Digest,* August 1978, Jan. '23, 1981, (let, 5, 1979, January 1981, Aug. 27, 1982; *Electronics News*, Sept. 6, 1982; *Intel-Trade* Apr 15, 1979.

tern was designed and installed, as well as 10 maintenance centers and two surveillance centers to detect faults in the system. The system was integrated into the national long-distance network. This project was actually begun by the Italian firm, SIRTI, which provided microwave links between Jeddah, Taif, Riyadh and Dammam. Norconsult of Norway, Swedetel of Sweden, and Preece, Cardew, and Rider of Great Britain were consultants to the Saudi PTT on this project for the SIRTI and Western Electric phases.

Western Electric, as prime contractor, was responsible for overall orchestration of the project. It supplied the multiplex equipment, Rockwell-Collins Systems International, Inc., of Dallas, was a major subcontractor (with a contract worth more than $100 million), supplying the radio relay equipment and supervising field testing. Anixter Communications Systems constructed over 687 shelter modules; Charles Payne and Company helped design and engineer the shelter building; Shafat GmbH supplied the AC generators and Harmer & Simmons Ltd. provided the DC generators. Other subcontractors were used to supply towers, antennas, and in-country construction and support services.

The project team faced several difficult problems from the outset:

- Tight schedule: The first eight routes were promised to be cut into the national system within 16 months, with the rest of the system completed in phases by 30 months (December 1979). Some estimates suggest that given the extensiveness of the work, it would normally take at least twice as long to complete a project this size.
- Equipment protection: Techniques had to be developed to protect the sensitive equipment against a harsh environment.
- Transportation and installation: Problems arose in transporting the equipment and installing it in a country with limited facilities and limited trained technical help.

In order to meet the tight schedule, Western Electric immediately commenced production of the multiplex equipment. Living quarters and offices were constructed immediately in several locations. Sites for the microwave stations were inspected. An assembly and equipment testing facility was established in Atlanta. To avoid on-site problems, it was decided to assemble the system components in a modular fashion in the United States and implement needed changes in the United States before shipment. In line with this decision, the equipment was preinstalled in shelters.

Project requirements and environmental conditions necessitated modification of some equipment design. The radio relay and multiplex equipment at each site had to operate unattended for 4 months at a stretch, with high reliability and minimal maintenance. There was also a need to design and produce transportable, stand-alone, and self-powered buildings with an air-handling system that provided air conditioning and dust filtration.

Bell Laboratories was commissioned to modify Western Electric multiplex designs developed for the U.S. market so that they would meet international standards. A building was developed to shelter site equipment to withstand desert and mountainous conditions, salty sea air, high and low temperatures, and possible earthquake tremors. Bell Labs, along with Payne, designed a lightweight, strong, and insulated shelter that doubled as a shipping container for the equipment. These units were developed in a modular fashion to allow them to be fit together in different patterns to meet the particular specifications of each site. The modular design was also efficient for preassembly, with power generators being shipped directly to Saudi Arabia from their European suppliers.

Western Electric provided training on the microwave network in system management and technical operation. This was conducted at the same time the system was being designed and installed. Although Western Electric maintained the system for the first 12 months after completion, Sartelco, a joint Saudi-Italian venture, won the subsequent $75 million maintenance contract. It will use 120 Italian and 180 other technicians on its staff, several presumably being Saudi nationals.

The Saudi PTT in August 1982 awarded AT&T International a $377.5 million contract to expand the microwave network and supply 150 new towers. This will double the existing telephone capacity to 70,000 voice frequency channels and expand and strengthen the network's radio and TV channels.

EGYPTIAN PROJECT DESCRIPTIONS

Telecommunications Modernization[3]

The modernization of telecommunications in Egypt was awarded to a European consortium consisting of Siemens (West Germany), Thomson-CSF (France), and Siemens Austria in September 1979. No formal request for tenders was ever

[3] *Middle East Economic Digest,* April 1979, Sept,. 21, 1979, January 1981, Oct. 15, 1982, Oct. 24, 1980; Frith, Kirk, and Spinks, 1980,

issued. However, following the completion of the 20-year master plan by Continental Telephone International (U. S.) in 1978, several firms made presentations to the Egyptian PTT describing how they would implement it.

Major competitors included an American consortium consisting of Continental Telephone International, AT&T, and GTE. Ericsson, ITT, and Philips were also serious contenders. The most important factor in the Egyptian award decision was financing. Egypt was looking for 75 percent of total financing from the supplier countries and the remainder from financial institutions. The European consortium was the only bidder that could provide this type of package. Soft 15-year loans with 5 percent interest and a 5-year grace period were offered by the three supplier countries in the consortium. Moreover, supplies and export credits were made available by France and West Germany.

