Distr.
LIMITED
E/ESCWA/TECH/1999/WG.1/8
3 March 1999
ORIGINAL: ENGLISH

ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA

Expert Group Meeting on Science and Technology Policies for the 21st Century
10-12 March 1999
Beirut

S AND T POLICIES AND STRATEGIES IN THE ESCWA MEMBER COUNTRIES

Prepared by

Omar Bizri
Technology Section
ESCWA

Note: This document has been reproduced in the form in which it was received, without formal editing. The opinions expressed are those of the author and do not necessarily reflect the views of ESCWA.

99-0211

Preface

The following is the draft summary of a study being prepared by the Technology Section of the Sectoral Issues and Policies Division in the Economic and Social Commission for Western Asia on the subject of "Science and Technology Policies and Strategies for the 21st Century in the ESCWA Member Countries."

The study is scheduled for finalization during the third quarter of 1999 and for distribution during the final quarter of 1999.

The present contribution presents a synoptic review of the state of S and T in the ESCWA member countries followed by a brief expose of the state of S and T policies in the member countries. Subsequent sections describe models for policy and strategy formulation outlining a set of particularities that have to be taken into account in constructing a framework for future action at the S and T policy and strategy levels. The contribution ends with concluding remarks and selected recommendations.

Science and Technology in the ESCWA Member Countries:

Introduction:

A simple model of a science and technology (S and T) system has often been used in addressing S and T development in the region, as well as many other developing countries. According to this model, functions fulfilled by the S and T system consist of performing R and D as well as acquiring and disseminating production and service technologies. The model allows these functions to be carried out through separate channels with somewhat limited possibilities for coordination and resource/information sharing. Thus, the public sector was mainly concerned with acquiring foreign technologies, while R and D and manpower resources development, through various forms of technical training, university education and the media, were supposed to be the responsibility of government institutions. According to this model the actual application of S and T knowledge was not considered part of the S and T system's sphere of activity.

A prominent virtue of this model is that it provides a clear and a correspondingly simple taxonomy for discussing problems concerning this or that component/feature of national S and T systems. Yet the fact that this model adopts a linear approach in interacting with its socio-economic surroundings through distinct input and output packages is, naturally, a gross oversimplification. This model, therefore, rapidly reaches the limits of its utility once relatively complex issues concerning S and T strategies and interaction among the S and T system's components and functions are addressed at any depth.

Furthermore, due to its inherent compartmentalization of functions and institutional forms, this simple model does not readily lend itself to the introduction of more recent and emerging notions pertaining to the innovation process and to mechanisms involved in, for example, the incorporation of innovations brought about by end-users in the production and services sectors. The impact of policies adopted in areas of socio-economic activity, whether adjacent or auxiliary to traditional S and T areas of activity, is also rather difficult to incorporate into this model.

S and T in the ESCWA Member Countries:

It is doubtful whether one could claim the existence of viable national S and T systems in many, if not most of the ESCWA member countries, regardless what level of simplicity one might adopt for the corresponding S and T model. For it should be remembered that, in its fullest sense, the concept of a national S and T system denotes an integrated and reasonably well equipped set of national institutions that:

- operate, for the most part, within declared policy frameworks;
- execute more or less clear strategies, that are geared to serving declared national development objectives in a range of sectors and application areas;
- enhance the stock of knowledge and facilitate its dissemination.

In this sense, S and T systems in the ESCWA member countries have a long way to go. Granted that the above characteristics of an S and T system, refer to a somewhat idealized state of affairs, S and T policy experts, even in the developed countries, often protest divergences from this ideal, bewailing many defects in their own national S and T systems that tend to reduce its effectiveness and efficiency. Nevertheless, problems of S and T systems in the industrialized, and probably some of the more recently industrializing countries, concern issues such as the need for policy adjustments, harmonization, and resource conservation. Those in the ESCWA member countries, on the other hand, will mostly relate to the fact that entire components, or subsystems, in national S and T systems may be missing or dysfunctional, links between existing and functioning subsystems weak or non-existent, with severe resource inadequacy and poor management. We shall not go through these issues here. Suffice it to say that differences between the two sets of S and T systems are wide and range across policy, strategy, resources, linkages and the legislative/regulatory environment.

A multitude of indicators will confirm the conclusion that the state of S and T in the ESCWA countries, indeed the Arab countries in general, is in need of greater attention. Indicators of both input as well as output of the S and T systems point to serious inadequacies. Table (1), for example indicates that the

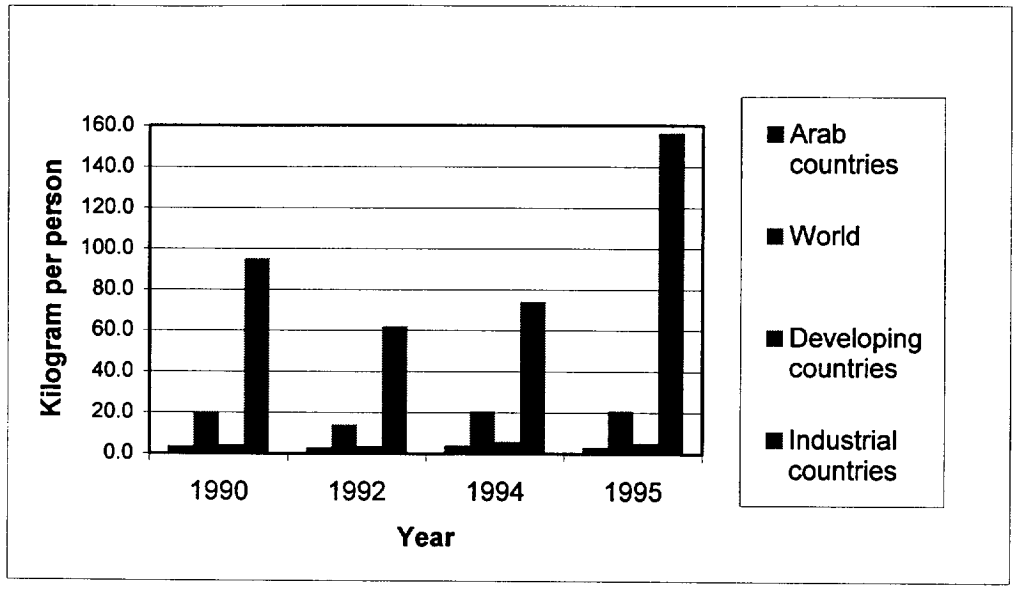
number of computers available per 1000 of the Arab countries' population falls below the average figure for the developing countries as a whole (5.7 computers per 1000 as opposed to 6.5). The number of people connected to the Internet per 1000 of the population in the Arab countries is less than half the figure for the developing countries (2 persons per 10,000 as opposed to 5 per 10,000 in the developing world). Things look worse when these figures are compared to those from the industrial countries and still worse as we compare the Arab countries to countries such as Singapore, Korea and even Malaysia. See table (1).

A possible S and T indicator that relates to the level of literacy and information dissemination in a given country is the consumption of paper for printing purposes. Table (1) and figure (1) present data on this indicator, revealing that the consumption of paper for printing in the Arab countries falls below the average figure for the developing countries as a whole (2.9 as opposed to 5.2 kg per person, or around 56 percent of the value for the developing countries).

Table 1. Access to information and communications **مؤشرات التعامل مع المعلومات**

Country	Internet users (per 1,000 people)	عدد الموصولين على الانترنت (لكل ألف شخص)	Personal computers (per 1,000 people)	عدد الحواسيب الشخصية (لكل ألف شخص)	Printing and writing paper consumed (kilogram per person)		استهلاك الورق السنوي في الطباعة والكتابة (كلغ لكل شخص)		الدولة
	1994	1995	1994	1995	1990	1992	1994	1995	
Arab countries	-	0.2	-	5.7	3.4	2.8	3.9	2.9	الدول العربية
World	60.9	4.8	-	43.6	20.3	14.1	20.6	20.9	العالم
Least developed countries	-	-	-	-	0.3	-	0.5	0.4	الدول الأقل تطورا"
Developing countries	1.5	0.5	-	6.5	4.0	3.5	5.8	5.2	الدول النامية
Industrial countries	223.2	17.9	14.2	78.2	95.2	61.9	74.0	156.3	الدول الصناعية
Hong Kong	117.3	48.5	11.3	130.0	94.0	32.2	153.3	98.4	هونغ كونغ
Singapore	102.5	30.1	15.3	180.8	54.0	66.5	117.9	98.0	سنغافورة
Korea	22.3	6.5	11.3	108.3	31.3	22.3	37.1	51.3	كوريا
Malaysia	4.5	2.0	3.3	37.3	23.8	14.5	27.5	32.6	ماليزيا
Arab countries									**الدول العربية**
Bahrain	-	1.7	-	50.3	4.2	6.0	11.0	7.6	البحرين
United Arab Emirates	-	1.1	-	48.4	-	-	39.3	38.4	الإمارات
Kuwait	7.3	2.1	-	56.2	16.2	5.7	27.4	6.7	الكويت
Qatar	-	1.8	-	-	8.2	5.5	3.7	2.2	قطر
Libya	-	-	-	-	2.1	2.2	0.9	0.5	ليبيا
Lebanon	-	0.6	-	12.5	9.1	8.0	16.9	4.1	لبنان
Saudi Arabia	-	0.1	2.5	-	3.9	5.4	5.9	4.6	السعودية
Oman	-	-	-	12.7	4.9	3.8	6.4	1.0	عمان
Syria	-	-	-	0.1	2.4	1.3	2.6	2.7	سوريا
Algeria	-	-	-	3.0	3.8	2.4	2.9	2.8	الجزائر
Tunisia	0.4	0.1	0.5	6.7	5.3	3.8	7.3	6.4	تونس
Jordan	-	0.2	-	8.0	4.4	8.9	6.9	7.4	الأردن
Egypt	0.2	0.3	-	-	4.6	3.8	5.0	3.2	مصر
Morocco	-	-	-	-	1.7	1.5	3.0	2.5	المغرب
Iraq	-	0.1	-	1.7	3.9	1.7	0.4	2.7	العراق
Mauritania	-	-	-	-	-	-	0.4	0.1	موريتانيا
Yemen	-	-	-	-	-	-	0.5	-	اليمن
Sudan	-	-	-	-	0.3	0.1	0.2	0.1	السودان
Djibouti	-	0.2	-	-	-	-	0.1	-	جيبوتي

