THE ROLE OF INSTITUTIONAL AUTONOMY IN

TELECOMMUNICATIONS PLANNING AND DEVELOPMENT:

A COMPARATIVE CASE STUDY

by

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(ABSTRACT)

This is a comparative case study of the relationship between telecommunications decision making and sector development. It employs a resource dependence model of organizational decision making (Pfeffer and Salancik 1978; Cohen, Grindle and Walker 1985) to explain the development of voice communications (telephony) in North Africa (Algeria, Morocco and Tunisia) from the early 1970s to late 1980s. The study finds that the autonomy of the telecommunications operating entity from domestic political organizations (for financial resources) and from technological organizations (for equipment and services) is associated with the supply and quality of telephone services. Dependence on external financial and technological organizations influences the decisions of the telecommunications operating entity in terms of the levels and priorities of investment, the level and role of technical expertise and choices of technology.

The findings of the study confirm preliminary research by Hirschman (1967), Saunders, Warford and Wellenius (1983), Israel

(1987), and Roth (1987), among others, that the autonomy of the telecommunications entity is associated with improved supply and quality of telecommunications services. It is inconsistent with the expectations of earlier studies insofar as it finds that greater autonomy is not always associated with higher levels of investment in the sector. Greater autonomy is associated with higher quality, wider distribution and a comparable provision of services. This occurs (in Algeria) where investment in telecommunications was lower as percentage of GDP than Tunisia. The entities of Tunisia and Morocco (until 1984) were less autonomous, and showed lower levels of technical expertise, and lower quality and supply of services. Given the tendency of a technical organization to function more effectively than a non-technical organization, this study concludes that organizational autonomy is more important to the supply and quality of services than the amount of funds handled by the entity.

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Only connect. (E.M. Forster *Howard's End*)

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Chapter I
INTRODUCTION

Communication is one of the most fundamental of all human activities, and a basic building block of social organization. Communication is defined, perhaps most succinctly, by Gerbner (1966) as "social interaction through symbols and message systems." Through communication group action is organized, coordinated, and implemented, whether that communication is face-to-face or mediated by communication technologies. Durkheim (1947) states that communication technologies, along with transportation, are one of the means by which societies progress to greater degrees of internal differentiation, functional complexity and integration due to an increase in the frequency of contacts among members of a population (what he calls "moral density"). This progress towards greater degrees of differentiation and complexity -- one of the basic aspects of social and economic development -- is achieved through the facilitation of physical movement which includes all forms of transportation, whether of individuals, materials, or ideas. Telecommunications has become one of the predominant means by which ideas and information are exchanged today.

Telecommunications is defined as "any transmission, emission or reception of signs, signals, writing, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems." (ITU 1983). Telecommunications infrastructure is the physical network of transmission, switching and terminal equipment that provide a variety of telecommunications services. This includes such two-way services as telephone, telegraph, telex, data, and facsimile, as well as one-way or mass communications, i.e., radio and television broadcasting. This study limits itself to the former subset of telecommunications, that is, two-way (or point-to-point) common carrier communication by technical means. This study focuses on telephone services (telephony) because it is the most widely used form of two-way telecommunications today; but whatever is said of telephones is generally true for other kinds of two-way services. Radio and television broadcasting are addressed only as they bear on two-way communications (hereafter referred to as telecommunications).

The role of mass communication in the development process of Third World countries (particularly radio and television) has been acknowledged for many years, both its positive and negative effects (Lerner 1959; Schramm 1964, 1973; Rogers 1963; Gerbner 1973; Nordenstreng 1975; Lee 1980; McAnany 1982; Schiller 1981). The role of mass communication in development has been perceived primarily as that of diffuser of innovation (Lerner 1959; Rogers 1963, 1972, 1983). Mass media can facilitate the diffusion and adoption of innovation that can lead to development through improvements in health, literacy, agricultural productivity, etc. Quite commonly, however, the state, which is typically the owner and operator of television and radio agencies -- uses mass communications for propagandistic and ideological purposes, i.e., to promulgate its world view, the ideas of modernization and the modernizing state, rather than for economic growth (McAnany; Nordenstreng; Mattelart; Hamelink).

This study is concerned primarily with *two-way* communication, what is hereafter referred to as telecommunications, because economists have identified an association between the presence of telecommunications and the advancement of economic growth and development. They have demonstrated important economic benefits derived directly and indirectly from the production and distribution of information and knowledge using two-way communications media (Machlup 1962; Bell 1973; Porat 1977, among others). Numerous economic studies have demonstrated that there are undeniable economic benefits derived from the presence of such telecommunications in developing countries, especially when extended throughout the country into rural and remote areas (Bebee and Gilling 1975; Gimpelson 1974, 1976; Polishuk and O'Bryant 1977; Clarke and Laufenberg 1981; Hudson, Goldschmidt, Parker, Hardy 1982; Hudson and Parker1979; Cleevely 1980, 1983; Cleevely and Walsham 1984; ITU/OECD 1983, 1986; Saunders, Warford and Wellenius 1983; Nicol 1984).

What is the Problem?

Developing countries are rife with severe shortages and chronic problems; many goods are in short supply and services are inadequate, operating poorly or not at all. The provision of goods and services in the telecommunications sector of most developing countries is no exception. Telephone and other less prominent two-way communications -- telex, telegraph, data -- are often characterized by poor quality of service and maintenance, congestion of circuits, limited access to facilities and services, long waiting lists for connections, and low density (e.g., often fewer than one telephone per 100 inhabitants on national average). But why should we expect the provision of telecommunications goods and services to be any better than other goods and services?

There are several important, if not unique, characteristics of telecommunications that distinguish it from many other sectors, and that raise the question of why telecommunications services and facilities are undersupplied. Most importantly, telecommunications is typically a revenue generating activity. The World Bank estimates that the economic rate of return on investment in telecommunications ranges from 17% to 50% and sometimes higher. Moreover, there is evidence of high demand for telecommunications and of willingness to pay the costs of connection and service. Thus, telecommunications is not like health, education or some other public service sectors where the state must generate funds from somewhere else to support sector activities; telecommunications can sustain its own growth and development as a sector, in addition to which it usually contributes revenues to the national treasury. Furthermore, it contributes to social and economic growth and development in other sectors.

This study argues that the dependence of the telecommunications operating entity in a developing country on equipment suppliers and operators for technological resources, and on domestic political institutions for financial resources, affects the decisions of the operating entity, and that this decision making structure tends to inhibit the development of the telecommunications sector, resulting in the undersupply of services.

Significance of the Problem

As stated above, economic studies associate telecommunications with economic growth and development. Moreover, these studies show significant constraints on economic growth in some sectors due to a lack of adequate two-way communications facilities. National economic productivity and efficiency and socio-economic integration increase with the elimination of inter-regional barriers to resource mobility, trade and the diffusion of information and innovations (Renaud 1981). The provision of transport and communications infrastructure is crucial to releasing the growth potential of every region of a country. Cleevely and Walsham employ central place theory to distinguish between rural and urban development patterns, allocations of resources, access to facilities and directional flow of information (from centers to peripheries). Saunders, Warford and Wellenius have used spatial and sector analyses to quantify telecommunications benefits and to describe and demonstrate the association between telecommunications and economic growth and development in developing countries.

Although telecommunications (e.g., telephone, data) are associated with economic growth, most facilities and services in developing nations are heavily concentrated in a few major urban areas. The heritage of a colonial past is often a transport and communication network that funnels goods and services into a capital city or major harbor and does not provide adequate lateral transport between inland regional centers. The infrastructure is often tree-shaped and drains all activities into a trunk line to the main export city connecting the country to external markets (Baum and Tolbert 1985). Moreover, the rationale of developing telecommunications networks primarily on the basis of a financial rate of return, exacerbates the concentration of telecommunications in urban areas where demand is greater, revenue earnings higher, and network expansion costs lower per additional subscriber, than in non-urban areas of the country (Jussawalla 1985). Urban lines are characterized by high per-line revenue and low per-line investment whereas rural lines are characterized inversely by low per-line revenue and high per-line investment cost. The combination of the network development under colonialism and under post-independence strategies of revenue maximization expands infrastructure for metropolitan centers and for international services, which are necessary and legitimate. But it does not support integrated regional and national growth and development through the extension of telecommunications into non-urban areas of developing countries.

The concentration of telecommunications in capitals and other primary cities sets up a network of "world cities" (Friedmann 1986; Thrift 1982; Armstrong and McGee 1985). Multinational corporations locate within urban areas of developing countries where there is reasonable access to communications and transportation infrastructure, among other resources. The telecommunications requirements of transnational corporations, as well as government and local businesses, have fueled the growth of telecommunications services in these major metropolitan areas. "World cities" are major sites for the concentration and accumulation of international capital; they play a central role in the pace and scope of international capitalist expansion (Armstrong and McGee 1985). The driving force of growth in world cities is found in a few rapidly expanding sectors, including communications, transport, corporate headquarters, and international finance. Telecommunications supports this global network of urban centers through the ever increasing pace and scope of the production, transmission and storage of information, made possible by such mechanisms as the international satellite network which is owned and operated by the International Telecommunications Satellite Organization, Intelsat.

The specific function of the large city or central sub-system is to act as a locus of capital accumulation, facilitated by two-way communications, and a diffuser of consumption patterns, as promoted through monopoly broadcast media (state-owned radio and television). Developing countries have tended to follow the industrial nations' practice of providing rural coverage as the last and farthest component of the complex urban and interurban system, once the latter has reached a considerable size and copes well with demand (Wellenius 1976). In developing countries, however, as Wellenius points out, as much as 90 percent of the population may live on agriculture in non-urban areas, and will continue to do so for the foreseeable future.

Nonetheless, even urban telecommunications infrastructure is typically undersupplied. Given the favorable economic conditions associated with two-way communications (high rate of return, high demand with willingness to pay, and significant contributions to economic growth and development), one would expect the state to invest heavily and expand this sector rapidly. However, investment levels are low, typically one of the lowest priorities in national budget allocations (averaging about 0.3% of gross domestic product as compared to 0.6% in industrialized countries). Why would a sector with such strong economic characteristics, which gives so much back to a national economy and social development, receive such a low priority in the allocation of public resources?

Candidate Explanations

Three basic reasons have been offered to explain the relatively low investment in telecommunications. The first emphasizes the scarcity of resources and claims that money is the main reason why services are undersupplied: foreign exchange is scarce, national income is low, and domestic funds are limited (Saunders 1985). The fact that national income is low and domestic funds are scarce in many developing countries must be acknowledged. But, as noted above, telecommunications actually generates revenue for the state. The World Bank estimates that the internal financial rates of return on telecommunications investment average around 18%, and can run as high as 35% return on investment. In situations where it has been possible to meaningfully quantify some of the benefits accruing to the country in excess of the internal revenues realized by the telecommunications entity, the World Bank reports economic rates of return in the range of 17 to 50%, with an average of 27%. Large economic returns also result from the telecommunications components in investment programs in other sectors (such as railways, power, tourism, banking and rural development). As for the foreign exchange constraint, it is true that a scarcity of foreign exchange is typical of most developing countries, and telecommunications is a capital intensive sector; most equipment is purchased from advanced, industrialized countries using scarce foreign exchange. But capital can generally be found from suppliers and other commercial sources to finance activities for which there are such high rates of return as well as demonstrated public demand (Roth 1987), and the demand for telephone services exists in all countries, although it is satisfied in only a few.

The second main reason that is given as to why services are undersupplied is the perception by national planners that telecommunications does not play an important role in economic development and growth. The modernization school of development prevailing throughout the 1950's and 60's ("growth will occur as a result of investment in the leading sectors and will trickle down to all levels of society") tended to treat two-way communications as one of the less important public utilities. Investment in telecommunications was justified when it was profitable. Urban lines are characterized by high per-line revenue and low per-line investment whereas rural lines are characterized inversely by low per-line revenue and high per-line investment cost. By the early 1970's mainstream development theorists shifted the focus of investment from urban, capital-intensive modernization techniques to rural labor-intensive strategies. The mainstream "basic needs" view of development prevailing throughout the 1970s ("development will happen if income is more equitably distributed and if the basic needs of the whole population are satisfied"), considered telecommunications investment to be counter-productive, since it was assumed to benefit primarily the more affluent urbanized segments of society, and in any case to pre-empt investment in other "more important" fields such as rural development, education, slum upgrading or public health (International Telecommunications Union 1983). Thus, the development rationale of the 1950s and 1960s of investing in telecommunications only where it was profitable (urban areas), and the 1970s strategy emphasizing "basic needs" and rural areas (whereby telecommunications appeared to be a luxury consumer good, benefitting only urban elites) resulted in an urban concentration of those two-way communications services that did exist and an overall undersupply of services nationwide.

The United Nations agency responsible for international telecommunications regulation, the International Telecommunications Union (ITU), also attributes the poor condition of telecommunications in developing countries to the conventional failure to recognize the contribution of telecommunications to economic and social development. ITU attributes this lack of recognition of the contribution of telecommunications to the limited evidence thereof. The difficulty of quantifying and measuring these benefits made progress slow and tentative in this research area. In many public utility projects such as power, water and sanitation, and telecommunications, the valuation of benefits raises significant problems. The usual practice is to derive a measure of the benefits from revenues received from consumers which can be estimated with some confidence. But since the benefits to consumers may substantially exceed the regulated tariffs they have to pay, the resulting rates of return represent a minimum estimate rather than a best estimate of the actual rate of return *to the economy*. But, as noted above, numerous economic studies, beginning in the early 1970s, have demonstrated that important direct and indirect economic and social benefits accrue from telecommunications, and that these benefits are highest in non-urban areas. This is not to minimize the fact that the telecommunications sector has been perceived as one of the less important utilities or an urban consumer luxury in many developing countries throughout the 1960's and early 70's. However, this explanation for low investment and slow expansion of the sector does not account for the fact that some countries, as diverse as Ethiopia, India, Algeria and the Sudan, and some countries of Latin America, proceeded to build fairly extensive telecommunications networks throughout the 1970s despite pressing needs in other sectors.

The third main explanation -- and the one that is tested in this study -- is that the telecommunications operating entity is organized and managed in such a way as to limit its autonomy from central government in its day-to-day and long-term financial, legal and administrative decision making (Saunders, Warford, Wellenius 1983; Ayub and Hegsted 1987). This day-to-day government interference includes detailed government approval of the normal technical, procurement and expenditure decisions which top management should be able to make following sector regulatory guidelines; tariff policies that in the short run do not promote an efficient allocation of telecommunications resources;[1] the practice of making changes in the entity's senior operating managers each time there is a change in government; the telecommunications entities' insufficient authority to collect bills promptly from all users including government subscribers; and the entities' inability to set salaries, wages and other benefits so as to attract capable staff at all levels. Cohen, Grindle and Walker (1985) emphasize the role of leadership and expertise among the institutional factors affecting performance of an organization. As a result of rapid turnover of managerial leadership, an institution may become less coherent and more fragmented, with little institutional memory and reduced social learning (Saunders, Warford and Wellenius 1983).

Setting up the telecommunications operating entity as a government-regulated corporation or a public enterprise is one way of achieving financial and managerial autonomy. But adequate autonomy can also be attained when the entity is more closely tied to government, for example as a government department, provided appropriate organizational measures are implemented to eliminate the above interventions and to orient the entity to a commercial operation.

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[1] In developing countries the presence of daytime call traffic congestion and large telephone and telex waiting lists suggests that prices may be too low. The use of price to help allocated the limited supply of telecommunications service has the advantage of leaving the decision as to the importance of the service relative to other goods and services in the hands of the beneficiearies, not the politicians. Nonetheless, while inappropriate tariffs may inflate demand for services, they do not cancel out the revenue generating capability of the sector. Lower tariffs may mean lower revenues earned per telephone, but they do not necessarily eliminate a revenue surplus.

Not only does the telecommunications operating entity of a developing country typically lack autonomy relative to domestic political organizations, but it is also dependent upon external (typically western or Japanese) organizations for its technological resources, including know how (technical expertise and training). This technological dependence may be alleviated or minimized by domestic manufacturing and adequate educational facilities.

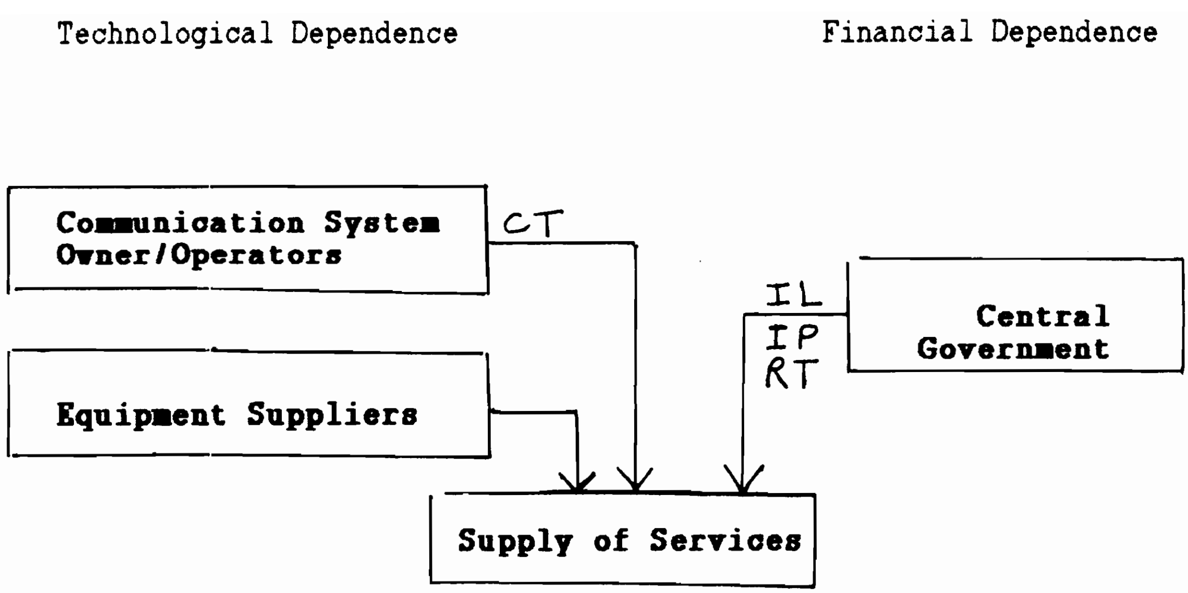
This study, guided by the resource dependence perspective of organizational decision making (Pfeffer and Salancik 1978, inter alia), tests the proposition that the lack of autonomy of the operating entity inhibits the development of the telecommunications sector. The research question, simply stated, is: Does institutional autonomy make a difference? Does the organization and management of the operating entity effect the development of the sector? What is the relative technological dependence of the operating entity, and how does that dependence effect the development of the sector? Is there an interaction effect between the institutional, political (most notably, financial) and technological autonomy? This study argues that the political and technological institutions and processes upon which the telecommunications entity depends for its resources affect the decision making of the entity, and consequently the development of the sector. An entity with greater autonomy from central government and technology suppliers and operators for its resources is more effective in its delivery of services, and more capable of evaluating and taking advantage of technological changes and investment opportunities in its environment in order to pursue more self-reliant and integrated regional development and economic growth.

System Map of Decision Making Structure

The decision making structure (represented in **Figure I-1**) consists of key institutional relationships and decision processes. These are, specifically, the relationships among institutions involved directly or indirectly in decisions concerning the provision or regulation of critical resources (primarily funds and technology, including know-how) for the telecommunications operating entity. These relationships are among the following key actors (institutions):

1) The telecommunications operating entity (typically a Ministry of Post, Telephone and Telegraph or PTT): the primary owner/operator of basic public telephone and other two-way communications (telex, telegram, public data networks and services) within a country. Often it is the sole or monopoly provider of all two-way services, public and private.

2) Central government: institutions of the central government (most notably, the Ministries of Finance and Planning) are responsible for the overall functioning of the political and economic system. It chooses and coordinates through national plans the economic development strategy for the country. It is also the



Specific Influences:

IL = Investment Levels
IP = Investment Priorities
CT = Choice of Technology
RT = Role of Technical Expertise

System Map of Influences on Organizational Decision Making

Figure I-1

arena for interaction with international actors (e.g., international donors, banks, corporations interested in domestic investment). The central government is limited in this study to those organizations which control critical resources of the telecommunications sector through regulatory, oversight or coordination functions vis-a-vis the telecommunications operating entity (e.g., the Ministry of Communication and Transportation, the postal department of the Ministry of Communication), and through the national planning and budget allocation processes (e.g., Ministries of Finance and Planning).

3) Suppliers: critical among its technological resources are equipment and training, which are typically provided by telecommunications equipment suppliers, that is, manufacturers and/or vendors of communications technology (e.g., AT&T, RCA, GTE, Harris, Scientific Atlanta, Hughes, Alcatel, Siemens, Ericcson, NEC). Suppliers are also sources of some technical training, as are some bilateral or multilateral assistance organizations (U.S. Department of Commerce, European/Japanese Ministries of Post, Telegraph and Telephone, and agencies of the United Nations such as The World Bank, the International Telecommunications Union and the U.N. Development Program). Equipment may be supplied by domestic equipment manufacturers, which offsets the high cost of importing technology with scarce foreign exchange.

4) Telecommunications system owners/operators: system owner/operators may be domestic (other than the public

telecommunications operating entity), regional (e.g., Arabsat, Orion, PanAmSat), or international organizations, (e.g., the International Telecommunications Satellite Organization or Intelsat, and Intersputnik). Domestic system operators in addition to the telecommunications operating entity, if they exist, typically might provide specialized data services and/or private data networks. Their relationship -- competitive or non-competitive -- with the primary entity is indicated by their formal status (separate organization or subsidiary of the primary entity) and by their legislated activities and constitutional divisions of authority.

According to the resource dependence model, we can expect the telecommunications entity to be most responsive to the influences of those organizations or groups upon which it is most dependent for critical resources. Two of the most critical resources of a telecommunications entity are finances and technology. Without either of these resources, there could be no telecommunications services whatsoever. As noted above, the organizations controlling financial resources of the telecommunications operating entity of a developing country are usually domestic and international political organizations of the central government (Ministries of Finance and Planning, Ministry of Communications and Transportation). These domestic political organizations influence indirectly the access the operating entity has to financial resources from commercial banks, (through legislation), bilateral aid agencies (through loan agreements) and through the control of the allocation of scarce foreign exchange, as well as by setting exchange rates for domestic currency. Some of the specific ways that domestic and international political organizations can influence decisions of the telecommunications operating entity are:

1. Level of investments: central government organizations control level of investment through budget allocation and approval process;

2. Priority of investments: an advanced, industrialized government may influence priority of investments through bilateral aid, which may be tied to its own operators or suppliers. Multilateral aid agencies (ITU, UNDP, IBRD) may also influence priority of investments through choice of project to fund. Commercial banks may influence investment priority on basis of profitability of network (ability to pay off loan).

Specific ways international and domestic technological organizations influence decisions of the operating entity are:

1. Choice of technology: International equipment suppliers may influence choice of technology through the provision of favorable terms of credit and financing, regardless of the suitability of the technology (e.g., compatible with existing network). Moreover, the choice of technology is limited by the design chosen by equipment suppliers and system operators in advanced, industrialized countries where the equipment originates (e.g., technology is designed for urban and thick route, not rural, thin-route, areas). Domestic suppliers may influence decisions of the operating entity with

regard to choice of technology by being able to provide equipment at lower cost than imported technology, regardless of the optimality of the equipment (e.g., obsolete versus state-of-the-art, analog versus digital).

Domestic system operators, other than the telecommunications operating entity, may influence the entity's decision to concentrate on basic services (typically provided by traditional, analog technology) or to offer specialized voice and data services (requiring investment in state-of-the-art digital technology). Such a decision might depend on whether the domestic operator is in a competitive position vis-a-vis the operating entity, and on other incentives and regulation stipulated by government. The primary operating entity may be interested in providing specialized services because these services are potentially very lucrative. But central government may choose to permit competition in service offerings in order to help meet market demand, and/or to stimulate the primary telecommunications operating entity to perform more effectively (Israel 1987). On the other hand, the central government may restrict competition because it doesn't want to lose potential revenues to the domestic private sector. It may also restrict foreign access to the local market because it doesn't want to lose potential revenues to foreign system operators. Domestic system owner/operators may also be established as subsidiaries of the primary operating entity, an arrangement which provides some separation of tasks and workload, while mitigating against potential competition from foreign system owner/operators or service providers.

2. Role of Technical Expertise: a predominance of technical personnel in the telecommunications entity should allow for a more knowledgeable group of decision makers interacting with technology suppliers, designers and system operators (domestic and international). Moreover, the presence of a majority of technical staff in the telecommunications entity should favor technical rationale over political rationale for network development. The presence of a majority of technical staff in the entity is more common where organizational measures of relatively autonomous organizations have been adopted (specifically, competitive salary and promotion policies). In this way, the level and role of technical expertise becomes the locus of an interaction effect between institutional development, political dependence and technological dependence. An autonomous or semi-autonomous organization is likely to have a majority of technical expertise, which, as a result, would likely dominate network decision making, as well as the dialogue with external technological organizations upon which it depends for critical resources.

Theoretical Framework

The study employs a resource dependence model of organizational decision making (Pfeffer and Salancik 1978) to establish the relative autonomy of the telecommunications operating entity from external organizations and processes, and to analyze the relationship, if any, between institutional autonomy and the development of the telecommunications sector.

The resource dependence perspective derives from organization theory and the literature of development administration (Selznick 1953; Esman 1972; Pugh 1976; Swerdlow 1975; Rourke 1976; Rondinelli 1982; Cheema and Rondinelli 1983; Meier 1980; Cohen, Grindle and Walker 1985; Rondinelli, Nellis and Cheema1987; Ayub and Hegsted 1987). The resource dependence perspective sees organizational decision making as externally controlled, other-directed, not self-directed. Organizations must engage in exchange relations with external organizations and processes in order to obtain the resources necessary for their survival and operation. In so doing, external organizations and processes, by virtue of their control over needed resources, affect the decisions made by the focal organization. The focal organization -- in this case the telecommunications operating entity -- is confronted with external control which creates resource dependencies. It seeks to avoid such constraints, and at the same time, to shape its own context. It is involved in a constant struggle for autonomy (Pfeffer and Salancik 1978)). Rondinelli and Cheema (1983) associate autonomy with the concept of centralization, one of the five primary structural characteristics of organizations, according to classical (Weberian) organization theory. Autonomy is one major form of decentralization, i.e., the delegation of decision making and management authority for specific functions to semi-autonomous or parastatal organizations that are not under the direct control of central government ministries.

Autonomy, or its inverse, dependence, is the central aspect of the resource dependence decision making model. Autonomy is typically defined in terms of power, which is an important component in every type of organization. Autonomy is the degree to which a social system has power with respect to its environment (Selznick 1953). Power refers to the degree to which an individual or other actor has the capacity to obtain performance from other individuals (Parsons 1963), or as a relationship between two or more actors (Dahl 1957).

Rondinelli and Cheema (1983) among others have pointed out that greater autonomy does not always lead to more effective institutional performance in terms of the delivery of goods and/or services it sets as its objectives. When does the granting of greater autonomy lead to effective performance? Arturo Israel (1987) has found that the public agencies that perform most effectively are those which are more technical in nature or whose functions are technical. He cites telecommunications as one of the the most successful institutional development cases. Israel finds in his study of 175 ex post evaluations of World Bank projects (representing thirteen subsectors in sixty-six countries) that the pattern of results of institutional development programs is stronger by sector, subsector and activity, rather than by country. The most successful were found in industry, finance, utilities and telecommunications. The least successful were found in agriculture, education, and services. Israel concludes that the successful cases embody one or both of two factors, specificity and competition, which seem to provide the central explanations for variations in institutional performance, and to offer incentives to improve that performance. Cohen, Grindle and Walker (1985) concur, noting that an institution's behavior may be effected by the characteristics of the program or project being implemented. Albert Hirschman's analysis in his 1967 study *Development Projects Observed* anticipates Israels's findings; in this study Hirschman outlines the contrast between industry and agriculture, presents concepts of lattitude and discipline and an analysis of the discipline imposed by high technology and by time-bound and even location-bound activities.

The concept of specificity is linked to theories of organization that put special emphasis on technology and the technical core as determinants of the structure of organizations. The telecommunications operating entity is an agency of high specifity and a discipline imposed by the telecommunications technology itself, but little or no competition. Typically, the operating entity is a monopoly provider of services. Where competition is minimal or non-existent (as is often the case in telecommunications), competition can be simulated. The two external competition surrogates are pressure from clients, suppliers and the government. These factors have been the subject of extensive work among organization theorists.

Most public telecommunications services in developing countries are provided by self-regulating, monopoly organizations that are partly or wholly owned government entities. The monopoly position (lack of competition) by itself builds in conservatism and inertia in the organization, and removes some incentive for the entity to respond in an efficient manner to demand and other investment opportunities (Roth 1987; Saunders, Warford, Wellenius 1983; Ayub and Hegsted 1987; Israel 1987). The monopoly telecommunciations entities are organized in several forms: a conventional government department, a semi-independent branch or board of a government department, or a regulated corporation. The least autonomous form is a government department or ministry (e.g., the Ministry of Post, Telephone and Telegraph or PTT). Saunders, Warford, Wellenius (1983) argue that institutional autonomy is the central aspect of the organization and management of the telecommunications operating entity effecting development of the sector. Governments have generally tended to give little autonomy to telecommunications entities; they have closely regulated and controlled the production and distribution of telecommunications services by placing authority for allocating sector investment in the hands of a few central planners and by employing telecommunications personnel under civil service statutes (e.g., holding salary scales below those paid in the private sector for comparable expertise).

As argued for public sector enterprises, the limited operational autonomy given to the telecommunications entity, inevitably has an adverse impact on the efficient internal operations of the sector. Perhaps the most common cause of inefficiency in the sector is political interference (Cook and Kirkpatrick 1978). Therefore, the most fruitful area for generating improvements in the economic performance of the telecommunications operating entity, like organizations of the public enterprise sector, may be in the reform of the relationship that typically exists between government and the operating entity. The granting of greater autonomy with a clear demarcation of the roles and responsibilities of government and the entity will serve to make political 'interference' in the operations of the entity more overt and thereby less prevalent. Granting greater autonomy to the telecommunications entity would make it more like a public enterprise, but it should go further, so as not to carry over or reproduce the same political interference that writers claim makes public sector enterprises inefficient.

A change to partial or complete private ownership can be expected to lessen the scope for political intervention in the operations of the entity, like public sector enterprises. The entity's objectives would be simplified, overly complex networks of dysfunctional bureaucratic controls would be reduced, and the likelihood of arbitrary 'interference' in operating decisions would be lessened. Each of these changes can be expected to contribute to an improvement in productive efficiency. But these changes are not conditional upon privatization; internal reform of the operating entity, as with a public enterprise, is an alternative option for realizing the same gains. 'The key factor determining the efficiency of an enterprise is not whether it is publically or privately owned, but how it is managed. In theory it is possible to create the kinds of incentives that will maximize efficiency under any type of ownership.' (World Bank)[2]

If privatization merely converts a public monopoly into a private monopoly, the enterprise will not be compelled by competitive pressures to improve its productive efficiency. The opening up of the telecommunications entity to domestic or international competition is often difficult and in some instances, inappropriate. In these circumstances, it would appear that improvements in the internal management of the entity will offer the main means of improving economic efficiency and performance. Public sector reform rather than privatization, is likely to be the major focus of pubic enterprise policy in LDCs in the coming period.

As a government department, the telecommunications operating entity is part of government. Government generally provides lower quality of services because of shortages in skilled labor, technical expertise, financial resources, and bureaucratic inertia (Roth

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[2] **World Development Report. Washington, D.C.: The World Bank, 1983, p. 50 .**

1987). Given the high specificity of the telecommunications sector noted by Israel, we can argue that the telecommunications operating entity is predisposed to function more efficiently as an autonomous organization than as a government department.

The resource dependence model, although developed with the advanced, industrialized countries in mind, is particularly powerful in analyzing the role of the state in developing countries. Interest in greater institutional autonomy, and particularly privatization, in developing countries is a reflection of a fundamental reassessment of the role of the state and its contribution to the process of economic growth and development.

Research Design and Method

This is a case study of the telecommunications decision making structure and its effects in three countries of North Africa. The study uses a multi-measurement approach comprising qualitative data (elite interviews, archives, institutional histories) and quantitative data (primarily statistics). The face-to-face interviews were conducted with those carefully selected decision-makers (approximately eight to ten per country) who are involved in the sector planning and development process. The identification of key decision-makers was based on information from a variety of expert sources, including the International Telecommunications Satellite Organization (Intelsat), International Telecommunications Union (ITU), and the operating entities themselves. The face-to-face interviews were conducted by the researcher in Geneva, Algiers and Tunis (approximately two weeks each) during the months of October and November 1987, and June 1990. The interviews constituted exploratory research to identify the critical variables of the study; follow-up interviews with some of the key actors were conducted by telephone, as necessary. In addition to the interviews, the qualitative data include reports, minutes and other archival documentation of the technical standards and technical standards setting process within Intelsat and the relevant ITU Consultative Committees (CCIR Plenary Assembly, Study Group 4, Study Group 9) and relevant ITU reports; draft proposals and verbal proceedings of the Space WARC treaty negotiations[3]; and reports about the infrastructure in selected developing countries.

Quantitative data concerning investments, entity performance and technology choice is derived from the national plans and sector reports of selected countries, and the ITU Yearbook of Telecommunications Common Carrier Statistics (1972-1986). These data are clarified and supplemented, as necessary, through archival records and face-to-face and telephone interviews with country economists working closely with these countries, and with representatives of the telecommunications operating entity in these countries.

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[3] **World Administrative Radio Conference on the Use of the Geostationary Satellite Orbit and the Planning of the Space Services Utilizing it, to which the researcher was a member of the U.S. delegation at the First Session (August 16-September 9, 1985). Second (and final) session took place September-October 1988.**

The study employs a resource dependence model to analyze and test the relationship, if any, between the relative autonomy of the telecommunications operating entity and the development of the telecommunications sector in Algeria, Morocco and Tunisia (the selection and comparison of countries is described below). The extent of dependence of the telecommunications entity on technological and political institutions and processes provides a measure of its relative autonomy. The relative autonomy of the telecommunications entity is measured according to the three criteria identified by the resource dependence model; these are:

1) the importance of the resource being exchanged between the focal organization (the telecommunications entity) and other organizations (e.g., central government ministries, telecommunications equipment suppliers);

2) the extent to which the organization has discretion over resource allocation and use; and

3) the concentration of control over a resource, i.e., the extent to which there are alternative or substitutable sources for the same resource.

The importance of the resource is measured in terms of its criticality and magnitude, i.e., respectively, the extent to which the organization requires the resource for operation and survival, and the proportion of total inputs that the resource provides. The most critical resources for the telecommunications operating entity are financing and technology, including know-how. The main external organizations that typically control these resources are, respectively, the central government and equipment suppliers and telecommunications system operators.

Discretion over the allocation and use of resources is operationalized as the extent to which the telecommunications operating entity controls access to and use of finances and telecommunications equipment, facilities and knowledge. Access, distribution and use of financial resources are indicated by the budget allocation process of central government. The use of financial resources is indicated by the regulatory constraints and oversight exercised by external organizations over the telecommunications entity. The use of technological resources, however, are largely determined by technology design. Therefore, this variable is indicated by changes in design of technology (changes in technical standards, telecommunications system configuration and design trade-offs). The part ownership by Algeria, Morocco and Tunisia of their own Arab regional satellite system, Arabsat, allows them greater discretion over configuration of the satellite system than they exert over the international satellite system, Intelsat, of which they are minority shareholders. Their participation in satellite system planning and development provides a comparison of system use, technology choice and domestic network development.

The concentration of sources for resources is operationalized as the number or range of alternative or substitutable sources for financial and technological resources. The concentration of sources for financial resources is indicated by the number and substitutability of commercial banks, bilateral and multilateral aid agencies, and the national treasury. The concentration of sources for technological resources is indicated by the number and substitutability of telecommunications equipment suppliers (domestic and international), and communications system owners/operators (international, regional and domestic, if any, in addition to the entity providing basic services).

A measure of the relative autonomy of the telecommunications operating entity is thus obtained from both the qualitative and quantitative evidence concerning the three criteria of the resource dependence model. Relative institutional autonomy is then analyzed in terms of its relationship, if any, to the development of the telecommunications sector in Algeria, Morocco and Tunisia.

The development of the sector is operationalized as the commitment of financial resources indicated by such variables as investment per capita, the percent of gross domestic product and gross fixed capital formation invested in the sector, as well as the average growth rates in these variables, and by the physical output of the telecommunications operating entity, i.e., its services and facilities, or technological resources, indicated by system size and quality (e.g., telephone density, quality of service, switching capacity, urban-rural distribution of services), technical skills and know-how (percentage of technical staff, number of training sessions and facilities), and growth rates in these variables. All of these variables are examined over a 15 year period (roughly 1972-1986), in Algeria, Morocco and Tunisia.

Selection of Countries

Algeria is of special interest because it is one of the few developing countries with extensive infrastructure throughout the country. Algeria pioneered in the early 1970s the use of non-standard earth stations and the use of the international (Intelsat) satellite system for a domestic communications network. In contrast to Algeria, Tunisia and Morocco are small countries, where satellite communications may not be cost effective (i.e., less costly than terrestrial communications) to provide telephone services throughout most of the country. A non-satellite solution has been employed to provide a domestic network in these countries. Nonetheless, Tunisia hosts the headquarters of the second technical control center for the Arab regional satellite system, Arabsat, as well as the Arab States Broadcasting Union which uses Arabsat to broadcast television programming, primarily sports and news, among the twenty-two Arab states. The study concentrates primarily on Algeria, and draws upon the cases of Tunisia and Morocco for comparative purposes.

Algeria, Morocco and Tunisia have also been selected because they offer certain important similarities in culture, religion, language, colonial history, location, and level of economic development, e.g., they are all middle-income countries. But they also represent important dissimilarities, in geographical size, economic development strategy and political system. The opportunity to have done field research in Algeria and Tunisia, and the availability and accuracy of data have shaped this selection as well. The greater abundance of data for these cases provides an opportunity to explore questions in greater detail and to investigate the development and evolution of the sector over a period of fifteen years (early 1970s to mid 1980s).

Contributions of the Study

The study should contribute to theory regarding organizational behavior, elite decision making and national development through the illumination of the role of the state in the allocation and distribution of public resources. Moreover, it should advance theory and knowledge regarding the transfer of technology, specifically communications technology, and its impact on the development process.

The study should contribute to the practice of telecommunications sector planning by identifying impediments to the supply of communications services, and to growth of the sector which would allow it to contribute -- according to its known potential -- to more balanced regional development and economic growth.

Chapter II

TELECOMMUNICATIONS DECISION MAKING IN THE THIRD WORLD

Key institutional relationships and decision processes, centered around major decisions of a particular issue area over time (such as telecommunications investment levels and priorities), constitute a decision making structure. The major aspect of the telecommunications decision making structure that is investigated in this study is the relationship, if any, between the relative autonomy of the telecommunications operating entity and the development of the telecommunications sector, i.e., the supply of services. The relative autonomy of the entity is a measure of its dependence upon the political and technological organizations and processes which control the resources critical to its survival and operation.

The Study of Decision Making

The study of elite decision making in developing countries has its roots in the modernization approach of political theorists such as Huntington (1968) whose work is concerned with the level of institutionalization and the need for highly centralized forms of government. In these studies, the degree of government, not its institutional relationships, is the key distinction in deciding whether development will occur. Some of the studies in this tradition on the role of elites in the public policy making process have been criticized, however, because their focus on the fundamental role of decision-making elites is a way of stressing, and perhaps advocating, regime maintenance and order at both the lower level of the nation, and at the higher level of the relationship between national and international elites (Rothchild and Curry 1978; Rothstein 1977). If the analysis of planning and public policy in developing countries is not broadened beyond the activity of government, conceived as regime maintenance and centralization, then it is in danger of being merely "instrumental and technocratic" (Lowi 1970). These early analyses of public policy analysis tend to pay little or no attention to the role of the state and its socio-economic and decision making structures. Rather they are concerned with psycho-sociological explanations of political behavior in the Third World and treat the state largely in the pluralist sense of 'neutral arbiter' (Higgott 1983).

The central political questions of power over resource allocation within a developing country -- who gets what, how, and at the expense of whom -- must take account of international structures and the relationships between the developed and developing states, and to the role that the state plays in these relationships, as well as in the relationships among its domestic institutions.

Like the modernization approach, the radical perspective has made valuable contributions to the political-economic study of development. But the radical school is rooted in theoretical assumptions about the primacy of the economic whole, and is therefore largely reductionist with regard to politics and the role of the state (Higgott 1983). Much of this Marxist-inspired scholarship insists that the state must reflect the interests and goals, not of the political elite, but of specifiable economic actors. While important and profound insights have been generated by scholars working in the Marxist tradition, the logic of political explanation remains reductionist (Kohli 1986). Their theoretical framework treats politics and the state as dependent variables, influenced and determined by the more fundamental socio-economic changes. There are limits to how far one can strain the logic of socio-economic determinism in political analysis since it cannot focus attention on some of the salient political relationships in the state. These relationships are simply better analyzed by a political logic that is interactive with socio-economic variables. No single factor may properly be considered a basic "cause" of development problems; rather, as Myrdal has argued, all factors are interdependently related. Most scholars acknowledge that there is a circle of interdependencies whereby economic factors affect political and administrative conditions which, in turn, have a feedback effect upon economic development (Riggs 1964).

Administrative defects and inadequacies are as much a consequence of underdevelopment as a cause of it. There are few, if any, direct causal sequences, either from political and social to economic conditions, or from economic forces to governmental. Economic change and public administration have this kind of interdependent relationship with one another, and with the total cultural setting in which they take place (Riggs 1964).

It is becoming increasingly clear that the dynamics of development are also being moulded by Third World states themselves rather than by international economic factors alone (Cardoso 1979; Evans 1979; Sklar 1979, 1987; Higgott 1983). Some political structures and processes result from a partially autonomous logic -- a political logic that cannot be reduced to or derived from socio-economic variables (Kohli 1986). The idea that policy can make a difference in development has emerged in recent studies: that the modern state, with all its powers, could not only dominate, but transform societies. An understanding of telecommunications development therefore, requires a detailed knowledge of the actual relationships and processes of decision making within the broader context of the socioeconomic and politico-administrative structures in which they operate. (Higgot 1985; Fitzgerald 1978).

This investigation is inspired by and attempts to build upon earlier studies (Stepan 1978; Waterbury 1983; Smith 1986; Skocpol 1985; Kohli 1986) that assert the significance of certain political factors and relationships to their respective analyses of development issues while taking account of socio-economic structures. These earlier studies attempt to highlight the significance of some of the political variables -- state actions, relations among the political elite, political traditions or patterns of state organization -- for explaining patterns of change in developing countries. Patterns of state intervention in society (e.g., investment in telecommunications) can be empirically analyzed for understanding both why specific development strategies or options were adopted, and the consequences of political choices for social and economic change. An appropriate perspective for this type of analysis highlights the diversity in state structures within the Third World and the different capacities of these states to facilitate development (Smith 1986).

Both mainstream and radical schools study the ruling group, whether it be called the 'decision or policy making elite' or the 'ruling or dominant class.' Both research programs have come to recognize the fundamental role of the state in political and economic activity. Both are much more historically and spatially specific. The research approach of this study -- the resource dependence perspective of organizational decision making -- draws upon the strengths of both mainstream and radical schools to produce an analysis of the actual decisions, institutions and decision-making process within the context of international and domestic economic and political structures. The primary focus of this investigation is on the telecommunications decision making structure, i.e., decision processes and institutional relationships, and their effect on the supply of telecommunications services in three countries. The study takes the view that the decision making structure embodies elements of the socioeconomic and political structure, but not in a deterministic way. A decision is the result of the interaction between institutional actors and politico-economic structures.

