

VI. FRAMEWORK FOR FUTURE ACTIONS

The case studies discussed in the preceding chapters have shown that capacity-building initiatives can facilitate technology transfer, enhance high-technology dissemination and contribute to economic development, although there is no unique recipe that guarantees their success on these fronts in all countries. While ESCWA member countries have a good deal in common, their economic systems display some marked differences, especially with respect to State involvement in the planning and running of their economies. It follows that every national initiative should be adapted to the economic system of the country concerned and should focus on its development needs as expressed in its strategy and development plans.

Nevertheless, there are important lessons to be learned from experience in the developed and newly industrialized countries, and it is possible to formulate criteria which, if properly applied, will give national capacity-building initiatives, such as technopoles and technology incubators, a better chance of succeeding. In the following sections, criteria relevant to the ESCWA/Arab countries are discussed. They should be incorporated into those countries' planning, design and implementation initiatives, whether relating to policy or innovative institutional forms, in order to maximize the chances of success and reduce the risks of failure, taking into account each country's distinctive economic, social and political characteristics.

Within the larger issue of capacity-building initiatives in general, the present framework focuses on capacity-building through the establishment of institutional forms such as technopoles and technology incubators, given their importance in stimulating innovation and their proven effectiveness in technology transfer. Policy initiatives leading to the establishment of strategies for national capacity-building are of primary importance, and are discussed first. The promotion of innovation-friendly, dynamic environments through appropriate political, legislative and regulatory action is another road to success, and is included in this framework, as are financial aspects, which are essential for nurturing most capacity-building initiatives. Institutional S and T structures constitute the backbone of capacity-building initiatives, and their level of maturity is a crucial factor. The design and implementation of new institutional forms, including establishment, management and networking aspects, constitute an important part of the framework. Finally, specific roles for governments, civil society and United Nations/international organizations in launching and sustaining various capacity-building initiatives are also set forth in this framework.

A. POLICY INITIATIVES

“While several important components of national S and T systems were created in all of the ESCWA members during the past two decades, S and T capacity-building in general has had to proceed largely without the benefit of explicit and comprehensive S and T policies.”¹ Comprehensive policies related to S and T and specific policies focused on technology and innovation diffusion constitute important initiatives that should be launched in ESCWA member countries, with a view to:

- (a) Establishing better co-ordination among the educational system, industrial institutions and financial markets;
- (b) Strengthening technology diffusion mechanisms through well-designed programmes;
- (c) Removing obstacles to international S and T co-operation by, *inter alia*, adopting intellectual property rights;
- (d) Reforming R and D institutions to make them more flexible and adapted to rapid technological change with stronger links to industry;

¹ ESCWA, *Science and Technology Policies in the Twenty-First Century* (New York: United Nations, 1999), p. 1.

(e) Increasing public funding for R and D that offers prospects for long-term technological opportunities.

Comprehensive S and T policies should also be supplemented with innovation-promoting initiatives such as:

(a) Development of public/private partnerships in fields of technology that are deemed to merit priority;

(b) Encouraging private investment in and financing of innovation, especially by venture capital in any form, through tax exemptions or by other means.

Policy initiatives on science, technology and innovation, provided they are framed so as to take continuing technological change into account, and the promotion of new growth areas such as Internet-based services and environmental services, lead to favourable conditions for scientific and technological progress while increasing productivity and contributing to job creation. They can also minimize mismatches between demand and supply for scientific knowledge and technological skills. Furthermore, the creation of new technology-based firms and the growth of existing ones are likely to be facilitated by such initiatives through policy directives designed to promote technological entrepreneurship and to remove, or at any rate reduce, regulatory, information and financing barriers.

It is therefore essential for governments in the region, with the assistance of concerned international organizations, United Nations agencies and regional institutions on the one hand and national non-governmental organizations on the other, to guide the public and private sectors in their quest for appropriate policy and strategy initiatives. Priorities for such initiatives should include the creation of synergy and encouragement for creative co-operative approaches by stakeholders with a view to accelerating growth and socioeconomic development on the basis of new technology inputs.