Figure 1. Printing and writing paper consumed (1990-1995)



Spending on R and D in Arab countries is at best 1/10 of its value in industrialized countries.

The picture is even less encouraging when one considers S and T output. S and T publications in refereed journals, the number of patents awarded to firms and individuals in the ESCWA, and the Arab countries at large, fall far below world averages and do not compare well against similar figures from other developing countries. Table (2), presents electronically published data on patents originating from a number of ESCWA countries and registered in the United States, during 1992-1996. While no information is available on the patent titles or area of application,[1] the small number of patents registered by operators in the ESCWA member countries is noteworthy. The total number of patents registered annually by all ESCWA member countries is contrasted with the corresponding number for Israel, which ranges between (350 - 500) per annum.

Table 2. US registered patents originating from ESCWA member countries

Country	1992	1993	1994	1995	1996
Egypt	1	1	4	3	3
Jordan	1				1
Kuwait	1	2	1	1	2
Lebanon	1	2	1	1	
Oman		2			
Saudi Arabia	8	4	11	10	12
Syria	2				
UAE	1	1	1	1	1
Total	**15**	**10**	**18**	**16**	**19**

Source: American Patents Office Page on the Internet

Nonetheless, reviews conducted in preparing for the ESCWA study point to evidence of greater determination to build on, and complement, existing S and T structures and to improve their effectiveness and efficiency. An inescapable conclusion of the above-mentioned reviews is that there is now more awareness than ever before, on the part of governments, chambers of commerce and industry, trade federations and professional societies of the need for viable national S and T policies and strategies. Efforts are now needed to determine:

[1] ESCWA study on S and T Indicators, 1997.

a. the bases on which such policies and strategies must be formulated;
b. how might such policies and strategies best be linked to, (integrated with) policies and legislation in other related spheres of socio-economic activity;
c. modalities for the implementation of such policies.

This positive attitude is manifested at several levels and in a number of directions. One might cite increased spending on education as a percentage of GNP. See table (3). Figures for spending on education as a percentage of GNP have been improving. The average for the Arab countries is now comparable and even exceeds that pertaining in the developed nations.

Additionally, while spending on defense in the Arab countries seems to have fallen somewhat, at least during the period 1992–1996, for which comprehensive figures are available, it still exceeds spending on education. See table (4) and figure (2).

This is not to say, however, that all is well with educational systems in the ESCWA member countries, or indeed the Arab countries as a whole. Analysis of the performance of educational systems, particularly at the tertiary stage, indicates a number of gaps, deficiencies and inefficiencies. While this falls beyond the scope of the present contribution, a lot remains to be done in order to improve S and T systems in the region at the structural, resource and operational levels. Furthermore, such improvements cannot be formulated, introduced and sustained without adequate policy instruments.

Figure 2. Military Expenditure (1985-1996)

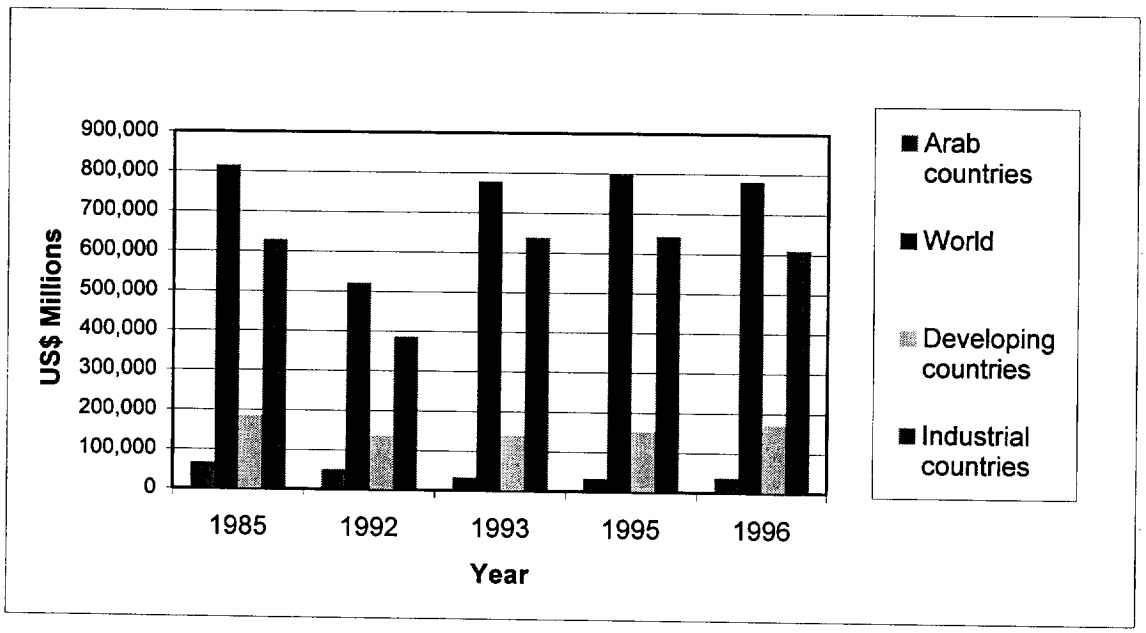


Table 3. Education

التعليم

Country	Tertiary natural and applied science enrolment (% of total tertiary)		نسبة عدد طلاب العلوم الطبيعية والتطبيقية في التعليم العالي	Public expenditure on education (as % of GNP)			الإنفاق على التعليم كنسبة منGNP		Public expenditure on education (as % of total government expenditure)		الإنفاق على التعليم كنسبة من الإنفاق العام	Higher education (as % of all levels)	نسبة عدد طلاب التعليم العالي إلى مجموع الطلاب	الدولة
	1990	1992	1995	1985	1990	1992	1993/4	1995	1990	1992	1993/95	1990	1995	
Arab countries	34.0	25.0	-	5.7	6.2	6.4	-	5.1	-	20.5	-	-		الدول العربية
World	-	32.0	-	4.9	-	5.1	5.1	4.9	-	14.0	-	-		العالم
Least developed countries	33.0	26.0	-	-	-	3.0	2.8	-	-	12.1	-	-		الدول الأقل تطورا"
Developing countries	-	33.0	-	4.1	-	3.9	3.6	3.8	-	15.7	-	-		الدول النامية
Industrial countries	31.0	30.0	33.0	5.1	-	5.4	5.4	5.2	-	13.7	-	-		الدول الصناعية
Hong Kong	-	35.0	36.0	2.8	3.0	-	-	2.8	17.4	18.1	17.0	37.0		هونغ كونغ
Singapore	-	-	-	4.4	3.4	-	3.3	3.0	-	-	23.4	35.0		سنغافورة
Korea	42.0	40.0	39.0	4.5	3.6	4.2	4.5	3.7	22.4	14.8	17.4	8.0		كوريا
Malaysia	30.0	27.0	-	6.6	6.9	5.5	5.3	5.3	18.8	16.9	15.5	17.0		ماليزيا
Arab countries														**الدول العربية**
Bahrain	53.0	39.0	39.0	4.1	-	-	4.7	4.8	-	-	12.8	-		البحرين
United Arab Emirates	15.0	13.0	-	1.7	1.9	2.0	-	1.8	14.6	15.2	16.3	-		الإمارات
Kuwait	43.0	29.0	23.0	4.9	5.0	6.1	5.6	5.6	-	11.4	11.0	16.0		الكويت
Qatar	10.0	24.0	-	4.1	3.4	3.4	-	3.4	-	-	-	-		قطر
Libya	-	-	-	7.1	-	-	-	-	-	-	19.8	-		ليبيا
Lebanon	-	-	17.0	-	-	1.9	2.0	2.0	11.7	12.5	12.5	-		لبنان
Saudi Arabia	26.0	16.0	-	6.7	6.2	6.4	-	5.5	17.8	17.0	17.8	18.0		السعودية
Oman	32.0	21.0	-	4.0	3.5	3.8	4.5	4.6	11.1	16.2	16.3	6.0		عمان
Syria	40.0	29.0	29.0	6.1	4.1	4.2	-	-	17.3	14.2	17.3	-		سوريا
Algeria	63.0	50.0	52.0	8.5	9.1	8.1	5.6	-	27.0	27.0	17.6	-		الجزائر
Tunisia	35.0	27.0	24.0	5.8	6.1	6.1	6.3	6.8	14.3	13.5	17.4	19.0		تونس
Jordan	33.0	29.0	28.0	5.5	5.9	6.5	3.8	6.3	13.3	13.3	16.6	34.0		الأردن
Egypt	28.0	18.0	15.0	6.3	6.7	5.0	5.0	5.6	-	11.0	13.8	36.0		مصر
Morocco	37.0	34.0	29.0	6.3	5.5	5.8	5.4	5.6	26.1	26.7	22.6	16.0		المغرب
Iraq	36.0	-	-	4.0	-	-	-	-	-	-	-	21.0		العراق
Mauritania	12.0	9.0	8.0	-	4.7	-	-	5.0	22.0	-	16.1	20.0		موريتانيا
Yemen	13.0	8.0	-	-	-	-	-	7.5	-	-	20.8	-		اليمن
Sudan	21.0	16.0	-	-	-	-	-	-	-	-	-	-		السودان
Djibouti	-	-	-	2.7	3.3	3.8	3.8	-	10.5	11.1	11.1	14.0		جيبوتي