Resource Dependence Model

Both classical and contemporary theories of bureaucracy recognize that a bureau is dependent on the outside world for its resources (Eisenstadt 1959; Hall 1982). But while classical theories of bureaucracy recognize organizational dependencies, much research still neglects the role of the environment, and analyzes organizational action or structure isolated from its context. Writers who adopt such an open systems model of organization theory (March and Simon 1958; Katz and Kahn 1966; Pfeffer and Salancik 1978, inter alia) identify the environment not only as the social context in which organizations exist, but also as an important determinant of organization structure, process and decision making (Cook 1977). That a system is open means, not simply that it engages in interchange with the environment, but that the interchange is an essential factor underlying the system's viability (Buckley 1967).

Contemporary organization theory is dominated by environmental considerations. The need to compete for resources is a basic aspect facing every governmental department. From the very beginning, a bureaucracy is in a state of constant interaction with its environment and has to develop different ways of maintaining a dynamic equilibrium. This contextual perspective is especially important in the analysis of telecommunications organizations in developing countries, where the central government is heavily involved in economic development activities of all kinds, and where so much of modern technology and technical know-how is externally produced and provided by advanced, industrialized countries. Rondinelli and Cheema (1983) associate autonomy with the concept of centralization, one of the four primary structural characteristics of organizations. They identify autonomy as one major form of de-centralization, i.e., the delegation of decision making and management authority for specific functions to semi-autonomous or parastatal organizations that are not under the direct control of central government ministries.

The resource dependence model has strong ties to the political economy model of organizations (Wamsley and Zald 1973; Benson 1975), and the dependence-exchange approach (Hasenfeld 1972; Jacobs 1974). The model also incorporates contingency theory of organizations (Hannan and Freeman 1977; Kasarda and Birdwell 1979), which states that environmental factors select those organizational characteristics that best fit the environment (a natural selection model). But the contingency model is criticized for not explaining well the behavior of large contemporary private or public organizations whose survival is guaranteed, e.g., the telecommunications monopoly provider (Aldrich 1979; Pfeffer and Salancik 1978). Moreover, the contingency model downplays the role of organizational actors in determining the fate of the organization. The resource dependence model brings organizational decisions and actions back into consideration while retaining the environment as a critical influence.

Organizations vary in their vulnerability to environmental pressures, but every organization is dependent on its environment to some degree (Jacobs 1974). The need for resources is one of the major reasons for an organization to interact with its environment and to develop inter-organizational relationships. Whenever two or more organizations transact resources of any kind (money, physical facilities and materials, technical services, etc.) an inter-organizational relationship exists (Van de Ven and Ferry 1980; Aldrich 1979). The resource dependence model attempts to explain the processes set in motion by that relationship based on need for resources It argues that an organization involved in exchange relations with external organizations and processes that control the resources necessary to the organization's operation and survival becomes other-directed, not self-directed. An organization formulates its actions in response to demands from other organizations, specifically those organizations upon which it is most dependent for its critical resources.

Two of the most critical resources of a telecommunications operating entity are financing and technology, including know-how. Without either money or technology there would be no telecommunications infrastructure. Telecommunications entities in developing countries are most dependent on political organizations of the central government (for financial resources) and on equipment suppliers and system owner/operators (for technological resources, including technical skills and knowledge) which are usually based in advanced, industrialized countries.

Organizations strain to achieve or maintain autonomy (Gouldner 1959). But the fact that they must interact with other organizations in order to obtain resources necessary for survival makes them dependent on the environment to some degree. The dependence of the organization on the environment makes external control of organization behavior possible (Pfeffer and Salancik 1978). The organization tends to be influenced by the external elements that control the resources it requires, and tends to adapt internal strategies to deal with the perceived environmental dependencies or pressures (Snow and Hebreniak 1980). The resource dependence model stresses the importance of power arrangements and the demands of external groups in the decision making process and the determination of choices (decisions) made. Decisions are made in a political context and are affected by power positions and power coalitions in an out of organizations. The decision making process is a political one in that different particular options are supported by different factions within the decision making structure (Hall 1982).

Resource dependence writers regard the control of scarce resources as the most important factor in the creation of power dependencies (Robinson, Hinings and Greenwood 1980). Institutional autonomy is the degree to which an organization has power with respect to its environment (Selznick 1953). In political terms, power is defined as the ability to make decisions that affect the distribution of societal values (Easton 1965; Lowi 1969). Autonomy means that an organization is capable of choosing the course of action it wishes to pursue (Levine and White 1961; Clark and Wilson 1961), that it has the ability to use resources primarily at its own discretion, rather than according to strict legislation, regulation, or the controls of oversight authorities. It involves the delegation of authority, which is one of the major concerns of organization theory and development administration (Weber 1947; Urwick 1947; Riggs 1964, 1971; Rothwell 1972; Schaffer 1974, 1981; Swerdlow 1975; Gant 1979; Hall 1982).

Pfeffer and Salancik's three factors (discussed in the previous chapter) indicate the relative dependence of the focal organization on its environment. Each factor indicates ways in which an organization tries to control parts of its environment and to adapt its goals to a changing environment or to different ways that groups outside the organization control and direct its activities. According to this model, the greater the dependence of the telecommunications entity, the greater the influence these external institutions exercise over the day-to-day and long-term financial, administrative and technical decisions of the telecommunications sector. This study argues that the influence of these external political and technological organizations actually inhibits the development of the sector, i.e., inhibits the supply of telecommunications services in developing countries.

Why Autonomy for Telecommunications?

Rondinelli and Cheema (1983) among others have pointed out that greater autonomy does not always lead to more effective institutional performance in terms of the delivery of goods and/or services. It is clear from experience with attempting to implement decentralization policies that not all of the alleged benefits materialize and that few developing countries have been highly successful in carrying out decentralization programs. Simply creating decentralized structures for decision making and administration do not guarantee that they will be effective or that they will generate economic growth with social equity. Little attention has been given to identifying the appropriate functions that governments can and should decentralize or to the obstacles to implementing decentralization policies. Some insight , however, is provided by the work of Hirschman (1967) and Israel (1987).

As noted earlier, Hirschman and Israel have found that the public agencies that perform most effectively are those which are more technical in nature. Within institutions, technical and financial activities fare best, while maintenance, personnel issues and coordination are the least successful. Israel cites telecommunications as one of the the most successful institutional development cases.

Israel concludes that two factors, specificity and competition, seem to provide the central explanations for variations in institutional performance, and to offer incentives to improve that performance. Albert Hirschman's analysis in his 1967 study *Development Projects Observed* supports Israel's findings, with his contrast between industry and infrastructure and agriculture, his concepts of latitude and discipline and his analysis of the discipline imposed by high technology and by time-bound and even location-bound activities.

The concept of specificity is linked to theories of organization that put special emphasis on technology and the technical core as determinants of the structure of organizations. Specificity is defined in terms of two groups of elements: 1) the extent to which it is possible to specify for a particular activity the objectives to be attained, the methods of achieving those objectives, and the ways of controlling achievement and rewarding staff; and 2) the effects of the activity -- their intensity, how long it takes for them to become apparent, the number of people and other activities affected, the practical possibilities of tracing the effects. In addition to the traditional economic conception of competition (external competition from others attempting to provide the same or similar goods or services), three other kinds of competitive pressures may be exerted on an organization. They are referred to as competition or market surrogates because they are capable of influencing institutional performance when market competition is not possible or desirable. In general, competition provides an incentive, or pressure, in a way similar to that of specificity. It reduces the areas of discretionary behavior for individuals and groups in the organization, and imposes a discipline that results in a higher level of performance. Competition and competition surrogates work by threatening an organization's survival; if it does not adapt it may be forced into bankruptcy or the equivalent (Aldrich 1979).

Telecommunications is an activity with high specificity (as are most high technology activities), but generally little or no competition. There is no point, however, in opening up an activity to competition, especially in the public sector, if it will induce the loss of the best customers or beneficiaries and therefore actually decrease effectiveness (Hirschman 1958). How does economic competition affect the performance of public sector activities that are *not* threatened with extinction (such as telecommunications)? As noted earlier, the resource dependence perspective, with its emphasis on the role of institutions and groups with which an entity interacts and the social and economic system in which it operates, attempts to explain decision making by large public sector organizations whose survival is not threatened. A related line of inquiry is also relevant in this respect: "task environment," a term used by organization theorists to refer to all aspects of an institution's environment that are "potentially relevant to goal setting and goal attainment" (Dill 1958). A "task environment" approach is related to the resource dependence model in that the resource dependence model claims that an organization adjusts its decisions and behavior (e.g., means become ends or goals) on the basis of critical environmental demands and pressures.

Israel notes that there are several mechanisms -- competition surrogates -- that can be activated to compensate for a lack of competition. These include the budget process of government, pressure from clients and beneficiaries (similar to Hirschman's concept of "voice"), partial privatization of public enterprises (e.g., leasing contracts), and increases in the competitive atmosphere within an institution, to overcome what Israel calls the "conglomerate phenomenon".

The conglomerate phenomenon is the combination of two or more distinct activities, e.g., post and telecommunications. The conglomeration of postal and telecommunications services is common in developing countries. Internal competitive pressure can be brought to bear by creating divisions between these activities rather than conglomeration, so that they operate as independently as possible rather than trying to achieve high levels of coordination between them (Israel 1987). In short, surrogate competition pressures can be brought to bear by clients, beneficiaries, or suppliers, and by the political establishment and controlling and regulatory agencies. These two external competition surrogates (pressure from clients, beneficiaries, or suppliers and that from the political establishment) have been the subject of extensive work among organization theorists.

According to Hirschman and Israel's argumentation, the telecommunications operating entity is an agency of high specificity with a discipline imposed by the communications technology and technical tasks; as such, it is predisposed to perform more effectively than non-technical sectors and programs. If the telecommunications entity has a proclivity toward effective performance, why do we see large unmet demand for telecommunications services, poor quality of service, and relatively low investment in the sector? This study argues that the technical aspects of the organization predispose it to perform effectively, but the decision making structure of the sector -- the entity's lack of autonomy from political and technological organizations -- holds back the effectiveness of the entity and accounts for a large measure of the undersupply of services that is observed in so many countries.

Israel suggests that where there is no competition, surrogate competition pressure from the political establishment, in the form of the budget allocation process, can improve institutional performance. Yet, Saunders, Warford and Wellenius argue that the lack of autonomy of the telecommunications operating entity from the political processes of government reduces the entity's effectiveness. Is the central government, through the budget allocation or regulatory processes or otherwise, exerting pressure on the operating entity to perform more effectively? This study argues that these decision making processes act as disincentives to improved performance by the entity.

The telecommunications operating entity in a developing country typically depends upon political organizations for financing, and on technological organizations for much of their equipment, certain system services (e.g., international satellite communications), and some know-how or training.

The combination of financial dependence and technological dependence reduces the ability of the operating entity to perform effectively in the supply of telecommunications services. In light of Hirschman and Israel's finding that technical organizations are predisposed to perform effectively, this study argues that the greater the autonomy of the telecommunications operating entity from external political and technological organizations, the greater the supply and distribution of communications services.

Financial Dependence

Three criteria determine the relative autonomy (or dependence) of an organization on elements in its environment: 1) the importance of the resource (criticality and magnitude) to the operation and survival of the organization; 2) the discretion of an organization over resource allocation and use; and 3) the concentration of sources of resources, i.e., the number of alternative or substitutable sources for the same resource.

Telecommunications is a capital intensive sector. The importance of finances as a critical resource is well established. Labor cannot be substituted for capital in this sector as it can in some others which may draw upon so-called appropriate (labor-intensive) technology. A labor-intensive version of telecommunications technology might be the messenger who runs among buildings in a city delivering notes. This kind of system exists where the capital intensive technology of telecommunications, the actual cables and switches, are defunct or impossibly overcongested (e.g., as used to be the case in Cairo). But a modern telecommunications system cannot substitute labor for capital in this way.

The allocation of financial resources is typically controlled by the central government. Financial resource allocation is a process of budget development by individual ministries, and budget debate and approval by central government, typically Ministries of Finance and Planning, Cabinet Ministers, and Parliament, with the President or King having final approval. The discretion of the telecommunications entity over financial resource allocation is severely limited when the entity relies on the budget allocation process of central government for its critical financial resources. The entity must compete with other bureaucratic organizations for scarce domestic funds and foreign exchange, and therefore must struggle against the "imperialism" of more powerful bureaus or ministries. Pfeffer and Salancik argue that conflict is exacerbated where resources are scarce, a major characteristic of developing countries. Israel notes that financial resources tend to flow toward high-specificity and competitive activities because they offer greater potential for growth and control. Yet, evidence shows that telecommunications receives one of the smallest budget allocations in National Plans of most developing countries, typically about 0.3% of gross domestic product as opposed to about 0.6% in industrialized countries (Wellenius 1987). Does the lack of telecommunications autonomy inhibit this tendency of financial resources to flow towards telecommunications?

Cohen, Grindle and Walker (1985) stress the importance of financial (political) dependence in their administrative system and policy space research, most notably the impact of a set of influential environmental constraints, i.e., budget allocations, legislation concerning activities and oversight, constitutional divisions of authority, and the "imperialism" of other bureaucratic organizations. Administrative systems and policy space research lies within the resource dependence perspective insofar as it attempts to explain institutional behavior (administrative system) within a macrosocial context (policy space). Their research focuses on elaborating how and why specific development institutions operate as they do and takes account of opportunities and constraints on bureaucratic actors in the planning and implementation of policies and programs, in light of the institution's relationships with other agencies. It aims to understand the realistic policy options decision-makers can consider given their specific environmental pressures and constraints. The budget allocation process, as well as constitutional divisions of authority and the oversight of other agencies, reveal the dependent relationship between the telecommunications operating entity and the central government, specifically the extent of government control over financial resources and therefore the investment levels of the operating entity. A decision maker's perspective (policy space) is shaped by these environmental constraints, which in turn effect his/her decisions concerning the goals and activities of the organization.

The regulation and oversight of the telecommunications entity effects the entity's discretion over the *use* of financial resources. Constraints imposed by external organizations with regulatory oversight are indicated by the extent to which external organizations allow the operating entity: (a) to revise tariffs to adjust for inflation; b) to generate funds to cover operating costs and new investment; (c) to collect bills promptly from all users, including government subscribers; and (d) to function separately from postal services.

The typical primary source for financial resources is domestic government (The National Treasury). For additional financial resources, a telecommunications operating entity might be permitted to call upon various sources of financing besides central government; these are: self-financing, bilateral governmental aid; suppliers' credit; commercial banks; private financial companies;

and multinational financial institutions. The role of each of these sources of financing is different. Kouassi Apetey (1986), former Minister of Posts and Telecommunications for the Ivory Coast, summarizes them as follows:

- Suppliers' credits and funds from commercial banks and private finance companies are comparatively easy to turn to, but they have certain disadvantages: they are tied to specific types of equipment, are offered at very high rates of interest, and capital repayment periods are very short. The dependence of the telecommunications operating entity on foreign suppliers can be compounded by the foreign supply of credit or financing for the purchase of equipment. Telecommunications entities can reduce dependence by forming joint ventures with foreign suppliers.

- Bilateral governmental aid, be it in the form of grants or loans, generally comes from industrialized countries and is frequently a reflection of political affinity. Beneficiary countries have no choice regarding the equipment tied to such loans, which sometimes means that prototype equipment is included in a network which entails additional financial burdens and technical complications for the operating administration. The suppliers' credits, commercial banks or bilateral aid, are hardly ever concerned with the technical and financial viability of projects and far less with the management capacity of the recipient telecommunications entity.

- Multilateral financial institutions, having as their main objective the socio-economic development of the countries with which they are involved, are concerned with promoting the project sector as a whole and with the organizational and managerial capability of the executing agency. That is why, when financing these projects, multilateral institutions (U.N agencies such as the World Bank, the International Telecommunications Union, and the United Nations Development Program) are not only concerned with the purchase and installation of equipment, but also with the evaluation of implementing agencies and even with the financial and economic situation of the country as a whole.

Therefore, the concentration of sources for financial resources is low if the entity is permitted to borrow from a wide variety of sources -- domestic and international -- and, most importantly, from itself through self-financing (keeping earned revenues to reinvest in sector development).

Technological Dependence

Additional environmental constraints arise from the dependence of the telecommunications entity on external technological organizations, thereby putting the entity in a kind of double bind. The telecommunications entity obtains its critical technological resources primarily from equipment suppliers and telecommunications system owner/operators, the majority of which are based in advanced, industrialized countries.

The technological dependence of the telecommunications operating entity is the product of the importance of the technological resources to the organization, discretion over their allocation and use, and the extent to which these resources are controlled by relatively few organizations. Technological dependency is a long-term reliance by developing nations on technology and technological decisions made in the core (advanced, industrialized) nations. The term 'dependency' which is used to characterize the relations between core and periphery or semi-periphery states (developing countries), means that a substantial proportion of the decisions as to production and accumulation are made outside the developing economy, through foreign enterprises or other pressures (Fitzgerald 1978).

The importance of the technological resources to the telecommunications entity is indicated by the criticality and magnitude of the resource exchange. The criticality of telecommunications equipment and maintenance is indisputable, insofar as there could be no telecommunications facilities and services without a vast array of technology, including the technical expertise to maintain and operate the equipment. The magnitude of the technology resource exchange is a proportion of total inputs, i.e., the proportion of total budget designated for construction costs. To what extent is the operating entity able to substitute domestic equipment for foreign imports?

There are many sources for technological resources (equipment and technical assistance), because there are many equipment manufacturers and vendors, as well as related governmental agencies, most of which are based in advanced industrialized countries (e.g., Hughes, Siemens, Aerospatiale, Nippon Electric Company, among others, as well as the U.S. Department of Commerce, the Ministries of Post, Telephone and Telegraph of the European countries and Japan). Possession, including possession of knowledge, is one obvious form of external control over a resource (Pfeffer and Salancik 1978). The dependence of the telecommunications operating entity of a developing country on these external technological organizations is inevitable, given the greater level of skills and knowledge in advanced, industrialized countries. The question that concerns this study is the extent of that dependence.

The industrial property system has not facilitated the indigenous generation of relevant knowledge (Hamelink 1985). The transfer of technology that is North-South (between developed and developing countries) is mainly transfer of entire packages, or turnkey projects, such as telephone and data switching equipment, radio/TV stations, or intra-firm transfer. The absorption of foreign technology requires an institutional context that can accommodate the new technology. Technology must be mastered, locally produced and integrated into the socio-cultural environment to be 'owned' (Stewart 1977; Hamelink 1985). Transfers often by-pass the usual avenues of human resource development, local research and development, and socio-cultural relevance, thereby increasing dependence and underdevelopment. The result is a vicious cycle of technological dependency.

Some writers argue that the technological progress that has led to the 'communication revolution' will only exacerbate the current inequalities and disparities between the developed and developing countries (Schiller 1981; Hamelink 1985; Mattelart 1985; Jussawalla 1985). Industrialized countries will preserve their comparative advantage in high technology and knowledge-based industries, and the Third World will be relegated to labor-intensive industries. The dependent economy becomes locked into the world economy by which foreign companies may control large portions of domestic resource extraction, industry and finance. Telecommunications goods and services can themselves be transferred according to this pattern, and they can become a tool for private and public organizations to facilitate the continuation of this pattern through the rapid and voluminous exchange of information between the organization in the developing country and its parent organization in an advanced, industrialized country. Most multinational corporations now exercise control through technology, not through shareholding (Fitzgerald). Therefore, the capability of the developing country to substitute equivalent local manufactured equipment for imported technology is an important means of reducing dependence on foreign sources of technology.

The telecommunications operating entity's discretion over the allocation and use of technological resources is limited by the design of the technology. Technology design determines use. Technological organizations in advanced, industrialized countries -- equipment suppliers and system owners -- generally determine technology design and innovation (Hemenway 1975, Lusignan 1983, Martinez 1985). Equipment manufacturers and system owners can affect the design of a technology cluster (e.g., a satellite communications system) on the basis of when -- and if -- they make available the inputs necessary for all the elements (Rogers 1983), e.g., higher powered satellites which allow the use of smaller, less expensive earth stations. Manufacturers design and produce technology according to market demand; owner/operators of satellite systems affect technological resources through design trade-offs built into the network configuration. The design of telecommunications technology and the configuration of communication systems have been developed primarily to meet the greatest demands of the telecommunications market, i.e., clientele in the advanced, industrialized countries. The design requirements in advanced countries are for the greatest channel capacity at the lowest possible cost because the volume of traffic is high. In contrast, the need in non-urban areas of developing countries, with low communications volume, is for a few reliable channels, with little maintenance. Technology design (and therefore, its use) is often less than optimal for the two-way communication needs of rural areas of less developed countries (Martinez 1984; ITU/OECD 1983; Maitland Report 1984, among others).

Much of the earth station technology ("Standard A") required for interconnection with the international satellite system owner/operator Intelsat is expensive, large, and requires substantial power generation (including air conditioning for electronic components), and skilled maintenance. Most LDCs can afford to own and operate only one such station and they generally locate them in the primary urban center(s) for the reception and transmission of international communications traffic. The large, expensive earth stations are appropriate for connecting an LDC with other countries for international communications. But smaller, less expensive earth stations are more appropriate (more feasible and affordable) for building integrated infrastructure *within* many LDCs, i.e., to link urban and rural areas, as well as rural areas to each other (Martinez 1984; ITU/OECD 1983; ITU 1986; Parker 1984). Since the Intelsat satellites have not been designed for rural areas of LDCs, even the smaller earth stations (Standard D, Vista stations) are relatively expensive (approximately $55,000 each FOB) and can only accomodate a few telephone channels which limits growth and expansion of the network.

Therefore, while the concentration of sources for technological resources is low (i.e., there is a large number of equipment suppliers from which an operating entity can obtain equipment and training), the discretion of an entity over the allocation and use of the equipment is effectively limited by the design of the technology. The fairly limited designs and system configuration trade-offs are indicated by the technical standards and other technical characteristics of a communications system. Technical standards can, in principle, act as a means of advancing the interests of both the developing country as customer, and the manufacturer, but in practice, developing countries generally defer to the decisions of the supplier (Hemenway).

Participation in decision making is central to an organization's discretion over the allocation and use of technological resources (Pfeffer and Salancik 1978). The participation of developing countries in the decisions of technical standards setting bodies (e.g., Intelsat, the International Telecommunications Union -- the United Nations agency responsible for international regulation of telecommunications) has been limited by the cost involved in sending participants to such meetings, and by the scarcity of technical expertise on the part of developing country personnel. Participation of developing countries in the technical standards decision making of the International Telecommunications Satellite Organization (Intelsat) is also limited by the fact that developing countries have a minority investment share, with minority voting power, in the organization. Participation of developing countries in decisions concerning the design of equipment is therefore only possible where local mastery of the technology permits domestic research and development and manufacturing, or where the developing country has formed a joint venture with a foreign company which permits local participation in technical design decisions.

Telecommunications system owners operate at a domestic, regional or international level. At the domestic level there is the telecommunications operating entity, which provides at a minimum, public telecommunications services In addition there may be other system owner/operators providing communications services (e.g., private leased networks and services). At the regional level there may be a regional satellite system. At the international level there are two satellite system owner/operators providing communications services between and within most countries of the world -- the system established by the United States, Intelsat, and the system established by the Soviet Union.

The twenty-two Arab states of the Arab League own and operate their own regional satellite, Arabsat. This ownership, in principle, allows them greater discretion in the allocation and use of the technological resources (the design of the satellite and technical configuration of the network). How have Algeria, Morocco and Tunisia, which are members of this regional satellite network, responded to these technological opportunities in their environment? Have they designed systems that would provide, among other things, comprehensive domestic telephone services? Has the supply of services been effected by this greater discretion over resource allocation and use?

CHAPTER III

RESEARCH DESIGN AND METHOD

Case Study Method

This investigation is a case study of the relationship between telecommunications decision making structure and sector development in three countries of North Africa. As such, it is an empirical inquiry of a contemporary phenomenon within a real-life context in which multiple sources of evidence are used. The study, therefore, is similar to naturalistic research, but with more constraints (Yin 1984); these are that: 1) the study is carried out in typical settings where the researcher intervenes deliberately, rather than in a purely natural or "undisturbed" environment; 2) the research focuses on particular groups, individuals, settings or events; 3) the research examines limited classes of behavior rather than all activity and total context of behavior. The research design comprises five elements: 1) the study's questions; 2) its propositions; 3) its unit(s) of analysis; 4) the logic linking the data to the propositions; and 5) the criteria for interpreting the findings. As a case study, this research does not manipulate independent variables, but rather involves observations about relationships among variables, with statements of high or low probability that when one variable is present the other also occurs. Therefore, it can provide the *basis* for initial causal inferences, but, as with other case study research, it does not make causal inferences. It helps to identify and describe a relationship between two variables, a kind of probability relationship referred to as a contingency (Graziano 1989).

Insofar as this investigation considers three cases (Algeria, Tunisia, and Morocco) it is a multiple case study, and therefore the study as a whole uses a multiple case design. Some fields such as political science call a multiple case design a "comparative case method." Using multiple cases provides greater external validity to the study. The variables are often "embedded" units of analysis, i.e., a lesser unit than the case itself (e.g., the size of the telephone system within a case country), for which numerous data points have been collected (Yin 1984). The embedded unit may be some archival indicator -- telecommunications system size, switching capacity, etc. -- or some service outcome, such as the number of clients served by an organizational unit that is the subject of the case study (e.g., the number of telephone subscribers). The relevant analytic techniques of embedded units can cover nearly any of the techniques of the social sciences. In multiple case studies with embedded units of analysis, such as this study, the appropriate analysis is first conducted within each case. Results are interpreted at the single case level. The patterns or explanations for each single case are then compared across cases, following a replication mode for multiple cases. Finally, the conclusions drawn for the multiple cases become the conclusions for the overall study.

The investigation uses a multi-measurement approach comprising qualitative data (elite interviews, archival data, institutional histories) and quantitative data (primarily statistics) over a fifteen year period from the early 1970s to the mid-1980s. Mixing qualitative and quantitative methods is referred to as "triangulation" indicating that different kinds of data have been collected about the same phenomenon (Smith 1975). The use of multiple sources of evidence in case studies allows for the development of converging lines of inquiry, following a corroboratory mode. The mixing of qualitative and quantitative data allows for statistical analysis and secondary analysis of data which a qualitative study alone does not provide (Kuhns and Martorana 1982). Triangulation between methods (qualitative and quantitative) is common in political science and public administration.

Quantitative data concerning investments, entity performance and sector development are derived from the national plans and sector reports of the case countries, and the ITU Yearbook of Telecommunications Common Carrier Statistics (1972-1986). The data are clarified and supplemented, as necessary, through archival records and face-to-face and telephone interviews with area specialists and country economists working closely with North Africa, telecommunications suppliers, and with representatives of the telecommunications operating entities in these countries.

Qualitative data include interviews, institutional histories and other archival material. Qualitative methods require careful specification of the context in which research findings emerge in order to ensure that institutional analysis is grounded in real world patterns. The concept of context is a major assumption of historical study and qualitative methodology. It predicates that any thought or act is part of a web of experience and indeed is a product or function of that web. Moreover, the past is part of the context of the present; the immediate past has a significant effect on the present by setting conditions. For this reason, tracing changes over time is a often a major component and strength of case studies to examine and interpret the evidence. Tracing changes over time is one of three analytic techniques used in case studies.

This study uses a combination of three analytic techniques: time series analysis, pattern matching and explanation building. Time series mode of analysis matches a trend of data points compared with: 1) a theoretically significant trend specified before the onset of the investigation; and 2) some rival trend, also specified earlier, versus 3) any trend based on some threat to internal validity. This study investigates trends in data concerning the development of telecommunications infrastructure (growth in system size, traffic, investment levels, etc.) over a fifteen year period (1972-1986). Investigating the variables over time is necessary for several reasons: 1) investment in telecommunications tends to be lumpy, and lumpy investments must be averaged out for a valid representation of trends; 2) development of sector takes place over time; 3) technological change and its consequences occur over time;

4) institutional adjustment to technological change in the form of re-organizing and re-structuring occurs over time; and 5) it takes time for institutional changes to influence the development of the sector.

Pattern matching compares an empirically based pattern with a predicted one (or with several alternative predictions). An explanation building mode of analysis is used for explanatory case studies (as opposed to strictly descriptive case studies) to compare details and evidence of the case against an initial theoretical statement or proposition about policy or social behavior. This investigation compares the details and evidence of institutional autonomy and sector development in three countries against the initial proposition that the supply of services is inhibited by a lack of autonomy on the part of the telecommunications operating entity. On the basis of the initial proposition, we would predict that in Algeria, where telecommunications services are better supplied than in Morocco or Tunisia, the telecommunications operating entity is less dependent on external political and technological organizations for its critical resources than are the operating entities in Morocco and Tunisia.

Operationalization and Measurement of Variables

Institutional autonomy is operationalized as the extent to which an organization needs external resources to attain its selfinterest goals for a specified period of time (Van de Ven and Ferry 1980).

Resources are generally operationalized as either tangible goods and services (money, office space, physical equipment, client referrals, joint planning activities, technical assistance) or intangible qualities (public visibility, goodwill, prestige). This study is concerned primarily with tangible resources. The most critical resources of the telecommunications operating entity are those related to financing and technology, including know-how. Resource transactions or exchanges are measured in terms of degree and direction: 1) to what extent does the organization receive resources (money, physical equipment, technical assistance) for its involvement with the other specified organization? 2) resource flow is from the external organization to the telecommunications entity or vice versa? A qualitative and quantitative understanding of the nature and extent of the dependence between the telecommunications entity and certain external organizations, discussed in the next two sections, provides an overall measure of institutional autonomy.

This study examines four major factors: the development of the telecommunications sector; the financial dependence of the telecommunications entity; and the technological dependence of the entity. The operationalization and measurement of each of these factors are discussed below.

Financial Dependence

Financial dependence is operationalized as the extent to which the telecommunications entity relies upon external organizations for its critical financial resources. The relevant external organizations controlling capital resources are the ministries of the central government with budget approval, regulatory, oversight or coordination functions with the telecommunications entity (most notably, Ministries of Finance, Planning, Communications and Transportation).

The first factor determining financial dependence of the telecommunications entity, the importance of the resource, is measured by the relative magnitude of the resource exchange and by the criticality of the resource. The criticality of financial resources is undisputed. The relative magnitude of the resource exchange is established by assessing the proportion of total inputs or the proportion of total outputs accounted for by the exchange. This is indicated by: 1) the proportion of the total budget for the telecommunications entity which comes from the central government; and 2) the proportion of total central government funds which comes from the telecommunications entity.

The second major determinant of autonomy is the organization's discretion over, i.e., capacity to determine, resource allocation and use (e.g., telecommunications investment levels and priorities). This discretion is indicated by the extent of government control over the budget authorizations and allocations for telecommunications sector plans and by the regulation and oversight of the telecommunications entity. Discretion over resource allocation is indicated by the procedures for budget approval (e.g., does the telecommunications entity retain the right to keep earned revenues or must it go through the budget allocation process for funds from the National Treasury?).

Institutional discretion over the *use* of financial resources is measured by several variables: 1) the ownership and formal status of the telecommunications operating entity (conventional government department, versus semi-independent branch or board within a government department, versus a regulated corporation); and 2) the extent to which regulatory procedures and oversight allow the operating entity: a) to revise tariffs to adjust for inflation and to generate funds to cover operating costs and new investment; b) the authority to collect bills promptly from all users, including government subscribers; and c) to operate separately from postal services.

The third major determinant of autonomy is the concentration of control over a resource, or the extent to which input or output transactions are made by a relatively few, or only one, significant organization. The concentration of control is measured by the number of alternative sources for necessary resources, and the extent to which the telecommunications entity can substitute sources for the same resource. Concentration of financial resources is measured by: 1) the number and substitutability of sources for domestic funds (e.g., domestic development or commercial banks, national treasury, private capital); 2) number and substitutability of sources for foreign exchange (e.g., commercial banks, multilateral lending, bilateral aid).

Technological Dependence

Technological dependence is operationalized as the extent to which the telecommunications entity needs resources from external technological organizations and processes, including technical skills and knowledge. The importance of the resource means the criticality of the resource to the focal organization and the relative magnitude of the resource exchange. Telecommunications equipment is highly critical to the survival and operation of the operating entity; without telephone instruments, data terminals, switching exchanges, transmission lines, etc., there could be no communications services. The criticality of foreign versus domestic suppliers of equipment, however, is relevant to the costs incurred in developing the sector. Foreign suppliers are critical when the domestic manufacturing component, if there is one, does not produce the necessary resources (e.g., electronic digital switches, earth stations) or does not produce them in sufficient quantity to meet the requirements of the telecommunications entity.

The magnitude of the technological resource transaction i.e., the proportion of total inputs or total outputs accounted for by the exchange of equipment, services, and technical assistance/training between the telecommunications entity and external technological organizations, is indicated by: 1) the proportion of all telecommunications equipment, services and technical assistance paid for in foreign exchange (i.e., comes from external international organizations); and 2) the proportion of all equipment, services and technical assistance that is provided by domestic organizations (manufacturers, other domestic system owner/operators, and independent training facilities).

The second major determinant of technological dependence is the organization's discretion over, i.e., capacity to determine, resource allocation and use. Technological design (e.g., telecommunications equipment design trade-offs) determines technology use. Technological organizations -- equipment suppliers and manufacturers, and system operators -- determine the design of the equipment and the trade-offs within the technical system configuration. In so doing, these organizations have pre-determined the final use to which their equipment can be put by any operating entity. Thus, external technological organizations effect the decisions of telecommunications operating entities regarding technology choice. Technical designs and system configurations are indicated by technical standards, and the technical trade-offs in the system. Changes in technical standards allow for alternative designs and system configurations, thereby changing the use of the network.

Technical standards -- performance requirements and criteria of the communications equipment which standardize the quality of the transmission signal and assure some compatibility among interrelated parts -- are set by various bodies dominated largely by equipment manufacturers (Hemenway 1975). A technical analysis of the changes in standards and a content analysis of the verbal proceedings of the Space WARC treaty negotiations[4] provide a measure of the diversity and suitability of the available technical designs and system configurations for telecommunications networks in developing countries. The capacity to determine technological resource allocation and use is measured by: 1) technical standards and changes in technical standards; and 2) communications system configuration trade-offs.

The third major determinant of technological dependence is the concentration of control over a resource, i.e., the number and substitutability of technology sources, or the extent to which input or output transactions are made by a relatively few, or only one, significant organization. Sources of telecommunications equipment, services and know-how include domestic and international equipment manufacturers, system operators, and bilateral or multilateral conduits for technical assistance. The number and substitutability of sources for necessary technological resources is indicated by: 1) the number of organizations -- domestic and international --

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[4] Space WARC is the nickname for the World Administrative RAdio Conference on the use of the geostationary satellite orbit and the planning of space services utilizing it. Space WARC meetings were conducted in 1985 and 1988.

providing equivalent expertise or training; 2) the proportion of domestic versus foreign construction costs, and 3) the number of equivalent system owner/operators for domestic, regional and international services.

The concentration of sources for technical skills and knowledge is measured by the personnel policies of the entity and the training capacity of the country. Freedom to set salaries, wages and other benefits is directly related to the ability of the telecommunications operating entity to attract and keep qualified personnel, including its leaders. Personnel expertise is operationalized as the degree of professional skills of people in the organization (Van de Ven and Ferry 1980). Moreover, people most often obtain job skills from three basic sources: formal school education, job entry orientation and training, and on-the-job continuing education. Domestic technical expertise is indicated by 1) the proportion of technical staff; 2) the number of trainees per 1,00 DELs; and 3) the quantity and quality of training facilities available to staff. Leadership is operationalized as the individuals or groups of persons who hold formally designated leadership positions, who are actively engaged in the formulation of the doctrine and program of the institution, and who direct its operations and relationships with the environment. It is measured by: 1) the initiation of deliberately induced change; and 2) the exercise of important continuing influence over the activities of the telecommunications entity.

The resource dependence model thus provides a measure of the relative autonomy of the operating entity vis-a-vis specific organizations in its environment which control its critical resources. The relative autonomy or dependence of the telecommunications operating entity is subsequently analyzed in terms of its relationship to the development of the sector.

Development of the Sector

The development of the sector is operationalized as the commitment of financial and technological resources to the telecommunications sector. The commitment of financial resources is measured by investment levels. The term "investments" is used here to refer to the expenditure associated with acquiring the ownership of property and plant. This includes expenditure on initial installations and on additions to existing installations where the usage is expected to be over an extended period of time.[5] Investment levels are indicated by several variables, as available, over a fifteen year period, including: 1) investment in telecommunications as percent of gross fixed capital formation; 2) investment in telecommunications as percent of gross domestic product; 3) investment per capita, and 4) the average annual growth rates in these variables.

[5] **ITU Yearbook of Telecommunications Common Carrier Statistics, Geneva: ITU Publications, 1987, p. 19.**

In order to determine whether increases in telecommunications investment have been called for over the fifteen year period of the study, the investigation compares investment in the telecommunications sector relative to investment in other infrastructure sectors, in light of economic rate of return and demand for each sector (two basic and universal economic criteria for investment). The investigation compares the economic rate of return and the percent of demand met for each infrastructure sector (e.g., power, water, transport, telecommunications) for the selected countries, and their respective investment levels over a fifteen year period (1972-1986). If the economic rate of return is lower, and percent of unmet demand is lower, but investments are higher, for other infrastructure sectors than for telecommunications, then investment increases are justified for the telecommunications sector, according to these basic, universal criteria.

Investments priorities are established by the proportional investment in various services and characteristics of the network. Priorities are indicated by several variables: 1) Development of the network (e.g., telephone density or the number of telephones per 100 population, automatic versus manual equipment, analog versus digital equipment); 2) quality of service (e.g., fault rate, repair rate, completed call rate, system congestion or switching capacity) ; 3) distribution of services (e.g., urban versus rural telephone density; urban versus rural number of public call boxes); 4) projections for the future (estimated expenditures on certain services, etc.).

The direction of resource exchange is two-way, if the telecommunications entity is not self-financing. That is, the telecommunications entity receives its funding from central government, but it also turns over its earned revenues to central government. Typically, the entity earns more revenues than it gets back in the budget allocation process.

Comparison of Cases

The case study method is most appropriate here for several reasons. First, the investigation lies within the beginning stages of research in a new area. While the argument by Saunders (1985), Saunders, Warford and Wellenius (1983) and Pfeffer and Salancik (1978), Van de ven and Ferry (1980), among others, concerning the importance of institutional autonomy is well-specified, empirical research testing this hypothesis in individual cases is in the beginning stages. Thus, another rationale for a case study is relevant here, i.e., when the case represents a critical case in testing a well-formulated argument or theory. The theory specifies a clear set of propositions as well as circumstances within which the propositions are believed to be true. The critical case will be used to confirm, challenge or extend theory, to determine whether the theory's propositions are correct, or whether some alternative set of explanations might be more relevant. This case study is a critical test of existing theory. Thirdly, one of the bases for selecting a particular case for study is that the site selection is a "best case." In such instances, the researcher seeks to answer the question "what accounts for an effective program?" This study begins with a focus on Algeria as a "best case," as a study of what accounts for what appears to be a fairly effective telecommunications development program (well supplied services). Lastly, the selection of a cluster of sites (the Maghreb states) is a purposive basis for case selection in that the research seeks to demonstrate how different programs, within a reasonably uniform cultural range, compare with each other.

The three countries under investigation have been selected primarily on the basis that they have not unduly disregarded the telecommunications sector. They offer important similarities in culture (Berber and Arab), religion (Islam), language (Berber and Arabic), colonial history (French), and geographical location (North Africa). They are all middle income countries, although Algeria is an upper middle income country, and Tunisia and Morocco are lower middle income countries. These three cases also provide important dissimilarities, in geographical size, economic development strategy and political system. The opportunity to have done field research in Algeria and Tunisia, and the availability and accuracy of data have shaped this selection as well. The greater abundance of data for these cases provides an opportunity to explore some questions raised by the study in greater detail and to investigate the development and evolution of the sector over a period of approximately fifteen years (early 1970's to mid 1980s). The study concentrates primarily on Algeria, and draws upon the cases of Tunisia and Morocco for comparative purposes.

Algeria is of special interest because of it is one of the few developing countries with extensive infrastructure throughout the country. Algeria pioneered in the early 1970's the use of non-standard earth stations and the use of Intelsat transponders (satellite channels) for a domestic satellite network. In contrast to Algeria, Tunisia and Morocco are smaller countries, where satellite communications may not be as cost effective (i.e., less costly than terrestrial communications) in providing telephone services throughout most of the country. Since scholars of Algeria's socio-economic development have been impressed with the quality and coverage of its telecommunications infrastructure, the study begins with an examination of the development of the telecommunications sector (in all three Maghrebi states) in the next chapter. This chapter is followed by chapters on Financial Dependence and Technological Dependence, which seek to test an explanation for such exemplary infrastructure, i.e., the autonomy of the telecommunications operating entity from external organizations controlling its financial and technological resources.

CHAPTER IV

TELECOMMUNICATIONS SECTOR DEVELOPMENT IN ALGERIA, MOROCCO AND TUNISIA

BACKGROUND

Basic Indicators

The World Bank classified Algeria, Tunisia and Morocco, as middle income countries throughout the period of the study (1975-86). Algeria was an upper middle income country, while Tunisia and Morocco were lower middle income countries (**Table IV-1** Basic Indicators). Algeria was the richest of these three middle income countries, with a per capita GNP of $2,590 in 1986 (similar to Argentina and South Korea). It is the second largest country in Africa covering an area of slightly less than 2.4 million square kilometers. In 1986 the population was about 22 million, 95% of which lived along the narrow northern coastal zone lying between the Mediterranean and the Atlas mountains. Virtually all non-hydrocarbon related activities of the economy were concentrated in the northern coastal zone: agricultural production, governmental units, services and industry. In 1985 43% of the total population lived in urban areas, with about 10% of that urban group (about 2 million) living in the nation's capital and largest city,

Table IV-1

BASIC INDICATORS (1986)

	ALGERIA	MOROCCO	TUNISIA
Pop	22m	22m	7m
Life Expectancy	61	59	63
Area (sq km 10^3)	2,382	447	164
GNP pc $US	$2,590	$590	$1,140
GNP pc GR 1965-86	3.5%	1.9%	3.8%
Inflation rates			
1965-80	9.9	6.1	6.7
1980-86	6.1	7.7	8.9
Investment Rates[1]			
1973-78	48.3	24.9	28.8
1979-84	39.7	22.3	30.7
Savings Rates[2]			
1973-78	39	16.5	21.5
1979-84	38	12.2	22.7

Source: World Bank Development Report (1986) p. 274

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[1] Investment rate=gross domestic investment/gross national product

[2] Savings rate=gross national savings/gross national product

Algiers Algiers was the only city with a population of over 500,000 persons Only about 5% of the population lived in the highlands and Saharan zones which made up 82% of the country's land area The economy of the south was based on hydrocarbons (petroleum and liquified gas)

Morocco was the poorest of these three middle income countries with a GNP per capita of $590 in 1986 (similar to the Ivory Coast and Equador) **Table IV-1** "Basic Indicators" shows that the total population in Morocco in 1986 was 22 5 million, very close to Algeria's The rural population accounted for 56% of the total population; the urban population was 44% Until the late 1980s there was only one city, Casablanca, with a population over one million Total land area covered 270,123 square miles The economy of Morocco relied heavily upon its main export -- phosphate minerals It is distinguished among the countries of North Africa by the magnitude of its mountains (Swearington 1987) The high, rugged Atlas Mountains extend for more than five hundred miles in three parallel ranges This has made the establishment of terrestrial communications lines especially difficult and costly

Tunisia was also a lower middle income country, but with a higher GNP per capita than Morocco, at $1,140 in 1986 (similar to Turkey and Ecuador) **Table IV-1** shows that it covered an area of 164 thousand square kilometers In 1985, 56% of the total population lived in urban areas Tunisia's biggest sources of foreign exchange were mining and tourism

In 1986, 60% of the population of all three North African countries was under 25 years of age One of the countervailing forces to increasing the number of telephones per 100 inhabitants (telephone density) is rapid population growth Algeria has one the highest population growth rates among developing countries, a constant 3 1% average annual growth between 1965 and 1986 Morocco's population growth rate also constant during these years was 2 5%, Tunisia's was 2 1% (1965-80) and 2.3% (1980-86)

All three Maghrebi states experienced economic growth during the 1970's In Algeria, the major increase in oil revenues after 1973 enabled large investments in many sectors of the economy including telecommunications Tunisian economic performance in the period 1960-1979 was 4 8% average annual increase (in real terms) of GNP per capita Morocco, an oil importer, offset the oil price increase by raising the price of its major export, phosphate, in 1974. It suffered a slowdown in growth in the late 1970's, when cheaper phosphate sources, such as Florida mines, took business away from Morocco Nonetheless, as a major exporter of phosphates, Morocco has not been without resources and prospects

French Colonialism and Communications

All three Maghrebi states are former French Protectorates, Algeria from 1830 to 1962, Morocco from 1912 to 1956, and Tunisia from 1881 to 1956. Under French colonization, all foreign telephone calls were routed through Paris. Internal communications networks followed only a few main arteries of information exchange. In Algeria, for example, a maximum of only nine domestic calls could be placed simultaneously along the north-south axis of the country. These domestic telephone calls traveled over wires on poles. During the national uprising for independence beginning in 1954 these pole wires were easy targets of Algerian revolutionaries trying to disrupt the long-distance communications of the French colonizers. In order to overcome this vulnerability, the French developed a new long-distance radio communications network centrally controlled through the office of the Poste, Telegraph and Telephone (PTT) in Algiers. By using radio (over-the-air) communications instead of terrestrial lines, the French were able to overcome the disruption of north-south long distance communications. In addition to the public lines operated by the PTT under French control, foreign oil companies since the late 1950s, operated an extensive local radio system to aid in the search for oil in the Sahara (Debbasch et al 1970; Hermassi 1972).