The winning team used other marketing strategies as well in its successful bid. While the master plan identified a $2,400 million expenditure in the first 5 years of implementation, the consortium estimated the cost to be only $1,800 million. The consortium also benefited from the intervention of Austrian Chancellor Bruno Kreisky, who, as a long-time friend of President Anwar Sadat, sent a personal emissary to Egypt to promise additional German and Austrian investments in Egyptian industrialization. Siemens Austria promised to finance the renovation of Egypt railway signaling network and its rolling stock. Siemens promised to finance a feasibility study along with Krupp of West Germany on Egypt's coal resources. In addition, the two companies offered to establish a management consulting firm along with Egyptian interests.

The other bidders also made their interests known to Egyptian authorities, although they could not match the low-cost, long-term financing package of the consortium. The U.S. team sent its chairmen and presidents to meet with President Sadat and present its proposals. European bidders held that the U.S. team attempted to tie the sale to possible U.S. military exports to Egypt and tried to prevent open tendering. Using a less aggressive, but persuasive strategy, CIT-Alcatel (France), which was already under contract to install digital electronic switching systems in Egypt, received permission from the French PTT to install equipment originally earmarked for domestic use in order to meet contractual deadlines.

Although the contract was awarded in September 1979, work startup was delayed for over 3 years, until October 1982. This delay resulted from details in the agreement that still needed to be finalized. Siemens agreed to a memorandum of understanding concerning the prices for equipment (which could be no more than 15 percent higher than U.S. equipment provided under the AID package) and the use of local contractors for civil works (laying cable and installing ducts). Thomson agreed to a similar memorandum on prices, engineers' salaries, and training of Egyptian technical personnel. The contract and memoranda then had to be ratified by the Egyptian parliament.

The scope of this 5-year project includes: 1) installation of 500,000 new phone lines and renovation of 350,000 existing lines, losing 100,000 existing antiquated lines in the process; 2) supply of analog switching systems; 3) provision of coaxial cables in Lower Egypt and microwave systems for Upper and Lower Egypt linked to Cairo; 4) establishment of repair centers; 5) provision of 3 years' supply of spare parts; and 6) training of Egyptians to enable handing over of operations within 3 years.

The Continental Telephone master plan projected that additional telecommunications projects through the year 2000 could amount to over $17 billion. The European consortium would appear to be in the most advantageous position to win much of this additional business.

Technical and Managerial Services[4]

Following the submission of Continental Telephone's master plan for Egypt's telecommunications system in 1978, the company put in a bid, along with AT&T and GTE, to implement the first 5 years of the plan. It lost to the Siemens consortium. In May 1980, a contract was awarded to Continental Page Consultants (a subsidiary of Continental Telephone) and Arthur D, Little International for $20.5 million to supply managerial and technical advisory services. Of the total, $17.4 million was provided by USAID. Consulting work is expected to continue through 1985.

The work is equally divided between the two firms. A. D. Little is focusing on improvements in planning, management, operations, and training. Specifically, the company will design and develop managerial, financial and data systems. Continental is providing more of the technical, plant-related work—rehabilitating existing equipment, designing and installing four electronic exchanges and

[4] Telephony, June 16, 1980 *Communicator*, summer 1981

three outside plant systems in Cairo and three electronic exchanges and outside junction cables in Alexandria, and training Egyptian personnel in operations and maintenance. The team will award hardware contracts to U.S. firms.

In the training effort, Continental is attempting to transfer not only specific knowledge on installation and repair, but also broader technical concepts on the operation of telecommunications networks. On-the-job training is implemented along with extensive formal classroom training. Owing to language barriers, Continental trains Egyptian instructors who then teach the craft employees.

ALGERIAN PROJECT DESCRIPTION

Telecommunications Project[5]

This project was awarded in 1974 to a U.S. firm following a competition involving about 12 companies; the United States and Japanese firms were the front runners. The apparent critical factors in winning the contract included: 1) a desire by the Algerian PTT to loosen its dependence on the French; 2) a desire for reliable U.S. technology, and, most importantly, 3) price. The American firm offered the lowest bid.

Project specifications in the tender were written by another American firm that had conducted a 1-year pre-engineering study prior to the award. This firm continued to provide consulting assistance to the Algerian PTT for 4 to 5 years into the contract.