Table 4. Military expenditure (1985-1996)

الإنفاق العسكري (١٩٨٥-١٩٩٦)

Country	Defence expenditure per capita			الإنفاق العسكري السنوي للشخص (دولار أميركي)		Defence expenditure as % of GDP			الإنفاق العسكري كنسبة من GDP		Defence expenditure (US$ millions)			الإنفاق العسكري (مليون دولار أميركي)		الدولة
	1985	1992	1994	1995	1996	1985	1990/91	1994	1995	1996	1985	1992	1993	1995	1996	
Arab countries	353	261	170	143	151	12	7.0	7.6	-	-	65,733	50,400	34,176	33,766	37,433	الدول العربية
World	182	105	141	143	137	4.7	3.4	3.2	2.8	2.9	814,496	521,820	778,100	797,143	781,093	العالم
Least developed countries	13	16	7	9	10	4.3	3.5	2.9	2.7	2.5	5	-	3,510	4,935	5	الدول الأقل تطورا"
Developing countries	51	35	34	35	39	7.1	3.5	3.6	3.1	3.7	185,515	136,010	140,030	153,628	171,934	الدول النامية
Industrial countries	728	390	525	526	493	4.2	3.4	3.1	2.7	2.7	628,981	385,810	638,070	643,515	609,149	الدول الصناعية
Hong Kong	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	هونغ كونغ
Singapore	634	590	1,043	1,349	1,325	6.7	5.8	4.8	5.9	5.5	1,622	1,619	2,982	3,970	3,959	سنغافورة
Korea	209	160	294	320	336	5.1	3.8	3.6	3.4	3.3	8,592	7,189	13,153	14,359	15,168	كوريا
Malaysia	155	128	135	177	148	5.6	3.1	3.9	4.5	4.2	2,409	2,315	2,652	3,514	3,542	ماليزيا
Arab countries																**الدول العربية**
Bahrain	494	466	439	456	476	3.5	4.7	5.5	5.2	5.5	206	238	246	261	279	البحرين
United Arab Emirates	1,993	2,418	1,149	1,044	830	7.6	4.8	5.7	4.8	5.2	2,790	4,249	2,055	1,880	2,028	الإمارات
Kuwait	1,434	5,000	2,019	2,091	2,218	9.1	6.5	12.2	11.8	12.9	2,453	10,185	3,009	3,147	3,505	الكويت
Qatar	1,301	-	559	600	1,334	6	12.5	3.8	4.4	10.2	410	-	294	326	740	قطر
Libya	490	249	210	259	227	6.2	7.8	3.7	5.5	5.1	1,844	1,177	1,062	1,401	1,272	ليبيا
Lebanon	102	7	75	102	116	9	3.5	4.4	5.3	4.4	273	18	301	407	474	لبنان
Saudi Arabia	2,125	1,371	1,109	699	1,030	19.6	14.0	11.2	10.6	12.8	24,530	14,535	13,917	13,215	16,999	السعودية
Oman	1,841	943	991	978	955	20.8	16.4	15.9	15.1	15.6	2,946	1,498	1,854	1,840	1,876	عمان
Syria	453	245	168	142	105	16.4	16.8	8.6	6.8	4.8	4,756	3,095	2,358	2,026	1,553	سوريا
Algeria	59	59	44	44	62	1.7	1.6	2.7	2.5	4	1,301	1,599	1,249	1,234	1,764	الجزائر
Tunisia	80	42	25	41	42	5	2.9	1.4	2.0	2	569	355	219	369	390	تونس
Jordan	235	133	96	100	85	15.9	10.6	7.1	6.7	5.6	822	586	422	440	390	الأردن
Egypt	73	60	47	42	43	7.2	4.0	5.9	4.3	4.5	3,527	3,427	2,641	2,417	2,629	مصر
Morocco	40	27	44	49	54	5.4	4.6	4.3	4.3	4.3	875	692	1,197	1,347	1,539	المغرب
Iraq	1,105	381	132	128	56	25.9	16.0	14.6	14.8	8.3	17,573	7,490	2,628	2,700	1,224	العراق
Mauritania	42	12	16	12	13	6.5	4.1	2.7	1.9	2.9	71	25	35	28	31	موريتانيا
Yemen	66	59	29	24	24	9.9	14.4	5.2	3.9	3.7	668	682	401	345	354	اليمن
Sudan	7	20	11	14	13	3.2	2.0	3.5	4.3	4.3	146	532	298	389	397	السودان
Djibouti	102	89	42	35	31	7.9	-	6.2	5.3	5.2	44	38	25	22	20	جيبوتي

Many developing and developed countries now resort to cooperative arrangements in various aspects of their S and T endeavors. The ESCWA member countries avail themselves only sparingly of the opportunities offered by schemes operated by international agencies and regional groupings such as the European Commission. This is illustrated in the following frame.

Frame (1); Euro-Mediterranean Science and Technology Co-operation Projects[2]

The European Commission (EC) published, in 1997, a report listing briefly, joint research projects involving participants from the European Union and Mediterranean Partners (Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Syria, Tunisia, Turkey, West Bank and the Gaza Strip). These projects reflect regional trends and capabilities in research and development. Starting dates of the projects covered fall within the period from 1988 to 1996, while ending dates of some of the projects extend up to the year 2000.

From a quantitative viewpoint, Morocco, Tunisia, and Egypt participated in a large proportion of the projects covered in the catalogue, followed by Algeria. However, given Egypt's population, 33 projects might be considered a modest share of the total number (19%). The same remark may be made regarding Syria, with a project share of only 3% (See figure 1 in appendix II). On the other hand, Jordan seems to be quite active in R and D co-operation, with a total of 11 projects.

Table (1) in appendix (II) shows the number of research projects according to research topics undertaken in ESCWA member countries included in the report (namely Egypt, Jordan, Lebanon, Syria, and PAT), as well as Algeria, Morocco, Tunisia and Israel.

Figure (2) in appendix (II) shows project distribution in ESCWA member countries with respect to research topics, namely water, soil, environment, energy, agriculture, health, information & communication technology and materials technology. From the chart, it is seen that water supply and water treatment have the highest share (29%), followed by public health (21%), then by information and communication technology (16%). Research in these areas is crucial to ESCWA. Crop and livestock production and other agriculture related issues appear neglected, however, especially in Jordan, Lebanon and Syria, in comparison with the Maghreb countries. In addition, materials, production technologies, biotechnology and environmental research do not appear to receive much attention anywhere in the region, in contrast with Israel.

Clearly, development of national S and T systems has come as a result of policy decisions, whether explicit or implicit, intentional or by default, policies adopted on the basis of national initiatives or as a reaction to outside influences.

As mentioned in the preface to this contribution, ESCWA is in the process of conducting a study on S and T policies in its member countries. The following summary provides an account of the main features of S and T policies in member countries. Efforts made by countries found to have taken significant steps towards formulating, or preparing for the formulation of national S and T policies are highlighted in the appendix.

An overall assessment of S and T policy orientations:

Policies designed to improve any aspect of socio-economic development are usually the sum total of:

- a policy framework
- policy objectives;
- policy directives;
- an outline of policy tools and policy implementation modalities.

All of the above elements are found in a variety of decrees and articles of legislation in the ESCWA member countries.[3] However, S and T policies are only rarely enshrined in documents dedicated to advancing S and

[2] Source: ESCWA Technology Review 1998.

T capabilities at the national level. Furthermore, issues relating to these policies are rarely made the subject of wide debate involving both the S and T "providers" as well as those at the end-users of the S and T system's output and beneficiaries of its services. Countries in which such debate has been attempted, include Egypt, Jordan and Lebanon.