Most radio equipment used before independence in Algeria, as in Morocco and Tunisia, came from French manufacturers, most notably the Compagnie Francaise Thomson-Houston and Societe Francaise Radioelectrique-Afrique, which operated a manufacturing subsidiary to produce standard telephone sets in Algiers. Prior to independence in Algeria in 1962, the majority of telephone subscribers were, not surprisingly, in the two largest cities, Algiers, the capital, and Oran. Following independence, Algeria emphasized technical expertise in the administration of the country (Debbasch et al 1970; Hermassi 1972).

In Morocco, there was a private concession for telecommunications (ending in 1964) in the former Spanish zone, and another in the city of Tangier (ending in 1967) that served about 7,000 subscribers. But the major part of telephone services were run as a state enterprise for which the Ministry of Posts, Telegraph and Telephones was responsible. The Directorate of Telecommunications was a public agency with a revenue earning function, but it was also dependent on the Ministry of PTT. It was not a public enterprise of a commercial nature independent of a ministry. In 1969, there were 160,000 telephone subscribers, mostly concentrated in Casablanca and other major cities.

In Tunisia, the Post, Telephone and Telegraph (PTT) was established in 1888 by the French Protectorate administration The PTT, along with various other technical bureaucracies ("*directions*") including Finance, Agriculture and Public Works, was formally under the control of the Tunisian Prime Minister But in actual practice, it was a separate ministry, controlled and staffed exclusively by French nationals (Anderson 1986). The exclusion of Tunisians was justified on the grounds that they lacked technical education Early in the 1920s, Tunisian revolutionaries used the telecommunications system for mobilizing against French colonial rule. They used telegrams to organize demonstrations and campaigns from the distant reaches of the country (Anderson 1986) In the late 1960s, there was a strong concentration of telephones in urban areas, rural areas were served by radio telephone, if they were served at all Urban-rural distribution in 1968, was heavily urban-biased, with 83% of the country's telephones in the capital city of Tunis and its suburbs (with approximately 8% of the total population of the country).

Independence and Central Planning

The Democratic Socialist Republic of Algeria, had a centrally planned or "command" economy during the period of the study In a typical "command" economy, the central planning body issues planning guidelines at the beginning of the allocative process and asks all sectors to supply information to their coordinating ministries in conformance with those guidelines The Algerian government s guidelines for its economic development have been based on national self-sufficiency in important sectors. Algeria has pursued development through industrialization, which has been supported extensively by the export of energy resources (gas and petroleum). During the 1970's Algeria's national plans emphasized investment in heavy industry and development of natural gas resources The associated development of a satisfactory telecommunications infrastructure was critical to achieving these investment goals (Booz-Allen Hamilton 1983) The National Charter of 1976 states that adequate telecommunications are a requisite to the economic expansion and activities of Algeria

Algeria s rapid industrialization and overdependence on energy revenues throughout the 1970's resulted in a number of problems the emphasis on heavy industry contributed to shortages of agriculture and consumer goods, industrial productivity was low Overdependence on one source of export earnings (petroleum and liquefied gas) resulted in economic instability with changes in oil and gas prices For example, by 1980, almost 95% of Algeria's total export earnings (which amounted to approximately 65% of total revenues) came from petroleum and liquified natural gas production (Middle East and North Africa 1981). Algeria's debt burden in 1980 was high (38.7% of GNP), but the balance of payments was positive in 1979 and 1980 due to high oil and gas prices (Booz Allen Hamilton 1983). In the mid-1970s, however, a fall in oil prices brought lower than expected government revenues. These economic problems, plus the death by natural causes of President Boumedienne, inspired a re-evaluation of development goals for the 1980s, and a delay by two years of the Third National Plan.

When it was finally completed, the Third National Plan (1980-84) began a shift toward greater privatization of some activities in the economy. It encouraged the private sector and called for the decentralization of many government operations in an attempt to stimulate the economy (Entelis 1986, Rummel 1988). Industry still received 38.5% of total expenditures, but almost two-thirds of the total investment was allocated for the social sector (health, education, and public utilities). During the first three years of the Plan, however, the local telecommunications equipment suppliers of (analog) switching and transmission equipment (telephone cables) were not able to produce at levels high enough to meet P&T's requirements. As a result of this limited capacity of suppliers and of the cost and service advantages associated with modern electronic digital techniques, the P&T's Directorate General of

Telecommunications made major decisions concerning the rapid introduction starting in 1984 of electronic digital techniques in switching and transmission systems

The Kingdom of Morocco emphasized institutional continuity and commitment to system maintenance and traditional modes of legitimation throughout the period of the study. It was a kingdom -- a traditional mode of authority -- ruled by King Hassan II who inherited the throne from his father in 1961, five years after independence King Hassan II was both secular and religious head of state The country was ostensibly a constitutional monarchy, in which the King ruled with a parliament But the King could dissolve Parliament and rule by decree in national emergencies, a condition which persisted from the mid-1960s to the late 1970's Only since 1977 did the king permit a kind of limited democracy to operate

Economic decision making and other broad powers were centralized in the person of the king, and there was a large measure of government participation in the economy Nonetheless, the economy was fundamentally based on private ownership of property, private enterprise, and a capitalist form of monetary apparatus Thus, Morocco had a mixed economy, which means it made use of the market mechanism to allocate and distribute factor inputs, investment funds, and final outputs, as well as government regulation where social advantages outweighed private benefits Generally, in a mixed economy, the telecommunications entity's planning decisions are influenced by the governing authority's regulation policies and priorities (ITU 1976) In the case of Morocco, the government took considerable participation in transportation and communications, as well as other productive services As noted above, Morocco's economic development relied heavily on phosphate mining

The political system of Tunisia oscillated between 'reconciliatory' and 'mobilization' methods of governance and development since independence (Apter 1964; Hermassi 1972) During the 1960s (1962-69), Tunisia experimented with a mobilization approach, a more centrally planned economy, and with the introduction of rapid and radical social and economic change During the 1970's and 1980s, the government followed a more 'reconciliatory' approach, i e., compromise between groups with a preference for moderate programs and a mixed economy On November 7, 1987, the newly appointed Prime Minister and long time Minister of the Interior, Zine El Abidine Ben Ali, declared the President, Bourghiba, incompetent to continue governing on medical grounds, and proclaimed himself the new President of Tunisia, in a bloodless coup The people of Tunisia, as well as other national governments, greeted the coup with some relief, insofar as Bourghiba's failing health caused many people to doubt his good judgement in the final years of his long reign (1956-1987) beginning with Tunisia's independence

TELECOMMUNICATIONS SECTOR DEVELOPMENT

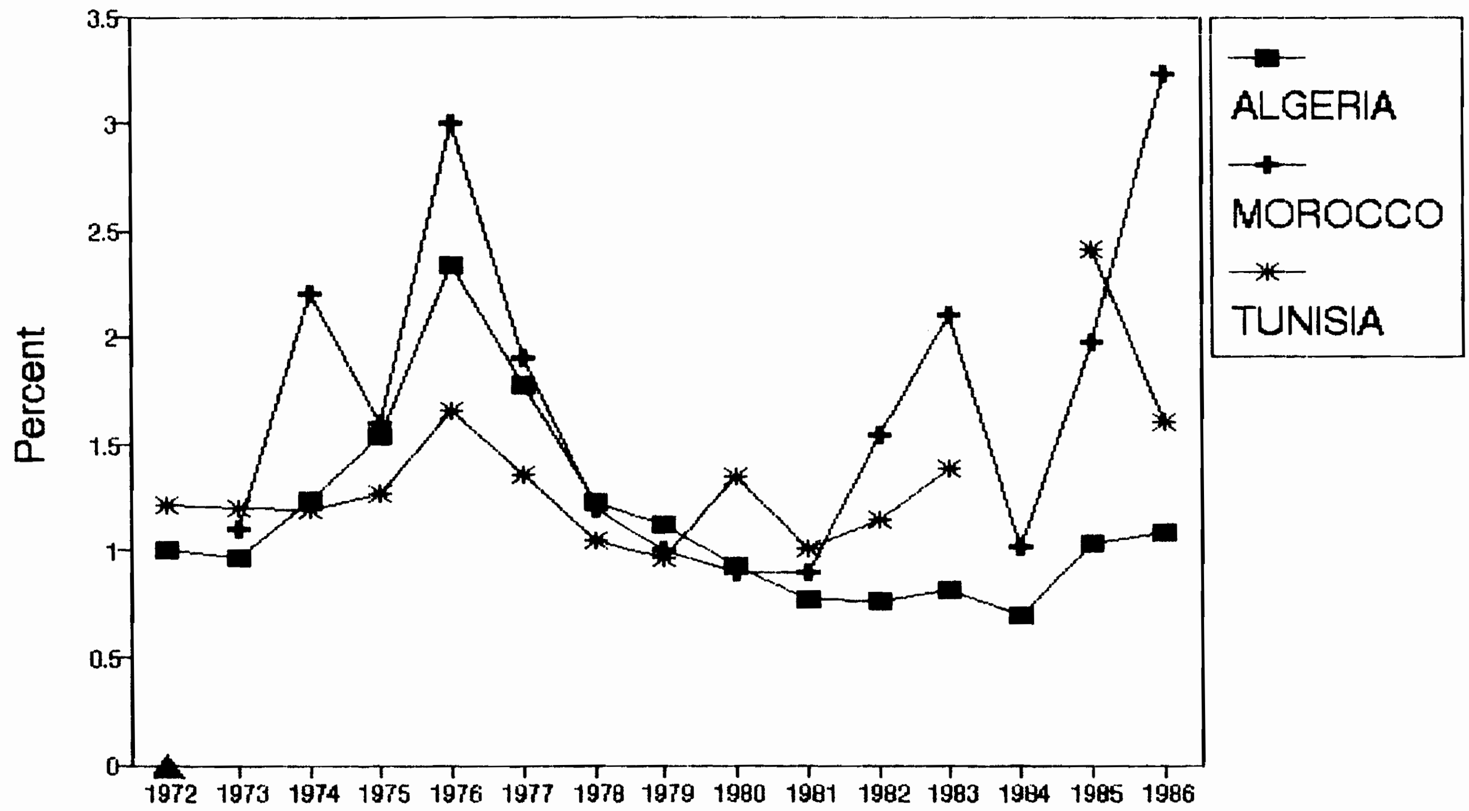
This chapter analyzes what "sector development" means in quantitative terms, and the subsequent chapters on Institutional Development, and Financial and Technological Dependence examine how organizational conditions have influenced and contributed to the development of telecommunications infrastructure in three Maghrebi states between 1972 and 1986. Consideration is given to developments since 1986, where data is available, including projections for the future

Development of the sector is operationalized as the commitment of financial and technological resources (investment levels and priorities), that result in the provision of telecommunications facilities and services. The term 'investment' generally means the expenditure associated with acquiring the ownership of property and plant. This includes expenditure on initial installations and on additions to existing installations where the usage is expected to be over an extended period of time (ITU 1987)

Criteria for Investment

In order to determine if higher levels of investment were warranted in telecommunications, the study compared investment levels in telecommunications with other basic infrastructure investments (water, road transportation and electric power), according to the usual criteria for economic planning: economic rate of return and demand. Economic rate of return and demand are basic universal guides for determining whether greater or lesser amounts of scarce resources are called for in a given area of the economy. If the economic rate of return on investment is high and demand is high, the commitment of additional resources is warranted to facilitate economic growth and development.

This section considers these criteria in light of investment levels in each of the major infrastructure sectors for Algeria, Morocco and Tunisia. Each country is considered separately, with investments and criteria compared within each country. Investment level is given as a percentage of gross fixed capital formation (GFCF), i.e., total fixed investment (See **Figure IV-1** Investment as Percent of GFCF: Algeria, Morocco and Tunisia). In the 1980s the average telecommunications investment level for developing countries generally was less than 1% of total investment (gross fixed capital formation). Advanced,



Investment as % GFCF 1972-86
Figure IV-1

industrialized countries typically spent about 2% of total investment in the telecommunications sector.[1] The water sector is limited to drinking water, and does not include such water resource expenditures as irrigation. Demand for water services is measured in several ways: 1) the proportion of total population which has access to safe drinking water; or 2) the proportion of total population which is connected to the public water system.

The transportation sector includes various modes of transport: roads, ports, civil aviation, maritime, and the transport equipment associated with each of these. Of these various modes, the most comparable with other countries is roads, since not every country has ports, shipping or its own national airlines. Therefore, only roads are considered here. Demand for transportation depends on the demand for the goods being transported. It is difficult to calculate this kind of demand and to compare it with other countries. More useful is a comparison of the total road network per capita on the assumption that everyone in the country would like to have access to roads, and to compare percentages of paved and unpaved roads, which indicate the quality of road transportation. To account for differences in the size of countries, the road network is described in terms of road

[1] **Dr. Walther Richter, Head, Telecommunications Economics Group, International Telecommunications Union, Geneva. Personal communication, October 22, 1987.**

density (length of road network per square kilometer of total area for a given country)

The electric power sector is comprised of an integrated network of electricity generation, transmission and distribution facilities. Demand for electricity is measured as electricity generation capacity divided by amount of electricity required by all types of consumers. Where this data is not available, it is measured on as amount of electricity generated per capita, and compared with the other Maghrebi states.

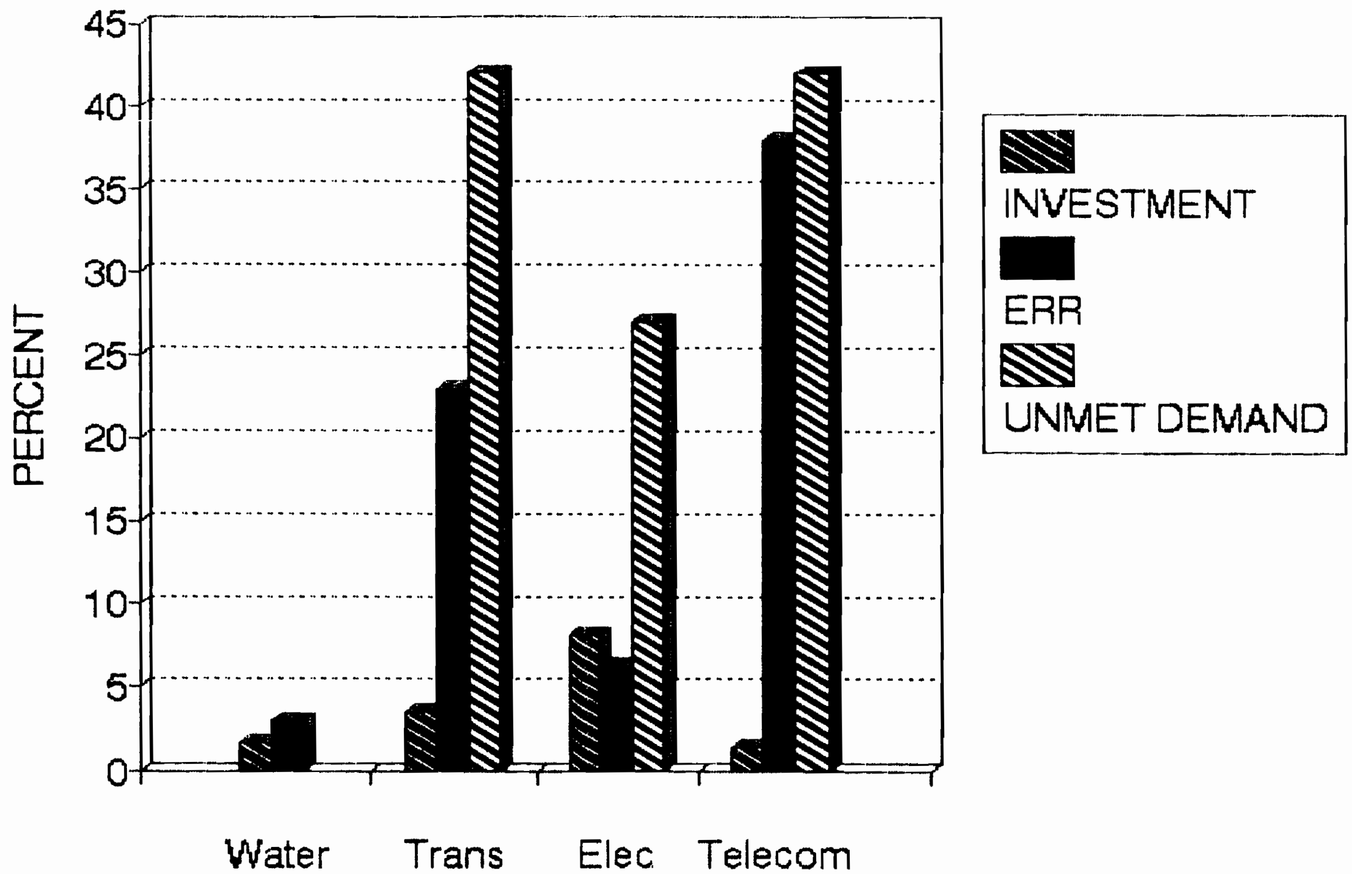
The results of the analysis are given in **Table IV-2** Comparative Infrastructure Investment: Algeria 1972-1986, and **Figure IV-1** Infrastructure Investment: Algeria 1985-89; **Table IV-3** Comparative Infrastructure Investment: Morocco 1972-1986, and **Figure IV-3** Infrastructure Investment: Morocco 1981-85; and **Table IV-4** Comparative Infrastructure Investment: Tunisia, and Figure IV-3 Infrastructure Investment: Tunisia 1987-91. **Table IV-2** shows that economic rate of return for telecommunications in Algeria was lower than other infrastructure sectors (except water) in the 1970s, and unmet demand was lower than other sectors. Therefore, investment levels of 1.5% of total public investment program (GFCF) seem appropriate. But in the 1980s, these conditions changed (See **Figure IV-2** Algeria: Infrastructure Investment 1985-89). ERR for

Table IV-2

ALGERIA

COMPARATIVE INFRASTRUCTURE INVESTMENT

		WATER	TRANSP	ELECTRIC	TELECOMM
Invest	1974-79	1	3.4		1.37
	1980-84	1.4	3.7	2.7	1.43
	1985-89	1.7	3.6	8.2	1.45
ERR	1974-79		25.5	7	
	1980-84			7.2	38
	1985-89	3	23	6.3	
Demand	1974-79	40	32	42	26
	1980-84	51	37	40	34
	1985-89		42	27	42



ALGERIA: Infrastructure Investment 1985-89
Figure IV-2

telecommunications was comparable to or higher than all other infrastructure sectors, and unmet demand was higher than all other sectors except water But investment in the telecommunications sector remained proportionally the same (1 5% of GFCF) as before, and it was lower than all other infrastructure sectors Therefore, investment levels in the 1980s seem lower than called for according to these criteria for investment Towards the end of the 1980s, we see that investment levels for telecommunications have begun to rise again.

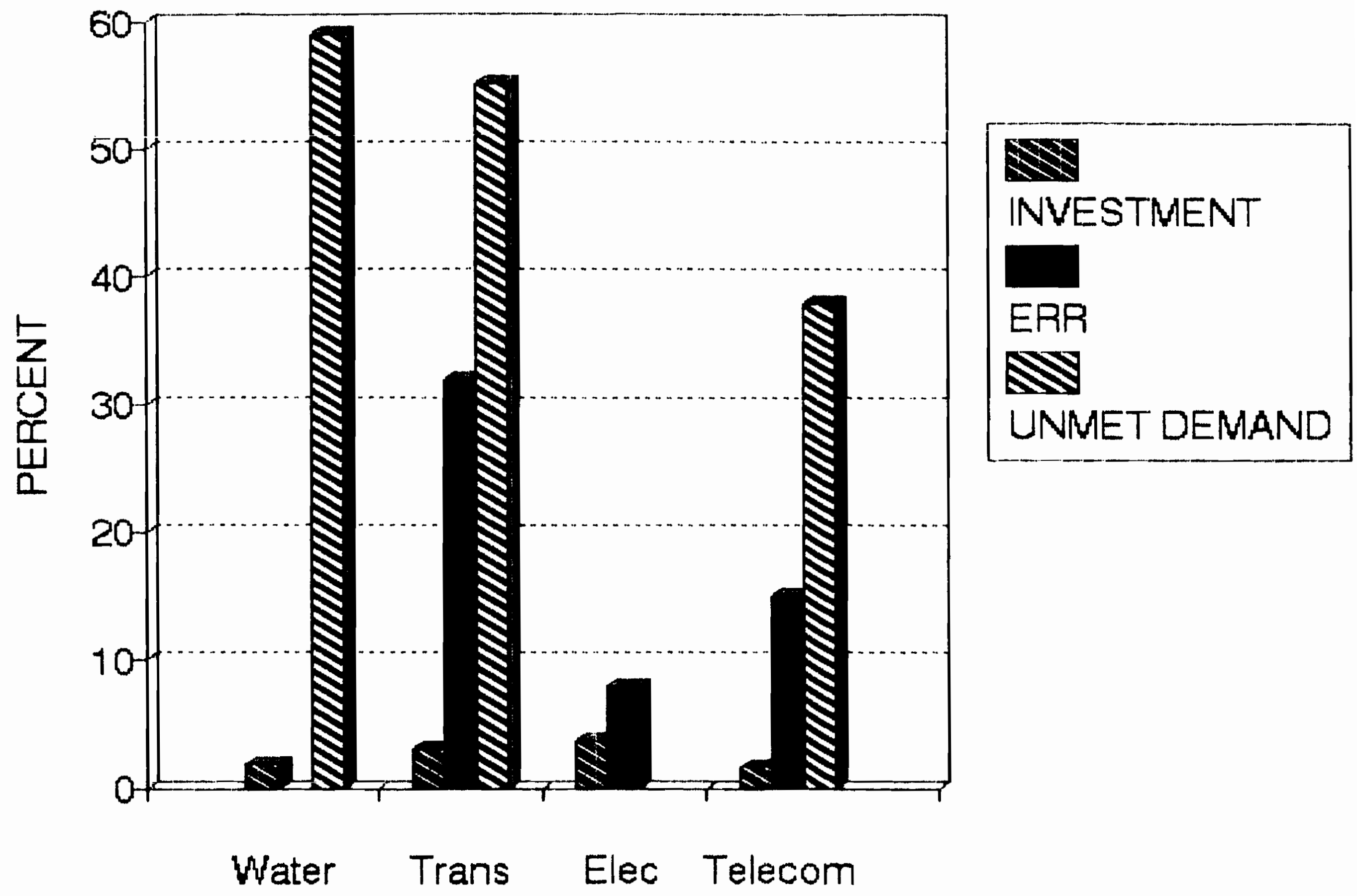
Table IV-3 shows that in Morocco, telecommunications sector investment was lower than all other infrastructure sectors throughout the fifteen year period of the study In the 1970s, investment was low, given high unmet demand relative to other sectors, i e , unmet demand for telecommunications was comparable to road transportation and probably to electricity, as well. Only water had higher unmet demand The economic rate of return on investment in telecommunications in the 1970s was not higher than other sectors except water, but this may have been aggravated by low tariffs for telephone service By the mid-1980s, ERR on telecommunications investment was higher than all other sectors except transportation (See **Figure IV-3** Morocco: Comparative Infrastructure Investment 1981-85) Therefore, the investment increases that were implemented in the late

Table IV-3

MOROCCO

COMPARATIVE INFRASTRUCTURE INVESTMENT

		WATER	TRANSP	ELEC	TELECOMM
Invest	1970-80	2.25			1.28
	1981-85	1.9	3	3.6	1.6
	1986-91				
ERR	1970-80				11
	1981-85		32	8	15
	1986-91	18		12.4	26
Demand	1970-80	49	60		31
	1981-85	59	55		38
	1986-91				40



MOROCCO: Infrastructure Investment 1981-85
Figure IV-3

1980s were warranted on the basis of these criteria

Table IV-4 shows that in Tunisia, economic rate of return on investment in telecommunications was assumed to be above the opportunity cost of capital (data not available); unsatisfied demand was higher than transportation and water during the years for which comparable data were available (1973-81) Nonetheless, investment in the sector was lower than investment in all other infrastructure sectors throughout the 1970's and most of the 1980s Thus, increases in the level of investment in telecommunications were warranted for Tunisia After 1987, such increases in telecommunications investment materialized (See **Figure IV-4** Tunisia: Comparative Infrastructure Investment 1987-91)

Telecommunications Investment Levels

Investment Per Capita

Figure IV-5 "Algeria, Morocco and Tunisia: Telecommunications Investment Per Capita shows investment per capita in the telecommunications sector (in current dollars) among these three Maghrebi states. The level of investment per capita is highest in Algeria, and lowest in Morocco

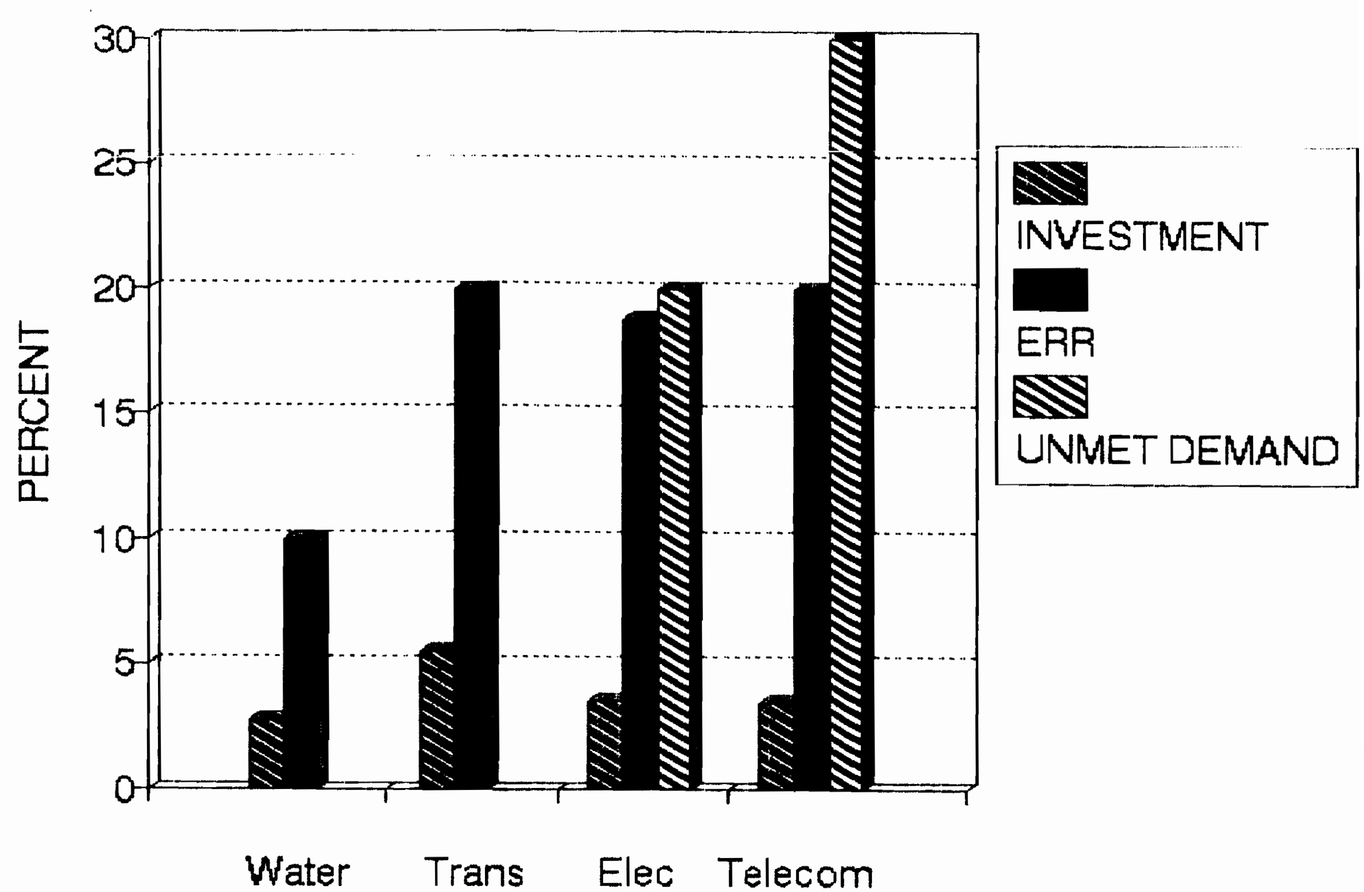
Investment per capita in post and telecommunications in Algeria was (in current dollars) $1.40 in 1972. It averaged $6.33 during the 1980-84 Plan period. In 1986

Table IV-4

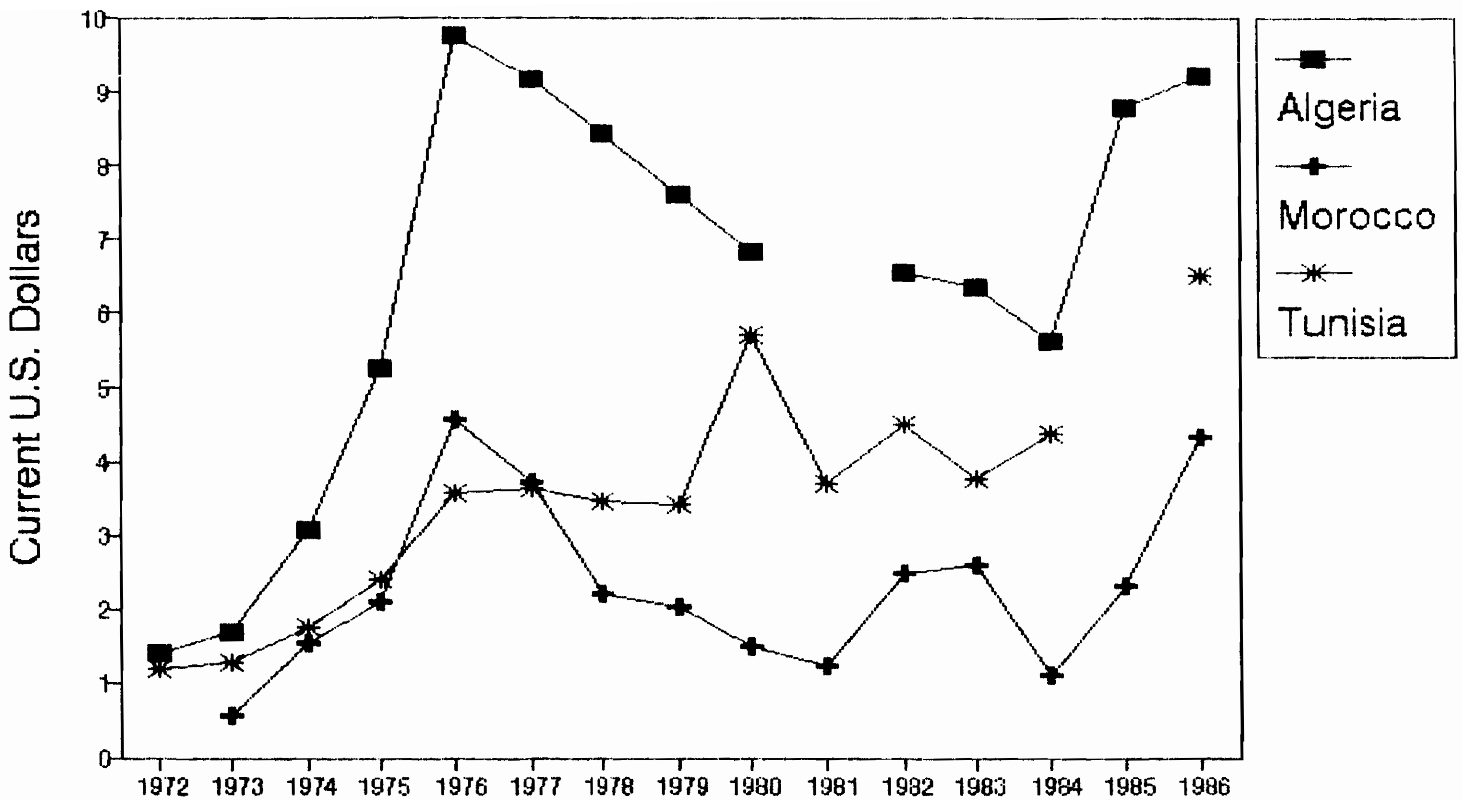
TUNISIA

COMPARATIVE INFRASTRUCTURE INVESTMENT

		WATER	TRANSP	ELEC	TELECOMM
Invest	1973-76	3.4	6.6	4.3	1.9
	1977-81	4.1	4.9	4.8	1.6
	1982-86	3	3.3	5.4	2
	1987-91	2.7	5.5	3.5	3.45
ERR	1973-76				
	1977-81				15
	1982-86	8.75			
	1987-91	10	20	18.8	
Demand	1973-76	52	52		25
	1977-81	41	53	35	32
	1982-86			31	36
	1987-91			20	30



TUNISIA: Infrastructure Investment 1987-91
Figure IV-4



Investment Per Capita 1972-86
Figure IV-5

investment was $9 21 per capita

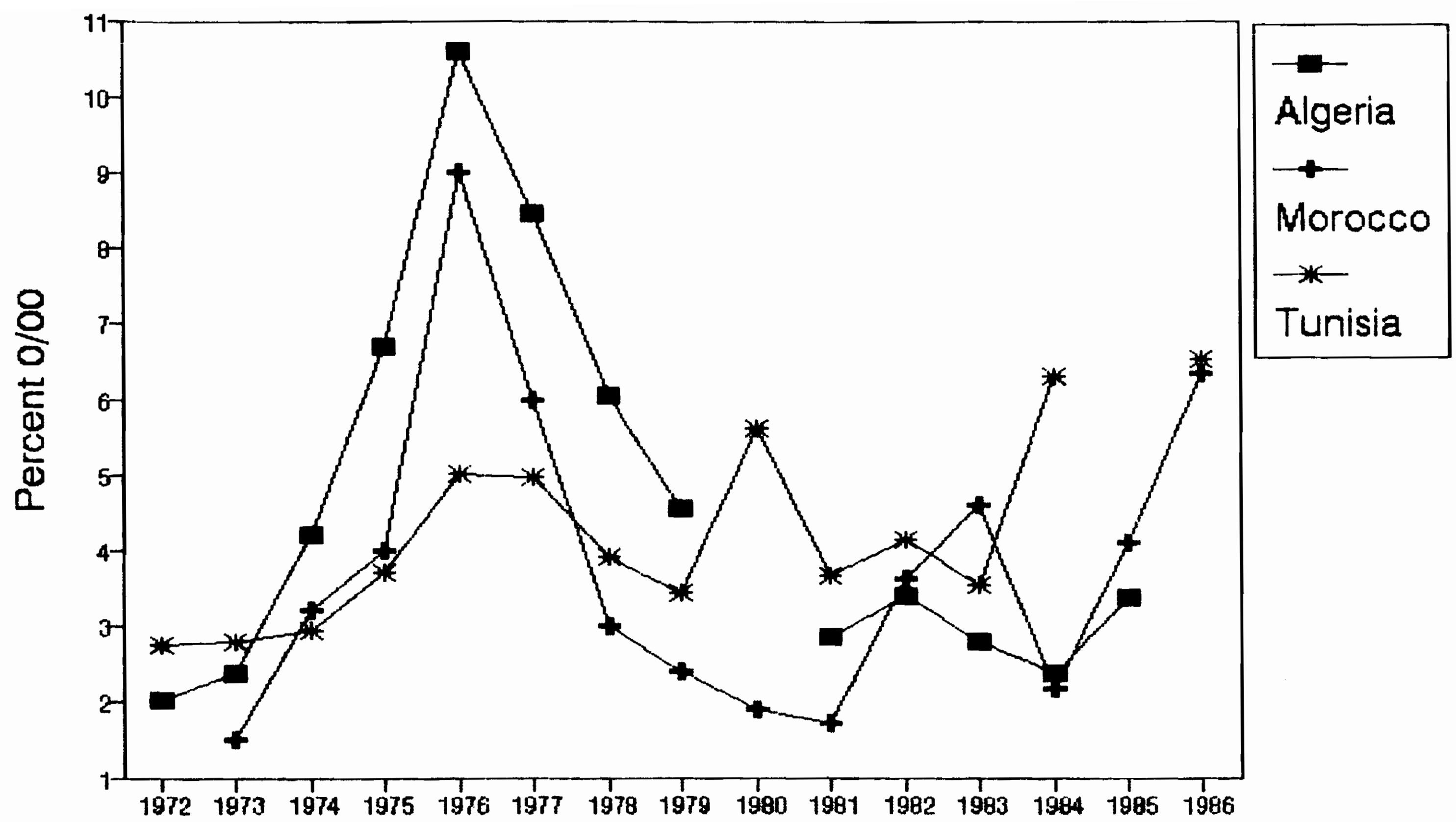
In Morocco investment per capita averaged $1 98 during the 1981-85 Plan period In 1986, investment in telecommunications was $4 32 per capita

Investment per capita in post and telecommunications in Tunisia was situated between Algeria and Morocco throughout the 1970's and 1980s It was $1 19 in 1972; it averaged $2 25 per capita during the 1973-76 Plan period, $3 98 per capita during the 1977-81 Plan period, and $4 79 per capita during the 1982-86 Plan period In 1986, the end of the VIth Plan, investment in telecommunications was $6 50 per capita in Tunisia

Expenditure forecasts by Algeria during the 1990-2000 decade were also the highest among the three states Total per capita spending on telecommunications in 1990 is estimated at US $203 00, compared with Morocco's US $37 10 and Tunisia's US $32 00 For 1995, per capita spending on telecommunications in Algeria is estimated at $375 00, compared with Morocco's $44 20 and Tunisia's $37 20 For the year 2000, Algeria's per capita spending is estimated to be $590 00; Morocco $50 20 and Tunisia $43 70

Investment as Percent of GDP

Figure IV-6 "Algeria, Morocco and Tunisia: Investment as Percent of Gross Domestic Product" shows that



Investment as % GDP 1972-86
Figure IV-6

Algeria had the highest levels of telecommunications investment per capita and percent of gross domestic product (GDP) during the mid-1970s. During the latter portion of the study (mid-1980s) Algeria's investments were lower as a percentage of GDP than Tunisia or Morocco, and yet the supply of services was comparable and the quality of service was much higher.

In Algeria, average investment in telecommunications services (total gross annual investment, including land and buildings) during the period 1974-82 was about 0.58% of GDP, well above the average for developing countries of 0.3% (Advanced industrialized countries were investing about 0.6% of GDP in the early 1980s). Investment was low (0.2% of GDP) in 1972 and 1973 (0.24%). But when Algeria purchased and installed the domestic satellite earth station network (1974-79), investment rose to 0.6% of GDP in 1975 and 1978, and 1.06% of GDP in 1976. In the early 1980s investments decreased (0.24% to 0.28% of GDP) with a high in 1982 of 0.34% of GDP. For the period 1983-88, telecommunications investment averaged 0.32% of GDP.

In Morocco, annual investment in telecommunications was 0.36% for roughly the same ten-year period 1973-1982. From 1983 to 1988, telecommunications investment averaged 0.5% of GDP. Over the 1988-94 long range period, the Moroccan government increased expenditures to approximately

1% of GDP

In Tunisia the investment in telecommunications as a share of GDP fell between Algeria and Tunisia, with an average just under 0 4% between 1972 and 1982 In the mid-1980s telecommunications investment in Tunisia increased noticeably For the period 1983-88 telecommunications investment averaged 0 44% of GDP For the 1982-86 (VIth National Plan) total investment in telecommunications averaged about 0 46% of GDP Investment in 1986 was as high as industrialized countries, i e , 0 6% of GDP This was largely due to the digitization of analog networks, the purchase and installation of new central switches (digital and analog)[2] in 1985, and to the expansion of digital networks for data applications

The fact that Algeria's telecommunications investment as percent of GDP in the 1980s was lower than Morocco's and Tunisia's, but quality, distribution and supply of services were higher (see below), demonstrates that the level of investment may not be as important as the priority of investment

Telecommunications Investment Priorities

The evaluation of the development of the sector must consider the impact of investments in terms of the

[2] **Types of switches installed included AXE, E10B, crossbar and ARK (rural semi-automatic)**

availability (provision) of service, the quality of service, and the distribution of service. Investment priorities are the hierarchy of preferences for funding and development resulting in the provision, quality, and distribution of service. The provision of service is indicated by: 1) the number of main telephone lines (direct exchange lines or DELs); and 2) the density of main telephones (number of DELS per 100 inhabitants).

The quality of service is indicated by: 1) the congestion of circuits, or exchange fill; 2) call completion rates (the probability of getting a busy signal due to circuit overload); 3) the number of faults (telephone breakdowns) per year per subscriber; 4) the proportion of faults repaired within 48 hours; 5) the waiting time for a telephone connection; and 6) the proportion of the network which is handled by automatic (subscriber direct dialing) versus manual (operator assisted) equipment.

The distribution of services is indicated by telephone density in urban versus rural areas; and 2) quality of service indicators noted above (rural versus urban), where available.