ESCWA/Arab economies will need to devote special attention to the task of developing policy regimes and related strategies with the aim of promoting greater involvement by private enterprise in joint initiatives with the public sector as a prelude to forging long-lasting partnerships in technological capacity-building. Incentives aimed at encouraging the private sector to play an active role in providing a continuous stream of innovative inputs for socioeconomic development and environmental amelioration are of paramount importance.

With the above in mind, national science, technology and innovation policies and strategies must be formulated by an organization that is affiliated to the central decision-making power, yet guided in its deliberations by an interactive consultation process in which private and public sector concerns and the institutions of civil society are closely involved. Since policies designed to revitalize national systems of innovation may contribute significantly to competitiveness and productivity, this bottom-up approach is likely to achieve results, provided it is illuminated by analysis and informed choices. It follows that mechanisms for securing effective involvement by professional and business associations and by chambers of commerce, industry and agriculture in the formulation of these policies and strategies are crucial for success.

In addition to comprehensive national S and T policies and strategies, governments should formulate specific policy and strategy initiatives aimed at developing sectors deemed to merit priority through innovation promotion schemes based on new technologies, with a view to making those sectors more productive and more competitive on the global scene.

Efforts to promote the establishment of regional associations of R and D managers and technical directors² may be useful in this connection, and may lead to more responsive innovation policies and strategies.

² Along the lines of the European Industrial Research Management Association, or the Industrial Research Institute in the United States.

In seeking to develop national policies and strategies, the ESCWA member countries should also promote the creation and upgrading of basic technical infrastructures through the organization of services in such areas as metrology, standardization, certification, calibration and testing, in addition to their existing public utilities, technical centres and laboratories. Regional standardization and harmonization would then be attainable through networks of such infrastructures, enabling national firms to become more competitive in the international market.

B. LEGISLATIVE AND REGULATORY ENVIRONMENTS

In order for national initiatives in science and technology to flourish, legislative and regulatory environments conducive to their establishment and effective operation are essential.

1. *General policy, legislation and regulation*

Legislative and regulatory instruments must take into account the degree of liberalization of national economies and make provision for progressive change in the direction of greater liberalization. In particular:

(a) Political backing for S and T initiatives at the national and local levels provides essential impetus by removing obstacles and creating a more fertile decision-making environment. In the absence of such backing, many thriving initiatives, such as Sophia Antipolis in France and others in Great Britain, would never have come into being;

(b) A national S and T strategy, specifying areas of priority for the national economy, is essential as a means of guiding the public and private sectors toward appropriate initiatives aimed at synergy and faster growth;

(c) R and D organizations and centres require a special status in order to be able to interact with industrial and economic institutions and support the creation of new capacity-building institutional forms, particularly technopoles, incubators and innovation centres;

(d) In centrally planned economies, the public sector should allow private firms to assume a more prominent role, since "mixed" initiatives are likely to be beneficial for the national economy;

(e) National programmes aimed at the design and promotion of capacity-building initiatives, given supervision and backing by political leaders and key government agencies and the necessary technological capability, will produce positive results in record time (cf. Israel's incubator programme in section G of chapter II above).

For small countries of the ESCWA region, multinational initiatives in any mutually suitable form make a lot of sense and should receive the political and legislative backing they deserve. An institution located close to a free zone is one example of an initiative of this kind that may have reasonable prospects for success.

While United Nations agencies and other regional and international organizations may provide assistance with the formulation of workable legislative and regulatory frameworks, governments, with the aid of concerned non-governmental organizations, must bear most of the responsibility for that task.

The importance of revising and reforming legal and regulatory frameworks in order to bring them into line with ongoing global change in a variety of fields, including industry, trade and technology in particular, cannot be overemphasized. Areas especially in need of such revision include technical harmonization of standards between ESCWA member countries and international groupings such as the European Union, as well as facilitation and encouragement for the creation of new institutional forms such as technopoles, technology incubators, high-technology industry clusters, innovation centres and campus companies.

2. Specific legislation and regulation

Taxation systems in the ESCWA member countries need extensive reviewing and updating in the context of those countries' efforts to fashion responses to the exigencies of the emerging knowledge-based global economy. Special initiatives should be undertaken with the aim of enhancing synergy between taxation schemes on the one hand and efforts to build national innovative capabilities, and thus foster competitiveness in the global market, on the other.