As outlined below, a number of problems may be pointed out in all S and T policy efforts, whether declared or implicit.[4]

> *Not many countries in the region possess S and T policies, indeed, many ESCWA member countries still need to formulate, and make public, sectoral development policies on which S and T policies may ultimately have to be based.*

It is important to state at the outset that only a few of the ESCWA member countries have embarked on exercises aimed at national S and T policy formulation. Indeed, there are still some important weaknesses, not to say lack of, development policies that address certain important sectors in many of the ESCWA countries.

This is not to say that these countries operate in a policy vacuum. On the contrary, it is quite possible for the ardent student to discern both general features and even some detailed characteristics of operative policy "regimes". Still, the fact that policies, both for sectoral development as well as S and T development are still implicit, undeclared, and, therefore, most likely in conflict with other operative policy regimes, places severe constraints on the S and T policy makers and the strategy designer.

> *Existing policies and strategies, whether implicit or explicit, have been authored/designed by government officials and government sponsored committees with limited participation by, or consultation with, the business sector. Heavy emphasis ensues on the supply side; on S and T inputs, numbers of students in S and T related subjects, expenditure on higher education, etc..*

Past attempts to formulate S and T policies and strategic plans have invariably been made by government ministries and government sponsored institutions, mainly higher education and central research institutions. Actual participation by public and private sector enterprises has been minimal. As a result the concerns and needs of these enterprises, as truly seen by them, could not be taken into account. Emphasis on the supply side, on S and T inputs and failure in forging links between the supply and the demand sides was the natural outcome. Thus, few ties, if any, appear to link production and services sectors to R and D institutions and universities. Consequently, these sectors maintain closer links to outside sources of technology and technical expertise than to national sources. Such links may clearly be beneficial for a certain period of time. They do, indeed, constitute a logical step when new capabilities are being established but are detrimental if they become an all-encompassing modality for accessing technology, for modifying and disseminating it in order to build national capacity.

At any rate, over-emphasis of the supply side is apparent in all policy documents reviewed, with the exception, perhaps of the Jordanian effort. This should come as no surprise since in most cases S and T policy makers have their roots in academia and in government sponsored research establishments rather than in industry. (See also footnote 3)

---

[3] It goes without saying that legislation, a variety of laws, rules and regulations, have given rise to de facto policy regimes in many ESCWA member countries. However, since such legal and regulatory arrangements have never been subjected to comprehensive and public examination with a view to moulding them into a unified policy body, they can often tend to follow contradictory paths resulting in reduced effectiveness, even some confusion. In effect open debate over legal and regulatory arrangements concerning S and T policies should ensure, among other things, coherence and compatibility between legislative instruments and regulatory regimes in order to guarantee optimal results.

[4] An often quoted cause for the lack of S and T policies or their inadequate "sectoral" orientation is the lack, in many member countries, of clear cut and self-consistent sectoral development policies from which S and T policies could draw guidance, support and sustenance.

Certain priority areas are discernible in current policy documents, and generally, in implicit policy regimes.

Agriculture, agro-food industries, health services and achieving an improved competitive stance are among the priorities listed in various policy pronouncements in a number of ESCWA member countries.

Thus, almost all member countries appear to set a high priority to policy objectives that relate to achieving food security, in addition, of course, to national security. A good deal of attention is also allocated to health and basic services.

Emphasis on manpower resources is also apparent in almost all policy statements. Issues relating to manpower development acquire a special position in the documents developed by Jordan and Lebanon, in particular. Pronouncements made by high-ranking Kuwaiti officials also indicate a similar direction for the future Kuwaiti S and T policies.

Many countries in the region have not progressed beyond S and T policy documents and broad policy statements, to consider comprehensive strategic, and, consequently, harmonised and comprehensive executive plans.

With the Exception of Jordan's case, and possibly that of Egypt as well, S and T policies, formulated or being considered, have rarely progressed towards detailed strategic planning with due consideration to implementation modalities.[5]

In Egypt it is not policy documents and pronouncements as much as established practice and cumulative practices that spell out the outlines of strategic orientations and implementation modalities. This, it should be remembered, is the result of the many more years of S and T activity in Egypt than in the other ESCWA member countries. More recently focused efforts are being made within the framework of a project being implemented by the Ministry of Scientific Research (MOSR) and the World Bank. The project involves launching a number of national S and T initiatives.

In Saudi Arabia, the intention is to achieve linkage to implementation modalities that may be rationalised within the framework of the five-year national development plans.

R and D, particularly, as performed by central R and D institutions is considered as the main source of technological innovation.

A high level of commitment to R and D activities is apparent in S and T policy documents drawn up by Egypt, Jordan, Lebanon, Saudi Arabia and Syria. It should be remembered that these policy documents are often produced by R and D professionals and university professors with little help from private or public sector concerns. Additionally, other sources of innovation are bypassed.

The need to enhance technology inputs in SMEs is acknowledged, at least in the Jordanian and the Egyptian documents. There are few indications that workable suggestions are in the offing, on the other hand.

The role of the private sector in supporting R and D activities and the requirements of small and medium enterprises (SMEs) are also addressed in various national policy documents and pronouncements to a greater or lesser degree. There is, however, little evidence that in-depth consideration has, in fact, been made of practical measures needed to enhance local technology inputs to SMEs. Nevertheless, the SME needs are accorded a more prominent position in Jordan's and Egypt's S and T policy efforts. It is worth noting that private enterprise is mostly referred to as a contributor to R and D funds in S and T policy

[5] The fact that this "natural" progression from policy to strategy to executive planning has been absent is responsible for inadequate results obtained in a number of areas. Particular examples could be cited from the field of higher education and manpower training. Less-than-satisfactory results have often been attained. Accommodating relatively high percentages of secondary education graduates, within mainly theoretical science, arts and humanities, at national universities coupled to limited career opportunities, on the one hand, and the weaknesses in intermediate technical education systems, on the other, are two such examples.

documents. No mention is made of possible contributions in other directions, e.g. towards standardisation, calibration and quality assurance institutions.

Technology transfer policies and strategies are in need of more thorough consideration.

On the question of linking technology transfer to indigenous research efforts, the fact that few policies provide possibilities for directly linking technology transfer and R and D is noteworthy. It is only in the case of Egypt's policy document, that explicit mention is made of involving research centres in activities aimed at the acquisition, adaptation and dissemination of technologies.

Gulf countries such as Kuwait, the United Arab Emirates and Saudi Arabia operate so-called "Offset Schemes" aimed at ploughing back a percentage of the investments in, mainly defence contracts, in technology-based production enterprises. This may entail setting up manufacturing facilities incorporating development, testing and quality control laboratories. It is doubtful whether such schemes comprise R and D facilities. In any case, only limited information is available as yet on such arrangements.

Only a few on-going national S and T initiatives may be cited.

National initiatives designed to tackle particular issues through focused R and D, technology transfer, specialised technical training, etc., are a recent occurrence in the ESCWA member countries. Thus, only Egypt and Jordan appear to have launched such initiatives, to deal with environmental issues and to upgrade "earth resources", respectively. Syria's R and D promotion initiative, on the other hand, is aimed primarily at revitalising links between university research facilities and the country's public sector enterprises with a broad set of targets and implementation modalities.

In particular, they do not always reveal commensurate awareness of the array of new mechanisms and linkage modalities that have become accessible to the S and T community. Thus, only two countries in the region, Egypt and Jordan, appear to have launched co-operative initiatives, to deal with specific cross-cutting issues; Egypt in its environmental amelioration in the Nile/Greater Cairo area and Jordan in its "earth resources" projects.

Limited use is made of regional and international S and T programmes:

Despite the fact that available policy documents and related pronouncements underline the need to make good use of international and regional initiatives aimed at enhancing local S and T capabilities, available policy documents allocate little space to practical measures. The following frame takes a glimpse at existing co-operative S and T ventures.

Networking, even at the national level, is yet to receive due attention

The need to co-ordinate and streamline S and T activities, to reduce duplication and conserve resources is expressed in almost all policy documents and related pronouncements. Co-ordination committees have been set up for this purpose in a number of cases. Little else is being done otherwise. Given the constraints under which S and T institutions operate it is unlikely that committees will be an ideal solution. Linking efforts through national and regional initiatives with clear objectives and division of labour might stand a better chance.

Technology alliances with technology holders from outside the region are evident in some member countries but have remained the exclusive preserve of the larger enterprises. Further, they appear to generate little or no spin-off for national innovation systems.

Several industrial concerns in the Gulf member countries have concluded technology alliances particularly in the petrochemical industry, but also more recently in the pharmaceuticals industry. It is significant that these alliances do not always stipulate the supply of modified or renovated manufacturing technologies as they become available to the original technology holder. Frame (2) presents a few notes on this issue.

Frame (2); S and T Co-operation between ESCWA Member Countries and Regional/International Institutions

Numerous examples may be cited of co-operative S and T ventures between certain S and T institutions and universities in ESCWA member countries. It is only in a limited number of ESCWA member countries that such ventures have developed into long-term associations that show something more than joint publications, memoranda of understanding, etc. Notable examples of such long-term associations may be found in Egypt, Syria and in Saudi Arabia. In all of these countries projects aimed at setting up advanced R and D facilities have been reported. In Egypt, co-operation with USAID, for example, has resulted in the execution of a number of joint activities with immediate benefits for industry. In Syria too, co-operation with a federation of institutes of higher education and research has resulted in setting up high-level training and research facilities in information technology, automation, applied physics, etc. In Saudi Arabia, co-operation with US agencies has resulted in setting up facilities in solar energy and remote sensing.