The average annual growth rates of the measures of these variables demonstrate patterns of sector development over the fifteen year period of the study. Historically, no country has been able to sustain over long periods, a growth in new subscribers of substantially more than 15% per year This requires doubling its facilities every five years, even if demand is growing at a faster rate

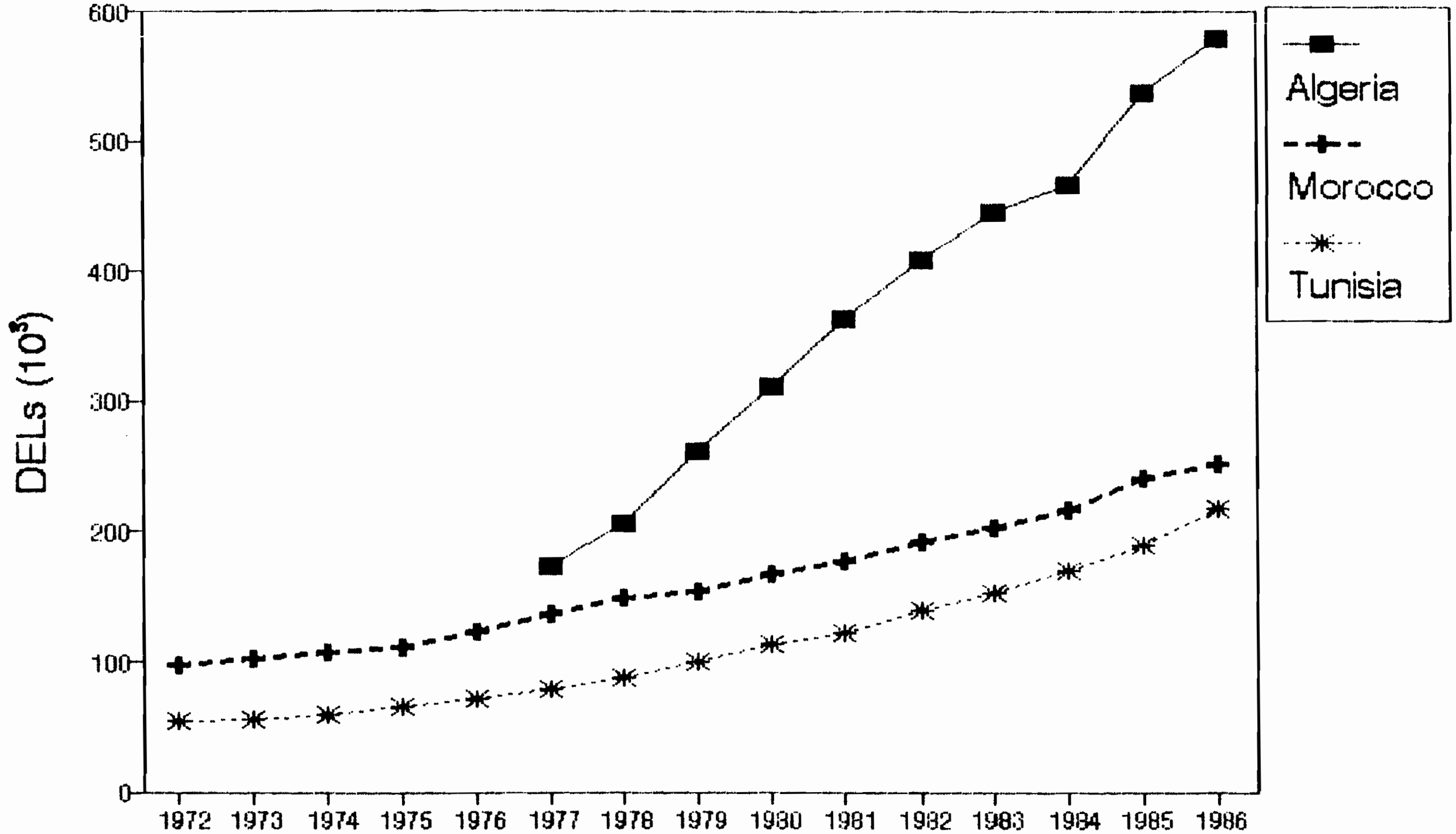
Provision of Service

Number of Main Telephones (DELs)

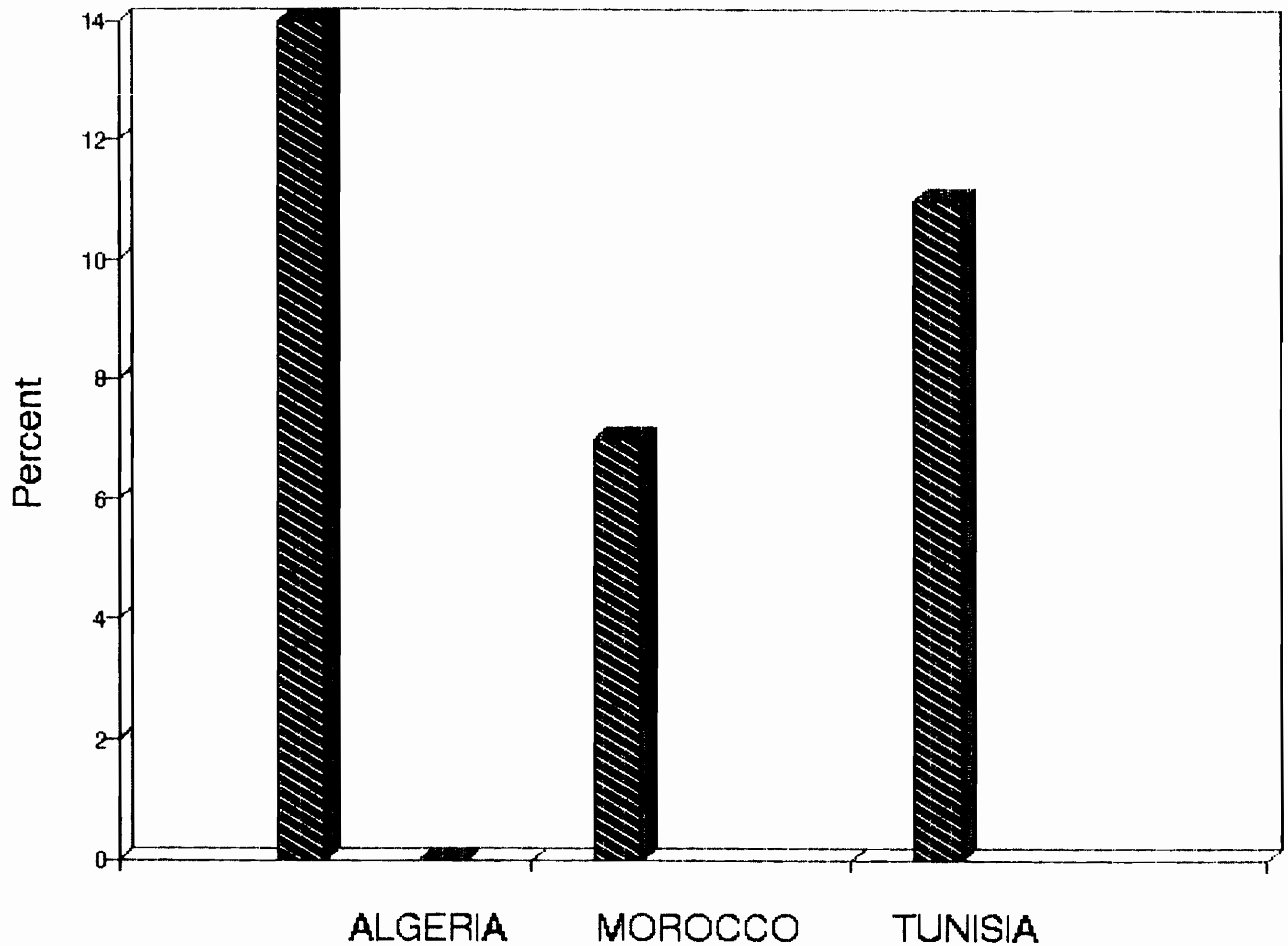
Among these three North African countries, Algeria had the highest *number* of DELS throughout the fifteen year period between 1973 and 1986 (**Figure IV-7** Number of DELs: Algeria, Morocco and Tunisia) The average annual growth rate in the *number* of DELs in Algeria was about 14% (1972-86); in Morocco 7% (1972-86); in Tunisia 8% (1972-86) (**Figure IV-8** Algeria, Morocco and Tunisia: Average Annual Growth Rate in the Number of DELs) But Algeria had a higher population than Tunisia, therefore the telephone *density* (number of Direct Exchange Lines or DELs per 100 inhabitants) is more important than the absolute number of telephones. Algeria had a slightly lower DEL density than Tunisia. Both Algeria and Tunisia had DEL densities higher than Morocco (**Figure IV-9** "Algeria, Morocco and Tunisia: DEL Density")

DEL Density

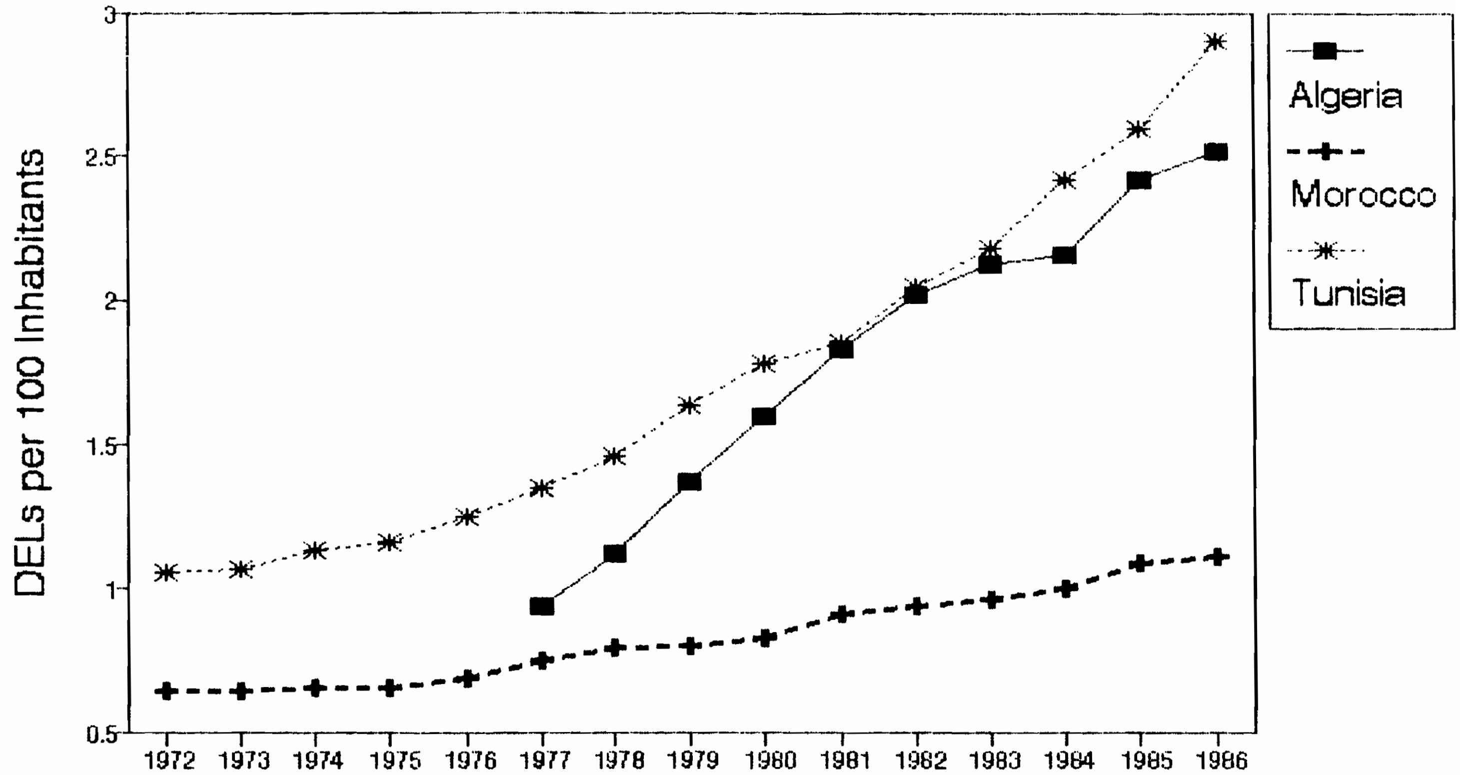
Algeria's DEL density of 2 6% in 1986 is higher than that of Morocco (1%), but slightly lower than that of



Number of DELs 1972-86
Figure IV-7



Average Growth in Number of DELs 1972-86
Figure IV-8

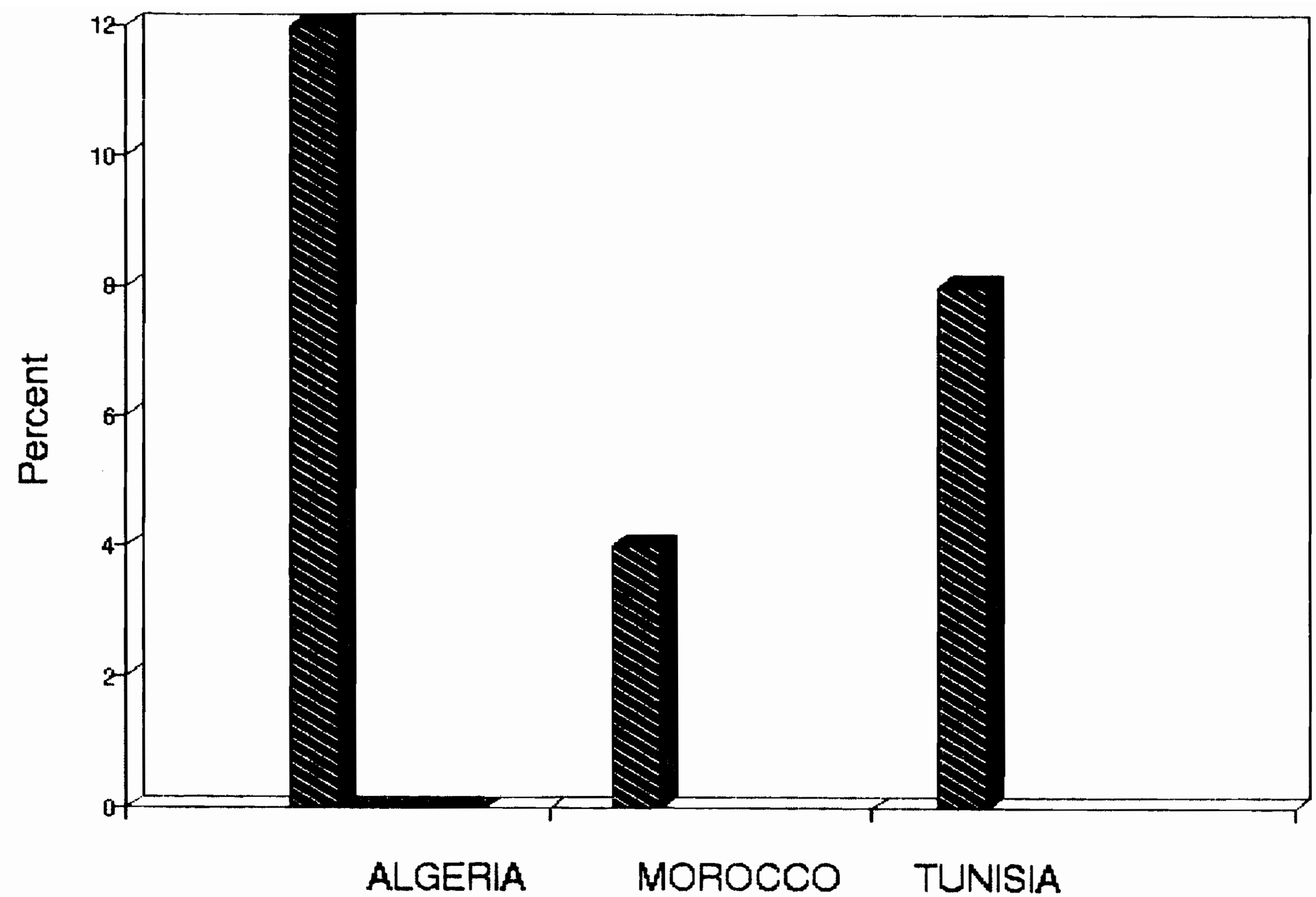


DEL Density 1972-86
Figure IV-9

Tunisia (2.9%). While DEL density in Algeria has more than tripled in fourteen years (from 0.8 % in 1973), the 1986 density of 2.6% is below the 3% average among developing countries in general. Moreover, it compares poorly with developing countries with similar economic activity such as Jordan (7%), Iraq (5.9%), Syria (5%) and Hungary (8%). The Algerian P&T's dependence on local equipment suppliers, which were unable to meet P&T's requirements, limited network growth and subscriber connections in the 1980s. Nonetheless, the average annual growth rate in DEL density is highest in Algeria (12%). Growth rate in Tunisia is 7% and Morocco is 4% (**Figure IV-10** "Algeria, Morocco and Tunisia: Average Annual Growth Rate in DEL Density").

Telephone density in Tunisia in 1972 was 1%, i.e., one telephone per 100 inhabitants. The average annual growth rate of telephone density for the fifteen year period between 1972 and 1986 was only 7%. But because of Tunisia's small population (7 million) in 1986, fifteen years later, telephone density was 2.9%. This density was very close to the 1986 average of 3% among developing countries generally.

Morocco's DEL density of 1% (1 DEL per 100 inhabitants) in 1986 was the lowest density of the three North African countries. It was also far below the average of 3% among developing countries at this time. It was two to three times lower than developing countries with similar



Average Growth in DEL Density 1972-86
Figure IV-10

per capita income The average annual growth rate in DEL density for the fifteen year period between 1972 and 1986 was only 4% DEL density in 1976 was 0 64 %; an increase from 0 64 telephones per 100 inhabitants to only 1 0 telephones per 100 inhabitants in ten years is not a dramatic improvement in the availability of service

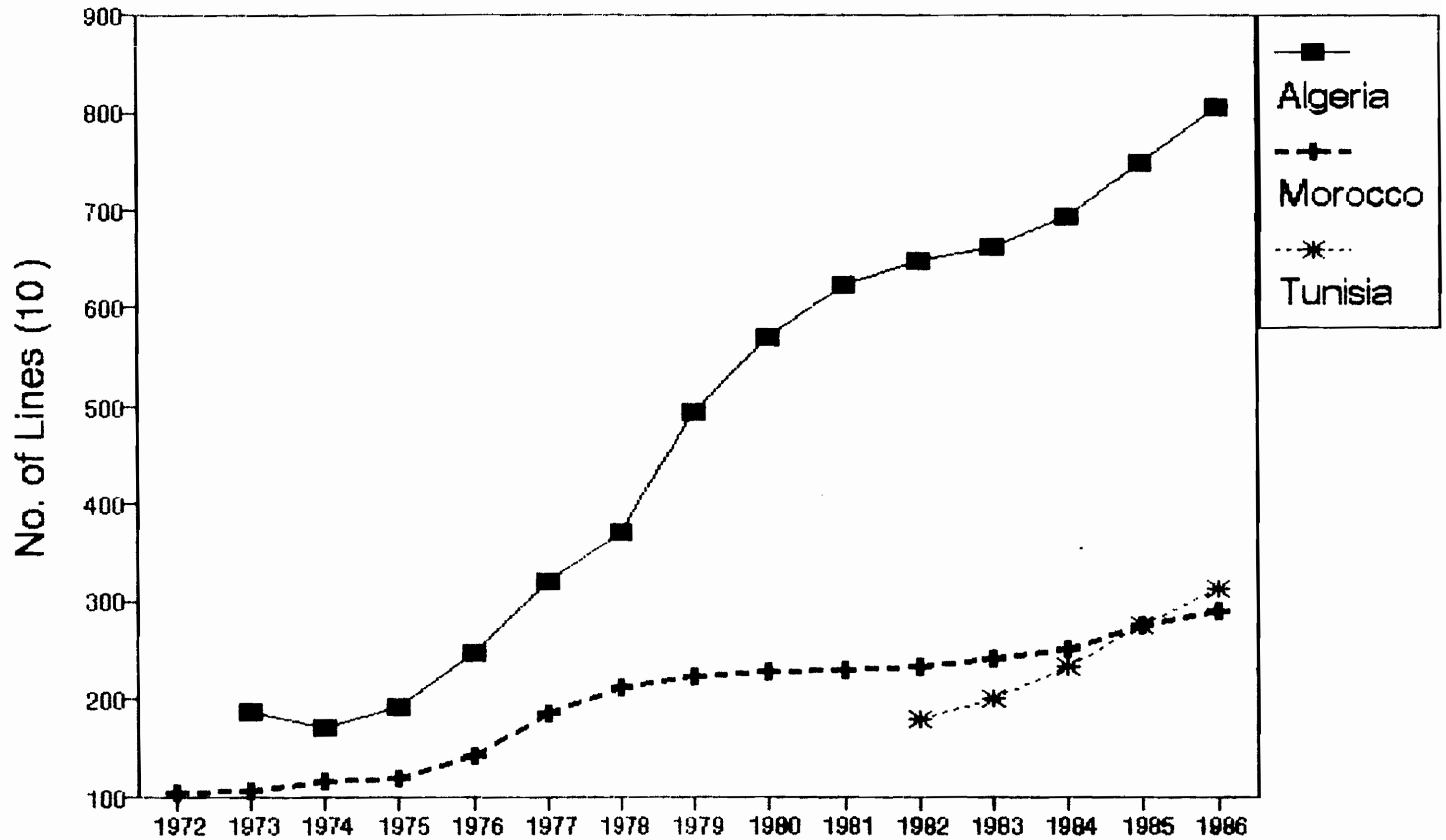
While Algeria had a slightly lower DEL density than Tunisia, the quality of service in Algeria was considerably higher, as demonstrated by the excess capacity of the Algerian system and other indicators noted below

Quality of Service

Connection Capacity

Figure IV-11 "Connection Capacity Algeria, Morocco and Tunisia" shows that the number of DELs in service as a proportion of the total connection capacity was highest in Algeria throughout the study Connection capacity, or exchange fill, is a measure of the congestion of circuits Exchange fill determines the ability to complete a call (i e , probability of a busy signal due to circuit congestion). An appropriate level of exchange fill (ratio of total number of DELs to connection capacity) for LDC's is considered to be about 85%, in order to allow for peak hour traffic and transfers [3]

[3] **Robert Saunders, Jeremy Warford and Bjorn Wellenius,**



Connection Capacity of Local Exchanges
Figure IV-11

In Algeria, exchange fill measured well below 85% throughout the 1972-86 period (in 1977 exchange fill was only 54%, it rose slowly to 62% in 1982, and reached only 72% by 1986). Unlike most developing countries, in Algeria there has been *excess* exchange capacity in the telephone system. The exchange fill did not even approach the recommended limit of 85% at any point during this fifteen year period. These levels of exchange fill (well below 85%) indicate plenty of switching capacity (see glossary). This is the opposite problem from most developing countries (including Tunisia and Morocco), where there was insufficient switching capacity. In most developing countries, the telecommunications entity connects additional subscribers to an already congested network without the necessary expansion of switching capacity, thus creating congestion of circuits, i.e., resulting in the caller getting a busy signal.

Algeria's excess switching capacity means that there was less circuit congestion, but it also means that switching equipment was underutilized. Exchange fill tended to be lower than 85% because of delays in connecting subscribers due to poor network architecture planning, i.,e., efficient routing of traffic between cities,[4] and,

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[4]Pierre, Lecharny, Africa Technical Department, Industry and Energy Division, The World Bank, personal communication, December 21, 1990.

as noted above, to production delays on the part of the public enterprises that manufactured and installed equipment (ENICAB, ENTC and SONATITE) necessary for connecting new subscribers. Despite P&T's efforts, network expansion was slower than the planned rate, due to the inability of local suppliers to produce sufficient quantities of switching equipment and cables, especially in the period 1978-81, but also prior to 1978. These state owned enterprises where not operating efficiently or at full capacity, which caused delays in their delivery or installation of the equipment these organizations supplied and installed for the P&T.

In Morocco, there was severe congestion of circuits in urban areas, as indicated by an exchange fill far above the reasonable limit of 85%. In Morocco, exchange fill nationwide was 77%-84% between 1981 and 1983, below the 85% cut-off point, but in the urban areas exchange fill was higher. Beginning in 1984, exchange fill nationwide went above the 85% mark, climbing steadily from 86% to 88% in the years 1984-1986. In the commercial districts of Casablanca and Rabat, the exchange fill was as high as 92% in 1986. This indicates extreme circuit congestion, i.e., very poor quality of service.

In Tunis, the capital of Tunisia, the exchange fill was 88% as early as 1969. In the outskirts of Tunis (Carthage and other suburbs) exchange fill was over 86% in

1969 In the early 1970 s, the country wide average exchange fill was over 85% The telephone networks were also congested in some of the secondary cities in the early 1970's: Sfax (96%), Sousse (93%), Nabeul (92%) Moknine Ksar Hellal (87%) The rest of the interior was less congested, with exchange fill at about 78%, which is reasonable. In Tunis congestion was still high in 1978 (86%) and 1982 (85%) New central switches were installed in many areas of Tunisia in 1984-85 The absolute growth in switching (connection) capacity just in the four years between 1982 and 1986 was about 73% Annual gross investments for telephone switching equipment increased by 97% between 1982 and 1986, with an average annual growth rate of 23%. This increased connection capacity brought exchange fill in Tunis down to 74% in 1984, rising to a safe 77% by 1986 Only a couple of other cities were still close to peak congestion (Kairouan at 85% fill and Jendouba at 86%) in 1986. Despite the lower exchange fill in Tunis after 1984, lines were still often congested during the day simply because there was no off-peak pricing, which meant there was no incentive to make calls in the evening or early morning, or on weekends, when lines would be less busy.

Call Completion Rates

The consequence of congested circuits (see glossary) is the failure to complete a call Thus, the call completion rate is a measure of the quality of service related to switching and transmission capacity Not surprisingly, Algeria, with the highest capacity, had the highest quality of service in terms of call completion rates Peak hour call completion rates in Algeria for local calls in 1982 was 95%; for long distance calls during peak hour within the same region 80%; and long distance calls between different regions was 50% call completion rate

Peak hour local call completion rates were low in Morocco s primary cities (about 60% in of Rabat and 50% in Casablanca) in 1986 Peak hour completion rates for interurban and international calls were only 20% to 30% In 1987, average call completion rates nationwide for local calls was 54% This means that almost half the time one placed a call, it did not go through due to circuit congestion For long distance calls the nationwide call completion rate was 35% in 1987 up slightly from 1986; and for international calls 45% (outgoing) and 30% (incoming)

In Tunisia, call completion rates in the 1980s on a nationwide average were as follows 37% (1984), 44% (1985), 68% (1987), and 65% (1988) While there is a steady improvement in the call completion rate, it is still lower than Algeria

Telephone Faults

Another measure of the quality of service is the number of telephone faults per subscriber per year, and the percentage of faults which are repaired within 48 hours. A telephone fault is a malfunction of the telephone set or the line connecting the subscriber to the central office (switch). An acceptable number of telephone faults per subscriber per year for developing countries generally is 0.5 (i.e., no more often than one breakdown every two years). An acceptable standard in urban areas for the percentage of faults repaired within 48 hours is 90%; 80% is considered reasonable.

Algeria had slightly higher quality of service than Tunisia or Morocco in terms of the number of telephone faults per year per subscriber. In 1983 each telephone on average experienced 1.2 faults per subscriber per year. This is just over one breakdown per year. For Algiers, the fault rate was slightly lower (0.9 faults per subscriber per year). In 1983, about three-fourths (74%) of the faults were cleared within 48 hours of being reported.

Faults in Morocco averaged 1.3 per line in service per annum in 1987. Only half (50%) of the telephone faults in 1987 were cleared within 48 hours.

In Tunisia, the number of telephone faults per year per subscriber in 1985 nationwide was 1.4 (Tunis was 1.1;

Tunis suburbs was 1 9); 66% of the faults were repaired within 48 hours In 1986 the national average fault rate rose slightly to 1 44, and, the proportion of faults repaired within 48 hours remained at 66%

While Algeria's telephone fault rate was higher than the acceptable standard, it was lower than that of either Morocco or Tunisia

Waiting Time for Telephone Connection

The quality of service was highest in Algeria in terms of the waiting time for a telephone connection. In Algeria, the waiting time in 1972 was 31.1 months (2.6 years) Between 1975 and 1980, waiting time for a connection averaged 32 4 months (2 7 years) For 1981-82 period, the waiting time rose to 58 months (4 8 years) But this was still lower than Morocco or Tunisia

The waiting time for obtaining a telephone connection in Morocco in 1984 was 72 months (6 years) By 1987, the waiting time had risen slightly to 76 months (6 3 years)

The waiting time for a telephone in Tunisia in 1989 was approximately five to six years

Quality of service is also indicated by the equipment being used by subscribers. The proportion of automatic versus manual subscriber equipment, and the proportion of digital versus analog equipment (see glossary) Automatic equipment allows the subscriber to dial directly; manual equipment requires the assistance of an operator to reach the other party Tunisia had the highest proportion of automatic network (95% in 1980; 99% in 1988 nationwide, 100% in Tunis), with Algeria close behind (91 3% in 1980; 97% in 1988), and Morocco third (80% in 1980, 95% in 1988)

Digital equipment is state-of-the-art technology with greater advantages for the service provider than the typical residential subscriber Digital technology requires less maintenance, and has greater channel capacity than analog technology It also allows the service provider to offer specialized, especially, data services (see glossary). The typical residential subscriber, however, is not likely to need specialized services, only telephone (voice) service For government and business users, digital technology can make it possible for the provider to the introduce new services (e g , data retrieval, storage, transmission, and such voice services as call forwarding, call waiting, etc)

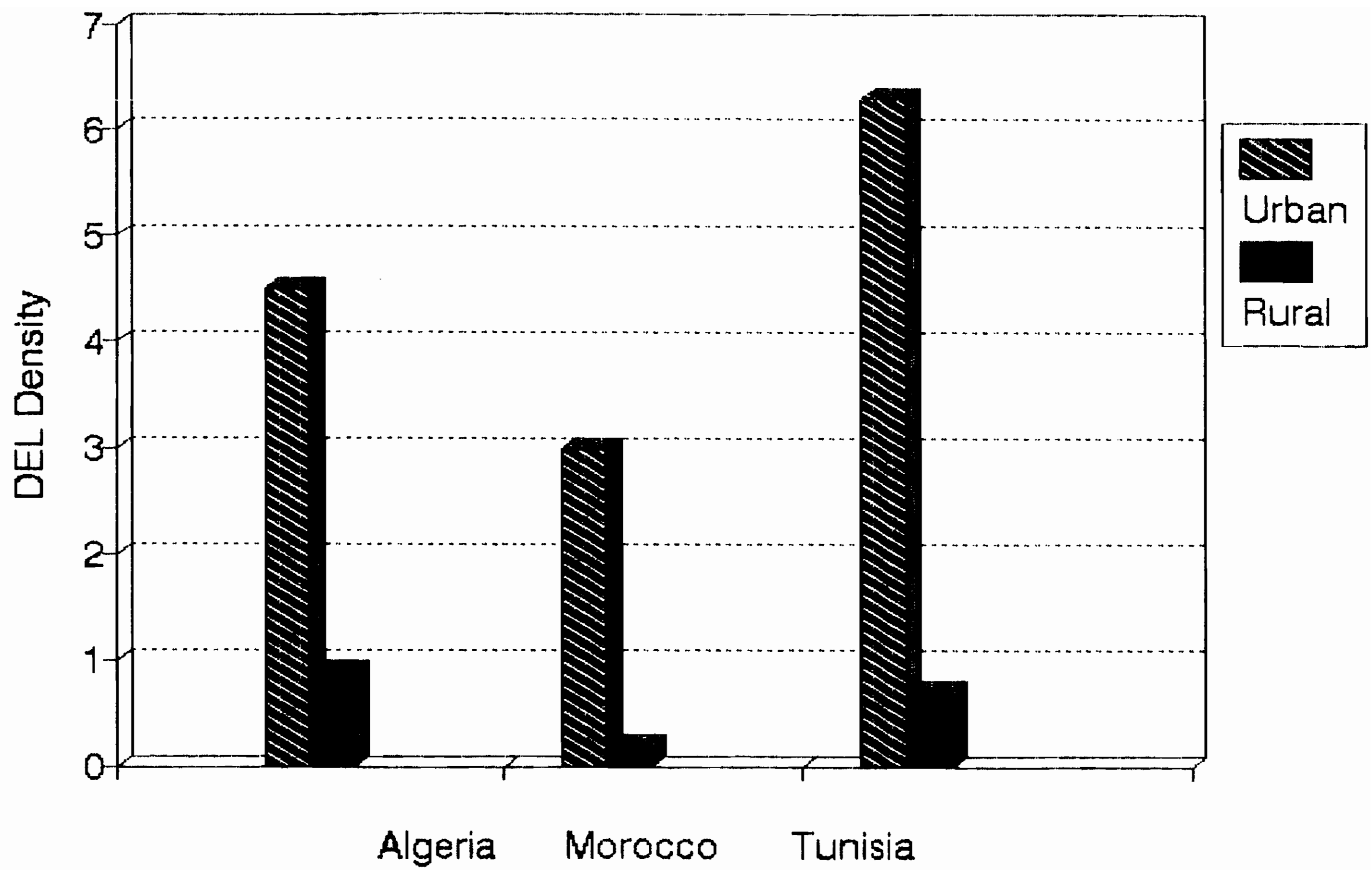
The proportion of the total network equipped with digital technology was highest in Tunisia Digitization of the network began in earnest after 1982 with the introduction of digital equipment in high density regions (urban and interurban links) The existing analog system was retained in low density areas The transition to a digital network is reflected in investment increases beginning in 1982 By 1988, 50% of the telecommunications network was digitized The following year, 1989, PTT reported that 63% of the network was digital

Algeria got a slow start toward digitizing its network because it had committed itself to building a local telecommunications industry around analog technology as early as 1972 Making the transition to digital manufacturing and manpower skills was therefore more difficult for Algeria than Tunisia or Morocco, where there was no significant local industry Algeria began the introduction of digital equipment in 1984

In Morocco, only 5% of the network was digital in 1983. By 1985, about a third (34%) of the network was digitized. Projections for 1990 were that 60% of the network would be digital

Distribution of Services

Algeria had the most widely distributed telephone services among the three Maghrebi states (**Figure IV-12** Urban vs Rural DEL Density: Algeria, Morocco and Tunisia) The discrepancy between urban and rural telephone densities was lower in Algeria than in Tunisia or Morocco. In 1980, national average DEL density in Algeria was 1.6%; density in the principal cities (with 25% of the population) was 4.5%;



Urban-Rural DEL Distribution 1980
Figure IV-12

rural density was 0 9% Two years later, urban telephone density was only slightly higher (4 7%), while rural density had grown to 1 4% At the end of 1982, every town with a population greater than 5,000 had some local and long distance telephone service Of the 290 towns with 2,500-5,000 population, only 23 towns did not have telephone service The 1985-89 Plan called for the introduction of public telephone call offices in approximately 800 small communities (fewer than 2,500 people) where no service had previously been available. The P&T proposed a rate of growth in telecommunications access in the less developed wilayas which was significantly higher than more developed areas of the country The growth rate for DEL density between 1979 and 1982 for the capital city Algiers was only 21%; for other principal cities, DEL density grew at a rate of 39% between 1979 and 1982; for the rest of the country, the growth rate was highest during this period at 56%. This reflects Algeria's effort toward an equitable distribution of access to telephone service, and the effort to avoid reinforcement of higher urban use While the telephone expansion in rural and provincial areas aimed primarily at providing service for all administrative entities at those levels, increased access by rural and provincial areas provided a more even distribution of the telephone service in the long run (at least through public telephones, if not residential), and thus better opportunity for the rural areas to participate in economic exchange. The target densities for 1988 were 4.1 nationwide, 9.5% for principal cities (11% in the capital city, Algiers; 8% in other principal cities), and 3% for the rest of the country.

Figure IV-12 shows that in Morocco, in 1986, the primary cities (Casablanca, Rabat-Sale, and Tangier) with 19% of the population, had a DEL density of 3% (compared with 1% nationwide). In the six secondary cities (Agadir, Fes, Kenitra, Marrackech, Meknes, Tetouan) with 23% of the population, DEL density was only 0.54% in 1986. In the rest of the country, with 58% of the population, DEL density was only 0.24% in 1986.

In Tunisia, the strong concentration of telephones in the capital city of Tunis and its suburbs (with approximately 8% of the total population of the country) that characterized the colonial period persisted long after independence in 1956. From 1972 to 1985, 62% of the country's telephones were in Tunis. In 1986, 61% of the total number of phones were in Tunis. The capital city had a very high telephone density relative to the rest of the country, including other cities. In 1977, for the country as a whole, including Tunis, DEL density was 1.34%; DEL density in Tunis was 6.6%, the next highest density was less than 1.2% in the secondary city of Sfax; for the rest of the country telephone density was just under 0.7% in 1977. **Figure IV-12** shows that in 1980, nationwide average DEL density was 1.8%. DEL density in the principal cities (with 19% of the population), including Tunis, was 6.3%; DEL density in the rest of the country was 0.7%. In 1988 the telephone density in Tunis alone (with 10% of the total population) was 12.7%; for the rest of the country DEL density averaged 2.3%, and the nationwide average DEL density was 3.5%.

Beyond 1986

In 1988 the Algerian P&T awarded a contract to a Canadian company to expand the domestic satellite network (see glossary) with an additional nineteen small earth stations (see glossary) for rural and remote areas. This decision demonstrates Algeria's commitment to an extensive domestic, including rural, infrastructure. In 1987, Algeria established a joint venture company (*Societe Industrielle de Telecommunications*) between its own manufacturing company ENTC (65% share) and Ericsson of Sweden (35% share). SITEL will locally produce Ericsson's AXE digital switch. In 1989, Algeria contracted a Finnish company, Nokia, to install a cellular telephone system (Nokia NMT-900) in Algiers and three other coastal cities, which would give Algeria the largest cellular telephone network in Africa.

Morocco aimed to increase telephone density to 3% by 1994, and to provide telephone service to 90% of rural communities as well as to most seats of municipal government. Morocco intended to satisfy 80% of total expressed demand for telephone service, compared with 60% in 1986.

Tunisia aimed to increase telephone density to 5% by 1991, and to introduce packet switching equipment (state-of-the-art digital data services).

CHAPTER SUMMARY

The World Bank classifies Algeria, Tunisia and Morocco, as middle income countries during the period of the study (1973-86). Algeria was an upper middle income country, while Tunisia and Morocco were lower middle income countries. Algeria was the richest of these three middle income countries, with a per capita GNP of $2,590 in 1986. Most (95%) of the population lived along the northern coastal zone. In 1985 43% of the total population lived in urban areas. Only about 5% of the population lived in the highlands and Saharan zones which made up 82% of the country's land area. The economy of the south was based on hydrocarbons (petroleum and liquified gas).

Morocco was the poorest of these three middle income countries with a GNP per capita of $590 in 1986 (similar to the Ivory Coast and Equador). The rural population accounted for 56% of the total population; the urban population was 44%.

Tunisia was also a lower middle income country, but with a higher GNP per capita than Morocco, at $1,140 in 1986 (similar to Turkey and Ecuador). All three countries experienced rapid population growth throughout the period of the study. In 1986, 60% of the population of all three North African countries was under 25 years of age.

All three Maghrebi states experienced economic growth during the 1970's. In Algeria, the major increase in oil revenues after 1973 enabled large investments in many sectors of the economy including telecommunications. Tunisian economic performance in the period 1960-1979 was 4.8% average annual increase (in real terms) of GNP per capita. Morocco, the fourth largest producer of phosphates, was not without resources.

Relative to other basic economic infrastructures, telecommunications in all three countries (except Morocco in the 1970's) had higher economic rates of return and at least comparable, if not higher, unmet demand (except for water in all three countries), but lower levels of investment as percent of total national plan budgets. Thus, on the basis of the investment criteria of economic rate of return and demand, the commitment of higher levels of financial resources was economically justified for the telecommunications sector in all three states

The findings of the study measuring development of the telecommunications sector in Algeria are consistent with the observation of other writers that Algeria operates one of the most exemplary and sophisticated telecommunications networks among developing countries The availability of telephone service in Algeria was comparable or higher than Morocco and Tunisia Telephone density was slightly higher in Tunisia than Algeria, but quality of service was considerably higher in Algeria in terms of call completion rates, proportion of faults repaired within 48 hours, and waiting time for a telephone connection Morocco had the lowest density and lowest quality of service of the three states Telephone services were largely concentrated in urban centers in all three countries, as with other countries generally But Algeria showed the least discrepancy between urban and rural telephone densities throughout the period of the study

Investment in telecommunications per capita was higher in Algeria than in Tunisia or Morocco throughout the period of the study and beyond But investment as percent of gross domestic product was higher in Algeria only in the 1970's, and dropped below that of Tunisia and Morocco in the 1980s Nonetheless, the quality of service remained highest in

Algeria throughout the 1980s This emphasizes the way in which scarce resources are expended rather than how much resources are expended The role of technical decision making in Algeria may have been the impetus behind rational investment decisions that resulted in higher quality of service without sacrificing availability of service.

The next two chapters consider the relative autonomy of the of the telecommunications operating entity in each country in terms of its dependence on external financial and technological organizations for its most critical resources (i e., financing and technology).

CHAPTER V

FINANCIAL DEPENDENCE

Financial dependence is the extent to which the telecommunications entity depends on external organizations for its financial resources. The organizations that typically control most of the financial resources of the telecommunications entity, either directly or indirectly, are domestic political and economic organizations of the central government. The institutions controlling financial resources are the ministries with budget approval, regulatory, oversight or coordination functions with the operating entity (typically, the Ministries of Finance, Planning, and Communications).

The extent to which the operating entity depends on these external organizations for financial resources is evaluated according to the three criteria of the resource dependence model: 1) the importance of the resource, i.e., criticality of the resource for survival and operation, and the magnitude of the resource exchange, measured in terms of degree and direction, i.e., the proportion of total inputs or the proportion of total outputs accounted for by the exchange; 2) discretion over resource allocation and use; and 3) concentration of sources for financial resources.

CRITICALITY AND MAGNITUDE OF RESOURCE EXCHANGE

As noted earlier, the criticality of financial resources to the survival and operation of any telecommunications entity is unquestionable. The direction of the financial resource exchange was usually two-way, however, i.e., the government allocated funds to the operating entity, and the operating entity returned earned revenues to the central government. The entity was a source of revenues for the national treasury.

The relative magnitude of the resource exchange is indicated by the proportion of the total budget for the telecommunications entity which comes from various sources of funding. Typically, these were the central government through the domestic budget allocation process, domestic borrowing through loans or credit, foreign borrowing through bilateral and multilateral aid and loans, and equipment supplier credit.

Magnitude of Financial Exchange: Algeria

The magnitude of the transfer of financial resources from central government to the Algerian P&T was high until 1983. This indicates that the P&T was highly dependent on the central government for funding during this period. The proportion of the total budget of the Algerian P&T coming from the national treasury between 1978 and 1982 averaged

70% percent of investment. The remaining investment funds were contributed largely from net internal cash generation (27% on average); an additional small proportion came from loans by the Algerian organization "*Credit Industriel et Commercial*" (2.5% on average), and a tiny fraction from "contributions" (by government and Sonatrach, the state-owned oil enterprise) in the amount of about 0.5% (on average 1978-82).

In 1983, the P&T increased tariffs by 50%, which allowed it to finance over half (57% on average) of investment costs from net internal cash generation (NICG) between 1983 and 1988. This reduced its dependence on central government. Financial resources from the national treasury dropped to only 17% of total domestic borrowing during this period. Additional sources for funds (1983-88) were the Algerian "*Credit Industriel et Commercial,*" (1% of investment), and contributions from government and Sonatrach provided another 7% of investment. This makes a total of 25% of investment coming from domestic lending sources. The World Bank provided international credit for the 1983-88 period, amounting to 7% of total investment, and other international borrowings amounted to 11% of investment, for a total of 18% of investment from foreign lending sources.

Thus, the magnitude of the financial resources transferred to the Algerian Ministry of P&T from the national treasury decreased from 70% on average 1978-82, to 25% of investment between 1983 and 1988. This decrease in resource exchange, due to tariff increases which increase P&T's surplus revenues, allowed the P&T greater financial autonomy from central government.

The direction of the resource exchange was two-way, insofar as the P&T transferred all earned revenues to the central government upon their receipt, except for a capital working balance of three months.