Legislation that encourages foreign direct investment (FDI) by establishing favourable conditions for its expansion is crucial for the sustainability of the innovation process. Special initiatives must be launched with the aim of creating more attractive investment climates for innovative international firms and removing psychological obstacles to their relocation within member countries. At the same time, laws and regulations should seek to support and encourage the growth of innovative private-sector enterprises based on indigenous efforts as well as international partnerships.

Laws guaranteeing intellectual property rights are necessary in any national innovation environment. The ratification and enforcement of such laws play an important part in the innovation process, including the activities of technology innovation centres, incubators and technopoles. Accordingly, the promulgation and strict implementation of intellectual property rights regimes are an essential component of a climate conducive to national innovation.

3. Legislation for new institutional forms

In addition, it is essential to devise a special legal status for new institutional forms, such as technopoles, incubators and innovation centres. Appropriate laws are needed to facilitate interfacing between private- and public-sector institutions that are concerned with national innovative endeavours. Preferential treatment for collaborative efforts among these institutions, at any rate in their initial stages, should constitute a priority objective of legal reform.

Such reform should also include laws designed to encourage and promote innovation based on academic research. Since universities and research centres are public institutions in almost all ESCWA member countries, legal and regulatory frameworks are needed to facilitate the transfer of R and D output from these academic institutions to the market, along the lines of the French Government's action in adopting the Law on Innovation and Research in 1999 (see section E of chapter II above). There are a number of possible ways of expediting the transfer process, including the creation of spin-offs and the development of innovative products based on output from R and D institutions. Such frameworks should, among other things:

(a) Encourage and facilitate the movement of researchers from academia into the business environment by giving them the minimal security they need in order to be able to take the risk of setting up an enterprise to industrialize/commercialize products based on their research output, including the right to return to their institution if the project fails or their services are terminated;

(b) Allow academic personnel to perform remunerated consultancy tasks for enterprises engaging in the industrialization of innovative products based on research conducted at their institutions, or to participate in the management of enterprises that are turning research results into innovative products;

(c) Make it feasible or easier to establish partnerships between academic institutions and private firms with a view to the exploitation of R and D results, particularly through the establishment of incubators that host spin-off projects.

It should be noted, however, that the formulation of such legal frameworks in ESCWA countries will involve taking all necessary measures to avoid any possible conflicts of interest that may arise for academic personnel as a result of their double allegiance, to their academic institution on the one hand and to the private enterprise that they are creating or supporting on the other.

The fact that even a developed country like France has quite recently felt the need for such a legal framework to strengthen links between state-owned academic institutions and private firms underlines the importance of such initiatives for ESCWA countries.

C. FINANCIAL ASPECTS

Adequate financial support is a key factor in the success of capacity-building initiatives. Such support may originate from a variety of sources, including government, private business, non-governmental organizations, multinational and international firms and international agencies and donor groups. Financial support for S and T initiatives from such sources should be regarded as an investment, not as an expenditure.

1. *Indirect financial support*

Governments will need to play a major role in providing indirect support for new institutional initiatives and start-up enterprises through investment laws and tax incentives. Incidentally, taxation systems in the ESCWA member countries should be regularly reviewed and updated to accommodate the requirements of the global economy. They should take into consideration the needs of S and T initiatives that will enhance the performance of national innovation systems and hence national firms' ability to compete in the global market, which in turn will facilitate access to further funding support from traditional national/international sources and concerned donor organizations.

2. *Direct financial backing*

At the same time, governments should provide direct financial backing, especially in the early stages of capacity-building initiatives. Start-up companies need post-graduation capital investment that may not be available from banks or private investors because of the risks involved. Projects with clear objectives linked to national socioeconomic development should be targeted for special support in the form of government grants and loans. Depending on the national S and T strategy, various programmes might be made available under which these start-up firms could apply for and receive the necessary capital in accordance with well-defined rules, including monitoring and regular assessment of their performance by competent agencies.