One of the main obstacles that seem to have hindered more extensive and longer lasting co-operation appears to be the disparity between the objectives of R and D institutions in the ESCWA member countries as compared to their counterparts in the developed countries.

In general, Jordan appears to stand out among other ESCWA member countries as making best use of international and regional S and T development programmes. Nevertheless, the general picture leaves a good deal to be desired.

Source: ESCWA Study on the "Assessment of R and D in the ESCWA Member Countries;" Call number: E/ESCWA/TECH/97/5.

S and T Strategies

Without the foundations normally provided by explicit policy directives, attempts at formulating strategic agenda in S and T development have naturally been isolated, fleeting, and often concerned with introducing piecemeal improvements. It is worth noting that even where S and T policy documents have been formulated, their attention to implementation modalities has generally been less than adequate, resulting in incoherent strategic agenda.

S and T strategy, be it national, sectoral, or technology-specific, should ideally come as a result of a series of activities, including:

- a close look at the status of S and T -at the national, sectoral or specific technology levels;
- an examination of national development plans to establish priority areas and special S and T needs; (this should include analysis of strategic challenges, opportunities and orientations facing the sector or specific technology under consideration due to action by other "players;"
- analysis of existing trends and future perspectives in selected S and T areas;
- formulation of strategy alternatives and examination of their respective requirements with respect to resource levels and in regard of necessary linkages, alliances, etc., as well as their implications for the various functions of an S and T system; i.e. research and development, higher education, technology transfer and dissemination;
- selection of a strategy alternative (or a combination of elements from several alternatives) on the basis of the above considerations, i.e. priorities, resource needs, legislative and regulatory environments, etc.;
- devising an implementation strategy including measures to link and harmonize the selected strategy to other development strategies and plans; *(combining component S and T strategies into an integrated whole is a matter of the utmost importance in order to ensure ironing out duplications and highlighting areas where strategies might provide mutual benefits and exploit possible synergies)*
- design of detailed methodologies for implementation including plans, feedback routes and modalities for subsequent iterations and trajectory correction.

The above-mentioned stages are essentially the result of applying common sense to the question of strategy formulation. In order to develop the above sequence of stages into a specific model for "strategy formulation," particularities of the member countries must be incorporated. They would need to be reflected

in the design of the sequence of strategic actions, through emphasis on certain aspects in implementation modalities as well as in the addition or omission of certain activities as they are applied to particular situations in the member countries. Aspects that correspond to points of weakness and strength in a member country, to certain characteristics of an application sector or to the state of a specific technology, must be highlighted in the very design of the strategy formulation and implementation exercises.

In other words, the above sequence may be regarded, at best as constituting no more than an incipient and a generic model. In need of being "customized" and "operationalized" through considering detailed aspects of the countries/sectors/technologies in question before it could be applied to S and T capacity building within a given context.

With this in mind, it is useful to mention some of the main weaknesses of the above "model" or "sequence of stages" for strategy formulation. A major weakness of this model is its simplicity. Thus, despite its numerous stages, the theoretical foundations upon which it rests are essentially simplistic. Yet, it could provide the basis for successful strategy formulation, in our view, particularly, on account of its simplicity. Experience in S and T strategy formulation in the region is embryonic and dialogue between and among those involved in strategy formulation would be facilitated through adoption of the simple approach. There is need, however, to guard against the inherent dangers involved in dealing on its basis with admittedly complex issues. This too has to be reflected in the design of the formulation and implementation phases. A maximal degree of interaction and consultation has to be embedded in the former and an optimal measure of flexibility has to be incorporated in the latter. It is only within this context that the "generic model" described above could be used as reference in this respect.

In brief some of the main points that have to be considered in customizing this model for the purposes of the member countries are:

- Lack of detailed and up-to-date information about several aspects of S and T systems in the member countries. This is especially the case regarding qualitative and output-related assessment of S and T systems.
- Missing components in national S and T systems.[6]
- Ineffective links and limited networking arrangements at the national and regional levels.
- Lack of significant expertise in certain critical areas in which a strong need exists for credible performance in the medium and short terms.
- The need to build, or revive, confidence, on the part of end-users, in S and T institutions.[7]

The situation, in many ways, closely approximates the proverbial vicious circle. If information about the status of S and T in the member countries is inadequate and essential components[8] are missing then strategic decisions will also be at best ineffective. The S and T system in question would stand a high chance of continuing to evolve in an arbitrary fashion. In order to break vicious circles of this nature, it is essential to tackle areas where the more prominent weaknesses/deficiencies in national S and T systems lie; namely, information, networking capabilities, missing components, retrieving "lost" confidence, etc. Human and financial resource issues constitute another set of priorities for parallel efforts.

Departure from the strict sequential methodologies is called for. In seeking to reshape S and T systems in the member countries, it is essential to advance in a manner that emphasizes "parallel processing" and "multitasking." It is important to initiate, even during the strategy formulation stages, actions to remedy some of the more urgent structural deficiencies in present-day S and T systems.

---

[6] This is particularly the case in certain new technology areas such as remote sensing, advanced computer networking, modern tele-communications, etc. Missing components are evident both upstream (policy and strategy bodies) and downstream (in facilities that specialize in quality, standardization and calibration services and specialized technical training).

[7] Institutions that have, for so long, maintained focus on doing what they can do rather than what the end-user required.

[8] These are often components that constitute the "gray matter" of the system.

Actions towards this end may take the form of setting up ad-hoc bodies to collect and compile information that would eventually evolve into more or less permanent and essential components of the national S and T system. Additionally, it is essential to set up joint policy/strategy formulation bodies that would then be made to evolve into formal networks for policy/strategy review and follow-up purposes. Thus apart from high-level supervisory and steering committees that one would generally set up to provide overall guidance for the strategy formulation exercise, and possibly for related follow up activities, it is essential to create the rudiments of several S and T institutional forms. Ad-hoc committees, expert groups and networks would be initiated and made to gain valuable experience through participation in the strategy formulation exercise. Later these bodies would provide constant inputs as permanent institutional structures within the national S and T system created as a result of implementing national S and T strategy.

The lack of institutional capabilities and expertise in policy and strategy studies as applied to science and technology forecasting is a point of immense importance for the member countries. This is true of almost all ESCWA member countries.[9] One primary objective of the strategy exercise should, therefore, be to establish such facilities in parallel with, rather than as a result of, the strategy exercise.

Another area of expertise that remains homeless is technology assessment. Engineers and scientists in government departments might be able to contribute to the odd technology assessment exercise. There is as yet no single institution, however, whether in universities or research centres, that specializes in studies aimed at technology assessment.[10] Clearly, what is required is not merely to examine technical specifications and compatibility with raw materials, etc. There is great need, within the strategy formulation exercise, to acquire in-depth knowledge in the implications of certain technologies at the social and environmental levels. The creation of such facilities in ad-hoc form for the purposes of this exercise should ideally be conceived as a preliminary step to establishing permanent capabilities in technology assessment in the wider context.

This also calls for strong collaboration and consultation with non-governmental organizations and various citizen/consumer groups.

A similar situation might also present itself in responding to the special needs of specific technologies for which no national bodies have been established as yet. Examples of such orphan technologies in many of the member countries include biotechnology and genetic engineering, new materials, information and tele-communication technologies.

It is possible that national institutions with relevant mandates do exist in the member countries. Thus, agricultural and medical sciences research centres might consider that they possess a mandate with respect to the development of capabilities in biotechnology and genetic engineering. A similar situation might arise with PTT authorities in relevant government ministries acting as mentors in regard to the development of capabilities in tele-communications, and possibly even information technology. While it would not be advisable to exclude any of these institutions from the strategy formulation and implementation activities, it is essential to have special committees set up for the express purposes of the strategy exercise. Such committees should have representatives from concerned bodies. They should also cover as full a spectrum as possible of the range of required expertise.

Furthermore, tasks assigned to various committees and groups of professionals in the process of strategy formulation and the design of implementation modalities should be made to overlap in a judicious manner while ensuring effective links among them at all times.

---

[9] Studies have been conducted at different times particularly in Egypt, but also in other member countries on selected technologies. However, these studies were not conceived as part of an on-going activity and they are seldom linked to application areas is significant.

[10] Conducting technology assessment in a manner that takes into account prevailing socio-economic conditions is essential. This is why such exercises have to be carried out through endogenous capabilities, to the greatest degree possible. While it may not be possible to reverse all negative socio-economic implications due to S and T related developments, possession of endogenous capacity for S and T assessment will render a national S and T system better able to accommodate such changes and to counteract their impacts.

Gains achieved by this approach are three-fold:

- to fill, at an early stage, voids in the S and T system at the national level;
- provide the necessary multidisciplinary and multi-sectoral approaches in strategy formulation;
- while avoiding, to the greatest degree possible, institutional constraints and prejudices.