Magnitude of the Resource Exchange: Morocco

The magnitude of the total capital input from central government to the investment budget of the Moroccan entity (construction costs as opposed to operating expenditures) was about one-fifth (371 million dirhams or DH) of total investment during the 1980-85 Plan period. The private sector provided the remaining four-fifths of total investment (1,520 million DH out of 1,891 million DH total investment in telecommunications). External borrowings were lent to the P&T on concessionary terms similar to those obtained by other government entities in Morocco. The resource transfer was two-way insofar as the Moroccan Ministry of P&T was required to transfer earned revenues to the national treasury and reapply for necessary funds through the budget allocation process of central government until 1984. The Ministry of P&T covered 100% of investment from 50% of its net revenues (NICG), 5% of its revenues covered the debt service, and 45% of its revenues was transferred to government.

Following its establishment in 1984, the Moroccan entity, transformed into a public corporation (ONPT), gained the right to retain earned revenues which were reinvested directly in the sector. ONPT continued to transfer money to government after 1984. As a public enterprise, ONPT was subject to a 48% tax on its net income, a mandatory 'redevance de monopole' of about 60 million dirhams (U.S. $7.6 million 1984 dollars) per year to the government. This tax was expected to generate 4.4 billion DH for government between the years 1987 and 1994. Also during this 1987-94 period, ONPT was expected to pay 2.2 billion DH in other miscellaneous taxes. ONPT was expected to collect for the government a 12% surcharge on billings, which would provide an additional 3.4 billion DH to government between 1987 and 1994. Import duties on equipment (approximately 44% of foreign exchange cost) would provide another 2.8 billion DH. Total financial resources transferred from ONPT to government between 1987 and 1994 were estimated by the World Bank at 12.8 billion dirhams (approximately US $1.4 billion).

In 1985 (one year after the 1984 reorganization) domestic borrowing was in the range of 600 million DH, at 14% per annum for twenty years. For the 1987-1994 extended Plan period, ONPT was limited in its domestic borrowing to 300 million DH per year, but was not expected to need more than 700 million DH for the entire eight year period.

In short, the Moroccan telecommunications entity was dependent on the central government for financial resources before 1984, but given the magnitude of the exchange, this dependence was less than its dependence on the private sector. It was not financially dependent on the central government or the private sector after 1984 because it was permitted to retain earned revenues for re-investment. ONPT, as a public corporation, was entitled to borrow domestically or internationally after 1984 for the additional investment funding it could not generate from subscriber revenues.

Magnitude of the Resource Exchange: Tunisia

As with Algeria, the largest proportion of the Tunisian PTT's funding came from the national treasury. This made the PTT highly dependent on the central government, and gave the Ministry of Finance and Planning strong influence over the level of investment. For the 1973-76 (IVth) Plan, 71% of total sector investment came from the national treasury; 24% from international credit (7.1 million Tunisian dinars or TD out of 29.2 million TD), and 5% from gross revenues. During the 1977-81 (Vth) Plan period, 61% of investment came from national treasury, and 39% from international credit (70 million TD). For the 1982-86 (VIth) Plan period, 67% of financial resources came from the national treasury, 33% from international credit.

Like the Algerian and Moroccan telecommunications entities, the direction of the resource exchange was two-way. The Tunisian PTT requested necessary funds from central government and transferred earned revenues to the national treasury. After 1987, the Tunisian PTT gained the right to retain earned revenues for direct reinvestment in the sector.

DISCRETION OVER ALLOCATION OF RESOURCES

The second major determinant of financial autonomy or dependence is the organization's discretion over financial resource allocation and use. These two areas of discretion are considered separately. The telecommunications entity's discretion over the *allocation* of financial resources is indicated by the extent to which the telecommunications entity controls the allocation of its budget. The greatest discretion of the entity, and therefore the greatest autonomy, is represented by the right to retain earned revenues in order to re-invest them directly in the sector. The least discretion over financial allocations, and therefore the least autonomy, is represented by the requirement to transfer earned revenues to the national treasury and to request necessary funds through the budget allocation process of the central government.

The telecommunications entities of all three Maghrebi states were required to transfer earned revenues to their national treasuries and then reapply for necessary funds through the budget allocation process of central government. Morocco acted similarly until 1984, when it became a public enterprise and gained the right to retain earned revenues and began to reinvest them directly. After 1987 (the first year of the 1987-91 Plan), the Tunisian PTT was permitted to retain earned revenues for direct reinvestment in the sector, although it remained, as before, a conventional government department in all other ways. In October 1989, the Algerian P&T became a public corporation (National

Office of Post and Telecommunications or ONPT) and gained the authority to retain revenues for reinvestment in the sector, as well as the right to borrow commercially for additional funds.

Allocation of Financial Resources: Algeria

According to the Algerian budget allocation process by which funds are allocated to the Algerian P&T, all P&T revenues are turned over the the national treasury. All operating and investment funds required by the Algerian P&T were requested and approved through the formal budget process of the central government. P&T revenues were public funds all of which P&T is expected to transfer to the treasury when received. P&T was entitled to keep only a working capital balance equivalent to up to three months' of operating expenditures. Therefore, the P&T was completely dependent upon the central government for the allocation of its financial resources. The P&T was not permitted to retain any of the revenues it earned.

The Ministry of Posts and Telecommunications submitted a budget proposal for each National Plan period (approximately four or five years each). P&T's budget consisted of two parts: the operating budget and the investment budget. The operating budget was prepared at the wilaya (provincial) level, reviewed by the budget division of the general administration department, and was required to show an overall surplus. Unlike the policy of the 1970s, in the 1980s, P&T was required to cover all operating expenses, including depreciation and debt service, from operating revenues. This required increases in tariffs to cover the cost of providing services.

The investment budget was prepared by the central departments of P&T, within the framework of the national investment plan. The first draft budget proposal went to the Secretariat of Plan and required the approval of the Ministry of Planning. Then the Council of Ministries discussed the proposed budgets (operating and investment) along with all other ministries' budgets. Both operating and investment budgets of the P&T were then submitted to the National Assembly for approval in October/November of each year; final decisions on the National Plan were made in June after consideration of competing priorities of other sectors. The National Assembly adopted the P&T budget through vote and incorporated it in the finance law which detailed expenditures and authorized commitments and borrowings.

While various political organizations of the government have control over budget allocations, the Algerian central government was generally supportive of the telecommunications sector. This generosity is indicated by the level of investment in telecommunications as a percentage of gross domestic product (average 0.46% 1972-86) and as a percentage of gross fixed capital formation (average 1.16% 1972-86). Government support of sector development is also reflected in the government's philosophy during the period 1973-78: the Ministry of P&T's Telecommunications Branch was required to cover only its current expenditure plus debt service. All other funds necessary for the investment program were made available by the Government on very concessional terms. Thus, foreign borrowings, including suppliers' credits, were lent to P&T at uniform terms of 2.5% interest and a final maturity of twenty years, including four years of grace (i.e., at no interest). Local funds were advanced from the treasury on the same terms. These favorable government lending terms helped develop the domestic satellite system. For this reason, the contribution by the P&T Telecommunications Branch to investments from its net internal cash generation during the satellite network development period (1973 and 1978) was negligible, as discussed above.

Thus, while the P&T was not financially autonomous in terms of keeping the revenues it earned and re-investing them directly, the political organizations upon which it depended for its financial resources (Ministries of Finance and Planning) were generous to the telecommunications sector.

Allocation of Financial Resources: Morocco

Throughout the 1970's and early 1980's, as noted above, the Moroccan Ministry of P&T (the name of the entity prior to 1984), obtained financial resources from central government and the private sector through the National Plan budget allocation process. The Moroccan government presented its annual estimates of budgetary receipts and outlays in a finance law divided into three parts: the general budget of the state, a group of separate agency budgets annexed to the general budget, and a series of special treasury accounts. As with Algeria, the budget of the Moroccan Ministry of Posts and Telecommunications was annexed to the general budget of the state, and included an operating budget and an investment budget consisting mainly of expenditures connected with the Five Year Plan. The annexed budgets were thus basically an extension of the general budget. Annexed budgets were submitted by all government agencies in Morocco that resembled commercial institutions insofar as they had some independent sources of operating revenue. The annexed budgets were linked to the general budget through the transfer of their current surpluses to the general budget resources, and through the funding of their current deficits and investment outlays from the general budget expenditures. A draft of the finance law was prepared annually by the Ministry of Finance in cooperation with the planning division of the Five Year Plan organization. The draft was presented not later than November 1 to the Council of Ministers for their consideration and approval, and was then sent to the legislature to be discussed and voted into law.

Thus, the Moroccan entity did not have the right to retain earned revenues for direct reinvestment in the sector before 1984, but since the level of sector investment was so low, P&T was able to finance 100% of investment from earned revenues. After 1984, as part of the terms for a loan from the World Bank, the Moroccan government agreed to transform the government agency into a public corporation. Simultaneously, the central government granted the new corporation the right to retain earned revenues for direct reinvestment in the sector. It therefore became independent of the budget allocation process after 1984.

Allocation of Financial Resources: Tunisia

As a government department, the PTT was required to request funds from the national treasury during each national plan period in order to obtain its necessary financial resources. It did not have the right to retain earned revenues throughout the fifteen year period of the study. Nonetheless, the PTT was self-financing throughout the study insofar as its revenues exceeded its expenses. The PTT submitted two budget requests to the Ministry of Finance and Planning, the investment budget (Title I) and the operating budget (Title II). Beginning in 1987, the government changed its policy with regard to the allocation of financial resources for the sector, and granted the PTT financial autonomy. The PTT was no longer required to transfer earned revenues to the national treasury and to reapply for funds. During the VIIth Plan (1987-1991), the PTT retained its earned revenues and paid sector costs, i.e, operating costs and investment, directly from these revenues. In 1990, the PTT was still able to transfer excess funds to the national treasury.[1] Between 1987 and 1990, this amounted to three million TD (approximately US $3.3 million).

In 1976 and 1977, the surplus revenue (revenue minus expenses, or net internal cash generation) financed about a third (33%) of total investment. During the 1977-81 (Vth) Plan period, PTT financed about 48% of investment. For the 1982-86 Plan period, PTT financed approximately 67% of investment from NICG. PTT expected surplus revenue to amount to 314 million dinars during VIIth National Plan period (1987-91), which would allow it to finance 83% of

[1] Salem Missaoui, Head, Statistical Services, Ministry of Communications, personal interview, Tunis, Tunisia, June 24, 1990.

sector investments. This is a high ratio of net internal cash generation to investment (which is largely construction costs), indicating that the financial productivity of the PTT was good.

DISCRETION OVER THE USE OF RESOURCES

Institutional discretion over the *use* of financial resources is indicated by: 1) the ownership and formal status of the telecommunications operating entity; and 2) the regulation of the entity, specifically, extent to which external organizations with regulatory oversight allow the operating entity: (a) to revise tariffs to adjust for inflation and to generate funds to cover operating costs and new investment; (b) to collect bills promptly from all users, including government subscribers; and (c) to function separately from postal services.

Ownership and Formal Status

The ownership and formal status of the telecommunications operating entity is one of the most obvious measures of institutional autonomy. The most autonomous form of ownership is a private corporation, regulated by government. A semi-autonomous form of ownership is that of a public enterprise or a public corporation, or a semi-independent branch or board within a government department. The least autonomous form of ownership is a conventional government department. Nonetheless, Saunders, Warford and Wellenius (1983) point out, that it is possible for the entity to have close ties with government as long as key characteristics of an autonomous or semi-autonomous organization are observed by the government department. All three of the telecommunications operating entities in Algeria, Morocco and Tunisia were government departments during the greatest part of the study. But within their formal status as government departments, each entity was organized with important differences concerning their commercial orientation, personnel policies, and regulation. These differences are consistent with the argument that the greater the autonomy of the organization the greater the supply and quality of services.

Ownership: Algeria

The telecommunications entity in Algeria, as in Morocco and Tunisia, was established under French colonization as a government-owned department, the Ministry of Poste, Telegraphe and Telephone (PTT) headed by the Director of Poste, Telegraphe, Telephone (Pawera 1964). Government ownership of the entity continued after Algeria's independence from France in 1962. As early as 1976, however, the Algerian government re-organized the telecommunications entity on a commercial basis with day-to-day autonomy (Presidential Ordinance No. 76-168 of October 24, 1976). The decree, introduced with effect from January 1, 1977, was intended to improve efficiency within the administrative structure.[2] The 1976 decree confirmed the regulatory powers vested in the Ministry of Post and Telecommunications (P&T), for postal and telecommunications matters, and provided that the P&T would have a separate budget annexed to the government budget (See **Figure V-1** "Organization Chart: Algerian Ministry of Post & Telecommunications"). The extent of the day-to-day administrative autonomy was limited, however, since P&T was still governed by certain rules and procedures applicable to government departments.

The reorganization did not produce all the desired effects, however, and in 1978, the General Director of P&T, Abdelkader Bairi, expressed his support for studies by a

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[2] According to the 1976 organization, the services of equipment and exploitation (which had been separate directorates) were integrated under the directorate general of telecommunications. Postal and financial services were integrated under a director general of posts. The Director of Finance serving under the Director General of Posts was responsible for the computing activities, as well as the definition and design of the accounting system, including cost accounting for both postal and telecommunication services. The Directorate of Accounting (Agence Comptable) who was responsible for postal and telecommunication accounts remained independent as before. The Director of Budget formed a part of the Directorate of General Administration.

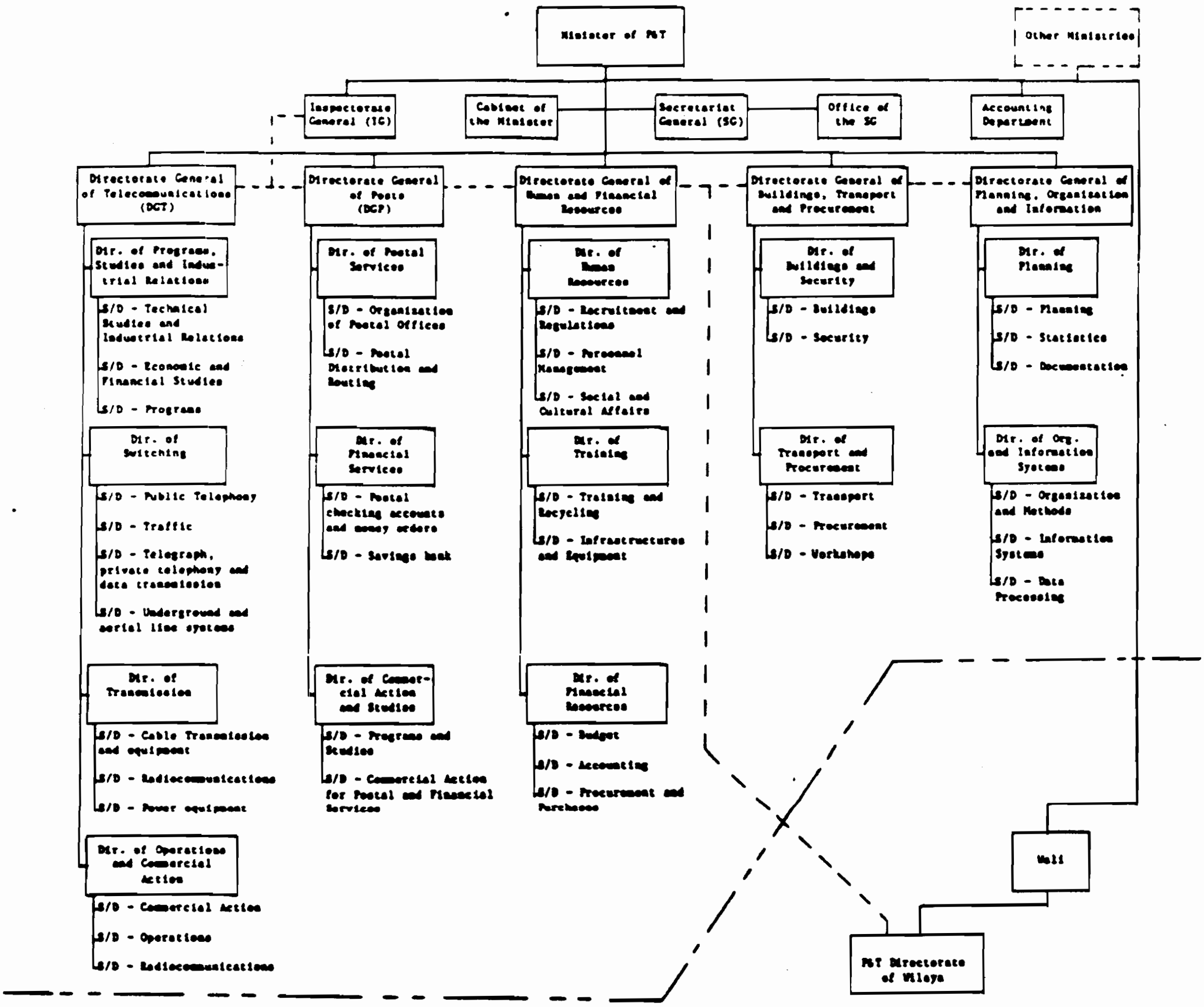
ALGERIA

MINISTRY OF POSTS AND TELECOMMUNICATIONS (P&T)

CENTRAL DIRECTORATE OF TELECOMMUNICATIONS (DCT)

FIRST TELECOMMUNICATIONS PROJECT

Organization Chart



Dir.	:	Directorate
S/D	:	Sub-directorate
- - -	:	Line of authority of the IG
——— — — ———	:	Separation line between central Government and regional levels of administration

IMD
April 1983

Source: the World Bank

Figure V-1

consultant to further improve the organization. Additional organizational changes were introduced with effect from January 1983. Three presidential decrees were promulgated to redefine the functions and responsibilities and the organization of P&T at the Ministry's central administration level. The 1983 organization aimed at improving P&T's efficiency and programming and planning capability and at streamlining the Ministry's various branches of activities. In 1985 the position of Director General for Telecommunications was eliminated. Between 1985 and 1989 all directorates relating to telecommunications, post, financial and postal services reported directly to the Secretary General.

The P&T was headed by a Minister, assisted by a Secretary General, Inspector General and several advisers. There were five Directorates General for: 1) telecommunications; 2) postal branch, 3) common services (buildings, transport and procurement), 4) financial and human resources and training; and 5) planning and information systems. Each directorate had subdirectors and bureaus. Under the authority of the Minister, the Ministry of P&T was basically organized into a central administration in Algiers and directorates in the wilayas. These directorates had basic responsibility for the service to the public in the wilayas and to the "walis" (prefects) who represented the government at the regional level. There was a directorate for posts and telecommunications in each of the 31 wilayas (provinces) headed by a director belonging either to posts or telecommunications assisted by a subdirector of the other branch.

In early 1989 the Minister of P&T reported that the Algerian Government was seriously considering the establishment of a national office for telecommunications with financial and administrative autonomy. In October 1989, the Algerian Ministry of Post and Telecommunications was transformed into a public corporation, the National Office of Post and Telecommunications, with government owned shares (no private capital). The new public corporation for telecommunications was entitled to keep its earned revenues and use them to re-invest directly in the sector. This final step toward autonomy eliminated the dependence of the telecommunications entity on central government for financial resources.

Ownership: Morocco

As noted above, the French established the telecommunications entity in Morocco after their own mould in Paris, a government department, the Ministry of Post and Telecommunications. From national independence in 1959 until 1984, all public telecommunications, postal and postal/financial services in Morocco continued to be provided by this government department. The organization of the Ministry of P&T was of a simple administrative type, with directors of the external services reporting to the Minister, either directly or through the Secretary General of the Ministry. The central administration was organized into three directorates for general administration (including budget, personnel, social affairs, buildings and transport services), postal financial services, and telecommunications; and three divisions for data processing, international and public relations, and training. Services to the public were provided by fourteen regional directorates which corresponded to the country's administrative organization.

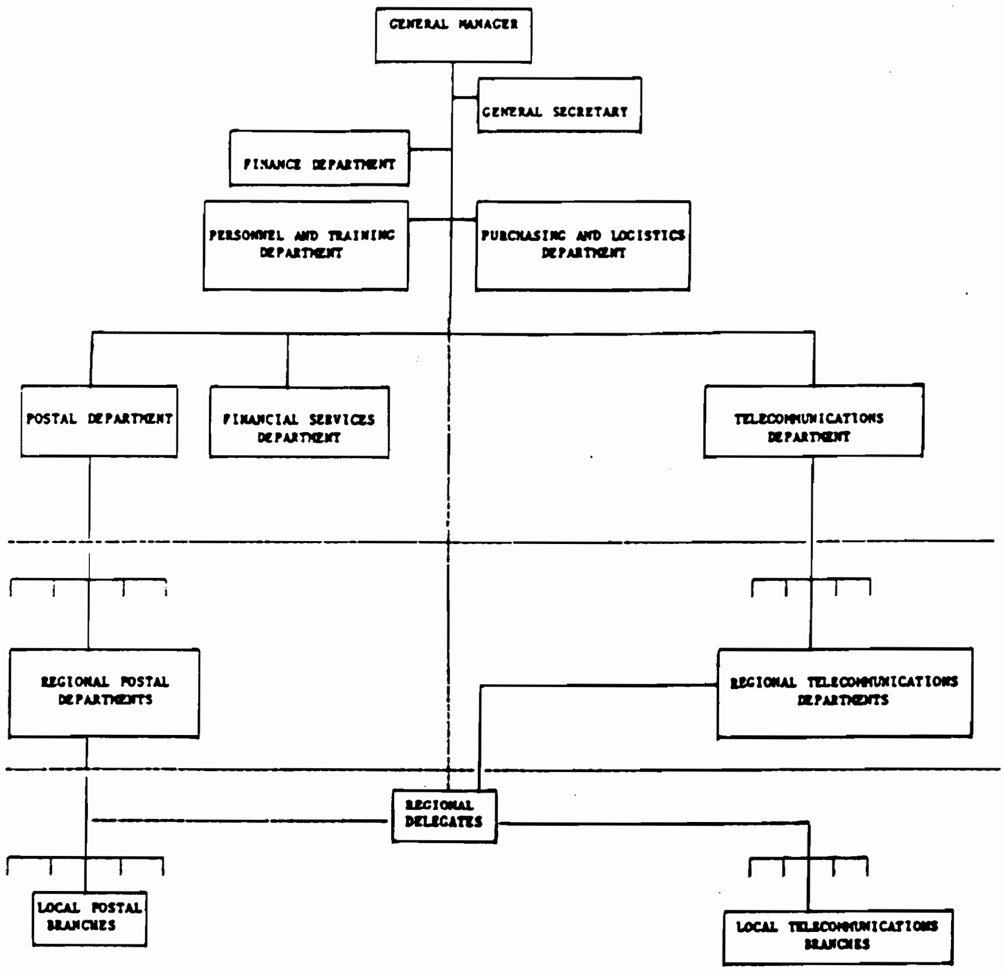
On January 10, 1984, a legally, financially and administratively autonomous public corporation, the 'Office Nationale des Postes et Telecommunications' (ONPT) was created by law (Decree No. 2-84-20) (**Figure V-2A** Organization Chart of the Moroccan National Office of Post and Telecommunications). ONPT was created, partly as a result of the World Bank's recommendations, with the express purpose of operating on a commercial basis. The overall aim was to reduce central government intervention in day-to-day operations. All operational and contractual responsibilities for telecommunications and postal services, including staff, assets and liabilities, were to be transferred from the Ministry of Post and Telecommunications to ONPT in January 1984; two years later, January 1986, sector assets and liabilities had not yet been transferred to ONPT. The Ministry of Post and Telecommunications and ONPT remained de facto virtually identical; ONPT was basically still a government department in terms of organization, management and personnel policies. Four years after the decree, however, January 1988, the separation of responsibilities between the Ministry and its semi-independent branch, ONPT, was clearer (**Figure V-2B** Organization Chart of ONPT's Directorate of Telecommunications). Staff and budgets of the two were separated. The budget of the Ministry was part of the government budget; the budget of ONPT was made up of its earned revenues and commercial borrowings. ONPT's right to contract borrowings was confirmed in practice. ONPT continued to operate under the supervision and regulation of the Ministry of P&T, as planned.

Before and after its reorganization into a public corporation, the Moroccan telecommunications entity was governed by an eight member Board of Directors. The Board was chaired by the Prime Minister; its members included the Ministers of Finance, Defense, Interior, Planning, Economic Affairs, Industry and Equipment, and Transport. In 1985, MOROCCO

OFFICE NATIONAL DES POSTES ET TELECOMMUNICATIONS (ONPT)

FIRST TELECOMMUNICATIONS PROJECT

ORGANIZATION CHART - ONPT



Source: the World Bank

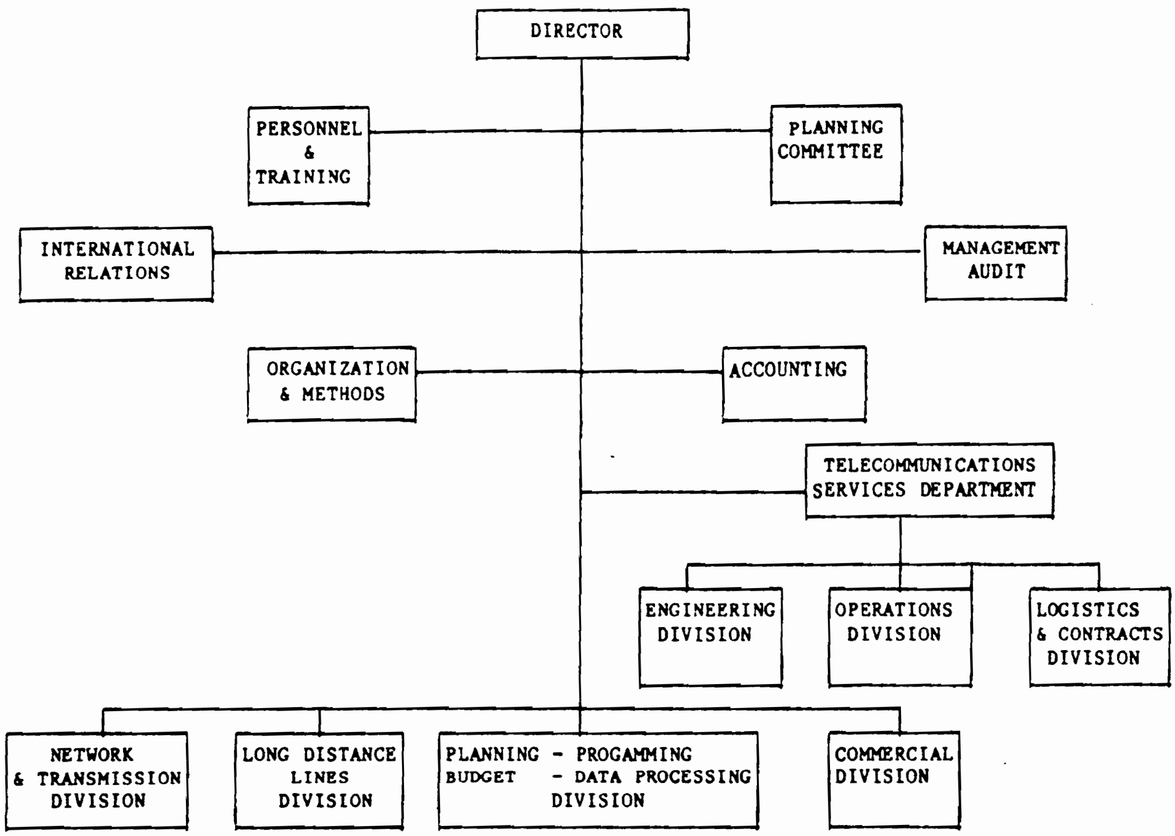
Figure V-2A

MOROCCO

OFFICE NATIONAL DES POSTES ET TELECOMMUNICATIONS (ONPT)

FIRST TELECOMMUNICATIONS PROJECT

ORGANIZATION CHART - DEPARTMENT OF TELECOMMUNICATIONS



Source: the World Bank

Figure V-2B

after the establishment of ONPT, the World Bank reiterated that the membership of Morocco's public enterprise boards should become more professional and effective by opening them up to people with technical and managerial experience. The World Bank noted that ONPT's Board of Directors was functioning effectively in 1985, but insisted that Morocco's public enterprise board memberships should become more professional.

The Board of Directors governing the Ministry of P&T determined the internal organization decree, organization chart and major appointments (director, deputy director and senior executives) of ONPT. The organization of ONPT consisted of a General Secretariat and six Departments: Telecommunications, Posts and Financial Services, Finance, General Administration (personnel, social and legal affairs), Common Services (buildings and transport), and Procurement.

In 1988 the French management consulting firm, SEMA-MATRA, recommended changes in ONPT's organizational structure which would have provided for greater autonomy within ONPT's principal branches of activity (telecommunications, posts, and financial services), while increasing responsibility and accountability at all levels. Under the proposed organizational structure, regional delegations would have increased operational responsibilities, and policy control at headquarters would have been strengthened. To achieve this, the number of regional delegations would have been reduced from the (1987) level of forty-one to four.

Ownership: Tunisia

Throughout the fifteen years of the study, the telecommunications operating entity in Tunisia was a conventional government department (Secretariat d'Etat), called the Ministry of Post, Telephone and Telegraph (PTT), the least autonomous of organizational forms (**Figure V-3** "Organization Chart of the Tunisian PTT"). The PTT was supervised and regulated by the Ministry of Communications. The operating entities of Morocco and Tunisia were similar as conventional government departments, but the Tunisian PTT was the least autonomous for the longest period of time. The Tunisian PTT was dependent on the central government until 1987 when it gained the right to retain earned revenues for direct reinvestment in the sector. In every other way, however, it remained a conventional government department.

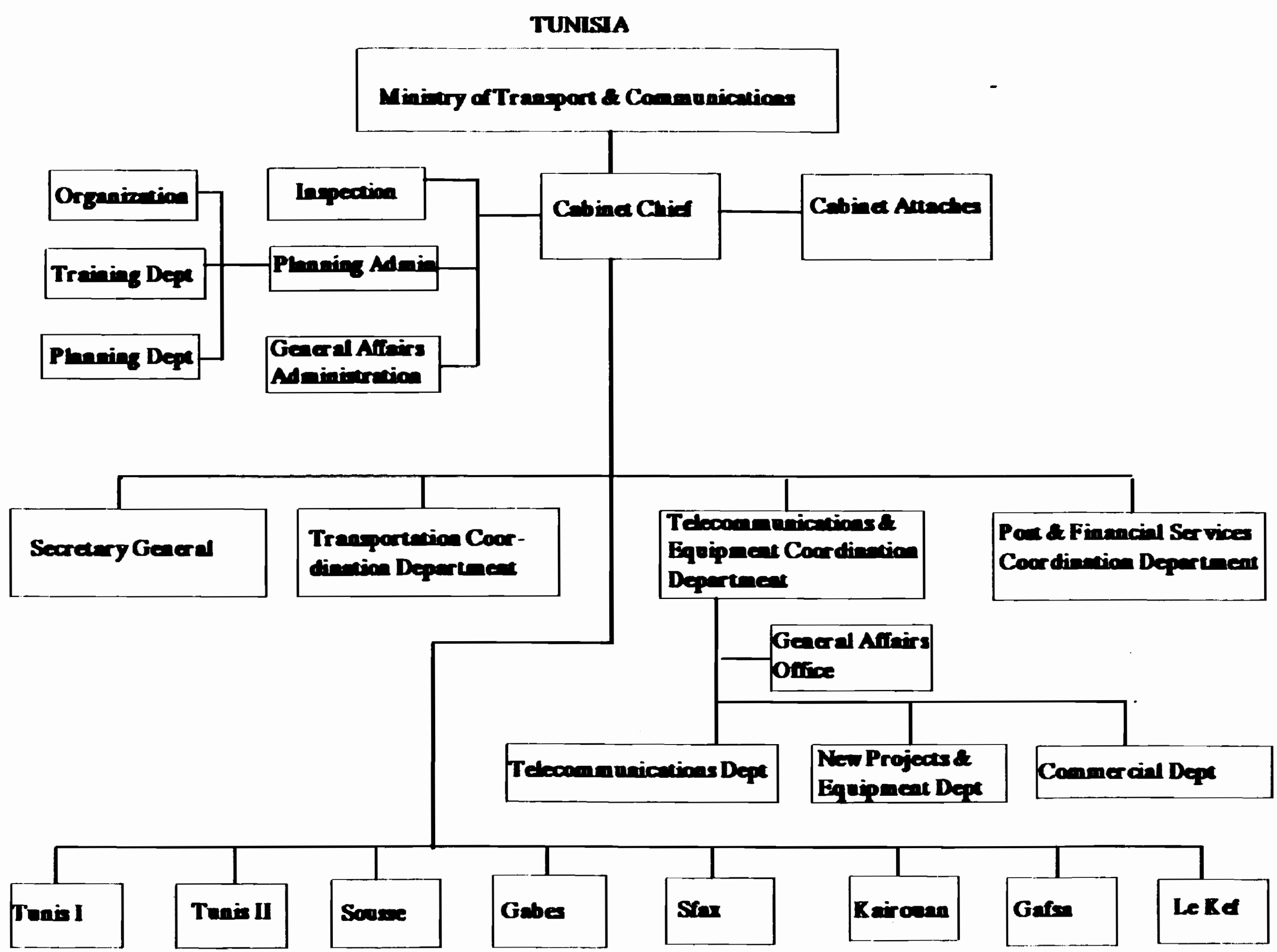

TUNISIA
Ministry of Transport & Communications
Organization
Training Dept
Planning Dept
Inspection
Planning Admin
General Affairs Administration
Cabinet Chief
Cabinet Attaches
Secretary General
Transportation Coor-dination Department
Telecommunications & Equipment Coordination Department
Post & Financial Services Coordination Department
General Affairs Office
Telecommunications Dept
New Projects & Equipment Dept
Commercial Dept
Tunis I
Tunis II
Sousse
Gabes
Sfax
Kairouan
Gafsa
Le Kef

Figure V-3

Regulation and Oversight

Authority to Set Tariffs

Granting the telecommunications entity the authority to set tariffs allows it to fully recover costs of providing service, and to generate substantial funds for new investment, thereby taking the burden off the public treasury. According to World Bank studies, an entity should be able to finance at least 50% of its new construction costs from net internal cash generation (NICG). NICG is an indicator of financial productivity. Ratios below 50% usually indicate that the entity is selling the service at tariffs lower than the cost of providing it. Ultimately, such tariff setting authority also promotes more efficient allocation of resources, especially through the use of peak/off peak pricing.

Authority to Set Tariffs: Algeria

Telecommunications tariffs are proposed by P&T and approved by the Ministry of Finance. Legislation in effect after 1982 required that P&T's tariffs enabled it to cover at least its own operating expenses, including depreciation and debt service. This is in contrast to the period 1974-82, when P&T financed only 26% of its consolidated construction requirements from net internal cash generation.

The remainder was financed almost entirely by treasury advances with a twenty-year final maturity, including a grace period of four years and an interest rate of 2.5%. (These same terms applied for treasury lending to other sectors of the Algerian economy.) Increases in tariffs in 1965, 1975, 1983, and once during the 1985-89 Plan period, did not effect consumer behavior, which indicates that tariffs were not too high, and may, in fact, have been too low. Algeria was the only one of the three Maghrebi states with off-peak tariffs, thereby distributing the use of the network more evenly, and relieving congestion during busy call hours. In 1983, there was a 40% reduction on medium to long distance calls between 8:00 PM and 8:00 AM and on Fridays (Algeria's Sunday) and official holidays.

The proportion of new construction costs covered from P&T's net internal cash generation was steadily increasing over the period of the study (1974-76: 26% of construction requirements covered by NICG; 1979: 33%; 1981: 38%; 1982: 43%; 1983: 50%; 1985: 59%.

Authority to Set Tariffs: Morocco

As regards regulatory procedures for periodic revision of tariffs to adjust for inflation, and the extent to which tariff setting guidelines allowed for generation of funds to cover operating costs and new investment, the following conditions applied in Morocco during the years of the study. Prior to 1986, the telecommunications entity obtained permission to increase charges from the Council of Ministers. Immediately after ONPT was created (during the years 1984 and 1985), ONPT proposed tariffs, but final decision and approval still rested with the Council of Ministers, in their role as executors of price control policy in Morocco. After 1986, however, ONPT was no longer required to obtain approval from this central government body. ONPT's tariffs were no longer subject to government control; ONPT had the right to gradually increase tariffs based on the financing requirements of its investment program with no prior approval by government. Tariff adjustments were geared to the local cost of financing requirements (allowing approximately 45% of construction costs to be covered by net internal cash generation). Just over half (53%) of total investment expenditures for the 1987-94 period were local costs, most of which were expected to be covered by ONPT's net internal cash generation. There were no off peak tariffs in Morocco to reduce circuit congestion during busy calling hours.

Authority to Set Tariffs: Tunisia

The Tunisian PTT proposed tariff increases, but final approval was given by the Minister of Finance. According to one PTT source, tariffs for postal services tended to be below the cost of providing service, but tariffs for telephone, telex and data services have historically tended to more than cover the costs of providing service.[3] The PTT had no peak-off peak tariffs, thereby eliminating any incentive to wait and make calls when lines were less congested (evenings and weekends).

The Tunisian PTT financed an estimated 38% of investment from net internal cash generation (NICG) in 1974, and 33% in the years 1976 and 1977. During the 1977-81 Plan period, PTT financed 48% of investment from NICG. For the 1982-86 Plan period, PTT financed 67% of investment costs (120 million TD out of 180 million TD) through NICG. For the 1987-91 (VIIth) Plan period, the PTT expected to finance 83% of sector investment (new construction costs) from net internal cash generation. In 1987, the Tunisian government changed its long-standing budget allocation policy and granted PTT the authority to retain its earned revenues in order to re-invest them directly in the sector rather than applying for funds from the national treasury.

Authority to Collect Bills

The authority to collect bills is important because delays in collection of receivables places a financial

[3] **Personal communication, Salem Missaoui, Head of Statistics, Ministry of Communications, June 14, 1990.**

burden on the organization. The ability of the telecommunications administration to command such authority is an indicator of its legitimate power (i.e., autonomy). A telecommunications entity with such power has the right to terminate service to any subscriber, including government, who does not pay bills promptly.

Authority to Collect Bills: Algeria

With regard to P&T's authority to collect bills promptly from all users, including government subscribers, the Algerian P&T accounts receivable was described by the World Bank in 1984 as excellent. P&T had the authority to discontinue service to any customer who was delinquint in payment of bills by more than one month. Arrears in 1982, for example, were only for one and a half months of billing. The collection authority of the P&T is substantiated by a 1978 decree, which states that government agencies can be forced to pay through direct deduction from their treasury accounts, even when budget allocations for telecommunications usage are exhausted. Nonetheless, some flexibility is shown toward payment delays by government users. The principal delinquint payers of arrears in 1985 were the Ministry of Defense, the Ministry of the Interior and the Ministry of Radio and Television (RTA). While the Ministries of Defense and Interior paid, however belatedly, RTA, with arrears of DA 89 million accruing since its initial use of P&T-controlled satellite channels, did not pay until payment of arrears by RTA to P&T became a condition for a World Bank loan.

Authority to Collect Bills: Morocco

The extent of central government control over the operations and performance of the telecommunications operating entity are demonstrated by the outstanding debt of the government to the ONPT. The level of unpaid bills for telephone usage by public agencies exceeded 50% of total billing in 1987. Unlike residential or private users whose telephones are disconnected after the sixth week of an unpaid bill, service is not disconnected for government users whose bills are not paid. Total arrears of the Government to ONPT were estimated at 1.2 billion dirham (US $43 million) in 1984. (Net arrears, however, were closer to 900 DH million because in 1986 ONPT owed the Government 200 DH million in accrued unpaid taxes.)

Telephone costs by public agencies far exceeded their budget allocations for this service. The 1984 decree creating ONPT stipulates, again as a result of World Bank conditions, that all outstanding debts between central government and ONPT be settled by June 30, 1984 (six months after the issuance of the decree). Two years later (1986), discussion of this issue continued between ONPT and the Ministry of Finance regarding future Government budget allocations covering telecommunications usage. The Ministry of Finance was willing in July 1986 to budget 160 million dirham per annum (instead of 90 million) to partially cover an estimated annual government telecommunications bill of 220 million dirham in 1987 and beyond.

Authority to Collect Bills: Tunisia

The Tunisian PTT did not have the authority to collect the total amount of payments due from the various ministries of the central government. The central government forfeited a fixed sum to the PTT during each Plan period, but the forfeiture was usually less than the total charges owed to the PTT based on government usage of telecommunications services. The PTT had no recourse for recovering the payment deficit. It simply forfeited the revenues, which could amount to several hundred thousand dinars.

Separation of Post and Telecommunications

The separation of post and telecommunications services is necessary in order to overcome what Israel (1987) calls the "conglomeration effect," i.e., poor institutional performance due to the mixing of productive with non-productive sectors or activities. The typically productive activity loses incentive and capability to perform efficiently. Moreover, there is a tendency under such conglomeration arrangements for insufficient definition and delineation of job descriptions and requirements, service standards and staffing norms, separation of responsibilities, and lines of delegation of authority.

The 1976 re-organization of the Algerian P&T was considered an interim step to prepare ultimately for the complete separation of the post and telecommunications branches. According to the 1976 re-organization, all personnel, including those in common services, were to be allocated either to post or telecommunications branches to facilitate eventual separation. The 1976 organization provided for a transition from a consolidated accounting for postal and telecommunications activities to a strict separation of their accounts, and also introduced structure needed for cost accounting. The objective was to eventually separate posts and telecommunications with distinct accounts. Under the 1976 decree, separate divisions for posts and telecommunications were established within the existing two directorates for personnel and general services. The personnel of the two existing directorates for general administration and personnel were allocated for specialization in either post or telecommunications activities.[4]

Nonetheless, in October 1989, when the Algerian P&T was transformed into an autonomous public corporation, post and telecommunications were still not separated into two organizations.

In Morocco, before and after the reorganization of the telecommunications entity in 1984, all postal and financial services were a separate branch of the telecommunications entity. While there was separation of personnel, there was no separation of financial statements for the post and telecommunications branches. In fact, prior to the creation of ONPT in 1984, no financial statements were kept for either branch of the entity. Financial performance of the Ministry of P&T was measured by the degree of implementation of its budget. ONPT did not adopt a cost accounting system producing separate financial statements before 1988.

In Tunisia, postal services and telecommunications were combined in the same entity in Tunisia, but personnel as well as budgets and accounting systems were separate.

[4] According to the 1976 Decree, the management of P&T on the day-to-day operational level was carried out by directors in charge of: 1) telecommunications, 2) posts, 3) general administration, 4) personnel and training, and 5) accounting.

CONCENTRATION OF CONTROL OVER RESOURCES

The third major criterion of financial dependence is the concentration of control over a resource, or the extent to which input or output transactions are made by a relatively few, or only one, significant organization. Concentration of control is operationalized as the number and substitutability of alternative sources for the same financial resources. It is indicated by the number and substitutability of sources for domestic funds; 2) the number and substitutability of sources for foreign exchange.

Concentration of Control: Algeria

While there are several sources of funds in Algeria, their substitutability was low. Sources for funds in Algeria during the period 1974-86 included: the treasury, the Algerian Development Bank (*Banque Algerienne de Developpement*), the Algerian loan organization *Credit Industriel et Commercial*, and international borrowing. During the 1970s, the greatest portion of funding came from the national treasury, as noted earlier; a very small proportion of the financing of local costs came from the *Banque Algerienne de Developpement* or from *Credit Industriel et Commercial*. The obvious alternative source for domestic funds was the P&T itself, through net internal cash generation, i.e., self-financing, which increased substantially after 1983, as noted above. This reduced the P&T's dependence on the national treasury. After October 1989, the P&T was made into a public corporation and permitted to retain earned revenues for direct reinvestment in the sector. This eliminated its dependence on the national treasury.