Some of these programmes might focus on proposals for entrepreneurial projects based on research output from public institutions which are likely to constitute valuable input to the national economy. Grants might be offered to cover a reasonable portion of the estimated costs entailed by the performance of basic tasks leading to maturity, including feasibility studies, consultancy, office space, training and services. Further support might be provided after graduation as a means of helping start-ups in their initial phase to cover a portion of the expenses incurred in launching the new enterprises on the market, in the form of loans to be repaid within a specified time frame. In both cases, a call for proposals might be issued and criteria for technical selection established in accordance with national priorities.

Other programmes might focus on the establishment of new institutions for technology transfer from R and D to business and industry, particularly technology incubators with high potential for economic expansion and job creation at low cost. Again, academic institutions might receive grants or loans for a limited time period to enable them to launch initiatives aimed at transferring research output into production through start-up companies.

Again, a call for proposals might be issued, followed by an evaluation based on selection criteria framed to ensure socioeconomic benefit, ongoing links with R and D institutions and the sustainability of the initiative. Selected initiatives should feature partnerships with industry, mainly in the private sector, with additional investment from the partners. This should encourage private firms, banks and financial institutions to provide venture capital for technology-based initiatives such as technopoles, technology incubators and high-technology industry clusters.

However, the tendency for such initiatives to become primarily real estate investment initiatives should be judiciously attenuated, while more attention should be paid to investment in services and firms.

Every effort should be made to avoid the financing of construction work for buildings, as the result is likely to be a set of real estate businesses instead of high-technology incubators, parks or clusters.

3. *International support*

Well-considered feasibility studies and project proposals facilitate access to sources of financing. Governments and other concerned parties should therefore ensure that sufficient attention is paid to the preparation of such studies and proposals. In that connection, they might seek assistance from United Nations agencies and international organizations with experience in planning and monitoring technological capacity-building initiatives.

Moreover, systems of awards and prizes, at both the national and regional levels, might play an important part in promoting innovation by encouraging individuals and start-up firms to turn novel ideas into useful products. Such schemes might be promoted by concerned national and regional organizations on the basis of established criteria that recognize merit and contribution to sustainable development through technological innovation.

D. INSTITUTIONAL STRUCTURES AND MATURITY LEVELS

It should also be emphasized that while technology-based initiatives may often require the creation of new institutional forms such as technopoles and technology incubators, other non-institutional processes aimed at building bridges and interfaces may merit priority in some situations in some countries.

By the same token, bridge-building institutional forms, including "liaison facilities" that interface production and know-how utilization, may be particularly important in certain areas. These institutions may be especially useful in the field of operative and strategic research marketing. The role of non-governmental organizations, particularly chambers of commerce, industry and agriculture, producers' federations and professional associations, in this connection cannot be overemphasized.

On the other hand, crucial infrastructure elements for capacity-building are still lacking or inadequate in the member countries, including standards bureaus, metrology institutes, centres for materials testing and certification, quality management, environmental protection, energy conservation and so on. Concerted efforts should be made to secure and support these elements throughout the ESCWA/Arab countries.

While such institutional forms are generally managed by the public sector, the involvement of representatives of individual firms and business federations may be more effective in orienting their activities toward common practical objectives and fostering a steady flow of innovative inputs into the productivity and competitiveness of companies.

A cornerstone of the S and T capacity-building process is the presence of bridging institutions operating at the interface between national R and D systems, private enterprise and government. Care must be exercised in the choice of consistent and responsive institutional forms. The fact that S and T initiatives aimed at the creation of bridging institutions are site-specific should also be taken into account.

Specific conditions and levels of maturity should be made explicit for various countries and should guide decisions on the nature and calibre of technopoles, which need not be as extensive and elaborate as technopoles in more developed countries.

S and T capacity-building is a necessity for any country, and can be realized through institutions capable of undertaking the technological modernization of private enterprises and public administrations. Government-created R and D facilities are frequently advocated by the scientific community, but may be a liability in the absence of careful assessment of the returns: heavy spending on scientific projects with high prestige value may yield very little for the investment. Similarly, scientific and technological maturity must be taken into account when new initiatives are under consideration, to ensure that project proposals are realistic and avoid disappointment at a later stage.