The contract had open financing, which resulted in payment delays of 2 to 3 years. No irrevocable letter of credit was issued by the PTT to ensure payment. Apparently, Algerian ministries will not issue such letters to foreign contractors, but some national companies will. As a result, large amounts of investment capital were put at risk by the company.

The project staff consisted of 42 employees at its peak, mostly American and British technicians, with nationals hired for clerical assistance. No PTT personnel participated in the project with the contractor's staff; it was handled as a turnkey operation. The work involved installation of equipment, sometimes in remote sites. No major modifications to the equipment were required, although additional engineering costs were entailed to deal with special ventilation and sand filtration systerns that were necessitated by local conditions. In some locations where the equipment was installed, climatic and terrain problems resulted in difficulties with the dual diesel generators.

For 3 years after installation, the firm was under contract to operate and maintain the equipment and train nationals. Formal training of about 40 Algerians took place in the United States and Algeria, with on-the-job training for 3 years side-by-side with American and British technicians. The training was provided in French or with translators. Most trainees had some form of engineering degree, but their formal education and practical experience varied widely. Most visible to the trainers was the apparent lack of motivation by many nationals in the program. While some equipment sites were well maintained with low downtime records, others were in poor shape.

The U.S. Government played no role in aiding the company to obtain the original procurement. During the course of the project, the program manager as well as other American businessmen had regular meetings with the U.S. ambassador to discuss problems encountered in conducting business in Algeria. Common difficulties included local taxation, contractual problems leading to nonpayment, and problems in getting contractor property out of the country after the project was completed. Although the ambassador listened, the businessmen felt that no action was ever taken by the U.S. Government to remedy these problems or to bring them to the attention of the Algerians on a government-to-government level.

The last Americans involved in the project finished their tasks and left Algeria in 1980, Since then, the Algerian PTT has issued a tender to purchase more of the same type of equipment. While the American company that provided the original systems is in a dominant position relative to foreign competitors, it has decided not to bid because of the investment risks and financial losses it experienced during its initial contract.

IRANIAN PROJECT DESCRIPTION

Telecommunications Training Program[6]

American Bell International Inc. (ABII), a subsidiary of AT&T, began work in Iran in 1975 to evaluate existing telecommunications facilities

[5] This description is based on interviews heId in December 1982 with a program manager at a large U.S. telecommunications manufacturer that has done business in Algeria. Details of the technology itself have been omitted to retain anonymity.

*Interview with supplier representative, held in December 1982; *Telecommunications*, August 1979.

and to identify future requirements. This work was initially conducted under contract to the U.S. Air Force, which was a consultant to the Iranian government. A year later, a master plan for telecommunications service was completed and ABI I was awarded a new contract to help implement the 10-year plan, Chief among ABII's tasks was technical consulting, integrating and supervising other contractors, and training Iranian managers, engineers and technicians in the efficient operation and maintenance of the evolving network. ABII reported to the managing director of the Iranian PTT.

By mid-1977, the training effort began with a staff of six people. By 1979, before the overthrow of the Shah, the effort included 29 ABII trainers and over 100 Iranian trainers. Most of the training took place in Teheran and several field locations, although some initial formal instruction was conducted at AT&T facilities in the United States. Training was conducted in Farsi by Iranian instructors and translators. However, highly technical hardware courses and management courses were taught in English.

Iran's stated goal was to establish self-sufficiency in training within 10 years. With this in mind, joint training policy committees were formed so that Iranian management would feel a sense of ownership in the contractor's training program. An Iranian training organization was established and courses were developed in coordination with ABII.

Hardware training dealing with maintenance and repair was developed by several equipment manufacturers. Successful graduates were then to train other employees in the field, This instruction proved to be effective in that it was practical and involved hands-on experiences. Courses included: 1) telephone maintenance procedures, 2) telephone cable fault locating, 3) management training, 4) record keeping for outside plant facilities, 5) cable laying, 6) outside plant engineering, and 7) sources of supply.

Other conceptual and management courses tended to be more difficult for the Iranians to grasp. The management skills courses proved to be too culture-bound and alien to many Iranians. The PTT also gave higher priority to the technical courses, giving management and administrative courses second place. Concepts such as team problem-solving skills, which are common in the West, were difficult for the Iranian trainees to accept and implement. Dropout rates in some of these courses reached 50 percent. In retrospect, some of the ABII trainers felt that these concepts should have been introduced more slowly, and a more extensive cultural orientation should have been given to Americans before they were sent to Iran.