Concentration of Control: Morocco

The number and substitutability of sources for financial resources was greater in Morocco than Algeria or Tunisia because of the contribution of the private sector to telecommunications allocations prior to 1984. Thus, it was not as dependent on the national treasury for investment in the sector as either Algeria or Morocco. The Ministry of P&T did not borrow domestically before 1984, because it financed all local investment costs from NICG. External borrowing was contracted by Ministry of Finance and on-lent to the Ministry of P&T on concessionary terms. When the Ministry turned over responsibility for post and telecommunications to the commercially oriented, public corporation, ONPT in 1984, investments were increased dramatically. During the 1987-94 period, earned revenues less expenditures (NICG) were no longer sufficient to cover all investment costs. The P&T was expected to cover about half (49% on average) of its investment from earned revenues. The rest of the required funds were to be borrowed commercially from domestic and international sources. Domestic sources for borrowing provided only 2% of total investment in 1984, 26% in 1985, and 16% in 1986. For the 1987-91 period, domestic borrowing was expected to be no more than 3% of total investment. The primary domestic source for domestic borrowing was the *Caisse de Depots et de Gestion*. ONPT's right to borrow internationally after 1984 gave it additional financial autonomy from domestic sources.

Foreign sources were numerous and fairly substitutable (either among countries or suppliers). Foreign sources for financial resources in the 1987-91 period totaled 47% of investment (US $674 million), and consisted of roughly 11% bilateral financing (tied procurement), 19% concessionary loan (from The World Bank) and 17% parallel financing (through suppliers credits with contracts under price and terms of international competitive bidding and limited internal bidding). There were three sources for bilateral financing: France, Sweden and Italy. Sources for supplier credits for the 1987-94 period were France, Sweden and Spain.

Concentration of Control: Tunisia

The concentration of sources for financial resources was high during the fifteen years of the study. Most domestic financial resources of the PTT came from a single source: the national treasury (70.5% from 1973-76; 69% 1982-86). This large proportion of sector funding from a single source, the public treasury, made the PTT dependent on the central government for these critical resources, which in turn gave the government strong influence over investment levels. We see that throughout the 1970s and early 1980s investment levels were lower than Algeria on a per capita basis, but higher than Morocco.

SUMMARY OF FINANCIAL DEPENDENCE

While administrative autonomy in Algeria was permitted, financial autonomy was not. The central government did not interfere with the day-to-day operations of the organization, but it maintained strict control over the financial aspects of the entity. The magnitude of the transfer of financial resources from central government to the Algerian P&T was high until 1983. This indicates that the P&T was highly dependent on the central government for funding during this period. The proportion of the total budget of the Algerian P&T coming from the national treasury between 1978 and 1982 averaged 70% percent of investment In 1983, the P&T increased tariffs by 50%, which allowed it to finance over half (57% on average) of investment costs from net internal cash generation (NICG) between 1983 and

1988. This reduced its dependence on central government. Financial resources from the national treasury dropped to only 17% of total domestic borrowing during this period. After October 1989, the Algerian P&T gained the right to retain earned revenues for direct reinvestment in the sector, thereby eliminating its dependence on central government for financial resources.

The direction of the resource exchange was two-way, insofar as the P&T transferred all earned revenues to the central government upon their receipt, except for a capital working balance of three months. Not surprisingly, therefore, according to World Bank sources in 1986, while the administration of the P&T was well managed, financial accounting was not well managed. The dependence of the Algerian Ministry of P&T on central government for its critical financial resources determined the level of investment in the sector. Moreover, it acted, in principle, as a disincentive for the entity to perform more efficiently, i.e., to take advantage of investment opportunities, to earn greater revenues for re-investment in the sector, and, in short, to meet demand for services.

The magnitude of the input from central government to the budget of the Moroccan entity was less than that of the Algerian or Tunisian entities, because the private sector provided some revenues to the entity. The resource transfer was two-way insofar as the Moroccan Ministry of P&T was required to transfer earned revenues to the national treasury and reapply for necessary funds through the budget allocation process of central government until 1984. The Moroccan entity, transformed into a public corporation (ONPT) in 1984, gained the right to retain earned revenues for direct reinvestment in the sector. This made it independent of central government for financial resources. Nonetheless, ONPT continued to transfer money to government after 1984 in the form of corporate taxes.

In Tunisia, as Algeria, the largest proportion of the PTT's funding came from the national treasury (ranging from 67-71% of total investment). This made the PTT highly dependent on the central government, and gave the Ministry of Finance and Planning strong influence over the level of investment. Like the Algerian and Moroccan telecommunications entities, the direction of the resource exchange was two-way. The Tunisian PTT requested necessary funds from central government and transferred earned revenues to the national treasury. After 1987, the Tunisian PTT gained the right to retain earned revenues for direct reinvestment in the sector.

While there were several sources of funds in Algeria, their substitutability was low. During the 1970s, the greatest portion of funding came from the national treasury, as noted earlier. The obvious alternative source for domestic funds was the P&T itself, through net internal cash generation, i.e., self-financing, which increased substantially after 1983, as noted above. After October 1989, the P&T was made into a public corporation and permitted to retain earned revenues for direct reinvestment in the sector. This eliminated its dependence on the national treasury.

The measures of autonomy related to discretion over the use of financial resources show that the telecommunications entity in Algeria was more autonomous between the mid-1970s and mid-1980s than either Morocco or Tunisia. Although the Algerian P&T was a government department, it adopted organizational measures associated with more autonomous forms of ownership. Notably, the Algerian P&T maintained competitive salary and promotion policies, a commercial orientation, and day-to-day administrative autonomy from central government. It had the authority to raise tariffs to keep up with costs of providing service, and the authority to collect bills from all users, most importantly, government users. Ironically, although Algeria was committed to state intervention and a centrally planned economy, it granted relative administrative autonomy and a predominantly commercial orientation to its telecommunications administration. This is in sharp contrast to Tunisia or Morocco (until 1984), which were committed to a mixed economy, but operated their telecommunications entities as conventional government departments.

The telecommunications decision making structure in Morocco throughout the 1970s and most of the 1980s, was highly centralized and allowed for very little autonomy of the operating entity. The Moroccan Ministry of Post and Telecommunications was a government department, governed by a Board of Directors. The Board was a highly political group, being chaired by the Prime Minister; its members included the Ministers of Finance, Defense, Interior, Planning, Economic Affairs, Industry and Equipment, and Transport. In 1984, the Moroccan government created the 'Office Nationale des Postes et Telecommunications,' which was designed to operate as a legally, financially and administratively autonomous public enterprise. The overall aim was for the entity to operate on a commercial basis and to reduce central government intervention in its day-to-day operations. While the Moroccan public corporation, ONPT, gained the authority to set tariffs to cover costs of providing services, it lacked the authority to collect outstanding bills from government users. Moreover, while there was separation of personnel in post and telecommunications, there was no separation of accounting between these two branches of activity.

The Tunisian PTT, still a conventional government department in 1990, was the least autonomous of the three entities for the longest period of time.

Post and telecommunications in Algeria were not separate organizations throughout the 1970s and 1980s. and even beyond the 1989 reorganization. But they were separate branches of activity with separate personnel and accounting systems. Tunisia, like Algeria, kept post and telecommunications combined within the same organization, with separate personnel and separate accounting systems.

The concentration (number and substitutability) of sources for financial resources was greater in Morocco than Algeria or Tunisia because of the contribution of the private sector to telecommunications allocations prior to 1984. Thus, it was not as dependent on a single source, such as the national treasury. The Ministry of P&T did not borrow domestically before 1984, because it financed all local investment costs from NICG.

In Tunisia, the concentration of sources for financial resources was high during the fifteen years of the study. Most domestic financial resources of the PTT came from a single source: the national treasury (70.5% from 1973-76; 69% 1982-86). This large proportion of sector funding from a single source, the public treasury, made the PTT dependent on the central government for these critical resources, which in turn gave the government strong influence over investment levels. We see that throughout the 1970s and early 1980s investment levels were lower than Algeria on a per capita basis, but higher than Morocco.

Insofar as the Algerian government was supportive of the telecommunications sector, the high concentration of control over financial resources was not unduly obstructionist or detrimental to investment levels for the sector. In Tunisia, the PTT was also financially dependent upon the central government, but the central government was not as generous to the sector as the Algerian government was. In Morocco, the Ministry of P&T was less financially dependent on the central government because it obtained some revenues from the private sector until 1984. This underscores the critical role played by the external organizations controlling the resource allocations. If the entity is dependent and the central planners are supportive of the sector, investment levels tend to be high; if the entity is dependent and the central planners are not supportive of the sector, investment levels tend to be low. If the entity is independent financially of central government or other external organizations, it can determine for itself what the level of investment will be based on its independent source of revenues: net internal cash generation. All three Maghrebi states eventually reached financial autonomy by the end of the 1980s. This should reduce if not eliminate the influence of central government on decisions concerning the level of sector investment.

CHAPTER VI

TECHNOLOGICAL DEPENDENCE

Technological dependence is the extent to which the telecommunications entity needs resources, services or support, including technical skills and knowledge, from external organizations. Technological resources include hardware (equipment, systems, facilities) and software (technical skills and knowledge).

The organizations that own the technical resources needed by the telecommunications entity are domestic and international equipment suppliers, communications system operators, bilateral/multilateral aid organizations and governments. These organizations are specifically: the international telecommunications equipment manufacturers and vendors (e.g., Scientific Atlanta, Siemens, Ericsson, NEC), and domestic equipment manufacturers; international system owners/operators (Intelsat, Intersputnik), regional system owners/operators (Arabsat) and domestic system operators, if any, other than the public telecommunications operating entity. These same types of external organizations are also typical sources of technical assistance and training, including such bilateral or multilateral aid organizations as the World Bank, the International Telecommunications Union, and the United Nations Development Program).

Domestic sources of technical assistance include training institutes and other formal educational institutions.

The extent to which the operating entity needs these resources is measured by the three criteria of the resource dependence model:

1) the importance of the resource, i.e., criticality of the resource for survival and operation, and the magnitude of the resource exchange, measured in terms of degree and direction, i.e., the proportion of total inputs or the proportion of total outputs accounted for by the exchange.

2) control over resource allocation and use; and

3) concentration of sources for the resource.

The relative technological dependence (or autonomy) of the telecommunications entity was measured and evaluated for each major category of technological resources -- i.e., telecommunications equipment, services, and technical assistance -- according to these three criteria of the resource dependence model.

CRITICALITY AND MAGNITUDE OF RESOURCE EXCHANGE

The criticality of technological resources -- equipment, services and technical assistance -- has been established. As noted earlier, telecommunications equipment is highly critical to the survival and operation of the operating entity; without telephone instruments, data terminals, switching exchanges, transmission lines, service operators and trained personnel, there could be no communications services.

The magnitude of the resource exchange between the telecommunications entity and external organizations is measured in terms of degree and direction. The direction of the resource exchange, in the case of developing countries, is usually one-way, i.e., the importation or transfer of technology (equipment, services and know-how) from advanced industrialized countries to developing countries. Some developing countries manufacture some equipment locally, but they rarely export what they produce. In the case of the three Maghrebi countries, the direction of the exchange was one-way, i.e., Algeria, Morocco and Tunisia import certain equipment, services and technical assistance from advanced, industrialized countries. None of the Maghrebi countries export locally manufactured equipment to other countries. Some trainees, however, of North African training institutes, were from other North African (and sub-Saharan African) states.

The degree of the resource exchange or transfer is operationalized as the proportion of total input accounted for by the resource exchange (or transfer). It is indicated by the proportion of total telecommunications costs (both operating budget and investment budget or construction costs) expended on technological resources (i.e., equipment, services, and technical assistance) in both foreign and local costs.[1] Further, in order to assess the magnitude of the resource transfer between the telecommunications entity and domestic technological organizations versus foreign technological organizations, the proportion of local versus foreign *construction* costs is given. In the 1980s, foreign exchange costs were typically 50-80% (average about 60%) of telecommunications investment costs in most LDCs (Wellenius 1987; Richter 1987).

Magnitude of Exchange: Algeria

In Algeria, for both Plan periods, 1980-84 and 1985-89, technological resources (both local and foreign costs) were 47% of total sector costs (operating expenditures and construction costs). That is, costs for technological resources were about half of total sector costs.

Within the technological portion of total sector

[1] Total telecommunications costs include both the current operating expenditures and investment expenditures. Operating expenditures, as reported by each country to the ITU, mean expenditures other than investments; they include personnel salaries and material costs of maintenance and repair of existing system, depreciation, interest, and taxation. Investment, as noted in Chapter IV, means the expenditure associated with acquiring the ownership of property and plant; these include expenditure on initial installations, and on additions to existing installations where the usage is expected to be over an extended period of time. Local cost means expenses in the currency of the country under discussion for goods and for services supplied from the territory of that country.

costs, *foreign* construction costs, i.e., technological resources from foreign sources, were about half (48%) of total construction costs (DA 4.408 billion out of DA 9.248 billion) for the combined period 1980-1989. This is under the average (60%) for developing countries generally in the 1980s. There was a rise in 1985 when foreign construction costs were 70% of total Algerian telecommunications market demand, probably due to the transition from analog to digital technology (importation of digital transmission and switching equipment). But in subsequent years, the foreign component dropped to about half of the total market demand: 54% in 1986 and 56% in 1987.[2]

Magnitude of Exchange: Morocco

In Morocco, the proportion of total sector costs (both foreign and local for operating expenses and construction) for technological resources was about 31% (1.896 billion dirham out of 6.040 billion dirham) for the Plan period 1982-86. For 1987-91, the proportion of total sector costs for technological resources dropped to about 24% (6.072 billion dirham out of 14.513 billion). Thus, technological resources were about one-third of total sector costs in the early 1980s, and about one-quarter of total sector costs in

[2]Lardjane, M."Industry Sector Analysis," Memorandum. August 1987, p. 44.

the late 1980s.

Within the constructions costs portion of total sector costs, *foreign* construction cost, i.e., imported technology and services, was about half (47%) of total construction costs (DH 2,835 million out of DH 6,072 million) for the combined period 1987-1991 Plan period.

Magnitude of Exchange: Tunisia

For Tunisia, in the mid-1970s (1976 and 1977), technological resources were 38% and 35% of total sector costs, respectively (for 1976, 8.78 million TD out of 22.732 million TD, and for 1977, 9.09 million TD out of 26.130 million TD). By the 1982-86 Plan period, when sector investments tripled, technological resources were estimated to be about 49% of total sector costs (for 1982-86, 184 million TD investment expenditure out of an estimated 374 million total sector costs, i.e., investment expenditure and operating expenditure). For the 1987-91 (VIIth) Plan period, Tunisia spent a lightly lower proportion (41%) of total sector costs for for technological resources.

Within the technological portion (construction costs or investment budget) of total sector costs, *foreign* construction costs, for the 1987-1991 (VIIth) Plan period, were estimated to be about 63% of total construction costs (98.4 million TD out of 151.5 million TD). This is close to the average (60%) for developing countries generally in the mid-1980s.

In summary, Algeria and Tunisia spent just under half of total sector costs, for technological resources (both local and foreign equipment, services and training) throughout the 1980s (for Algeria, 47% on average 1980-89; for Tunisia 49% between 1982 and 1986, then 41% between 1987 and 1991, which gives an average for Tunisia 1982-91 of about 45%). In Morocco, technological resources were about one-third of total sector costs in the early 1980s, and about one-quarter of total sector costs in the late 1980s.

Within the investment expenditure (construction cost) portion of total sector costs, about half of the Algerian construction costs throughout the two Plan periods 1980-89 was for *foreign* technological resources, with a peak of 70% in 1985. In Morocco, also about half of the construction costs for the 1987-91 Plan period was foreign cost. Tunisia had an estimated foreign cost component of about 63% for 1987-1991.

CONCENTRATION OF CONTROL OVER RESOURCES

The second major criterion of technological dependence is concentration of control over resources. This is operationalized as the extent to which input or output transactions are made by a relatively few, or only one, significant organization, i.e., the number and substitutability of sources for the same technological resources. As noted above, sources for technological resources (telecommunications equipment, services and know-how) are domestic and international equipment manufacturers, system owner/operators, and organizations providing technical assistance. The number and substitutability of sources for technological resources are indicated by: 1) the number of foreign versus domestic sources for equipment, services, and technical assistance; and 2) the substitutability of domestic for international equipment suppliers, system operators and technical training.

Concentration of Sources for Equipment

The number and substitutability of *foreign* or international sources for equipment was high throughout the period of the study. There were many manufacturers and vendors of telecommunications equipment in the United States, Europe, Canada, Japan and other industrialized countries. The majority of imported telecommunications technology in all three Maghrebi states came from France, which also provided additional bilateral assistance throughout the period of this study for the development of the telecommunications networks in its former colonies. Nonetheless, all manufacturers and vendors of telecommunications technology typically adhere to the same international technical standards. Standards help to make all equipment, services or assistance interchangeable. These countries have had similar access to international sources for technological resources insofar as suppliers, operators and foreign technical expertise comply with international technical standards and will normally sell to anyone interested in making a purchase or other agreement. Therefore, while the Maghrebi states, like other countries, are highly dependent on foreign technological organizations for resources they can not provide domestically, the international sources for resources are not concentrated. They are numerous and highly substitutable.

Domestic sources can be substituted for international sources when domestic resources are comparable to foreign resources. Domestic manufacturing reduces foreign exchange requirements for technological resources. The *number* of domestic sources for the same equipment, services or know-how provides a measure of the relative dependence of a country on its *domestic* technological organizations. The *substitutability* of domestic sources for foreign sources for the same resource provides a measure of the relative dependence of a country on *foreign* technological organizations. Each major type of technological resource -- equipment, services and expertise -- is considered separately.

Domestic Sources for Equipment: Algeria

During the 1970s and 80s, the number of sources for equipment was similar in Algeria, Tunisia and Morocco. Each country had only one domestic supplier (typically a public enterprise) of telecommunications equipment. All three countries had factories manufacturing telephone sets and cables. Algeria in addition, however, manufactured switching equipment. This means that Algeria was less dependent on *foreign* sources for switching equipment than either Tunisia or Morocco. This is discussed further below.

The government of Algeria placed great emphasis on the development of domestic production capability, local production for local use, in telephone and telex technology since 1974. The government established a state corporation in 1974, Societe Nationale de Fabrication et de Montage du Materiel Electrique et Electronique (SONELEC), or the National Society of the Electrical and Electronics Industry, for the Manufacture and Installation of Telecommunications Equipment. SONELEC began production of telephone sets and exchanges in 1978 at a newly built manufacturing complex in Tlemcen. It also took over the production of cable equipment, the local manufacture of which was started in 1928 and was nationalized in 1968. SONELEC was restructured into several state corporations in January 1984, and the factory manufacturing telephone instruments and analog (crossbar) switching equipment -- located in the city of Tlemcen -- was transferred to a newly created Enterprise Nationale de Telecommunications (ENTC). Another state corporation created from the restructuring of SONELEC was the Entreprise Nationale pour la Fabrication du Cable (ENICAB), located in Algiers, which produced small-capacity pair cables and one type of small diameter coaxial cable, and laid and jointed (installed) them for P&T. These two electronics manufacturing corporations (ENTC and ENICAB), which manufactured and installed cable and switching equipment for P&T, operated under the supervision of the Ministry of Heavy Industry.

In the early 1970s, when Algeria began local production in telecommunications equipment, analog technology was prevalent world-wide. Algeria established a manufacturing industry and related training programs around analog switching and transmission equipment. These sunk costs in manufacturing, which meant sunk costs in manpower training as well, made it very costly to retool toward the 1980s state-of-the-art digital technology. By 1979-80, the Algerian P&T realized the need to switch to digital technology, and began to introduce digital equipment into the network beginning with the 1985-89 Five Year Plan. But the presence of these state owned enterprises, i.e., domestic analog equipment suppliers, had an important influence over the decisions of the telecommunications entity. The investment in analog technology as an industrial base delayed Algeria's transition from analog to digital technology more so than Tunisia or Morocco, which had invested much less in the manufacture of analog equipment.

Still, there was only one domestic source for each type of equipment manufactured. This means the concentration of sources for that type of equipment (telephone instruments, exchanges and cables) was very high. Therefore, the telecommunications operating entity was highly dependent upon those domestic organizations for the specific equipment they provided. The domestic supplier of transmission equipment was producing at 80% capacity in the early 1980s, which made it impossible for the P&T to meet network expansion targets. One problem was a shortage of manpower. The three local telecommunications equipment manufacturing plants were intended to be self-sufficient in manpower, so as to decrease dependence on foreign assistance required in manufacturing and installing equipment. But attracting, training and maintaining sufficient manpower was a problem in both the production and installation functions, resulting in the need for continued foreign technical assistance between 1975 and the early 1980s (Booz Hamilton 1983).[3] ENTC was not able to keep up with P&T's growing needs for analog or digital equipment which resulted in delays in network expansion, and underutilization of the existing network capacity.[4]

The *substitutability* of domestic for foreign resources was higher in Algeria than Tunisia or Morocco, as shown in **Figure VI-1** "Algeria, Morocco and Tunisia: Proportion of Total Costs for Equipment by Type: 1980-91". **Figure VI-1** shows that in the 1980-82 period, of the total costs for switching equipment, 77% was foreign, 23% was local. In the 1983-89 period, of the total costs for switching equipment, 74% was foreign, 26% was local. The next highest costs were for transmission equipment. In the 1980-82 period, local costs were 60% of total costs for transmission equipment. But in the 1983-89 period, the foreign costs were higher (67% of total) for transmission equipment. The lowest foreign costs were for local network equipment. In the 1980-82 period, 23% of local network equipment costs was foreign, 77% was local; in the 1983-89 period, 38% of costs was foreign, 62% was local.

While switching equipment was consistently higher in

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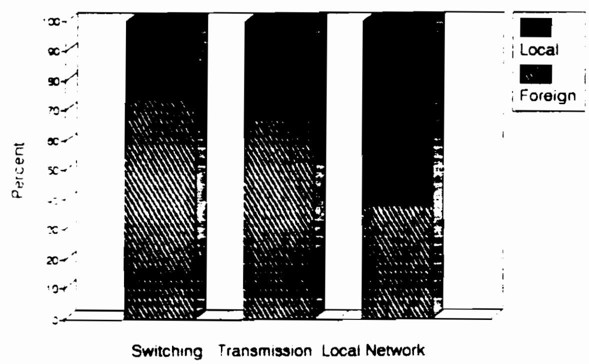
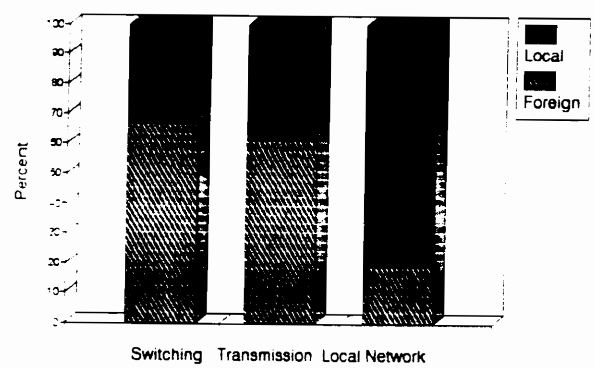
[3]In 1984 there were 2,300 ENTC personnel (for production of telecommunications equipment) and 900 SONATITE personnel (for telecommunications installations and maintenance).

[4]ENTC production levels in 1984 were about 60,000 analog exchange lines and 80,000 telephone sets.

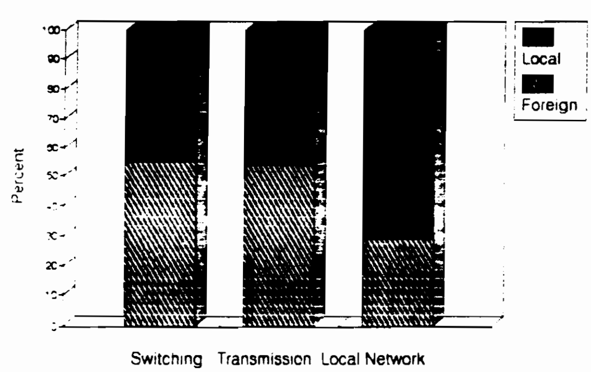
ALGERIA 1983-89
Proportional Cost by Equipment Type



MOROCCO 1987-91
Proportional Cost by Equipment Type



TUNISIA 1987-91
Proportional Cost by Equipment Type



Proportional Cost by Equipment Type
Figure VI-1

foreign costs, and local network equipment was consistently higher in local costs, foreign costs were higher for transmission equipment in the 1980-82 period, but local costs were higher in the 1983-89 period. The proportion of foreign costs for switching equipment should decrease dramatically after 1990, as the Algerian-Swedish joint venture (Sitel) manufacturing plant begins to produce digital switching equipment locally.

Domestic Sources for Equipment: Morocco

Morocco had a small telecommunications manufacturing, assembly and construction industry. It consisted of one government-owned company, Societe Nationale des Telecommunications (SNT), and four small private companies. SNT participated in the construction of ONPT's local and urban networks, and had equity participation in the four private firms. The four private companies were local subsidiaries of foreign suppliers. Three of them assembled or produced minor switching, radio, teleprinter, and power equipment components. The fourth factory produced cables, meeting a substantial part of ONPT's need for cables and accessories. The Moroccan government encouraged local private sector entrepreneurs in the installation of cable networks and the installation of subscriber plant. The Ministry of Finance and ONPT were both interested in the late 1980s in further developing a telecommunications and electronic industry in Morocco.

Table VI-1 "Proportion of Total Costs for Equipment by Type" shows that in the 1987-94 period, of the total costs for switching equipment, 67% was foreign (1,221 million DH out of 1,831 million DH). The next highest foreign costs were for transmission equipment, including telephone, telex, telegraph and data transmission. The foreign proportion (61% of total transmission costs) was higher than local costs in the 1987-94 period. The lowest foreign costs were for local network equipment. In the 1987-94 period, 81% of local network equipment costs was local. **Table VI-1** shows that while switching and transmission equipment was consistently higher in foreign costs (i.e., imported technology), local network equipment was consistently higher in local costs (i.e., manufactured locally) for the 1987-94 period. This is due to the overall investment increases in the telecommunications sector after 1984, which required the importation of switching and transmission equipment. As with Algeria, local network equipment was largely manufactured locally.

Domestic Sources for Equipment: Tunisia

There was one domestic factory ("Arabtel") manufacturing telephone instruments, and one domestic factory ("Chakira" located in a suburb of Tunis) manufacturing telephone cable for the telecommunications network.

In the late 1980s (1987-91 Plan) Tunisia, as in Algeria and Morocco, spent the largest foreign exchange proportion of equipment budget for switching equipment (55% or 36.6 million TD out of 66.8 million TD) and transmission equipment (54% or 22.5 million TD out of 42 million TD).[5] Foreign costs for local network equipment was the smallest proportion (an estimated 30% or 20 million TD out of 60 million TD).

In short, all three countries show the highest foreign equipment cost for switching equipment, which means they were more dependent on foreign suppliers of this type of equipment than foreign manufacturers of transmission or local network equipment. Algeria took steps to reduce its dependence on foreign switch manufacturers by establishing a joint venture with Ericsson of Sweden in 1987 to manufacture digital switching equipment. This factory was expected to meet 100% of domestic switching needs in the 1990's, meaning that 100% of Algeria's switching equipment costs would be local costs. In the early 1980s, Algeria's proportion of foreign transmission equipment costs was lower than local transmission costs, reflecting its transmission equipment

[5] **Estimates of foreign proportion of equipment costs based on PTT literature detailing type of equipment and foreign versus local cost proportions for 1987-91.**

manufacturing capability at the end of the 1970s and early 1980s. But with the introduction of digital technology, the proportion of *foreign* transmission costs in Algeria was predominant through the rest of the 1980s.

All three countries show lower foreign than domestic costs for local network equipment in the 1980s. Given Algeria's lower foreign costs for transmission equipment in the early 1980s, it was probably also lower than foreign costs prior to 1980 since Algeria was manufacturing analog switching equipment at its Tlemcen factory. Neither Tunisia nor Morocco manufactured switching equipment. Since Algeria was manufacturing local network, transmission and switching equipment throughout the 1970s, it probably had lower foreign costs in all three of these categories than either Tunisia or Morocco, although data was not available to confirm this. With the advent of digital technology in the early 1980s, the foreign proportion of technological resource costs (i.e., imported equipment) increased for all three countries. Algeria was the only one of the three countries with lower proportion of foreign costs in all three equipment categories by the beginning of the 1990's.

Concentration of Sources for Services

Domestic Sources for Services

All three Maghrebi states had some additional domestic communications services provided in the form of cable installation. In Algeria, SONATITE installed cable and switching equipment (from ENTC's Tlemcen manufacturing plant) for P&T. Under the Third Five-Year Plan (1980-84), SONATITE established a civil works branch for the construction of P&T's local networks and buildings, and expanded its cable laying and jointing branch. In Morocco the government-owned company, Societe Nationale des Telecommunications (SNT), participated in the installation of ONPT's local and urban networks. In Tunisia, a public enterprise, la Societe Tunisienne d'Entreprises des Telecommunications (SOTETEL), installed the majority of cable for the PTT. Three other companies also installed cable and provided civil engineering services, as necessary, for the PTT; these were: Entreprise Tarchi, SOMATRA, and SARRT. This larger number of sources for installation of cable equipment made the Tunisian PTT less dependent on any one cable installation company.

Algeria and Morocco, unlike Tunisia, had separate state corporations for the installation, maintenance and service of private telecommunications equipment, such as private branch exchanges (PABX's), which are basically private switches located on customer premises and owned by the subscriber. The Algerian government established the Societe Nationale des Travaux d'Infrastructure pour les

Telecommunications (SONATITE)[6] for the purpose of carrying out construction services for P&T and for the installation and maintenance of private branch exchange switches (PABX). This state corporation, under the supervision of P&T, was in charge of the country's private branch telephony, specifically, installing, connecting and maintaining private branch exchanges and subscriber terminal installations. In Morocco, the government-owned company, Societe Nationale des Telecommunications (SNT), installed and maintained private telecommunications equipment.

International Sources for Services

The number and substitutability of sources for *international* communications services throughout the early half of the study (1970s) was low. There were two organizations, Intelsat and Intersputnik, providing international telephone, data and video services to virtually every country in the world.[7] The International Telecommunications Satellite Organization (Intelsat), an intergovernmental organization, was established by the United States in 1963. By 1987 it comprised 114 member governments, with a majority of LDCs. Intelsat owned and

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[6] National Society of Infrastructural Works for Telecommunications
[7] The third international satellite system, Inmarsat, is for maritime (ship to shore) communications, with forty members in 1984, including the Soviet Union and the United States as the two largest shareholders.

operated the major international satellite network for public telecommunications.

The other international satellite owner/operator was Intersputnik, established by the Soviet Union, and utilized mostly by Soviet satellite states.[8] Martinez (1985) notes that ironically, most Soviet bloc countries were users of the higher-quality Intelsat circuits. Intersputnik was a much smaller organization than Intelsat in terms of membership (15 countries in 1987) and traffic (0.3% of the traffic volume carried by Intelsat in 1984).

The substitutability of the two international satellite systems was low. Membership in Intelsat provided an incentive to use Intelsat satellites because member countries earned return on investment calculated by actual use (minutes or pulses of telecommunications traffic). Intersputnik offered no such incentive.

Thus, the number and substitutability of sources for international communications services was low for the Maghrebi countries, like most developing countries, throughout the 1970s. This means the concentration of control over these technological resources was high, thereby increasing the dependence of the telecommunications entity

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[8] **In 1984, the membership of Intersputnik included fourteen countries: Bulgaria, Hungary, Czechoslovakia, Poland, East Germany, Romania, Mongolia, Vietnam, South Yemen, Afghanistan, Syria, Laos, Cuba, and the Soviet Union. Non-member users included Algeria, Iraq and North Korea.**

on either international satellite system for international communications services. Algeria minimized its dependency on either international operator by using the services of both, the only one of the three states to do so. Algeria introduced international satellite communications services via the Intelsat satellite network in 1975 with the purchase and installation of a Standard A earth station at Lakhdaria (outside Algiers) operating with an Intelsat IV satellite located over the Atlantic Ocean (for communications with countries to the west of Algeria). In 1976 Algeria purchased another Standard A earth station operating with an Intelsat IV satellite over the Indian Ocean (for communications with countries to the east of Algeria). In 1979 Algeria purchased an earth station operating with the Intersputnik satellite system.

Morocco accessed the Intelsat network through a Standard A earth station near the capital city, Rabat. Morocco began to lease an Intelsat transponder for domestic communications in 1983. Morocco was not a member, nor did it use, the Soviet system, Intersputnik. Tunisia accessed the Intelsat network through a Standard A earth station (located at Dkhila, outside Tunis). Tunisia did not belong to nor use the Intersputnik system.

Beginning in the early 1980s, the concentration of sources for international services *decreased*, i.e., the number and substitutability of sources for communications services *increased*, with the opening up of the telecommunications market to competition in several industrialized countries (most notably, the U.S., Great Britain, and Japan) Many private companies began to offer specialized services (voice and data, especially) with the advent of digital techniques and increased channel capacity that reduced system costs dramatically. Thus, in the 1980s, the number and substitutability of organizations providing communications services for the domestic market (the business community and government of a developing country, for example) increased dramatically. There was also a greater number of satellite communications operators, specifically, private satellite operators such as PanAmSat owned and operated by private capital), and regional satellite operators such as Arabsat (owned and operated by the Arab League states).

The substitutability of the Arab regional satellite for the international satellite was possible when communications traffic flowed among Arab states. Arabsat, launched in 1985, provided voice, data, and video communications among Arab states or within Arab states, as needed. Tunisia was the site (also at Dkhila, about 40 kilometers outside Tunis) of the second control center of the Arab regional satellite system. (The primary control center was in Riyahd, Saudi Arabia, the headquarters of the Arab Satellite Communications Organization (ASCO), which governed Arabsat.). Tunisia was also one of four permanent members of the Board of Governors of ASCO.

The Arabsat satellite was a regional alternative source for regional communications services, an alternative to the international system operators such as Intelsat when telecommunications traffic was within the Arab region. The North African countries could also minimize their dependence on foreign owner/operators of communications services in the 1980s (when many new foreign companies began offering specialized services), by building up their local capacity, through the public telecommunications entity and/or the local private sector. Throughout the period of the study (1972-1986), there were no domestic communications services operators other than the public telecommunications operating entity in all three Maghrebi states, with the exception of installation services and the maintenance of private branch exchanges in Algeria and Morocco, as noted under the section titled Sources for Domestic Services. All specialized services in all three states arising in the 1980s were handled by the public entity. In Morocco, the only domestic telecommunications owner/operator besides ONPT was a separate government-owned company, 'Societe Marocaine de Telecommunications par Cables Sous-Marins' (MATELCA) which operated and maintained the transmission facilities of the international submarine cables linking Morocco with European and African countries.

Concentration of Sources for Technical Expertise

The concentration of sources for international technical assistance was low throughout the study. That is, there were many interchangeable foreign sources for technical assistance; these were international suppliers (NEC, Siemens, Scientific Atlanta, etc.), international operators (Intelsat, Intersputnik), bilateral aid organizations and governments of advanced, industrialized countries, and multilateral aid organizations such as United Nations agencies (e.g., The World Bank, United Nations Development Program, International Telecommunications Union). The International Telecommunications Union obtained the bulk of its funds for technical assistance from the United Nations Development Program (UNDP).

The substitution of domestic for international sources of technical assistance is possible where local manpower exists to handle the job. Adequate staffing is key to building up a capable telecommunications entity (Saunders, Warford and Wellenius 1983). The rate at which a system can be expanded is limited by the ability of the entity to provide trained staff to plan, install and operate it. The effective use of human resources is accomplished through adequate staff training and appropriate personnel policies. In many developing countries, high turnover of the telecommunications personnel is common, a problem which is often attributed to personnel policies guided by a civil service statute. Expertise -- technical and managerial -- is often in shorter supply than clerical and support staff in the telecommunications entity of developing countries. In fact, the entity is often overstaffed, given the ratio of total staff that is unskilled. The World Bank considers 20 staff per 1,000 direct exchange lines (DELs) reasonable in terms of productivity of staff. A majority of the total staff should have technical or managerial expertise. A large proportion of clerical staff increases wages without increasing significantly the output or productivity of the organization. The proportion of technical staff gives a measure of the productivity of the entity. Israel (1987) notes that human resources gravitate toward high-specificity and competitive activities because the financial rewards and status are higher and, for certain individuals, because technological and financial activities are intellectually more satisfying. The "best and the brightest" are attracted to careers in these activities. But telecommunications entities in developing countries are often characterized as being overstaffed with unskilled personnel, and as having trouble attracting and keeping highly qualified technical and managerial expertise (Saunders, Warford and Wellenius 1983). These problems are identified with personnel policies guided by a civil service statute, rather than more competitive and flexible salary scales and promotion opportunities for personnel with expertise (Gant 1979; Rothwell 1972; Saunders, Warford and Wellenius 1983; Roth 1987).

Personnel policies effect not only the proportion of technical expertise in the organization, and the role of technical experts in decision making, but also the leadership of the organization. High level personnel may change with changes in government. Continuity of management, despite changes of government, is important to institutional cohesion, learning and morale (Saunders, Warford and Wellenius 1983). Leadership is considered the single most critical element in institution building because deliberately induced change requires intensive, skillful, and highly committed management of both internal and external relationships (Esman).[9] The leadership group

[9] **The other four variables Esman considers critical to institutional development are: 1) resources: the financial, physical, human, technological and informational inputs to the institution; 2) doctrine: the values, objectives, and operational style of an institution and the choices of methods it uses to achieve its objectives; doctrine is translated into the "program" of the institution, i.e., the concrete patterns of actions and the allocation of energies and other resources within the institution itself and in relation to the external environment; 3) program performance: those actions which are related to the performance of functions and services**

comprises both the holders of formally designated leadership positions and others who exercise important continuing influence over the institution's activities. Leadership consists of the groups of persons who are actively engaged in the formulation of the doctine and program of the institution, initiate and/or guide change over extended periods, and who direct operations and relationships with the environment.

Therefore, the substitutability of equivalent domestic for international sources of technical expertise is indicated by 1) personnel policies of the organization; 2) the proportion of total staff with technical expertise; 3) the number of trainees per 1,000 DELs, and 4) the quantity and quality of training facilities. Leadership is indicated by the initiation of deliberately induced change and by the exercise of important continuing influence over the activities of the telecommunications entity.

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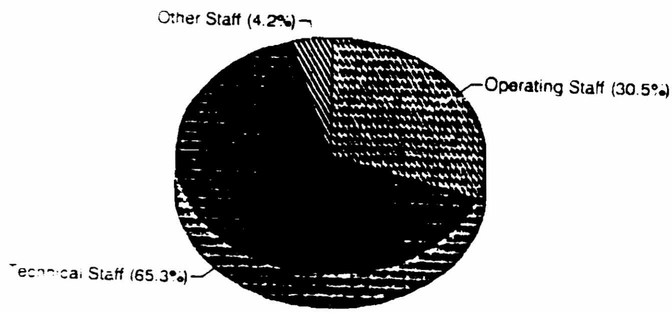
constituting the output of the institution; and 4) internal structure: the structure and processes established for the operation of the institution and for its maintenance.

Technical Expertise: Algeria

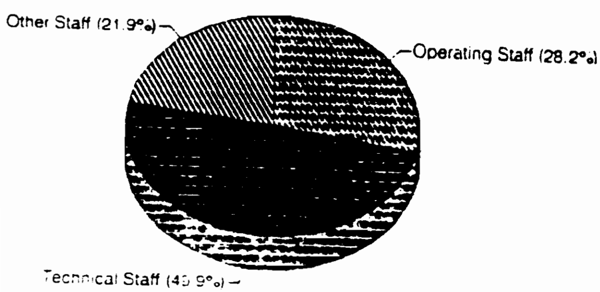
One of the most important institutional changes in the 1976 reorganization of the Algerian P&T was the abolition of the civil service statute. In 1976, the Algerian P&T switched from a civil service statute, typical of government departments, to competitive hiring, salary and promotion policies, which are typical of a commercially-oriented organization such as a private or public enterprise. Competitive personnel policies helped to attract and keep highly qualified expertise and leadership in the organization.

On average, over the fifteen year period between 1972 and 1986, P&T maintained a high ratio of technical expertise, 66% of total staff on average between 1977 and 1986 (**Figure VI-2** "Algeria, Morocco and Tunisia: Average Proportion of Technical Staff"). There was a very substantial increase of staff during the period 1973-77 which was justified by P&T on grounds of providing on the job training for staff who would be needed when the expansion of the network was completed (the domestic satellite network). In 1977, P&T had 42 staff per 1,000 telephones (total P&T staff was about 24,800 of which about 12, 500 were telecommunications staff.) The target staff ratio recommended by the World Bank was 20 staff per 1,000 direct exchange lines (DELs). Algeria's 1977 ratio of

ALGERIA 1972-1986
Staff in Telecommunications Services



MOROCCO 1977-1986
Staff in Telecommunications Services



TUNISIA 1972-1986
Staff in Telecommunications Services

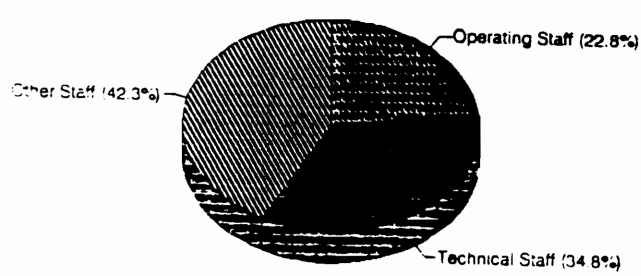


Figure VI-2

Average Proportion of Technical Staff

42/1,000 DELs falls in the range of staff levels of many developing countries, but it is high when compared with countries of similar staff wage levels. Nonetheless, almost 60% of these staff provided technical expertise. By 1982, P&T had reduced the staff ratio to 39 per 1,000 telephones (i.e., a total of 27,870 personnel, of which 15,800 were for telecommunications services). Approximately 70% of these staff provided technical expertise. By 1986 the telecommunications staff ratio was brought down to a more productive 36 per 1,000 telephones, with over 65% of these as technical staff.

Algeria had one outstanding individual, Abdelkader Bairi, in the P&T who demonstrated strong leadership throughout his long term with the entity from the late 1960s to the early 1980s. Abdelkader Bairi was Director General of Equipment from the late 1960s to the mid-1970s, and then rose to Director General of Telecommunications from 1977 to 1983. Bairi was educated in France where he obtained his engineering diploma at the Ecole Nationale de Telecommunications (ENST) in Paris. Bairi was a founding member, and the Algerian representative (from 1966 to 1983), to the International Telecommunications Satellite Organization (Intelsat), headquartered in Washington, D.C. He also served as representative of the Arab states in the Board of Governors of Intelsat. Bairi combined his intimate knowledge and familiarity with Intelsat and his own expertise in the conception, initiation and implementation of the lease of a satellite transponder from Intelsat for domestic communications in Algeria, the first developing country to do so.

Bairi finally left the Algerian P&T in 1983 to serve as Deputy Director General of the Arab Satellite Communications Organization (ASCO) which managed the Arab regional satellite, Arabsat. He was elected Director General of Arabsat (by its twenty-two Arab states membership) beginning a three year term in May 1986. He was elected to another three year term in 1989.

The leadership of the Algerian P&T is also demonstrated in the initiative and continuing influence of Noureddine Bouhired, an engineer and former senior official in the P&T. During his term of office in the P&T, Bouhired served as head of the Algerian delegation to Space WARC where he reaffirmed his reputation as one of the Third World's most effective, articulate and politically savvy spokesmen. On behalf of a large proportion of developing country members, Bouhired introduced at the Space WARC negotiations an *a priori* allotment plan according to which sections of the satellite orbital arc and associated radio frequencies would be set aside for each country.[11] Bouhired

[11] **Space WARC is the nickname for the World Administrative Radio Conference on the use of the geostationary satellite orbit and the**

spoke four languages in addition to his native Arabic. In 1986 he began an appointment as Head, Group of Engineers, for ITU's Center for Telecommunications Development, in Geneva, Switzerland, which was established to foster telecommunications development in the Third World.