One indicator of a country's maturity level in S and T is the presence of bridging institutions operating between R and D institutions and private enterprises. These institutions are generally site-specific, and real local industrial capabilities must be carefully assessed before they are established. None the less, involvement by private enterprise in the management of these institutions and the development of a demand-side strategic approach remain key success factors.

Moreover, although all capacity-building initiatives require some maturity on the part of national S and T institutions, there is no doubt that incubators are easier to establish and run, even in developing countries, given their relatively modest requirements in terms of qualified manpower and investment. A technopole, in contrast, may constitute a major undertaking requiring involvement on the part of the State as well as private business firms and high-level S and T institutions. Since collaborating S and T institutions are bound to play a critical role, whether by supplying qualified researchers or by providing backing for the laboratories and educational facilities needed by the new capacity-building institutional forms, it is essential to ensure that only top-notch S and T institutions are enlisted into these schemes.

E. THE PLANNING, DESIGN AND IMPLEMENTATION OF CAPACITY-BUILDING INSTITUTIONAL FORMS

While it should be borne in mind that there are no universally valid recipes for success in the planning, design and implementation of capacity-building institutional forms in all fields and under all circumstances, certain core ideas may be transferred and adapted to accommodate specific requirements. Critical success factors may also be identified, including:

- (a) The involvement of private enterprise in the management of capacity-building initiative;
- (b) A strategic approach focusing on demand-side considerations;
- (c) A gradual approach in relations with commercial firms.

In order to achieve more effective outcomes, it is important to harness such factors as:

- (a) National pride, sense of purpose, etc.;
- (b) Networks of relationships, especially with the nation's diaspora (big brother syndrome and mentoring);
- (c) Flexibility and informed policy.

A division of labour should be worked out at the inception of any technology-based initiative. Different institutions have different roles to play: governments are the promoters and, in part, the investors; local authorities, business associations and chambers of commerce are both investors and partners; universities are required to contribute by supplying expertise and highly skilled manpower.

In order to enhance an S and T initiative's chances of success, it is essential to set up facilitating operational frameworks and to foster processes conducive to learning from other countries and institutions. National and international promoters are also required to drive the initiative establishment process. Exclusion must be avoided, and local mores should always be respected and used to advantage in so far as possible. Particular attention should be paid to the demand side, having due regard for the fact that in certain cases, supply may create demand.

Information on national initiatives in fields deemed to merit priority in a variety of developed and developing country contexts should be gathered as an invaluable aid to the preparation of strategies and the identification of specific approaches. In particular, a study of the conditions that make a given set of legislative and regulatory conditions attractive to high-technology entrepreneurs would be fruitful.

1. *Conceptualization and preliminary activities*

Clarification of the main concept underlying any national capacity-building scheme and the forging of links to the process of socioeconomic development in the country constitute an essential first step on the road to a successful, sustainable technology-based initiative. Surveys, consultative meetings and analytical studies are all useful as means to the determination of needs and identification of the main objectives of the scheme and the forms of action that should be adopted to implement it.

It is essential to ensure that the highest levels of government possess a clear understanding of the importance of innovation and its potential contribution to economic development. Key policy-makers need to understand this, and must also have a clear vision of the appropriate process before embarking on the formulation of a detailed strategy. Preliminary activities should, among other things, serve to clarify and strengthen the vision held by key government officials, as otherwise any initiative is doomed to failure.

2. *Feasibility study*

Factual, well-balanced feasibility studies are a key factor in the success of any scheme. Inflated claims and exaggerated expectations often lead to failure further down the line. Moreover, excessive optimism in a preliminary study, to the neglect of possible difficulties and obstacles, will ultimately be harmful to the implementation of an initiative, regardless of its merits. Consequently, it is of the utmost importance that capacity-building initiatives are designed on the basis of high-quality studies setting forth both the positive and the negative implications of opting for a capacity-building scheme as a vehicle for introducing new technologies in emerging enterprises and enhancing productivity and competitiveness.

The study should also accommodate the views of concerned authorities with a thorough understanding of the scheme, who should participate in decisions on such vital issues as the scope, location and timing of the initiative. The distribution of innovation potential in the country should also be taken into consideration, as should national priorities, synergies, and the maturity of national human resources.