The present contribution is not, in fact, directly concerned with issues relating to strategy implementation. However, an essential point made here is that a strong link must be forged between the design phases and actual implementation measures that can be identified, a priori, as addressing important issues for the country, sector or specific technology strategy in question.

Modes of strategic action:

Delving into a taxonomy of strategy types is beyond the scope of this contribution. It is necessary to stress, however, that different modes of strategic action will have to be adopted in relation to various aspects, different phases in the process of building, or restructuring S and T systems that has to take place at several fronts in the member countries. The following are some of the issues the member countries would have to include in their agenda:

- renovating technologies in traditional sectors with a view to enhancing their economic performance and environmental compatibility;
- introducing new technologies with the aim of attaining higher added value from mineral and other natural resources;
- developing technologies for the amelioration and treatment of natural resources such as water and soil.

Clearly no single mode of strategic action will be adequate for tackling the needs of institutional construction, restructuring, entry into new technology areas, etc. Different sectors will also present national S and T systems with essentially different needs. Thus, strategic action in the various areas of S and T application areas will target different objectives in different areas. While the construction sector in some of the member countries might seek consolidation of available technologies with a limited degree of renovation, other branches can only benefit from total dismantling and renovation of existing technological capabilities/structures.

In most cases it may be advisable to adopt different modes of strategic approaches in sequence with a view to arriving at desired policy objectives. This notion of "strategic sequencing" together with a related notion of "strategy blending" will be dealt with at greater length in the final version of the study being prepared by ESCWA on the subject.

Frame (3) includes brief notes on strategic options involved in building S and T capacity to support technology adaptation and development in water desalination as well support for industrial activity aimed at the manufacture of equipment and consumable materials associated with this technology.[11] As the case of water desalination indicates, there will be need to address a number of equally important issues at the same time or in rapid succession. Further, different strategic options will need to be formulated to deal with a multitude of eventualities that may arise with time.

Different sectors, technologies and national settings will call for different strategic approaches reflecting specific aspects of the case under consideration. Many industrial and service activities will immediately benefit from relatively simple strategic approaches aimed at direct acquisition and instant infusion of new information and communications technologies (ICTs).[12,13] Other segments will require emphasis on

[11] Distinction between strategic and tactical action levels may be obscured in some areas. Strategic orientations are allowed to permeate down to the operational levels thus "colouring" tactical approaches to a particular issue.

[12] Examples of such activities may be found in the food industry and in tourism.

protracted technology alliances that could involve joint research, development and design (RDD) capabilities.[14] Still other industrial and service segments will have to depend upon a broader range of capabilities calling for greater regional collaboration.

Frame (3); Notes on S and T Capacity Building in Water Desalination in The ESCWA Member Countries

Water desalination appears to have become a widespread option in the water resource strategies of several member countries. Despite the enormous amounts spent on setting up desalination facilities and the transfer of related technologies, there is little evidence of emerging local capabilities in the dissemination and development of component technologies. Other countries in the region, indeed many other countries around the world, appear to be moving towards water desalination as a preferred option for water resource development. It would, therefore, make good economic sense for countries that have already made large investments in the acquisition of related technologies to retrieve part of that investment through enhanced mastery of the technologies. Clearly, attaining such mastery will not be possible in one step. Nor will attaining this mastery be the business of an exclusive set of S and T institutions or groups of professionals, since mastering the technologies will ultimately require a multitude of institutional competencies and professional skills.

At the level of resources there will be the need to educate and train the required manpower at the various levels. There will also be need for fund allocation. Additionally, information needs would have to be secured. Specific strategies would have to be formulated in all of these areas. Some will involve alliances, e.g. in the shape of joint regional and sub-regional manpower training.

In seeking to adapt, disseminate and further develop water desalination technologies, there will also be the need to upgrade R and D capabilities. These capabilities will naturally encompass a range of disciplines and research areas. To name but a few, there will be the need to acquire R and D capabilities in a variety of new materials technologies, in chemical engineering topics, in water treatment methodologies, in solar and combined power generation, computer control and automation, etc. Clearly acquiring these capabilities will call for different methodologies. Consolidation, penetrating new technology areas, networking have to be applied in different R and D fields.

When it comes to moving the products of R and D from laboratory to production line and ultimately to marketing desalination equipment, spare parts and consumables, a host of other competencies will be needed. The fact that design, production and industrial engineering capabilities in the region are particularly in short supply will impose a limited set of strategy options, with alliances at the forefront.

A host of supporting and auxiliary capabilities will also be needed. Acquiring facilities for water quality management and control may be relatively straightforward. Laying down standards for various water use categories will have to involve a number of institutions and calls for a strong networking component in corresponding action at the strategic and operational levels.

Strategies aimed at the acquisition of new technologies will also have to exhibit sensitivity in form and content to specific aspects of the technology under consideration. These features will still vary with the area of application. Acquiring effective capabilities in agricultural biotechnology will present a different set of

[13] To produce sustainable benefits direct acquisition and diffusion of new technologies may often require considerable infra-structural support and efforts in standardization. A case in point is information technology in the Arab countries with its requirements for extensive Arabisation.

[14] Petrochemicals, textiles and garments could be examples of such segments.

issues than medical biotechnology or biotechnology for industrial applications, in the production of pharmaceuticals or specialty food ingredients, for example. In general strategies for the acquisition of new technologies will have a greater requirement for alliances and networking. Areas in which some proven capabilities are already in place, e.g. in certain industrial and agricultural technologies could be candidates for more limited action aimed at securing effective research, development and engineering (RDE) capabilities.

In general, given the state of S and T systems in the region and the volume of challenges and opportunities faced by them, it may well be that technology alliances will constitute a major strategic option in many application sectors and technology areas. The challenge is to design alliance strategies that partners in the region can build upon to achieve added value to their initial investments.

A successful S and T strategy will need to:

- emulate the complexity of this situation without becoming so intractable as to defeat or negate its purpose;
- embody sufficient flexibility without losing its directions;
- incorporate the evolutionary attributes that the S and T capacity building process will need to possess.

To be successful the strategy formulation process itself must also possess design attributes that correspond to the multifaceted nature of the issues at hand. The strategy formulation process itself has to enjoy a large measure of flexibility and encourage the highest possible degree of interaction among all parties concerned. This process also has to be iterative since, in practice, there will often be need to revise and even reverse past choices concerning these options.

A Few Notes on Strategy Implementation:

Implementing strategies aimed at S and T capacity building will involve a multitude of tasks. There is need to muster a variety of resources, establish as well as restructure institutional arrangements, introduce and revise legislation, etc. This will clearly call for a "strategy" to implement the strategy. Efforts in this direction will also have to be conducted as interactively as possible.

Above all, it will be necessary to invest the "implementation strategy" with the possibility for allowing concerned parties real incentives for playing their part. An interactive approach in strategy formulation will address this issue only in part. Enhanced productivity, greater competitiveness, access to new technologies and to information resources should be built into the design of the implementation strategy. A special role must be preserved in all this for the small and medium enterprise (SME).

Launching S and T related initiatives [15] is often an effective strategy that, simultaneously, helps muster political support and allocation of resource as well as facilitate the infusion of certain technologies and accelerate the development of certain segments. Initiatives should have among their primary objectives the establishment of concrete capabilities at the end. This can only be assured through effective networking: in itself, a strategic objective that has to be targeted at the policy and strategy levels.

Given the state of S and T systems in most member countries there will be need for massive increases in S and T funding. Several factors will render mere increases in spending of limited effect, however. The ability of national S and T systems to assimilate and make good use of increased spending is very much a function of its intrinsic effectiveness. Thus, while there is, indeed, a real need for increased spending on S and T in the member countries this must come gradually and be strategically targeted from the outset.

Certain international and regional developments might also be usefully utilized in providing impetus for further efforts in closing important gaps in existing S and T systems. This may be true at the institutional and the resource levels. Several examples may be cited. These include the small but perceptible efforts in

[15] As exemplified in recent moves undertaken in Egypt during the second half of this decade.

building standardization, calibration and quality assurance facilities. Increasing availability of assistance, both financial and technical, in matters that relate to environmental pollution is another example.

Concluding Remarks:

Policies aimed at achieving radical improvement in S and T capabilities in the ESCWA member countries need to be formulated with due regard for the challenges and opportunities posed by global and regional developments. S and T policies to be developed for the coming century need to emphasize the special needs posed by socio-economic development objectives in these countries as well as the points of strength and weakness that characterize their S and T systems.

There is also urgent need for realistic strategies that embody flexibility and allow for iterative, gradual and evolutionary approaches in building S and T capacity in the ESCWA member countries. The strategy formulation process itself should embody attributes that highlight the desired strategy characteristics: being interactive, flexible, iterative and evolutionary.

No one characteristic strategy, or even a limited group of strategies, will be effective in dealing with the multitude of tasks at hand. In many areas there will be need to adopt strategic approaches that emphasize the need for alliances and networking. But in order to be sustainable, S and T capacity built in this manner has to have the support of strategies aimed at continued endogenous capacity building in a number of areas including research, development, design, engineering, quality management, marketing etc.

To regard policy and strategy formulation as a process rather than a one-off operation.