Algeria minimized its dependence on foreign sources of technical assistance by maintaining domestic technical education and training programs. Through its Personnel and Training Department, the P&T controlled the schools specialized in training the technical as well as administrative staff, who were assigned to posts or telecommunications directorate or moved from one to the other later. The necessary expertise required by P&T was assured through a central institute (in Oran), four regional training schools (in Algiers, Constantine, Ouargla and Saida), and seven vocational training centers. The training facilities were continuously expanded. P&T also relied heavily on the university, the Ecole National d'Administration, and on some foreign institutions, for training higher level managers.

In 1973-74, there was a shortage of qualified manpower

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planning of space services utilizing it. These international treaty negotiations, like other regional and world administrative radio conferences (RARC and WARCs) were held under the auspices of the United National agency responsible for regional and international telecommunications regulation, the International Telecommunications Union (ITU). Space WARC meetings were spread out over a three year period with two major conferences lasting about six weeks each, at ITU headquarters in Geneva, in 1985 and 1988.

which slowed the rate of network growth and rapidly increased the growing waiting list for telephone connections. P&T's investment program was restricted by this shortage of manpower. A large investment program between 1975-80 attempted to improve the situation. Cooperation between Algeria, the International Telecommunications Union and the United Nations Development Program, led to the establishment in 1977 of the central training institute for engineering, the Oran Institute, which was supervised by P&T.[12] The Telecommunication Institute of Oran was the highest training center in Algeria. Several levels existed in the training curriculae and instructions for technical staff and managers.[13] The Ministry of P&T used the regional schools at Algiers and Constantine to train workers at the lower levels (e.g.,

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[12] Training took place before 1977 through foreign schools, or through the Ecole Polytechnique of El Harach. The course in the central institute required a two-year general training at the university followed by three years at the institute itself.

[13] These levels were as follows: 1) *Ingenieurs d'Etat*: the highest level in the technical field. This training level required a prior two-year general training at the university followed by three years at the institute. 2) *Ingenieurs d'Application*: four years of study at the institute starting after high school graduation (*baccalaureat*) or equivalent examination. In 1978 there were 300 students. 3) *Techniciens Superieurs*, (or Senior Technicians) with two origins: a) from high school (*lycee, classe de premiere*), with two years at the institute -- about 160 students in 1978; and b) from P&T, internal recruitment open to technicians after five years at P&T -- training lasted one year at the institute. The Oran Institute also offered temporary courses lasting one year for technicians (about 50 students in 1978) in parallel with the normal school (Algiers, Constantine) and the military school for transmission.

junior technicians, operators, artisans) or very often instructors from regional schools were sent there when there were enough attendees for on the job training. P&T supervised regional training schools .

The total number of trainees in 1979, from all training centers, was 1,730 students. On the basis of 1,730 trainees in 1979, and 207,000 main telephones, there were about 0.84 trainees/1,000 DELS in Algeria in 1979. The growth rate in the number of DELs during that period (1973-77) was 13%. This is well above the ratio for Tunisia in 1977 (0.42 trainees per 1,000 DELs). In 1982 the number of trainees was 2,400 (0.66/1,000 DELs); in 1986 the number was 3,200 (0.72 trainees per 1,000 DELs). P&T expected to train 14,000 staff between 1983 and 1987.

According to World Bank evaluations, training facilities were well organized and adequate to the needs of the P&T. The laboratories were well equipped, partly with help from UNDP but also with equipment provided by manufacturers. This, together with competitive salaries, made it possible, as noted earlier, to maintain a majority level of technical expertise within the P&T (66% on average between 1972 and 1986).

The technical assistance and training component of the World Bank project during the 1983-87 period constituted only 0.8% of the total Bank loan (DA 11.5 million out of

1,437 million), and 0.1% of total investment costs (DA 11.5 million out of DA 9,247.6 million) during this period. This means that in Algeria during the 1980s, there was not a great need for technical assistance and training in addition to that provided domestically. Nonetheless, the major proportion (80%) of the small amount of required technical assistance and training was foreign costs (DA 9.2 million foreign costs; DA 2.3 million local costs). This means that the small amount of technical assistance that was sought was only available from foreign sources.

Technical Expertise: Morocco

As a government department until 1984, telecommunications staff worked under a civil service statute, which had a negative impact on the proportion and role of technical staff in the Ministry of P&T. The average percentage of technical staff in the Ministry between 1977 and 1982 was 41%, years when the civil service statute was still in effect.

A new personnel statue, applicable to technical staff only, was adopted after 1982, just before the entity changed from a government department to a public corporation in 1984. The new personnel policy was supposed to allow ONPT to attract technical staff of the necessary caliber by offering adequate salaries, and to introduce adequate flexibility in personnel policy. Technical staff were recruited according to separate provisions and had separate salary scales, which included payment of merit increases up to 15% of salary. The proportion of technical expertise in the organization after the introduction of competitive salaries and promotions, averaged 59% (64% in 1983 and 1984;55% in 1985; and 59% in 1986) (**Figure VI-2** "Proportion of Technical Staff"). Averaging the percentages of technical staff under both policies gives an average of 50% technical staff for the ten year period between 1977 and 1986. In 1986, all of ONPT's *non-technical* personnel were still working under a basic civil service statute. Consequently, staff salaries were inadequate to attract qualified *accountants* to the entity. The policy toward non-technical staff was changed in 1986 when new personnel statute meeting the requirements of a commercially oriented autonomous public enterprise was adopted. These changes are important because an excess of non-technical (clerical) staff reduces the overall productivity of the organization.

Between 1980 and 1984, the average number of staff per 1,000 DELs in Morocco was 32. (The World Bank considers a staff ratio of about 20/1,000 DELs a productive level). At the end of 1984, ONPT had reduced its total staff to 30 employees per 1,000 DELs in service.[14] This is still considered too high, but compares favorably to Algeria which had 36 employees per 1,000 DELs in 1984. But Algeria's higher number of staff was proportionally higher in technical expertise than Morocco's. By 1986-87, the number of staff per 1,000 DELs in Morocco was down to a more productive 29, with 59% of total telecommunications staff having technical expertise. Morocco planned to reduce this ratio to 18/1,000 DELs by 1994.

The leadership of the Moroccan telecommunications entity has been undermined in the late 1980s by the central government. In February 1986 the Secretary General of the Ministry of Post and Telecommunications and four managers of ONPT were put under house arrest in connection with charges of alleged misappropriation of funds. The five managers returned to their previous positions, but the Secretary General was replaced.

The Minister of the Moroccan P&T in 1984 -- Mohand Laenser -- served as acting Director General of the new telecommunications entity, ONPT, when it was created in 1984. He was appointed permanent Director General in the late 1980s in view of his demonstrated capability.. The Minister was described by a World Bank mission as a man of "great ability, whose entire career has been devoted to

[14] **Total ONPT staff was about 14,000; 7,400 of which was telecommunications staff, including 45% of common services staff.**

posts and telecommunications, and who has been the driving force behind sector reorganization and expansion". Thus, it was only toward the end of the period of this study, that the Moroccan entity benefitted from strong and capable leadership.

ONPT ensured specialized staff training through the Institut National des Postes et Telecommunications in Rabat and four small regional training centers for field training of lower level staff. The Institut received assistance from UNDP/ITU in preparing its curriculum. It also used a significant number of foreign teachers for specialized courses under a long-term agreement with the French PTT. Training capacity in 1985 was 800 students, all of which were under staff-trainee contract with ONPT. About 200 engineers, senior technicians and operational/administrative supervisors and about 360 lower level staff graduated each year from the Institut in the early 1980s. The need in 1985 was not for new training facilities so much as a re-arrangement of the distribution and flow of students in the existing training institute, and for equipment to optimize utilization of existing facilities. Given an estimated 560 students in 1985, and 215,421 main telephones, there were 0.26 trainees per 1,000 DELs in Morocco at this time, with a growth rate in the number of DELs (1980-84) of 6%.

ONPT began a revised training program for telecommunications staff in 1986. Under a World Bank project, ONPT was expected to increase existing student capacity by about 60%, adapt existing programs and create new ones, notably in accounting and finance, and improve laboratory and workshop facilities. ONPT would also increase the training capacity of the regional centers, which would handle most lower level training in the provinces. ONPT had to train an estimated 7,400 additional telecommunications staff through 1994. A World Bank mission in 1987 deemed the training arrangements generally satisfactory, but noted there were still urgent training needs in the Finance Department.

Technical Expertise: Tunisia

As a government department, the Tunisian PTT followed a civil service statute. This meant that the entity did not have the authority to set wages, salaries and promotions, and therefore, was not able to attract and keep a large cadre of qualified personnel. The average percentage of technical staff during the fifteen year period 1972-86 was only 33%, the lowest of all three Maghrebi states (See **Figure VI-2** "Proportion of Technical Staff: Algeria, Morocco and Tunisia"). The proportion of technical staff in 1974 was only 12% of total staff. Technical staff and workers ("*personnel technique et ouvrier*") in 1974 was 36%.

The number of total staff grew over the next fifteen years, but the number of technical staff grew slowly. By 1986, the proportion of technical expertise was only 32% of total staff. In 1988, the proportion of technical staff was only 29% of total staff.

The total number of staff in 1974 was 44 per 1,000 telephones. By 1986, the staff ratio dropped to 29 per 1,000 telephones, but the proportion of technical staff was very low. Thus, the staff to DELs ratio while reasonable, was not terribly productive because of the small proportion of technical expertise and the large proportion of clerical staff. When the central government allowed substantial increases in financial allocations to the Tunisian PTT in 1987, there were still not sufficient numbers of technical staff to plan, operate and maintain a rapidly expanding, modern telecommunications system.

The leadership of the Ministry of Communications changed four times between 1973 and 1989. Brahim Khouaja, Minister of Communications during most of the 1980s, was educated and trained in telecommunications, which might, in principal, have given him a greater interest in the needs of the PTT which his Ministry supervised. But, Khouaja's training was in plain old telephone service; thus his expertise was limited by the 1980s. Between 1987 and 1990, most of the top management and many senior technicians left the Tunisian PTT for the private sector. In 1989, Sadok Rabah succeeded Brahim Khouaja as Minister of Communications. Rabah was trained as a statistician in France, one of the country's elite students to be sent each year by the state. In June 1990, a colleague and former fellow student of his, said that Minister Rabah was trying hard to convince the Minister of Finance as well as President Ben Ali that the telecommunications operating entity should be more autonomous from central government.[15]

The Tunisian operating entity does not appear to have benefitted from the fact that a Tunisian, Mohamed Mili, was the Secretary General of the International Telecommunications Union for fourteen years from 1966 to 1982. Mili has been described by some of his professional observers and colleagues as a integrator, a mediator, of the interests of advanced industrialized countries and those of the Third World. During his tenure, Mili became intimately familiar with the international regulation and control of telecommunications and gained deeper knowledge and understanding of the industry, but he did not appear to translate his expertise into the improvement of his own country's network planning and development. Increases in Tunisia's telecommunications investments began only in the early 1980s, which was after Mili left the leadership

[15] Saleh Khamouma, Personal interview. June 18, 1990.

position of the International Telecommunications Union.

Although the Tunisian post and telecommunications training school was in existence since the early 1970s, fewer than 2,000 (1,865) students graduated in the fifteen years between 1972 and 1987, in three different divisions (telecommunications, post and financial services, and computer science) to meet the technical needs of several ministries.[16]

The Government established the School for Post and Telecommunications (*L'Ecole des Postes et des Telecommunications de Tunis*) in October 1971 to serve the needs of the Ministry of Transportation and Communications, as well as technical departments of other ministries (e.g., Ministry of Interior, Radio and Television of Tunisia). The professional training at the School for Posts and Telecommunications lasted from one to four years, but the average length of study was two years. A small proportion (under 5% on average of the total enrollment have been foreign trainees).

In 1977 the total number of trainees was 332 students (125 graduates, and 207 undergraduates). With 78,000 DELs, this makes 0.43 trainees per 1,000 DELs in 1977. For

[16] **Categories of telecommunications training included: engineers, assistant or junior ("adjoint") engineers, and junior technicians; categories of training for post and financial services included: Inspector, Assistant Supervisor ("Attache d'Inspection et Controleur"); categories of training for computer services included: analysists, programmers and operators.**

purposes of comparison with Algeria and Morocco, this does not include on-the-job trainees in curricula lasting less than one year, since comparative data for on-the-job trainees is not available for Algeria and Morocco. (There were 317 on-the-job trainees, i.e., less than one year of training, in Tunisia in 1977.) In 1985 the total number of trainees at *l'Ecole* was 947 students (385 students in the graduating group, including post/financial services and computer science graduates; 562 undergraduates). Of these totals in 1985, 204 were graduates of the telecommunications division, and 224 were undergraduates of telecommunications division.

In addition to enrollment terms of one to four years in the *Ecole des Postes et Telecommunications*, there were shorter sessions of supplementary, on-the-job training ("*recyclage*") lasting from one to nine weeks, but on average about three weeks, and continuing education seminars ("*seminaires*") and internships ("*stages*") at home and abroad, lasting from several days to several hundred days, but on average about 100 days. In 1985, a total of 14 interns participated in telecommunications internships or training ("*stages*") of some kind, often abroad (Sweden, Spain, France, and Italy), the average length of which was 463 days. There were also five training sessions ("*seminaires*") held in Tunis, and one in France, lasting on average 196 days each. Forty-six individuals participated in this type of telecommunications training in 1985. This gives a ratio of 0.5 trainees/1,000 DELs in 1985, when the average annual growth rate in the number of DELs (1982-86) was 11%. Algeria's ratio was 0.72 trainees per 1,000 DELS with an average annual growth rate in the number of DELs of 8% (1980-84). Morocco's ratio was 0.3 trainees to 1,000 DELs in 1985 with an average growth rate in DELs of 6% (1980-84).

In 1988, the number of trainees in Tunisia was at its lowest point, rather than its highest. A total of 60 students graduated in all divisions, and 167 students were undergraduates. In addition, 180 staff from the Ministry of Communications participated in short session, on-the-job training (*"recyclage"*), which lasted on average about three weeks. A total of 80 trainees attended internships in France, Sweden and Italy, lasting about 90 days on average. A total of 38 persons attended seminars in 1988, held in Tunis and abroad, lasting about 120 days on average.

ALLOCATION AND USE OF TECHNOLOGICAL RESOURCES

Technical design determines use. The capability of a telecommunications operating entity to allocate and use technological resources (i.e., to decide who gets what services and facilities) is limited *a priori* by the design of the technology and the technical trade-offs within the configuration of a communication system. Telecommunications technology is usually designed by manufacturers of equipment, (e.g., Scientific Atlanta, Hewlett Packard, IBM, Alcatel, Siemens, Nippon Electric Company), the majority of which are from advanced, industrialized countries. Manufacturers design equipment according to the needs and demands of the marketplace. The greatest market demand has been for advanced, state-of-the-art, high capacity, high speed, and high quality telecommunications technology. This is often the most expensive, and the most suited to urban, interurban or international communications (heavy traffic, also called "thick route"). The communications needs of developing countries are for some high capacity technology to serve urban areas. But the majority of the population of a developing country lives in non-urban areas, whose communications needs are more suitably met by low capacity technology (e.g., small earth stations using a high powered satellite) to serve rural and remote areas. Therefore, until more suitable technology is designed, a developing country's telecommunications operating entity must choose technology that is available on the market. Throughout the 1970s and early 1980s, the available technology was designed for heavy traffic areas, not the thin route traffic of rural areas of developing countries. The absence of suitable technology (i.e., inexpensive, durable, and easy to install and maintain) to meet the communication needs of rural areas, made it too costly for a telecommunications entity to expand domestic communications into rural and remote areas. As technological developments progressed, designs changed, and costs of network expansion fell.

Communications technology design and system trade-offs are indicated by the technical standards of equipment and by technical requirements of the system. Thus, the capacity of the P&T to determine technological resource allocation and use is indicated by: 1) technical standards and changes in technical standards; and by 2) trade-offs in the configuration of communication systems and changes in these trade-offs, as a result of technological developments.

Technical standards are the performance requirements and criteria of the communications equipment which standardize the quality of the transmission signal and assure some compatibility among interrelated parts of the communication system. These standards are set by various bodies (e.g., Intelsat, ITU); the various interests of the standards setting decision makers are indicated by the verbal proceedings of the standards setting bodies and of the Space WARC treaty negotiations (1985-89)[17]. The

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[17] **Relevant records of Space WARC are from Committee 5 "Planning Principles and Criteria and Regulatory and Administrative Procedures," and Committee 4 "Technical Parameters and Criteria," and draft**

technical standards and proceedings of these standards setting bodies and negotiations indicates the variability and substitutability of technical designs and configurations for telecommunications systems.

Technical Standards

As noted earlier, during the period of the study, there were two international satellite systems providing international telecommunications services for developing countries, Intelsat and Intersputnik. Most developing countries use the Intelsat system. These systems have been established by advanced, industrialized countries, for international communications, i.e., communication *between* countries, not *within* countries. The large, expensive (Standard A) earth stations that operated with the international Intelsat system were appropriate for connecting an LDC with other countries for international communications. But smaller, less expensive earth stations were more appropriate (more affordable, easier to install and maintain) for building integrated infrastructure *within* a country, i.e., to link urban and rural areas, as well as rural areas to each other (Martinez 1984; ITU/OECD 1983; ITU 1986; Parker 1984). The industrialized nations owned and operated separate satellite systems, nationally or

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documents and reports of the U.S. Advisory Committee of Space WARC, of which the researcher is a member.

regionally, for communication within their own countries. Most developing countries could not afford to own and operate a separate satellite system, either nationally or regionally, for domestic communications. Therefore, they had to use terrestrial communication networks, i.e., microwave and cable, to reach rural areas within their own countries. If there were geographical barriers, such as extensive mountain ranges, vast deserts, or large bodies of water, it was very expensive, and often physically impossible, to install terrestrial lines to reach rural areas. If a developing country decided to introduce domestic satellite communications, it was dependent on Intelsat to provide a satellite channel on the international system.

The technical standards set by Intelsat for earth stations to be used with the Intelsat satellite system kept the costs of developing domestic networks in developing countries very high throughout the 1970s and early 1980s. The earth stations with which the Intelsat satellites operated throughout the 1970s were expensive (Standard A earth stations cost about U.S. $7 to 8 million each), about 30 meters wide (90 feet); they required substantial power generation (including air conditioning for electronic components), and skilled maintenance. Most LDCs could afford to own and operate only one such Standard A station for international communications.

Algeria was the first developing country to use Intelsat for domestic communications. In an innovative move in 1973, P&T's then Director General for Telecommunications Equipment, Abdelkader Bairi, proposed the design and implementation a domestic satellite network using small, less expensive earth stations, and a transponder (channel) on an Intelsat satellite. According to Bairi, his proposal to Intelsat that Algeria lease an Intelsat transponder for domestic communications originally met with hostility. Nonetheless, the proposal was eventually accepted by Intelsat, and it established a precedent that institutionalized such arrangements for any country.

Algeria contracted an American company, GTE, in 1974, to custom-design fifteen earth stations in order to make them suitable to the harsh desert climate of southern Algeria. The GTE earth station was similar in size (11 meters) and price (about U.S $500,000 per station, i.e., or US $5-7 million (1974 dollars) for the total network of fifteen stations) to the existing Standard B station, but with custom changes, to make it more suitable to the Algerian climate. Algeria paid US $10 million per year 1975-79 for the leased transponder on Intelsat, on a pre-emptible basis. The first stations of the domestic system were placed in operation with Intelsat II in the Indian

Ocean on February 17, 1975. In 1983, Algeria awarded a contract to Scientific Atlanta, Inc. for two more of the same type of earth station. In 1988, Algeria awarded a contract to Northern Telecom, a Canadian company, to expand the rural satellite network by another 19 earth stations to access a subsequent generation (V) of Intelsat satellites. This extensive satellite network facilitated communication linkages from the major urban areas and population centers in the north coast to the natural gas fields, mining areas and industrial production complexes scattered across vast rural areas of sparsely populated desert in the south.

Intelsat began to lower its standards for earth stations in 1984, with the "Vista" earth station, intended for rural areas of developing countries. The Intelsat satellites were not designed to operate with small earth stations. As a result the Vista station had to be equipped with enough power to function with a "weak-powered" satellite . This made them still relatively expensive (Standard D, Vista stations cost approximately $55,000 each, in 1989, Freight-On-Board, meaning docked in the local harbor or airport; for the station to be unpacked, re-located and installed, would cost an additional $25,000). Moreover, the Vista station could accomodate only a few telephone channels (from a minimum of four to a maximum of only twenty-four simultaneous phone calls). Abdelkader

Bairi stated that the Vista earth station was not a good choice for building a domestic network because of the inherent limitation to network expansion imposed by the small number of channels that the station could accommodate.

Nonetheless, in 1985, Intelsat requested a "notification of interest" from all member developing countries in procuring Vista stations if the price was less than $US 50,000 (1985 dollars). Notification of interest came back to Intelsat from many developing countries, with a total of estimated procurements at four hundred and fifty Vista earth stations. On the basis of this response from developing countries, Intelsat sent out a Request For Proposal (RFP) for the development of the Standard D Vista earth station on a volume discount basis. Scientific Atlanta, Inc. won the bid, and signed a contract with Intelsat on October 18, 1986 to be the exclusive supplier of the Standard D Vista earth station. By 1987, only three countries had placed orders or issued letters of intent for up to twenty-two Vista Standard D-1 earth stations under the Volume Discount Agreement. In 1988 the total number of Vista channels in operation by all users was 144.

In the mid-1980s, Intelsat introduced several new earth station designs: Standard E, F, G and Z. These were smaller, less expensive and required less maintenance than the original Standard A (30 meter), Standard B (11 meter), or Standard C (up to 19 meters) antennas. The Standards E and F antennas, introduced in October 1983, had diameters from 3.5 to 9 meters and were designed for use with the Intelsat Business Service (IBS) and Intermediate Data Rate carriers. They were intended primarily for data, not telephone communications, and they had to be used with a leased transponder. Standards E and F were therefore used for private, not public, networks. The Standard G, introduced in 1984, accommodated a wide range of earth station sizes, including microterminals as small as 0.8 meters in diameter. However, it was authorized for accessing the space segment (satellite) for leased international services only, i.e., again for private, not public, services and networks. The Standard Z, introduced in 1988, was authorized for earth stations also operating with leased services, and domestic rather than international leased services. Leased services, however, were private services and networks, not public networks, on which public telephone service operates. The only earth station approved for the public network was the Vista station (Standard D), and its limitations have been mentioned.

The modifications made by Algeria to the Standard B earth station design ten years earlier (in 1974), turned it into a non-standard earth station, by Intelsat standards. Only by using non-standard stations was Algeria able to install a domestic satellite network that was cost effective and suitable to the climatic conditions of this developing countries. By 1987, twenty-five countries had followed Algeria's example of leasing an Intelsat transponder for domestic telecommunications.

Despite the option to use Arabsat instead of Intelsat for domestic communications, as of 1989, for economic reasons Algeria had not transferred its domestic telecommunications traffic from Intelsat to Arabsat. Algeria earned return on investment for the domestic communications traffic on Intelsat. Under Intelsat Agreement Article III b (II) of the Intergovernmental Articles of Agreement, a country can earn return on investment using an Intelsat transponder for domestic communications if the country must use the satellite transponder because of the kind of geographical barriers noted earlier. Under Article III b (ii), if the implementation of wideband terrestrial facilities is impossible to accomplish because of natural barriers of an exceptional nature, the provision of domestic telecommunications services via an Intelsat satellite transponder would be considered on the same basis as international public telecommunications services. That is, the country earns return on investment share "according to use" for domestic as well as international traffic on the

Intelsat satellite. This "return on investment share according to use" did not exist with the Arabsat system until two years after the 1985 launch, i.e., not until 1987. Thus, the economic incentive for Algeria was to keep domestic telecommunications traffic on Intelsat, where that domestic traffic increased the investment share, and therefore the investment return, which in turn increased its voting share in the Intelsat organization. In 1984, Algeria submitted to the Intelsat Board of Governors a request for renewal of the provisions contained in Article III b (ii) for a period of five years.

System Configuration

Developing countries are part owners/operators of Intelsat, and as such they have a voting share in its decisions concerning the design of the satellite system. Established in 1963, Intelsat is the major provider of international public telecommunications services, under the ownership and management of member nations, developed and developing, typically represented through their telecommunications operating entities. Voting power in Intelsat, however, is proportional to ownership shares, which was based on use of the system. The heaviest users of Intelsat satellites are developed countries, which therefore command the greatest voting power in the organization. They also have the highest stake in its ability to operate at peak performance and to earn return on investment.

Intelsat is managed as a commercial enterprise, even though it is an intergovernmental organization whose assets are owned by governments. The prime objective of Intelsat is the provision of satellite channels, which it makes available to any country for international communications, and since 1976 for domestic communications (the majority of domestic users are LDCs).

Intelsat has an economic incentive to reduce the costs of the space segment at the expense of the ground segment because each of the member countries of Intelsat individually purchases the connecting earth stations in its country. Throughout the 1970s, Intelsat used less expensive, lower powered satellites requiring more expensive earth stations, rather than more expensive, higher powered satellites which operate with less expensive earth stations. This system configuration forces individual participating states to pay more for each earth station than they would if Intelsat put more of the total system costs in the space segment of the technology cluster.

Algeria, Morocco and Tunisia, in cooperation with the twenty-two states of the Arab League, had the opportunity to design the Arab regional satellite system, an opportunity which allowed these developing countries greater control over the configuration of the communications system than they had Intelsat. The three satellites of the first generation of Arabsat satellites (Arabsat I) were built (beginning in 1981) by Aerospatiale of France, in collaboration with the American company, Ford Aerospace and Communications, a subsidiary of Ford. Two satellites were launched in 1985 (one in use, one for emergency backup), and the third, spare satellite was put in storage.[18] The total capacity of the Arabsat I satellite was 8,000 half circuits for regional and domestic applications, and seven television transponders, including one for community television.

All but one of the twenty-six transponders (channels) on the Arabsat I satellite operated at frequencies of 4/6 GHz (C-band). The earth stations that operated with C-band were typically 11 meters. The choice of C-band was made in the late 1970s and early 1980s, a time when C-band was a

[18] The European-launched Arabsat 1A, intended as the "on-line" in use satellite, failed to maintain its proper orbit. The second, shuttle-launched Arabsat 1B, intended as the back-up, took over as the "on-line" primary spacecraft. Arabsat 1A was subsequently correctly positioned over Zaire, and performed the emergency back-up role. According to a high level source at Intelsat, the third (spare) satellite of the Arabsat system may be purchased by Intelsat This would solve Intelsat's problem of obtaining a built satellite quickly -- rather than waiting the three year period for construction -- and mitigate against the shortage of satellites in orbit, due to the 1986 explosion of the SpaceShuttle Columbia and subsequent delays in new satellite launches. The sale would help amortize the cost of building, launching, and maintaining the Arabsat system. The orbitting Arabsat satellites have always had huge excess capacity which would more than compensate for the reduction in total system capacity as a result of the sale of the third (spare) satellite.

well proven technology, and the more recent Ku-band frequencies (11/14 GHz) were new and unproven. Ku-band has since become much more common and increasingly popular, largely because the higher frequency could accommodate smaller, less expensive earth stations (3-6 meters). Abdelkader Bairi, Director General of Arabsat, indicated in 1987 that the next generation of Arabsat satellites (Arabsat II) would probably be designed as hybrids (both C-band and Ku-band technology), if not all Ku-band. C-band technology, a rational choice in the 1970s, has since become suboptimal. In 1990, the request for proposals from the Arab Satellite Communications Organization for the second generation of Arabsat satellites specified a hybrid Ku-band C-band satellite design.

In 1987, nine countries owned a total of fifteen earth stations in the Arabsat network. That is fewer than one per Arab state, and included one state that was not a member of the Arab League, the Sudan.[19] Three countries leased a total of four Arabsat transponders for domestic communications; these were: Saudi Arabia, Oman, and Mauritania. The Gulf states (most notably, Kuwait, Bahrain and the United Arab Emirates) and Saudi Arabia were the most enthusiastic about the Arabsat plan from the outset; their

[19] In 1987, countries owning Arabsat earth stations were: Algeria, Tunisia, Morocco, Saudi Arabia, Jordan, Bahrain, Kuwait, Yemen and Sudan.

combined investment in 1976 was 65% of the initial total outlay. Algeria, Tunisia and Morocco were originally cool to the regional satellite idea (circa 1976). Their investment shares in 1978 were very small: 0.5% for Morocco, 0.6% for Tunisia, and 0.9% for Algeria. Each Maghrebi country purchased its Arabsat earth station in 1985 when the satellite was launched. But Algeria did not transfer its domestic communications traffic from the Intelsat satellite to the Arabsat satellite for reasons mentioned above.

By 1987, it appeared that the fact that the system operated with C-band may have inhibited the purchase of earth stations by participating Arab countries.[20] Since the second generation of Arabsat satellites was rumored to be based on Ku-band frequencies (11/14 GHz), any earth stations purchased to operate with the C-band frequencies would have to be retrofitted to function with Ku-band. Such technical and financial disincentives may discouraged member states from purchasing earth stations to use with the Arabsat I satellite, and consequently from expanding domestic as well as regional networks. This may be why the second generation will use both C-band and Ku-band.

Another factor contributing to the underutilization of the Arab satellite was the inability of Arab states to agree

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[20] Abdelkader Bairi, Director General of Arabsat, personal communication, Algiers, Algeria, November 15, 1987.

on television programming. One transponder of the Arabsat I system operated at S-band (6 GHz up to the satellite and 2.5 GHz down to the earth station receiver). The 2.5 GHz downlink had high transmitting power (EIRP of 41 dBw as opposed to 31 dBw of the C-band frequencies) which meant it could operate with relatively small earth stations (3 meters). This made them inexpensive (US $2-6,000 in 1985) and easier to install and maintain than larger stations, which was especially important for rural and remote areas. The S-band transponder was reserved for small community television and radio reception, intended for development communications, i.e., radio and television broadcasts promoting literacy, health, agriculture, plus some entertainment. The choice of S-band technology can be traced to COMSAT, the U.S. signatory to Intelsat, and technical advisor to the Arab League for the Arabsat project.

COMSAT recommended the S-band technology because it was inexpensive and had worked very well with the 1970s Indian satellite project, SITE, for similar purposes.[21] What the engineers at COMSAT had failed to consider, however, was the geo-politics of the Middle East. India was one state, one government, orchestrating the use of the community television network; the Arab states were twenty-

[21] **Personal communication with Donald Kutch, Arabsat Program Coordinator, COMSAT, November 16, 1985.**

two independent countries, twenty-two different governments, many of which were very different from each other ideologically, economically, and socially. It proved impossible for all twenty-two governments to come to agreement on the actual programming to be broadcast to the widespread small community television network. Until there was common programming (literacy programs, agricultural and health information), Arab states would not purchase the necessary earth stations, and the satellite would continue to be underutilized. Even if there was agreement on common programming, it was still possible for one country to transmit programming that was not agreed upon by other countries, and to have that programming received directly by remote antennas in neighboring (but not friendly) states. The S-band frequencies turned that portion of the system into a direct broadcast satellite, meaning signals could be received directly from the satellite by the remote antennas in the homes, offices, universities and other locations of individuals. The government could not intercept the signal and prevent it from being received. Therefore, it would have been easy for one country to direct broadcast "unapproved" television programs using S-band frequencies, and have the programs received by the individuals and institutions with remote antennas of a neighboring state. It was not even possible to use the S-band for telephony, if, for example, a particular state wanted to expand its own domestic communications to rural areas using the S-band transponder. The ITU"s International Frequency Registration Board had assigned S-band frequencies to television, not telephone, service.

The underutilization of the network made amortization of the costs of building, launching and operating the system a near impossibility. The establishment of an Arab satellite network was inspired not by telecommunications demand (i.e., heavy two-way communications traffic among Arab states), but rather by the Arab defeat in the 1967 war with Israel, and the subsequent desire on the part of political leaders, specifically within the ministry of information, for greater Arab unification.[22] The satellite system of the Arab League was launched by political incentive, not economic or technical rationale. It was the ministries of information of the Arab states, the home of mass media such as radio and television broadcasting, not the ministries of post and telecommunications, which were the major impetus behind the development and implementation of the system.

In response to the humiliating defeat by Israel in 1967, the Arab ministers of information of the twenty-two states of the Arab League decided at their Reunion in

[22] **Hamdy Kandil, "Aladdin-Sat"** ***Revue Tiers Monde*** July 1986.

Bizerte, Tunisia, in 1967, that Arab unity could be increased through better inter-Arab communications. Having their own regional satellite system would offer cost effective broadcasting together with exclusive Arab control. In 1976, the Arab Ministers of Communication joined the initiative and signed articles of agreement forming the Arab Satellite Communications Organization at their Third Summit meeting held in Cairo, Egypt. ASCO was established to manage the Arab regional satellite project, as an agency of the Arab League.

Unlike the Ministers of Information who saw the satellite as a source of messages that would unify Arab masses throughout the Middle East, the ministers of communications (supervisors of the post and telecommunications administrations) saw a more limited role for a regional satellite, i.e., for two-way communications, primarily telephone and telex, among Arab states. But a UNESCO feasibility study of the Arab satellite idea in 1970 emphasized that there was no evidence that the volume of telecommunications traffic among Arab states warranted a satellite network. Nonetheless, the communication ministers claimed that regional needs were too pressing and too great to be satisfied by leasing Intelsat circuits. But the actual use of the satellite in 1987, two years after launch, was only 16% of total capacity (1,326 circuits, out of

8,000), or six out of twenty-six transponders. The difficulty in coming to agreement among ministers of information about "entertainment" and educational programming has kept the volume of regional radio and television programming, and hence the use of the satellite, low. In 1987, the major users of Arabsat were the national telecommunications operating entities, for domestic and regional telephony and telegraphy.

CHAPTER SUMMARY

Magnitude of Resource Exchange

The magnitude of the resource exchange for all types of technological resources (equipment, services, technical assistance and training) was greater in Algeria and Tunisia than Morocco during the latter part of the study. Algeria and Tunisia spent just under half of their total sector costs on technological resources (construction, capital investment in the ownership of property and plant) during the 1980s. Morocco spent only about a third to a quarter of its total sector costs on technological resources during the same years. The remaining proportion of sector costs was operating expenditure (personnel salaries, debt services, taxes, etc.) in each country.

The magnitude of the resource transfer in Algeria and Tunisia, about half of their total resource inputs, is a large enough proportion of total inputs to establish their dependence on technology for operation and survival. In the case of Morocco, technological inputs were a smaller proportion of total resource inputs, indicating that Morocco was less dependent on technological resources, according to this measure. But such a small proportion of total inputs is also indicative of the slower pace at which Morocco was expanding its network.

The magnitude of the resource exchange for *imported* technological resources (the proportion of foreign versus local costs) provides a measure of the relative dependence of each country on the international (as opposed to domestic) market for technological. All three countries show higher foreign than domestic costs for switching equipment, and lower foreign than domestic costs for local network equipment, throughout the 1980s. This means they were more dependent on foreign technological organizations for switching than other types of equipment. Algeria established a joint venture company in 1987 to reduce its dependence on foreign suppliers of digital switching equipment. The establishment of a joint venture reduced Algeria's dependence on foreign suppliers by increasing domestic production of a major proportion of total technological resources (typically 30% of system expansion costs), and an expensive (especially if imported) technology. A joint venture also reduced Algeria's technological dependence by maximizing the transfer of technical skills and know-how through joint decision making and built-in training of local personnel.

Algeria, more so than Morocco or Tunisia, minimized its dependence on foreign sources for equipment by building up local manufacturing capacity. Algeria's lower dependence on foreign suppliers reduced the cost of expanding the telecommunications system.

Concentration of Control over Resources

Concentration of *international* sources for *equipment* was low throughout the period of the study for all three countries, since they all have equal access to the international market. Although France played a major role in developing the telecommunications networks of all three Maghrebi states, there were many international sources for equipment and they were highly substitutable, given international technical standards to which they all adhere.

The concentration of sources for *domestic* sources for equipment, however, was high in all three countries, meaning they were highly dependent on local equipment manufacturers. The development of domestic production in Algeria reduced its dependence on foreign suppliers for certain technology (most notably, switching and transmission equipment) in the

1970s and late 1980s. But there was only one domestic source for each type of equipment manufactured (analog switches, coaxial and other cables, and telephone sets). P&T's dependence on single-source domestic organizations for equipment production was costly for Algeria in several ways: firstly, the cable and switch manufacturing companies were not able to meet P&T's requirements in a timely fashion in the early 1980s, resulting in network expansion delays. Secondly, the sunk costs in analog technology and training slowed the adoption of state-of-the-art digital equipment. In the early 1970s, Algeria invested heavily in the manufacture and training of personnel in analog techniques. By 1979-1980 Algeria realized the future was in digital technology. In 1985, Algeria began to retool its manufacturing industry to produce digital equipment, and to retrain its telecommunications teachers and future P&T staff in digital techniques.

The undersupply of telecommunications services and network expansion delays in the early 1980s in Algeria is attributable to the dependence of the P&T on external (domestic) organizations which provided it with critical technological resources. The 80% production capacity of the state owned enterprises was insufficient to meet the service requirements of the telecommunications entity. In its effort to protect domestic industry through monopoly power, the governments of these three states made their telecommunications operating entities highly dependent because there was only one source for certain critical resources. If the telecommunications entities could have purchased necessary technological resources from a wider variety of sources, and not only from a single domestic supplier, the P&T could have obtained the necessary equipment more quickly. Competition among domestic suppliers might have stimulated improvements in the performance of these public enterprises, but the Algerian market for equipment may not have been large enough to sustain several producers. Importing equipment in short domestic supply could have been prohibitively expensive, unless if it were manufactured by a Third World country. But if the necessary equipment were manufactured by a Third World country (India or Brazil, for example) it might not have met international technical standards, i.e., it might not have been reliable, familiar and compatible with the existing network.

Concentration of sources for international *services* was high throughout the 1970s. There were only two organizations providing international services. Algeria, unlike Morocco or Tunisia, minimized its dependence on either organization by using both of them. In the 1980s the number and substitutability of communications services operators increased with the advent of specialized data services. Many new service operators from the industrialized countries offered specialized services and equipment (IBM, European PTT's, British Telecom, etc. for private networks and specialized services) to developing countries. These new service operators were a source of competition to the local public telecommunications entity in North Africa. The operating entities in all three Maghrebi countries began digitizing their domestic networks in the 1980s (beginning with Tunisia), and offering specialized data services in order to maintain their monopoly over domestic communications. Algeria formed a joint venture company to manufacture digital switching equipment. These actions reduced the dependence of each country on foreign operators. Moreover, all three states belonged to the Arab regional satellite system, Arabsat, which provided regional telecommunications services after 1985. This reduced the dependence of all three countries on international satellite system operators.

Concentration of sources for *domestic* services was potentially low (i.e., many system operators wanted to offer specialized services or networks in these three states). But the local telecommunications entity provided all communications services and did not permit competition from either domestic system operators or foreign owner/operators.

The one exception is Algeria, where a separate organization, SONATITE, installed and maintained private automatic branch exchanges (PABX's). Thus, in all three countries, concentration of sources for domestic services was high.

Concentration of sources for foreign *technical assistance* was low, i.e., there were numerous sources of technical assistance, and they were highly substitutable. Algeria, more so than Morocco or Tunisia, minimized its dependence on foreign sources of technical expertise by building up its local training and educational facilities, resulting in a larger cadre of trained, qualified personnel, and by offering competitive salary and promotion opportunities in the telecommunications entity which attracted qualified personnel to the organization. The prominence given to technical expertise reflects Algeria's policy following independence in 1962, to emphasize technical expertise in the general administration of the country (Debbasch et al 1970; Hermassi 1972). A small proportion (less than 1%) of the World Bank project loan during the period 1983-88 was for technical assistance. This means that there was not a great need for technical assistance and training in addition to that provided domestically. Nonetheless, the bulk (80%) of this small percentage of the technical assistance component was foreign costs. Therefore, the small amount of technical assistance that was needed could only be obtained from foreign sources. The high proportion of technical expertise in the telecommunications entity allowed a more prominent role to these experts in decision making, contributing to the predominance of far-sighted infrastructure investment, specifically investment in system capacity (switching equipment). Channeling resources towards switching equipment, a technical priority, increased connection capacity and maintained good quality of service.

Leadership within the Algerian telecommunications entity was strong, given the demonstration of initiative and continuing influence on the part of its long-term Telecommunications Director General, Abdelkader Bairi, in establishing an innovative, cost effective domestic satellite system for Algeria in the mid-1970s. The primary impetus behind the domestic satellite network appears to be the leadership of Abdelkader Bairi. Without competitive salaries and promotion opportunities it would have been very difficult for the Algerian P&T to attract and keep a qualified individual like Bairi. Moreover, without some autonomy from external political interference in day-to-day activities, telecommunications staff would probably not have felt that new ideas and innovative projects had a chance to succeed on their own merit (technological and socio-economic rationale as well as political appeal), and therefore, would not take any initiative or make proposals in the first place.

In Tunisia and Morocco, where dependence on foreign expertise was higher, and the proportion and role of local technical expertise was less prominent, there was a tendency to connect subscribers far beyond the capacity of the system. This was a political priority (granting telephone connections to satisfy demand rather than investing in connection capacity and granting connections more slowly, thereby preserving the quality of service for subscribers). Overloading the network indicates short-sighted, political motive, rather technical-economic rationale. It underscores the less prominent role played by technical experts in decision making in Morocco (until the mid-1980s) and Tunisia. When the Moroccan entity introduced competitive salaries and promotions for technical staff in the early 1980s, it was able to increase the proportion of technical expertise in the organization significantly. The leadership of the Minister of P&T, who became the Director of ONPT, was described by a World Bank mission as capable and strong.

While the central government increased levels of investment to the Tunisian PTT beginning in the early 1980s, the personnel policies of the telecommunications entity (a civil service statute) kept the level of technical expertise the lowest of the three Maghrebi states. This made it difficult for the entity to optimize the utilization of these increasing financial resources. Moreover, the leadership of the entity was fragmented by frequent changes in top and middle management due to the attraction of private sector salaries.

Allocation and Use of Resources

The use of a technological resource is determined by its technical design. Manufacturers and suppliers of equipment and owner/operators of telecommunications systems have designed technologies and systems primarily for the markets of the advanced, industrialized countries where demand is greatest and most diversified. The design trade-offs within networks and their components have thus been optimized for the needs of advanced countries (e.g., maximum channel capacity at minimum cost). These designs are appropriate for urban and interurban links in developing countries, but not for providing comprehensive domestic coverage, particularly to non-urban areas where the majority of the population of most developing countries lives. International satellite owner/operators such as Intelsat established a technical configuration for its satellite system which functioned optimally for international, not domestic communications, that is, between nations, interconnecting a network of what Friedmann (1987) calls "global cities." Such a technical configuration inhibits the use of the satellite for developing comprehensive domestic networks in developing countries. The technical standards for its earth stations to be used with the Intelsat satellite system have kept the costs of developing such networks very high. In a bold innovative move, Algeria designed and implemented a non-standard earth station network using smaller, less expensive earth stations, in order to overcome these technical limitations of the Intelsat system.