Building as wide a consensus as possible among the various actors is another task that should be performed during this phase, in order to define the objectives and specific goals of the initiative. A large number of government officials, organizations and prominent individuals should be consulted, including regional authorities, research institutions, financial establishments, venture capitalists and external consultants. Finally, a homogenization process should be carried out in order to complete the strategic planning exercise and arrive at a feasible project proposal, which will expedite subsequent phases of the process.

3. *Design*

A business plan is at the heart of the design of any S and T institutional form initiative. Yet this factor is frequently neglected or kept very sketchy. It should precede any space layout, investment in infrastructure or other implementation activity, which should only serve the implementation of the business plan. Otherwise, buildings may be designed for the wrong tenants, and irrelevant structures and equipment may be installed only to be removed later on, or become a nuisance for future users.

The business plan should include details of the core activities to be performed in the context of the initiative, as well as an estimate of the associated operational and infrastructural costs. Networking activities should be a prominent feature, and should be given special attention because of their role in leveraging the potential of any initiative by making it part of a broader community, thereby enhancing the value and reach of the initiative. Furthermore, entities that will take part in these activities should be described and their costs and benefits laid out. Any auxiliary or supplementary activities should also be specified, again with an estimate of the associated costs.

Requirements for qualified personnel in key positions must be included in the business plan, regardless of whether they are full-time or part-time, together with their salaries. The management structure should also be set forth in detail, including operational processes (such as network support and marketing)

and organizational units (such as research institutes and network administration). It is also desirable to include the basic administrative documents needed by management, so that their consistency and quality can be ascertained.

The plan should include full details of the financial resources required by the initiative, including their origin, the timing of their use, and expectations in terms of return on investment.

Once the business plan has been finalized, funding secured and the project adopted, the designing of the infrastructure can begin on the basis of the plan. The implementation of the initiative should proceed in accordance with the plan and in line with commonly accepted general principles and best practices. Some important aspects of the implementation process are discussed in the following sections.

4. Technology transfer mechanisms

In order to eliminate obstacles to technology transfer from research and technical support facilities at national R and D centres and universities to enterprises—small and medium-sized enterprises (SMEs) in particular—it is essential to improve communications between the two. Locating businesses, universities and research centres in a common setting such as a technopole will often facilitate technology transfer and bypass barriers to collaboration. It is also important to do as much as possible to narrow the gap resulting from the different value systems on the two sides of this divide. In fact, that gap has too often been widened by psychological barriers, and also by government policies and institutional regulations. In the implementation of the technopole concept, of course, the task of overcoming barriers of this kind will require greater emphasis on effective communication throughout the process.

Multi-modal technology transfer mechanisms should also be forged. This is essential in order to accommodate differing stages of development and maturity in the various areas that need to be addressed within S and T support entities, end-user enterprises, and socioeconomic conditions in general. Some processes are driven almost spontaneously by the knowledge economy itself, while others need to be launched and nurtured. Fostering an entrepreneurial climate throughout will often provide impetus in forging the required technology transfer mechanisms.

In industrialized countries, technopoles and technology incubators are developed on a substantial research and innovation base that has been built up over decades. In developing countries, in contrast, they would be attractive to potential tenants mainly because they would offer facilities and expertise not readily available elsewhere. Accordingly, in ESCWA/Arab countries, facilities and technological expertise that are in short supply at the national level should be readily available in technopoles and incubators.

5. Management of technopoles and incubators

Management in technopoles and technology incubators plays a key role in their success. A technopole manager must have a solid research and development background as well as business and industrial experience, while the manager of an incubator must be an experienced entrepreneur. In both cases, boards of directors should include representatives of leading institutions, investors and tenants. They should make sure that objectives and modalities are sufficiently clear and compatible to ensure that potential conflicts are avoided.

The screening of tenants in a technopole is a task that should be carried out very carefully and strictly but without undue rigidity. Regular monitoring and assessment are essential to ensure that problems are solved at as early a stage as possible. In addition, the technopole's management should actively seek linkages at the national and international levels. Strategic alliances with reputable international corporations are also important in order to increase the park's visibility and muster the necessary international backing while simultaneously enhancing competitiveness and developing a global market for the products.