Appendix (I)
S and T policies in the region:

Information presented in this appendix is derived from a variety of documents obtained from institutions responsible for S and T policy in the member countries during the period 1996 - 1999. This material will be expanded and further analysed in the study on "Science and Technology Strategies for the Twenty First Century in the ESCWA Member Countries;" as part of the ESCWA Technology Sections activities for the biennium 1998-1999.

Science and technology policy in Egypt:

A Science and Technology Policy Project Document for Egypt was finalised in May 1996. In an opening paragraph, this document states that the Government's "orientations and strategic objectives" constitute a basis for its deliberations. Objectives of this policy include "transforming Egypt to the level of the newly industrialised countries by the year 2017." Fields of activity termed "action areas" are listed in this document. See frame (1).

Frame (1); Main issues addressed in the Egyptian S and T policy document

- Institutional reform of national science and technology;
- Manpower and financial resources for science and technology;
- Enhancing returns on contributions made by R and D institutions;
- Innovation and competitiveness as the basis for an export strategy;
- Technology transfer;
- High technology and "big science" projects;
- International co-operation
- Complementarity with the fabric of Egyptian life;
- Harmonisation of relevant legislation.

In this policy document, the section devoted to technology transfer emphasises:

- preference for modern and environmentally sound technologies;
- the need for guidelines to assist importers of equipment and machinery in selecting, negotiating and contracting the importation of new technologies;
- co-operation in training Egyptian nationals and enhancing capabilities for "untying embodied technology bundles";
- the need to promote the involvement of industrial research centres and institutes in co-ordination with planning bodies in technology negotiations and at later stages in the adaptation, assimilation and development of imported technologies.

Social implications of technology development are also given some weight in this document.

The document mentions the areas of high technology, listed in frame (2), as requiring special attention.

Egypt's S and T policy document clearly indicates that intensive efforts will have to be made in support of national S and T development in the future. However, despite the fact that the document stresses the need to involve businesses most of its recommendations are directed at the Government.

The need to change the legislative setting so as to arrive at conditions that may be regarded as conducive for S and T development is acknowledged and broad outlines for the required changes are provided.

<<<<No specific dates are set for the achievement of numerically stated objectives.>>>>

The above exercise appears to be taken a step further by a recent national initiative presently being planned with a view to arriving at a prospective vision for Egypt in the year 2020. Intellectuals and specialists

from many disciplines have been enlisted in this project which includes the creation of future scenarios for the country. Both socio-economic and technology related futures are to be addressed in this project.

Frame (2); Areas identified by the Egyptian S and T policy document as requiring priority attention with a view to the introduction of new technologies

- genetic engineering;
- new and renewable energy resources;
- electronics and informatics;
- more advanced and environmentally sound industrial conversion technologies;
- pharmaceuticals and therapeutics;
- new materials;
- micromechanics;
- desert and marine technologies;
- environmental technologies.

Science and technology policy in Jordan:

The Higher Council for Science and Technology (HCST) played a major role in the formulation of Jordan's National Science and Technology Policy, which was finalized in 1995 following extensive discussions within the framework of the Second Science Week in Amman, 1994.

Jordan's policy addresses the following elements:

- Information;
- Human resources;
- Research and Development;
- Technologies.

Within these elements a number of "sectoral bundles," or projects and capacity building programmes are addressed highlighting specific issues, aimed at both short- and long-term objectives.

In addition, this policy addresses a number of "auxiliary elements", taken to include, legislation, financial arrangements, coordination, administration, etc.

HCST has also conducted a study on "National Scientific and Technological Requirements and Potential." This may constitute the basis for more specialized studies on sectoral and disciplinary policies/strategies.

Policy directives are used by HCST as criteria for the support of specific R and D projects from special funds. Mineral resources, water, energy and the environment are among areas emphasized in 1996. Multi-institutional participation is encouraged in all such projects.

Science and technology policy in Kuwait:

The Kuwait Institute for Scientific Research (KISR) and the University of Kuwait are the principal research institutions in the country. The Kuwait Foundation for the Advancement of Science (KFAS), on the other hand, plays an important role in financing R and D activities and in enhancing S and T awareness.[16]

[16] KFAS was established in 1976. It is supported by Kuwaiti corporations and overseen by a supervisory board of directors, headed by the Prince. Six members of this board are selected by Kuwaiti public companies. A Director General, with ministerial status, accountable to the board of directors, manages KFAS operations. He is assisted by the department managers and a number of experts and consultants. KFAS objectives include providing assistance for:

- cultural advancement in Kuwait as well as in other Arab and Islamic countries;
- researchers and students engaged in higher studies and advanced training activities.

Grants are awarded for pure and applied research in natural science, engineering, health, sociology, and economics. The Foundation also awards grants for co-operative research projects with Arab and international scientific organizations. In addition, KFAS produces television programmes on various subjects with emphasis on ecological issues. Support is also provided for symposia and conferences.

Appendix (II)

Figure 1. Distribution of Euro-Mediterranean S&T Cooperation Projects across Arab Countries (1988-1996)

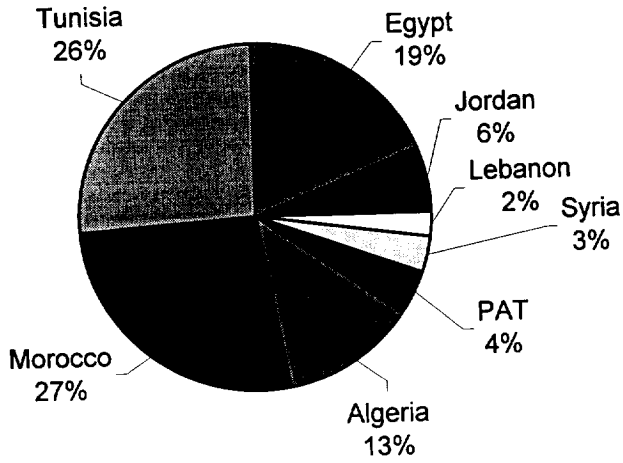


Table 1. Distribution of Euro-Mediterranean research projects across countries and research topics

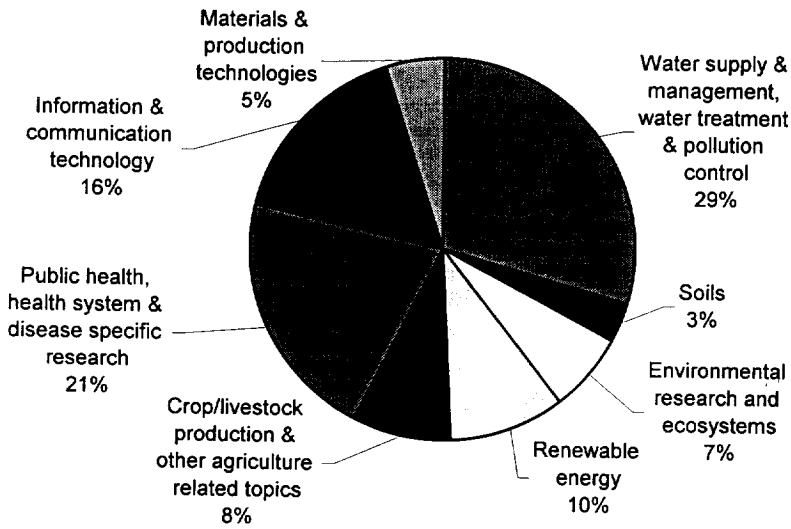
Research Topic	*ESCWA Member Countries*					*Total (EMCs)*
	Egypt	Jordan	Lebanon	Syria	PAT	
Water supply and management, water treatment and pollution control	6	7	0	3	2	18
Soils	2	0	0	0	0	2
Environmental research and ecosystems	4	0	0	0	0	4
Renewable energy	3	1	0	0	2	6
Crop production, livestock production and other agriculture related topics	4	0	0	1	0	5
Public health	5	1	3	1	3	13
Information & communication technology	6	2	1	1		10
Biotechnology	0	0	0	0	0	0
Materials and production technologies	3	0	0	0	0	3

Table 1 (Continued). Distribution of Euro-Mediterranean research projects across countries and research topics

Research Topic	*Other Arab Countries*			*Total (Other Arab Countries)*	Israel
	Algeria	Morocco	Tunisia		
Water supply and management, water treatment and pollution control	8	15	13	**36**	16
Soils	1	1	2	**4**	3
Environmental research and ecosystems	0	3	3	**6**	6
Renewable energy	1	3	1	**5**	3
Crop production, livestock production and other agriculture related topics	3	10	9	**22**	3
Public health	6	10	6	**22**	10
Information & communication technology	2	5	11	**18**	7
Biotechnology	0	1	0	**1**	14
Materials and production technologies	1	0	1	**2**	12

Source: European Commission, "Euro-Mediterranean S&T Cooperation", 1997

Figure 3. Distribution of Euro-Mediterranean S&T Cooperation Projects across Research Topics in ESCWA member Countries



The executive second set of responsibilities comprises:

- promotion and encouragement of scientific research in the applied and basic sciences, taking into account the broad outlines of the science policy ratified by the government;
- co-ordination of scientific research aimed at socio-economic development in Lebanon as well as orientating research and organising it within work programmes.