Algeria pioneered a technical and financial arrangement with the international satellite system, Intelsat, that introduced domestic satellite communications and greatly expanded the telephone network throughout rural areas. The decision to develop a domestic satellite network cannot be attributed solely to the high level of technical expertise and leadership in the P&T. It is a logical decision, given the need to communicate with gas fields and mining and tourist areas in the distant rural desert region of southern Algeria, and given a boom in oil revenues after 1973. Nonetheless, the initiation and implementation of the idea, came from one individual within the P&T, an individual who might not have stayed with P&T if the organization did not offer competitive salaries and promotion opportunities.

The non-standard earth station design and the pre-emptible satellite channel lease lowered the costs of each earth station and the cost of system operation which made it possible to install and operate a fairly extensive network (with 15 initial locations) throughout the country. Moreover, Algeria developed an extensive domestic infrastructure during a period (mid-1970s) when international donors (sources of financial resources) favored "basic needs" programs, and the international satellite system and earth station manufacturers (sources of technological resources) did not design equipment for the interconnection of small, inexpensive earth stations in rural areas of developing countries.

The capability to attract and keep highly qualified personnel, a component of autonomy related to the development of the institution, is directly related to the autonomy of the operating entity from external technological organizations. In the case of Algeria, the expertise and perspicacity of one individual in the P&T was critical to the initiation and implementation of the domestic satellite network. Having been able to attract such an individual and to promote him through the ranks of the organization, P&T benefitted from his expertise in satellite technology and negotiations with Intelsat for a domestic transponder.

The technological environment of the Third World operating entity has been changing rapidly and dramatically throughout the 1970s and 80s. The changes in this environment are most apparent in the variability of technology and technical configurations of systems offered by international equipment suppliers (Hughes, Siemens, Ericsson, NEC, etc.) and network operators (most notably, Intelsat). Throughout the 1970s there were major advances and breakthroughs in technological designs, largely due to developments in semiconductor microchips leading to the marriage of computers and telecommunications networks. These technological developments in computers, communications and microelectronics have led to significant increases in in network capability and declines in the cost of information processing and communication transmission. The extent to which these technological breakthroughs can benefit developing countries depends upon the ability of the telecommunications operating entities in these countries to participate in decision making, to master the technology and to harness these systems and their alternative designs and configurations for comprehensive domestic coverage in order to promote the widest possible distribution and access to these resources for balanced regional and national socio-economic development. Institutional autonomy and domestic training capability that ensures an adequate cadre a qualified personnel makes it possible for the operating entity to respond to a rapidly changing technological environment, to evaluate the local market for new technologies and services, and to analyze costs and benefits in terms of its own national development goals and interests, rather than being overwhelmed by the limitations of technical design, local production or the "tech-speak" of manufacturers, vendors, service providers or system operators.

CHAPTER VII

CONCLUSIONS, ASSESSMENTS AND PROSPECTS

The findings of this study confirm that the dependence of the telecommunications operating entity on external organizations for critical resources effects the decisions of the organization. The data show that dependence on central government organizations (for financial resources) influenced the level of investment in the telecommunications sector in all three countries (Algeria, Morocco and Tunisia). The telecommunications entity could not independently determine the level of investment in the sector. The measures of autonomy related to technological dependence (most notably, personnel policies) played a major role in determining the level of technical expertise in the organization, which in turn, affects organizational decision making, specifically in terms of decisions regarding the priority of investments (quality and distribution of service as opposed to quantity of subscriber connections). The role of technical staff also effects the dependence of the entity on external technological organizations, which in turn influences choice of technology. Thus, an interaction effect between financial autonomy and technological autonomy is evident.

The study tested the hypothesis that an entity with organizational characteristics associated with autonomous or semi-autonomous institutions, i.e., with greater autonomy from external financial and technological organizations, is more effective in the delivery of services, and more capable of evaluating and taking advantage of technological changes and investment opportunities in its environment. The results of the study of these three North African countries are consistent with this hypothesis.

Telecommunications Sector Development

The findings of the study measuring development of the telecommunications sector in Algeria are consistent with the observation of other writers that Algeria operates one of the most exemplary and sophisticated telecommunications networks among developing countries. The availability of telephone service in Algeria was comparable or higher than Morocco and Tunisia. Telephone density was slightly higher in Tunisia than Algeria, but quality of service was considerably higher in Algeria in terms of connection capacity, call completion rates, proportion of faults repaired within 48 hours, and waiting time for a telephone connection. Morocco had the lowest density and lowest quality of service of the three states. Telephone services were largely concentrated in urban centers in all three countries, as with other countries generally. But Algeria showed the least discrepancy between urban and rural telephone densities throughout the period of the study.

On the basis of the investment criteria of economic rate of return and demand, the commitment of higher levels of investment in telecommunications was justified in all three states. Relative to other basic economic infrastructures, telecommunications in all three countries (except Morocco in the 1970s) had higher economic rates of return and at least comparable, if not higher, unmet demand (except for water in all three countries), but lower levels of investment as percent of total national plan budgets.

Investment in telecommunications per capita was higher in Algeria than in Tunisia or Morocco throughout the period of the study and beyond. But investment as percent of gross domestic product was higher in Algeria only in the 1970s, and dropped below that of Tunisia and Morocco in the 1980s. Nonetheless, the quality of service remained highest in Algeria throughout the 1980s. This shows the importance of what was bought rather than how much money was spent. The role of technical decision making in Algeria may have been the impetus behind rational investment decisions that resulted in higher quality of service without sacrificing availability of service.

Growth and expansion of the telecommunications networks of Tunisia and Morocco have been slower which means that growth and development in other sectors has been constrained as well, due to inadequate communications facilities. Moreover, the full revenue generating capacity of the telecommunications sector was not realized, which means lower revenues were contributed by the sector to the national treasury for other development activities.

Financial Dependence

The magnitude of the transfer of financial resources from central government to the Algerian P&T was high until 1983. This indicates that the P&T was highly dependent on the central government for funding during this period. The proportion of the total budget of the Algerian P&T coming from the national treasury between 1978 and 1982 averaged 70% percent of investment In 1983, the P&T increased tariffs by 50%, which allowed it to finance over half (57% on average) of investment costs from net internal cash generation (NICG) between 1983 and 1988. This reduced its dependence on central government. Financial resources from the national treasury dropped to only 17% of total domestic borrowing during this period. After October 1989, the Algerian P&T gained the right to retain earned revenues for direct reinvestment in the sector, thereby eliminating its dependence on central government for financial resources.

The direction of the resource exchange was two-way, insofar as the P&T transferred all earned revenues to the central government upon their receipt, except for a capital working balance of three months. Not surprisingly, therefore, according to World Bank sources in 1986, while the administration of the P&T was well managed, financial accounting was not well managed. The dependence of the Algerian Ministry of P&T on central government for its critical financial resources determined the level of investment in the sector. Moreover, it acted, in principle, as a disincentive for the entity to perform more efficiently, i.e., to take advantage of investment opportunities, to earn greater revenues for re-investment in the sector, and, in short, to meet demand for services.

The magnitude of the input from central government to the budget of the Moroccan entity was less than that of the Algerian or Tunisian entities, because the private sector provided some revenues to the entity. The resource transfer was two-way insofar as the Moroccan Ministry of P&T was required to transfer earned revenues to the national treasury and reapply for necessary funds through the budget allocation process of central government until 1984. The Moroccan entity, transformed into a public corporation (ONPT) in 1984, gained the right to retain earned revenues for direct reinvestment in the sector. This made it independent of central government for financial resources.

Nonetheless, ONPT continued to transfer money to government after 1984 in the form of corporate taxes.

In Tunisia, as Algeria, the largest proportion of the PTT's funding came from the national treasury (ranging from 67-71% of total investment). This made the PTT highly dependent on the central government, and gave the Ministry of Finance and Planning strong influence over the level of investment. Like the Algerian and Moroccan telecommunications entities, the direction of the resource exchange was two-way. The Tunisian PTT requested necessary funds from central government and transferred earned revenues to the national treasury. After 1987, the Tunisian PTT gained the right to retain earned revenues for direct reinvestment in the sector.

While there were several sources of funds in Algeria, their substitutability was low. During the 1970s, the greatest portion of funding came from the national treasury, as noted earlier. The obvious alternative source for domestic funds was the P&T itself, through net internal cash generation, i.e., self-financing, which increased substantially after 1983, as noted above. After October 1989, the P&T was made into a public corporation and permitted to retain earned revenues for direct reinvestment in the sector. This eliminated its dependence on the national treasury.

The number and substitutability of sources for financial resources was greater in Morocco than Algeria or Tunisia because of the contribution of the private sector to telecommunications allocations prior to 1984. Thus, it was not as dependent on a single source, such as the national treasury. The Ministry of P&T did not borrow domestically before 1984, because it financed all local investment costs from NICG.

In Tunisia, the concentration of sources for financial resources was high during the fifteen years of the study. Most domestic financial resources of the PTT came from a single source: the national treasury (70.5% from 1973-76; 69% 1982-86). This large proportion of sector funding from a single source, the public treasury, made the PTT dependent on the central government for these critical resources, which in turn gave the government strong influence over investment levels. We see that throughout the 1970s and early 1980s investment levels were lower than Algeria on a per capita basis, but higher than Morocco.

One of the candidate explanations raised in the first chapter for the undersupply of telecommunications services in developing countries was the lack of financial resources. There is no question that money matters, but this study shows that after a point, more money does not ensure more or better services. This study has examined how existing resources are utilized. Increasing the flow of resources through a poorly functioning mechanism (institution) does not necessarily improve the performance of the mechanism. This study finds that autonomy has made a difference in the performance of the organizations providing telecommunications services in North Africa. Even a financially dependent entity with generous government allocations (like Tunisia in the late 1980s) is unlikely to perform at optimal level as long as the telecommunications entity functions as a conventional government department. Increases in government allocations are not likely to result in proportional increases in the supply of services because the proportion of technical expertise is low, and therefore the impact of technical experts on decision making is minimal.

The perceptions of national planners with regard to the role of the telecommunications sector is very important because it can make or break a dependent organization. But if the organization is not dependent on the budget allocation process for its financial resources, it is not vulnerable to the short-sightedness of national planners. The development of the telecommunications sector in Algeria was not inhibited by the entity's financial dependence because the central planners were generous in their budget authorizations to the sector, but more importantly, there was a high proportion of technical staff who were therefore able to influence decision making in the organization.

The Algerian entity was more autonomous from central government than Morocco (until 1984) or Tunisia, insofar as its authority was less undermined by regulation and oversight. It had the authority to raise tariffs to keep up with costs of providing service, and the authority to collect bills from all users, most importantly, government users. While post and telecommunications were not separate organizations, they were separate branches of activity with separate personnel and accounting systems. In October 1989 the Algerian entity was made into a public corporation, a semi-autonomous form of ownership, with greater autonomy with regard to financial resources, i.e., it no longer relied on central government for budget allocations, but rather retained earned revenues for direct reinvestment in the sector.

While Algeria was committed to state intervention and a centrally planned economy, it granted relative administrative autonomy and a predominantly commercial orientation to its telecommunications administration. This is in sharp contrast to Tunisia or Morocco (until 1984), which were committed to a mixed economy, but operated their telecommunications entities as conventional government departments. Writing in the early 1970s, Hermassi notes that the challenges confronting Tunisian political system are "power distribution and institutional reorganization. Algeria is finally displacing Tunisia as the symbol of progress in the Maghreb." This progress is seen again in the early 1990s, in the national elections which took place within the same month, June 1990, in Tunisia and Algeria. The municipal elections in Tunisia, June 10, 1990, were boycotted by opposition and independent parties on the basis that the dominant party, the Republique Constitutionelle Democratique would distort the results anyway, as they were accused of doing the previous year in parliamentary elections. In Algeria, two days later, a truly democratic, free election took place in which the Islamic opposition party gained numerous of seats in the Algerian parliament. The conservatism of the Tunisian regime and its commitment to state intervention in the economy has pervaded the telecommunications sector as well. The operating entities of Morocco (until 1984) and Tunisia were organized and managed as conventional government departments (following civil service statutes) for the greater part of the study. The Tunisian PTT was the least autonomous of the three entities for the longest period of time. The Tunisian entity was still a conventional government department in 1990. While the central government increased levels of investment in the sector beginning in the early 1980s, the personnel policies of the telecommunications entity (a civil service statute) kept the level of technical expertise lowest of the three Maghrebi states. This made it difficult for the entity to optimize the utilization of increasing levels of financial resources. Moreover, the leadership of the entity was fragmented by frequent changes in top and middle management due to the higher salaries offered by the private sector. Nonetheless, while post and telecommunications were combined within the same organization, they did have separate personnel and separate accounting systems.

In Morocco, throughout the 1970s and most of the 1980s, telecommunications decision making was highly centralized and allowed for very little autonomy of the operating entity. The Moroccan Ministry of Post and Telecommunication was a government department, governed by a Board of Directors. The Board was a highly political group, being chaired by the Prime Minister; its members included the Ministers of Finance, Defense, Interior, Planning, Economic Affairs, Industry and Equipment, and Transport. In 1984, the Moroccan government created the 'Office Nationale des Postes et Telecommunications,' ONPT, which was designed to operate as a legally, financially and administratively autonomous public enterprise. The overall aim was for the entity to operate on a commercial basis and to reduce central government intervention in its day-to-day operations. When the entity finally introduced competitive salaries and promotions for technical staff in the early 1980s, it was able to increase the proportion of technical expertise in the organization significantly. The leadership of the Minister of P&T, who was also the Director of ONPT, was described by outside observers as capable and strong. While ONPT gained the authority to set tariffs to cover costs of providing services, it lacked the authority to collect outstanding bills from government users. Furthermore, while there was separation of personnel in post and telecommunications, there was no separation of accounting between these two branches of activity until 1988.

The more politically-based structure of decision making in Morocco and Tunisia has effected investment priorities (e.g., connecting subscribers to try to reduce demand, rather than investing in connection capacity to maintain good quality of service as new subscribers are added at a slower pace), and the distribution of resources, (e.g., the largest distribution of telecommunications resources to more powerful ministries and sectors, such as tourism in the case of Tunisia where services are concentrated along the coast where tourist attractions are located).

This study anticipates that although telecommunications investment levels in Tunisia increased significantly since the early 1980s, and the entity gained the right to retain earned revenues after 1987, the telecommunications entity will not be able to optimize the utilization of increased revenue as long as it retains a civil service statute. Morocco, with autonomy since 1984, may do better than Tunisia in the supply and quality of services despite lower overall investment levels because it has a large cadre of qualified technical staff. This study further anticipates that the Algerian telecommunications entity, granted even greater autonomy in 1989, will continue to lead the Maghreb throughout the 1990's in terms of investment per capita, supply and quality of services, technical expertise, and technological innovation and design.

Thus, the formal status and ownership of the entity in itself is not indicative of efficient management in practice. The findings of this study are consistent with the argument of Saunders, Warford and Wellenius (1983), i.e., that it is possible for a telecommunications entity to be tied more closely to central government, as the Algerian entity was, and still perform effectively, as long as the entity incorporates key organizational characteristics associated with an autonomous or semi-autonomous organization, such as a public enterprise or corporation. The findings of this comparative case study emphasize that critical among the organizational conditions for efficient management of the sector is the authority of the P&T to set wages, salaries and promotions, thereby attracting and keeping qualified personnel. Related to this authority, and also critical, are adequate training facilities to ensure a sufficient cadre of qualified staff, that can maintain and operate an extensive modern telecommunications network. The authority to set wages, salaries and promotions, and thereby to attract and keep highly qualified personnel, which is a key form of autonomy from political organizations, is directly related to the autonomy of the operating entity from external technological organizations. In the case of Algeria, the expertise and perspicacity of one individual in the P&T was critical to the initiation and implementation of the domestic satellite network.

The interaction effect between financial dependence and technological dependence is also seen in the timing of the implementation of the Algerian satellite network. Financial dependence means that investment decisions of a telecommunications entity are also influenced by bilateral aid and soft loans targeted for various economic sectors and groups during different development decades (e.g., industrialization by leading sectors throughout the 1960s, rural and basic needs throughout the 1970s; free market approaches, including privatization, during the 1980s). The development of a fairly extensive domestic infrastructure by Algeria during a period when international donors favored "basic needs" programs demonstrates that greater autonomy of the Algerian telecommunications entity made innovative programs and solutions possible. Algeria's domestic satellite network was a pioneering effort at a time when such a project faced an unfavorable international financial and technological context.

Technological Dependence

The magnitude of the resource exchange for all types of technological resources (equipment, services, technical assistance and training) was greater in Algeria and Tunisia than Morocco during the latter part of the study. Algeria and Tunisia spent just under half of their total sector costs on technological resources (construction, capital investment in the ownership of property and plant) during the 1980s. Morocco spent only about a third to a quarter of its total sector costs on technological resources during the same years. The remaining proportion of sector costs was operating expenditure (personnel salaries, debt services, taxes, etc.) in each country.

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Tunisia, about half of their total resource inputs, is a large enough proportion of total inputs to establish their dependence on technology for operation and survival. In the case of Morocco, technological inputs were a smaller proportion of total resource inputs, indicating that Morocco was less dependent on technological resources, according to this measure. But such a small proportion of total inputs is also indicative of the slower pace at which Morocco was expanding its network.

The magnitude of the resource exchange for *imported* technological resources (the proportion of foreign versus local costs) provides a measure of the relative dependence of each country on the international (as opposed to domestic) market for technological. All three countries show higher foreign than domestic costs for switching equipment, and lower foreign than domestic costs for local network equipment, throughout the 1980s. This means they were more dependent on foreign technological organizations for switching than other types of equipment. Algeria established a joint venture company in 1987 to reduce its dependence on foreign suppliers of digital switching equipment. The establishment of a joint venture reduced Algeria's dependence on foreign suppliers by increasing domestic production of a major proportion of total technological resources (typically 30% of system expansion costs), and an expensive (especially if imported) technology. A joint venture also reduced Algeria's technological dependence by maximizing the transfer of technical skills and know-how through joint decision making and built-in training of local personnel. Algeria's lower dependence on foreign suppliers also reduced the cost of expanding the telecommunications system. Concentration of *international* sources for *equipment* was low throughout the period of the study for all three countries, since they all have equal access to the international market. Although France played a major role in developing the telecommunications networks of all three Maghrebi states, there were many international sources for equipment and they were highly substitutable, given international technical standards to which they all adhere.

The concentration of sources for *domestic* sources of equipment, however, was high in all three countries, meaning they were highly dependent on local equipment manufacturers. The development of domestic production in Algeria reduced its dependence on foreign suppliers for certain technology (most notably, local network and transmission equipment) in the 1970s. But there was only one domestic source for each type of equipment manufactured (analog switches, coaxial and other cables, and telephone sets). P&T's dependence on single-source domestic organizations for equipment production was costly for Algeria in several ways: firstly, the cable and switch manufacturing companies were not able to meet P&T's requirements in a timely fashion in the early 1980s, resulting in network expansion delays. Secondly, the sunk costs in analog technology and training slowed the adoption of state-of-the-art digital equipment. In the early 1970s, Algeria invested heavily in the manufacture and training of personnel in analog techniques. By 1979-1980 Algeria realized the future was in digital technology. In 1985, Algeria began to retool its manufacturing industry to produce digital equipment, and to retrain its telecommunications teachers and future P&T staff in digital techniques.

Thus, the Algerian P&T's dependence on domestic technological organizations slowed network expansion and the pace of subscriber connections. Domestic equipment suppliers were unable to meet P&T's requirements in the supply and installation of cable to connect subscribers. The Algerian case demonstrates that it is dependence on external technological organizations includes domestic dependence, and it is therefore necessary to increase *a priori* the capacity of the domestic technological organizations which supply resources (equipment and services) required by the entity. In its effort to protect domestic industry through monopoly power, the Algerian government handicapped the telecommunications operating entity in its task to meet demand for services. If the P&T could purchase necessary technological resources from a wide variety of sources, and not only from its domestic supplier, the P&T could obtain the network equipment more quickly. But the equipment might be more costly. Competition among domestic suppliers might stimulate improved performance by public enterprises such as the one manufacturing and installing telecommunications cable, but the Algerian market for such equipment may not be large enough to sustain several producers. Importing equipment that is in short supply may be prohibitively expensive, unless it were manufactured by a Third World country. But if the necessary equipment were manufactured by a Third World country (India or Brazil, for example) it might not be state-of-the-art, nor meet international technical standards, i.e., be reliable, familiar and compatible with existing network technology.

Concentration of sources for international *services* was high throughout the 1970s. There were only two organizations providing international services. Algeria, unlike Morocco or Tunisia, minimized its dependence on either organization by using both of them. In the 1980s the number and substitutability of communications services operators increased with the advent of specialized data services. Many new service operators from the industrialized countries offered specialized services and equipment (IBM, European PTT's, British Telecom, etc. for private networks and specialized services) to developing countries. These new service operators were a source of competition to the local public telecommunications entity in North Africa. The operating entities in all three Maghrebi countries began digitizing their domestic networks in the 1980s (beginning with Tunisia), and offering specialized data services in order to maintain their monopoly over domestic communications. Algeria formed a joint venture company to manufacture digital switching equipment. These actions reduced the dependence of each country on foreign operators. Moreover, all three states belonged to the Arab regional satellite system, Arabsat, which provided regional telecommunications services after 1985. This reduced the dependence of all three countries on international satellite system operators.

Concentration of sources for *domestic* services was potentially low (i.e., many system operators wanted to offer specialized services or networks in these three states). But the local telecommunications entity provided all communications services and did not permit competition from either domestic system operators or foreign owner/operators. The one exception is Algeria, where a separate organization, SONATITE, installed and maintained private branch exchanges (PABX's). Thus, in all three countries, concentration of sources for domestic services was high.

Concentration of sources for foreign *technical assistance* was low, i.e., there were numerous sources of technical assistance, and they were highly substitutable. Algeria, more so than Morocco or Tunisia, minimized its dependence on foreign sources of technical expertise by offereing competitive salary and promotion opportunities within the entity, and by building up its local training and educational facilities, resulting in a larger cadre of trained, qualified personnel. The lower dependence of Algeria on foreign technical expertise allowed a more prominent role to local expertise in technical decision making, contributing to the predominance of far-sighted infrastructure investment, specifically investment in switching equipment. Channeling resources towards switching equipment, a technical priority, increased connection capacity and maintained good quality of service. Leadership within the Algerian telecommunications entity was strong, given the demonstration of initiative and continuing influence on the part of its long-term Telecommunications Director General, Abdelkader Bairi, who appears to be the primary impetus behind the establishment of an innovative, cost effective domestic satellite system for Algeria in the mid-1970s. Without competitive salaries and promotion opportunities it would have been very difficult for the Algerian P&T to attract and keep a qualified individual like Bairi. Moreover, without some autonomy from external political interference in day-to-day activities, telecommunications staff would probably not have felt that new ideas and innovative projects had a chance to succeed on their own merit (technological and socio-economic rationale as well as political appeal), and therefore, would not take any initiative or make proposals in the first place.

In Tunisia and Morocco, where dependence on foreign expertise was higher, and the role of local expertise was less prominent, there was a tendency to connect subscribers far beyond the capacity of the system. This was a political priority (granting telephone connections to satisfy demand rather than investing in connection capacity and granting connections more slowly, thereby preserving the quality of service for subscribers). Overloading the network was a short-sighted, political, rather technical, decision. It underscores the less prominent role played by technical experts in decision making in Morocco (until the mid-1980s) and Tunisia.

The telecommunication entity's discretion over the use of technological resources is determined by its technical design. Manufacturers and suppliers of equipment and owner/operators of telecommunications systems have designed technologies and systems primarily for the markets of the advanced, industrialized countries where demand is greatest and most diversified. The design trade-offs within networks and their components have thus been optimized for the needs of advanced countries (e.g., maximum channel capacity at minimum cost). These designs are appropriate for urban and interurban links in developing countries, but not for providing comprehensive domestic coverage, particularly to non-urban areas where the majority of the population of most developing countries lives. International satellite owner/operators such as Intelsat established a technical configuration for its satellite system which functioned optimally for international, not domestic communications, that is, between nations, interconnecting a network of what Friedmann (1987) calls "global cities." Such a technical configuration inhibits the use of the satellite for developing comprehensive domestic networks in developing countries. The technical standards for its earth stations to be used with the Intelsat satellite system have kept the costs of developing such networks very high (e.g., Standard A earth stations cost about U.S. $8 million each during the 1970s). In a bold innovative move, Algeria designed and implemented a non-standard earth station network using smaller, less expensive earth stations, and pre-emptible access to the satellite, in order to overcome these technical limitations of the Intelsat system.

The technological environment of the Third World operating entity has been changing rapidly and dramatically throughout the 1970s and 80s. The changes in this technological environment are most apparent in the availability of technology and technical configurations of systems offered by international equipment suppliers (Hughes, Siemens, Ericsson, NEC, etc.) and network operators (e.g., Intelsat). Throughout the 1970s there were major advances and breakthroughs in technological designs, largely due to developments in semiconductor microchips leading to the marriage of computers and telecommunications networks. These technological developments in computers, communications and microelectronics have led to significant increases in network capability and declines in the cost of information processing and communication transmission. The extent to which these technological breakthroughs can benefit developing countries depends upon the ability of the telecommunications operating entities in these countries to participate in decision making, to master the technology and to harness these systems and their alternative designs and configurations for comprehensive domestic coverage in order to promote the widest possible distribution and access to these resources for balanced regional and national socio-economic development. Algeria's native technical expertise allowed the country to overcome its technological dependence on expensive, complex designs by developing a less expensive, less complex and more locally suitable non-standard alternative earth station design.

Organizational autonomy that ensures an adequate cadre a qualified personnel makes it possible for the operating entity to respond to a rapidly changing technological environment, to evaluate the local market for new technologies and services, and to analyze costs and benefits in terms of its own national development goals and interests, rather than being overwhelmed by the tech-speak of sales representatives with foreign manufacturers, vendors, service providers or system operators.

Implications for the Future

Writers as divergent as Marx and Schumpeter, among others, treat technology as an endogenous factor in social change: i.e, technology is created and conditioned by the functioning of a socio-economic system, and yet it is capable of changing that system. Two technologies with a synergistic relationship, such as computer and telecommunications systems, can spark a stream of inventions and innovations leading to significant changes in society (Lamberton 1983; Dordick 1986). When innovations lead to a realignment of economic sectors, change the nature of human activities, alter the course of cultural development, and demand the restructure of institutions, a revolution is under way (Dordick 1986). Some argue that innovation in communications technology is producing such a revolution, with low-cost electronics as the key input to a Kondratiev upswing in a long cycle of economic growth (Perez 1985; Teheranian 1985; Dordick 1986). Technological changes in communications are affecting the whole productive and distributive system, and forms of interaction, speeding up the pace and scope of exchange activities.

Technological change may be rapid, but social and organizational adjustments tend to be much slower (Ogburn 1932; Perez 1985). Communications and other institutions in advanced, industrialized countries are undergoing adjustments and restructuring in the face of technological change, driven primarily by the marriage of computer and telephone systems and rapidly decreasing costs of technology (e.g,. the divestiture of AT&T; the deregulation of satellite earth station ownership and signal reception; technological breakthroughs in low noise amplifiers; the proliferation of competition in the common carrier industry with such new entrants as Sprint, MCI, GTE, and smaller companies; the privatization of public telecommunications operating entities in some European countries and Japan; the entry of private international systems in the satellite industry).

The communications sector and its institutions (e.g., communications services providers) are restructuring in order to provide the infrastructural investment which undergirds this new mode of growth. Peter Hall, renowned British urban planner, describes the 1990's as a transition from an industrial mode of development to an information mode of development. New institutional structures and arrangements are most evident in advanced, industrialized countries where communications technologies are most pervasive. But in developing countries the changes in technology are also forcing communications institutions toward new structures and relationships.

Convergence of Economic Interests

Beginning around the early 1980s, there has been a convergence of economic interest in the development of Third World telecommunications networks on the part of both equipment suppliers, backed by their governments, international donors and loan agencies such as the World Bank, and on the part of the developing countries themselves. Advances in technology have brought the costs of equipment and systems down dramatically and provided increases in network capability and capacity with less maintenance. The telecommunications industry in the advanced countries has since the early 1980s become increasingly interested in the Third World as a market for its goods and services, as the markets of the industrialized countries become increasingly saturated or competitive. All three of these North African countries have strong ties with France which has been the most visible and the most active among the European countries in the telecommunications and information production race. France has aggressively built up its own industry and looked to its former colonies as markets. It has provided bilateral assistance since the early 1980s for the development of telecommunications networks in all three countries; the rest of Europe, the United States and Japan are also interested in this growing North African market.

Third World countries are interested in developing their telecommunications networks in light of decreasing costs and increasing demand, particularly with the greater reliance on networks on the part of government and business users. The heavy domestic users of the network, particularly the government and industry, have come to rely more and more on telecommunications, as demonstrated by their network usage beyond what is allocated in their budgets. These big users can see the possibilities for special services and lower costs, available in other countries, and therefore have an economic interest in seeing their operating entity provide better quality and more diversity of services at lower costs, or seeing them get out of the way -- let foreigners come in and provide the networks and services. This kind of pressure from clientele and beneficiaries is what Israel (1987) calls a surrogate for competition, which can be very effective in getting institutions to function more effectively. Israel's concept of competition, in the form of such surrogates as pressure from clients and government, is at work in all three North African countries in stimulating domestic interest in network expansion and sector development since the mid-1980s. Moreover, the traditional concept of competition is also at work, since equipment manufacturers and service providers are eager to sell their facilities and services directly to users in the Third World, thereby bypassing the domestic operating entity, its public network and the bureaucratic encumberments, regulation and delays, that may accompany them. As Israel has pointed out, such traditional and surrogate forms of competition act as powerful motivators for improving institutional performance in terms of the delivery of goods and services. The organization and management of the operating entity, in terms of regulation and tariff structure, goes a long way in determining how widely these potential improvements in institutional performance, i.e., the delivery of services, will be distributed among urban versus rural areas, and government/business users versus residential users, and telephone versus data communications.

The convergence of international and local interests related to telecommunications development makes possible a quantum leap in the development of domestic networks which has been in evidence since the early to mid-1980s in all three countries.

Conflict of Political Interests

Despite the recent emergence of agreement domestically and internationally on the economic rationale for digitizing and expanding networks, there is political conflict over who will control them. This conflict concerns the way the sector is structured, specifically who should provide what services to which users, i.e., the amount of competition and privatization of services that should be permitted. With a digital network there is no differentiation between basic telephone services and enhanced services (data storage, processing, handling); there is just a continuous stream of binary digits for various destinations. The advent of digital techniques and networks allows all types of services (voice, data, video) to be provided on the same network.

As a result of these technological developments and the increasing reliance on telecommunications by domestic and international users, there is a growing lucrative business in traditional and new telecommunications services. The political conflicts over who will control the networks -- domestic versus international operators and service providers -- involve the politics of trade (Dordick 1986). The telecommunications operating entity can maintain its monopoly by ensuring that it and its local telephone suppliers provide all telephone hardware. If the operating entities of the developing countries own and operate the digital networks and services in their countries, there will be little competition in telephones and terminal equipment or specialized services from foreign suppliers and service operators. The operating entities have political incentives to expand their networks using digital technology. Providing a digital network themselves preserves the carrier monopoly and helps keep out foreign competition. The threat of competition from outside or within the country has inspired the governments of Algeria (in 1989) and Morocco (ostensibly in 1984) to grant greater autonomy to their operating entities with a view to improving institutional performance and thus, the supply and diversity of services, and to maintaining national sovereignty over their domestic markets.

For developing countries concerned with minimizing dependent relations with advanced, industrialized countries, control over domestic communications network development can be very important to self-sufficiency. On the other hand, if there is no resource exchange among organizations, there may be a slowdown in sector development as a result of a slowdown in the transfer of knowledge and new technology. An undersupply telecommunications services can create obstacles to growth in other sectors of the economy, as demonstrated by numerous studies. It is clear from these three cases that the structure of decision making, the question of who decides, is crucial to optimizing the contribution that telecommunications can make to socio-economic growth and development.

GLOSSARY OF TERMS

analog/digital: anlaog transmission is the transmission of information represneted by a continuously variable signal; digital transmission is transmission of information represented by a binary code consistng of a sequence of discrete elements.

bandwidth: the width of frequencies in the radio frequency spectrum used by a communication's signal. Bandwidths are specified in hertz, i.e., cycles per second.

basic telecommunications services: the common carrier transmission services which result only in the movement of information and not in the manipulation or restructuring of information (see specialized telecommunications services)

binary: refers to a numbering system or code using a base of 2. The two digits used in the binary code of an electrical communications system are 1 and 0, the presence or absence of an electrical pulse (on/off). A binary digit, or "bit," is the smallest unit of information in a binary system, the choice between a one or zero value.

cable plant: the physical network of one or more conductors within a protective sheath, so constructed as to permit the use of conductors separately or in groups.

cable (coaxial cable): a transmission line in which one conductor completely surrounds the other

cable (optical fiber cable): transmission line made of transparent glass fibers bundled together parallel to one another. It can be used to carry relatively large amounts of information long distances.

channel: one circuit of a carrier system carrying speech or other communication signals.

circuit: a two-way communications path

common carrier: an entity that provides telecommunications services to the public, and which exercises no control of the message content.

communications satellite: a relay station that receives video, voice, data and other transmissions from uplink (tranmit) earth stations and retransmits them to downlink (receive) earth stations

direct broadcast satellite (DBS): a high power satellite in the broadcasting satellite service which transmits programming directly to community receivers or to individual home receivers, thereby eliminating the need to relay the program over cable or broadcast stations.

downlink: a unidirectional transmission path from a communications satellite to an earth station (opposite of uplink).

frequency: the number of recurrences of an electric or electromagnetic wave during a specified period of time, expressed in cycles per second (hertz or Hz, named after Heinrich Hertz who detected such waves in 1883).

frequency spectrum: the range of frequencies of electromagnetic waves used for radio communications from about 10 kilohertz (KHz) to 3000 gigahertz (GHz).

geostationary satellite: a satellite with a circular orbital path 22,300 miles above the earth in the plane of the earth's equator and which has the same rotation period as the earth; the position of a satellite in geostationary orbit remains constant relative to a point on earth.

gigahertz (GHz): a frequency of a billion hertz or a billion cycles per second

ISDN (Integrated Services Digital Network): a network in which communications (voice, data, video) are transmitted in digital form over compatible digital channels.

kilohertz (KHz): a frequency of a thousand hertz or a thousand cylces per second.

megahertz (MHz): a frequency of a million hertz or a million cycles per second.

microwave: the short wavelengths from 1GHz to 30 GHz used for radio, television, and satellite systems. Any form of signals can be transmitted at these frequenceies between two line-of-sight points.

PABX (private automatic branch exchange: an automatic exchange connected to the public telephone network on the user's premises and operated by an attendant supplied by the use; a private telephone exchange that provides for the transmission of calls internally and to/from the public telephone network.

postal, telephone and telegraph (PTT) authority: the term generally used to describe foreign telecommunications administrations, typically the sole common carrier organization in the country. PTTs are both the regulators and providers of telecommunications services and represent their governments in negotiations with foreign carriers and international telecommunications organizations.

radio frequency spectrum: those frequencies between the audio and visula ranges of the spectrum in which electromagnetic impluses can be radiated through space. This range is utilized for services such as communications, radar, earth resources sensing, and commercial radio and television.

specialized telecommunications services: common carrier tranmission services which involve the manipulation or alteration of basic telecommunications service offerings (for example, data processing services).

switch: a computer system which is capable of interconnecting circuits or transfering traffic between circuits.

tariff: a statment filed by a telecommunications common carrier (or PTT) with the approporiate public regulatory agency which describes the service it offers and lists a schedule of charges for the use of that regulated service.

telecommunications: the transmission of signal sof any kind by wire, radio, optical or other electromagetic systems.

telex: telegraph exchange service for subscribers.

transponder: the electronic circuits of a satellite which receive a signal from a transmitting earth station, amplify it, and transmit it to earth at a different frequency.

trunk line: a main cable or circuit running between major population centers.

voice communications: human speech over a telephone channel within the frequency range essential for transmission of speech of commercial quality (300-3400 hertz).

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Yin, Robert (1984). *Case Study Research: Design and Methods*. Beverly Hills, CA: Sage Publishing.

PERSONAL COMMUNICATIONS

ALGERIA

Bacha, M. Directeur des Radiocommunications, Ministere des Postes et Telecommunications, Algiers, November 21, 1987.

Chergui, Smain. Ingenieur a la sous direction des radiocommunications, Ministere des Postes et Telecommunications, Algiers, November 22, 1987.

Kezzal, Omar. Directeur de Planification et Informatique, Minstere des Postes et Telecommunications, Algiers, November 21, 1987.

Khouatmi, M. Ministere des Postes et Telecommunications, Algiers, November 21, 1987.

Mokrane, M. Directeur de Budget Annex, Ministere des Postes et Telecommunications, Algiers, November 17, 1987.

Ouhadj, Mahiddine. Directeur Generale des Telecommunications, Ministere des Postes et Telecommunications, Algiers, November 21, 1987.

Mahmoud Rachedi, Ingenieur a la sous direction des radiocommunications, Ministere de Postes et Telecommunications, Algiers, November 22, 1987.

Ahmed Salouatchi, Vice Ministre, Ministere des Postes et Telecommunications, Algiers, November 17, 1987.

Ahmed Salouatchi, Sous Directeur des Radiocommunications, Ministere des Postes et Telecommunications, Algiers, November 22, 1987.

TUNISIA

Algene, Said. Directeur Operationnelle des Telecommunications du Reseau International, Ministere des Postes, Telephone et Telegraph, Dkhila, Tunisia, November 10, 1987.

Azzabi, Mohamed Tijani. Directeur, *Communications* , Ministere des Postes, Telephone et Telegraph, Tunis, November 5, 1987.

Bangui, Mohamed. Ingenieur Directeur dela Station de Controle, ARABSAT, Dkhila, November 10, 1987.

Belakhal, Zouhayr. Directeur Generale du Ministere des Postes, Telephone et Telegraph, Tunis, November 5, 1987.

Boualeg, M. Directeur du Departement du Genie Electrique, Ecole Nationale d'Ingenieurs de Tunis, Universite de Tunis, Tunis, October 30 and November 2, 1987, June 5, 1990.

Boumaiza, M. Sous Directeur du Ministere des Postes, Telephone et Telegraph, Tunis, November 5 and 11, 1987.

Chaffai, Mongi. Ingenieur General des Telecommunications, Directeur General de la Telediffusion Tunisienne, Ministere des Communications, Tunis, November 7, 1987.

Deny, Michael. Directeur, Institut Regional des Sciences de l'Informatique et de la Teleinformatique, Tunis, November 10, 1987.

Ellouze, M. Directeur, Institut Regional des Sciences de l'Informatique et de la Teleinformatique, Tunis, June 8, 1990.

Friaa, Ahmed. Directeur, Ecole Nationale d'Ingenieurs de Tunis, Universite de Tunis, Tunis, October 30, 1987.

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Hasnaoui, Salem. Data Communications Division. Direction Generale des Telecommunications, Ministere des Postes, Telegraphe et Telephone, Tunis, October 30, 1987.

Missaoui, Salem. Direction Generale des Telecommunications, Ministere des Postes, Telegraphe et Telephone. June 13 and 14, 1990.

Khamouma, Salah, Progel-Chimie, Tunis, June 18, 1990.

Khouaja, Brahim. Ministre, Ministere des Communications, Tunis, November 6, 1987.

Masmoudi, Mustapha. Directeur Adjoint du Parti, Maison du Parti, Tunis, November 5 and 12, 1987, June 11, 1990.

Moore, Clement Henry. Professor, Political Science, University of Texas at Austin. Tunis, June 6, 1990.

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OTHER

Bairi, Abdelkader. Directeur General, ARABSAT, Geneva, October 26, 1987; Algiers November 15, 1987.

Balkind, Jeffrey. Europe, Middle East and North Africa Unit, The World Bank. March 24, 1987.

Bouhired, Noureddine. Engineer, Group of Engineers, Center for Telecommunications Development, International Telecommunications Union, Geneva, October 23 and 28, 1987.

Butler, Richard. Secretary General, International Telecommunications Union, Algiers, November 16, 1987.

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Harbi, M. Conseiller Superieur, Directeur de la Reglementation et de l'Ingenierie, International Telecommunications Union, Geneva, October 23, 1987.

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Kandil, Hamdy. Director, Oriensat, Algiers, November 17, 1987.

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Malegue, Daniel. Chef de Programme, ARABSAT, Algiers, November 16, 1987.

Nicolson, Richard. Assistant to the Secretary General, International Telecommunications Union, Geneva, October 23, 1987.

Ras-Work, M. Director, RASCOM African Satellite System, Geneva, October 20, 1987.

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Annenberg School of Communications, University of Pennsylvania

M.A., International (Development) Administration (1980)
School for International Training, Brattleboro, Vermont

B.A., English (1973)
Bates College, Lewiston, Maine

Diplome Superieur d'Etudes Francaises (1972)
Diplome de Langue Francaise
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FELLOWSHIPS AND GRANTS

Nine-month research grant, 1991-92, Fulbright, for research on the impact of privatization of telecommunications in Tunisia and Oman.

Short-term research grant, 1990-91, American Institute of Maghrebi Studies, for research on technology and social change in North Africa.

Cunningham Dissertation Fellowship (full tuition plus stipend), 1987-88; Virginia Polytechnic Institute and State University

Short-term research grant, 1987-88, American Institute of Maghrebi Studies, for dissertation research on the role of institutional autonomy in telecommunications development in North Africa.

Language and Area Studies Fellowship: Farsi and Middle East; U.S. Department of Education Title VI (full tuition plus stipend) University of Pennsylvania, 1983-85.

PROFESSIONAL EXPERIENCE

LECTURER IN COMMUNICATION STUDIES, Fall 1989. Communication Studies Program, Hollins College.

RESEARCH ASSISTANT, Part-time 1985 - 1987. Communications Network Services, Virginia Polytechnic Institute & State University.

RESEARCH ASSISTANT, Part-timer 1984-1985; National Telecommunications and Informational Administration, U.S. Department of Commerce.

ASSISTANT DIRECTOR, 1980 - 1983. National Committee for Internationalizing Education through Satellites, Inc., Middle East Center, University of Pennsylvania.

REFEREED PUBLICATIONS

"L'Autonomie Institutionel et le Developpement des Telecommunications," in Clement Henry Moore and Salim Habib (eds.) *Masghreb et Maitrise Maitrise Technologique,* Universite de Tunis: Centre d'Etudes, de Recherches et de Publications (forthcoming 1991).

"Star WARCs and New Systems: Analysis of U.S. international satellite policy formation," *Telecommunications Policy*, June 1986, pp. 93-105.

"Who Determined U.S. Satellite Policy?" *Journal of Communications* , June 1985, pp. 70-71.

OTHER PUBLICATIONS

Book review of W. Kingston, "The Political Economy of Innovation," in *Environment and Planning C: Government and Policy* Vol 6 (2) 1988, p. 241.

"Survey Analysis of University Telecommunications Systems," *Business Communications Review*, November 1986, pp. 9-15.

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"Language and Culture Learning Model," *ADFL Bulletin*, Association of Departments of Foreign Languages, New York, Fall 1983.

"Be There Now: Learning Languages by Satellite," *Satellite Communication*, July 1982, pp. 54-58.

CONFERENCE PAPERS

"L'Autonomie Institutionel et le Developpement des Services de Telecommunications dans l'Afrique du Nord," Conference on Technology and Social Change, Tunis, Tunisia, June 4-6, 1990.

"Le Transfert des Technologies de Telecommunications aux payes en voie de developpement," lecture (in French), Centre d'Etudes Maghrebbines a Tunis, Tunisia, November 24, 1987.

"The Arab Satellite System: Network Design toward Cultural Convergence?" Middle East Studies Association, New Orleans, November 1985.

"The Use of Satellites for Education," International Aeronautical Federation, Budapest, Hungary, October 1983.

"Space and the Environment," NGO conference in association with the U.N. Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE), Vienna, Austria, August 1982.

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