Thus, NCSR is entrusted with the design of programmes aimed at implementing Lebanon's science policy and with providing advice in relation to research allocations made by concerned government departments. Promoting scientific research in the applied and pure sciences was a primary objectives in the executive mission assigned to NCSR.

The first board of NCSR directors laid down the broad outline of Lebanon's first science policy in 1966. This was subjected to several reviews over the years culminating in a final revision that was ratified by the Board of Directors of NCSR, in 1994. NCSR undertook to collect comments and suggestions concerning this document from concerned ministries and institutions prior to its finalisation.

The science policy project drafted by NCSR addresses the general objectives presented in frame (3).

Frame (3); Broad objectives of Lebanon's Science Policy

- promotion of scientific research in areas related to reconstruction and development in industry, social and economic and population affairs as well as well as public health and the environment;
- providing resources for scientific research including establishment of laboratories and provision of equipment as well as training manpower and provision of research grants and assistantships;
- rationalisation of the utilisation of natural, human, economic and cultural resource, commencing with relevant surveys and conducting studies and research programmes aimed at the discovery of new resources and optimal methods for their utilisation;
- retrieving Lebanon's cultural and scientific roles with a view to counteracting its limited natural resources, that necessarily entail focusing on its human resources and on the promotion of scientific research as a means to improving productivity.

Lebanon's science policy document considers that the above objectives would have to be achieved through a number of "policy elements" that include:

- creating public awareness and promoting education methodologies that sustain national interest and capability in scientific research;
- retaining Lebanon's scientific brain power and attempting to retrieve immigrant brain power;
- preparing for participation by the private sector in supporting scientific research.

NCSR is entrusted, by the science policy project document, with conducting surveys of Lebanon's resources in scientific research, gathering information about science policy abroad and organizing programmes aimed at scientific manpower and information exchange with partners abroad.

In a section that discusses the financial resources Lebanon's science policy document recommends that spending on scientific research be assigned 1 percent of GNP and subsequently raised to 3 percent "in a gradual manner".

A special section in Lebanon's science policy document is dedicated to an outline of actions that have to be taken with respect to policy implementation. A five-year plan is among the Council's responsibilities. This plan is to constitute the basis for resource allocations and training of researchers. Other parts of the document deal with research support efforts based on both grants and contracts.

A particularly interesting feature of Lebanon's science policy is the fact that it addresses the issue of "un-directed" or basic research efforts. Such research is allowed, even encouraged, and grants are to be made available for conducting it by Lebanese researchers.

Science and technology policy in Saudi Arabia:

The King Abdulaziz City for Science and Technology (KACST), see adjoining frame, and the Research Institute of the King Fahd University for Petroleum and Minerals (KFUPM) are the leading R and D institutions in Saudi Arabia. In addition to its own R and D activity, KACST actually funds and co-ordinates R and D in Saudi universities.

Two major industrial companies, the Saudi Basic Chemical Industries (SABIC) and the Arabian American Oil Company (ARAMCO) have recently set up research facilities of their own.[18]

Frame (4); An Outline of KACST Mission and Activities

KACST was established by Royal Decree in 1977. Its mission includes conducting as well as providing support and co-ordination of applied scientific research activity at other scientific institutions in response to national development needs.[19] KACST is also charged with co-operating with competent institutions in the Kingdom in the identification of national priorities and policies in the fields of science and technology.[20] Additionally, it is also assigned the task of establishing a "scientific base" in the Kingdom, the promotion of national scientific manpower and the development and utilisation of modern technologies.

Cumulative financial support made available by KACST for scientific research in Saudi institutions, mainly in the Kingdom's universities, amounted to a total of more than SR 400 million, around US $130 million in 1996.

Source: ESCWA Study on the "Assessment of R and D in the ESCWA Member Countries;" Call Number: E/ESCWA/TECH/97/5

A major national exercise aimed at the formulation of a "Comprehensive National Plan for the Development of Science and Technology" was launched by KACST and the Saudi Ministry of Planning (SMoP) in 1996. This strategic plan is intended as an umbrella for four five-year S and T development plans to be incorporated within the Kingdom's national development plans covering the period 2000 - 2020.[21]

The project is envisaged as consisting of five components covering:

- the status of S and T in Saudi Arabia;
- forecasting futures for S and T in specific priority areas of S and T at the national and the international levels;
- producing a basic S and T policy document and drawing up subsequent implementation functional and sectoral strategies on the basis of that document;
- formulating strategic action plans and programmes;
- integration of the above plans and programmes within overall national development plans.

Several internal committees have been set up for the purpose of overseeing and co-ordinating KACST/SMoP efforts. A high-level committee has responsibilities for supervising the entire exercise.

Saudi Arabia's national S and T project has been allocated an amount in excess of US$3 million. A sizeable chunk of this amount has been taken up by data collection and studies aimed at establishing "current status" of

[18] Activities of the "SABIC Research and Development Complex" were briefly discussed in a previous ESCWA study but little appears to have been published about the R and D activities carried out by the ARAMCO research facility. Several pamphlets indicate a preoccupation with environmental research. The environmental impact of oil operations and coastal ecologies are areas of joint research carried out in collaboration with the Research Institute at KFUPM.

[19] It is possible for KACST to support scientific research at institutions both within and outside the Kingdom.

[20] KACST is managed by a President and two deputies. A "Supreme Committee" authorised by Royal decree oversees its affairs. The membership of this committee includes eight ministers as well as the president of KACST.

[21] The conclusion of this S and T policy formulation exercise is envisaged to coincide with the commencement of the seventh five-year national development plan in 2000.

science and technology in Saudi Arabia. Further, attempts at involving Saudi nationals have met with some success. Some of the contributions provided by Saudi specialists have been of a high calibre.

The second phase, involving a prospective view of specific S and T priority areas in the Kingdom and abroad was concluded in the fall of 1998. The formulation of policy objectives has also been initiated. The third phase, strategy and action plan formulation is in progress at the moment.

The design of the project embodies an iterative approach allowing results achieved in each phase to be revised by meetings of experts both from KACST as well as from other S and T institutions in the Kingdom.

Science and technology policy in Syria:

A presidential address, in 1992, helped re-launch earlier efforts aimed at building integrated national capabilities in science and technology that date back to the early eighties. Inter-ministerial consultations followed resulting in setting up a high level committee to oversee the implementation of the President's directives. Specialist working committees were formed on the basis of the recommendations of the high-level committee. Representatives from university faculty and research institutions, managers of the main public industrial enterprises as well as representatives of trade and industry federations have been co-opted for membership of the specialist committees.

The main outcome of the committees' activities has been a list of priority research areas, even specific R and D projects in some cases,. The list of areas has been published and distributed by the Ministry of Higher Education. It includes the following sub-headings:

- medical and related research;
- agricultural and veterinary Research;
- engineering research;
- basic scientific research.

The above-mentioned list is regarded as constituting an embryonic S and T plan. Both the Ministry of Industry and the Ministry of Higher Education supposedly collaborate in implementing parts of this plan through collaboration in specific project areas.

Financial resources have been made available with the universities being allocated sizeable funding by Syria's standards. Regulations have been reported as constituting an obstacle to rapid implementation. Thus, while regulations allow purchase of equipment and certain types of consumables, difficulties are sometimes encountered in hiring support staff, the purchase of auxiliary materials and in covering the cost of transportation for field studies, etc.

Appendix (II)

Figure 1. Distribution of Euro-Mediterranean S&T Cooperation Projects across Arab Countries (1988-1996)

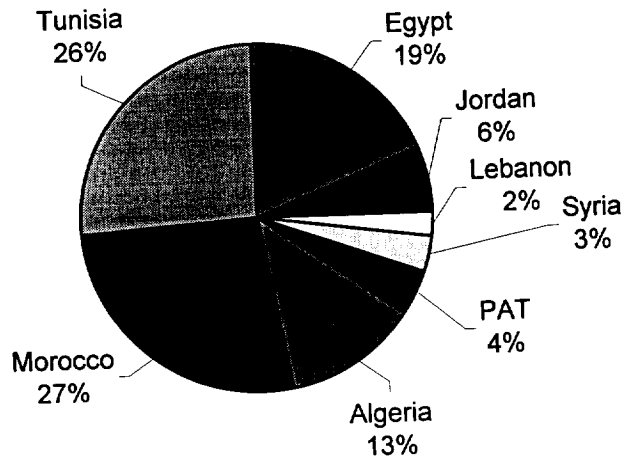


Table 1. Distribution of Euro-Mediterranean research projects across countries and research topics

Research Topic	*ESCWA Member Countries*					*Total (EMCs)*
	Egypt	Jordan	Lebanon	Syria	PAT	
Water supply and management, water treatment and pollution control	6	7	0	3	2	18
Soils	2	0	0	0	0	2
Environmental research and ecosystems	4	0	0	0	0	4
Renewable energy	3	1	0	0	2	6
Crop production, livestock production and other agriculture related topics	4	0	0	1	0	5
Public health	5	1	3	1	3	13
Information & communication technology	6	2	1	1		10
Biotechnology	0	0	0	0	0	0
Materials and production technologies	3	0	0	0	0	3