In technology incubators, it is essential to adopt clear objectives and monitoring procedures as well as strict selection rules for projects. Moreover, experience suggests that stakeholders should have clear objectives from the outset in order to avoid friction between different actors and assess progress. Advisory

boards with representatives of both public and private stakeholders are a useful mechanism for continuous monitoring and guidance.

At the outset, stakeholders should develop a common long-term vision and as clear a view as possible of future directions in order to avoid friction between different actors and assess progress. Furthermore, experience has repeatedly shown the importance of adopting clear objectives and dynamic methods in the management of technology initiatives.

The establishment of advisory boards with representatives of both public and private stakeholders affords a suitable mechanism for the continuous monitoring and guidance of incubator schemes and the revision of their future orientations. Issues that should be supervised and closely monitored by these boards include admission policy and performance assessment. The requirements for admission into a capacity-building initiative, for example, must ensure that standards are equitable and benefits balanced for all members, and should be applied in accordance with predefined criteria. On the other hand, the progress of an initiative should be continuously monitored and its performance examined against clear, comprehensive criteria.

6. Networking and decentralization

Networking is essential for the various S and T institutional forms, such as technopoles, technology incubators, and high-technology industry clusters, especially in ESCWA member countries, where resources are often limited. Duplication of activities and the resultant waste of resources can be avoided through the networking of similar and complementary entities. Networking also affords a valuable means of exchanging experiences.

Furthermore, linkages between incubators, start-up firms and investors are essential for the effective functioning of the incubator and the survival of emerging enterprises. These firms must remain in close contact with potential investors and capital venture institutions in order to obtain the necessary funding for their projects upon graduation and even for several years thereafter, before they attain the “critical mass” that will enable them to cover their financial needs.

Focusing on a group of integrated, rather than isolated, initiatives is a useful lesson highlighted by experiences in Latin American and East Asian countries. Clearly, groups or clusters of initiatives can be constructed only on the basis of a sound understanding of the characteristics and particular problems of a country’s national innovation system. In addition, initiatives that encourage linkages between different parts of the national innovation system should be implemented.

Decentralized S and T capacity-building initiatives should be encouraged. Central government agencies, which have other (and in many cases more urgent) matters to deal with, may fail to provide sustained, consistent support for centralized S and T capacity-building initiatives. This is especially the case where local rather than national development issues are at stake. Local authorities, non-governmental organizations and local development agencies should be allowed to play key roles in launching and leading such initiatives. Decentralized initiatives assume even greater importance in the larger ESCWA countries, which are characterized by a wider variety of local needs calling for special attention.

Even so, centralized S and T capacity-building initiatives are of immense importance, and are sorely needed in a variety of areas, particularly in relation to national policies and resource strategies as well as in education, health and other service sectors.

7. Partnership and co-operation in technology initiatives

For small countries of the ESCWA region, multinational capacity-building initiatives are the answer to small market size and resource constraints. Accordingly, such institutions should receive the multilateral political and financial backing their importance warrants. Appropriate settings, notably the free zone park format, are also important.

Strategic alliances and partnerships with internationally prominent companies are a useful means of obtaining access to the global market on the basis of established quality criteria and securing international backing, perhaps through foreign direct investment.

F. THE GOVERNMENT-UNIVERSITY-ENTERPRISE TRIANGLE

Most core spending on research and development must still be provided by government agencies, especially in the case of strategic research in areas offering little prospect of substantial short-term benefits. Each of the three components in this triangle has its own specific responsibilities.

Collaboration between the private sector and local universities may focus on continuing education for decision-makers and technical managers in areas of crucial importance for the building of knowledge-based societies for the twenty-first century. It may also focus on research and technological development.

The role played by the media, both old and new, in the dissemination of information on technology initiatives and as actual partners in certain information-technology-based initiatives, should be clearly recognized and supported.

University/industry partnership approaches that emphasize the needs of particular client groups have been found to be an important ingredient in success. Offering standardized services and technologies, on the other hand, is likely to be of little value.

Difficulty in customizing university/industry links has sometimes brought about a shift toward short-term problem solving and training rather than longer-term support for major projects entailing significant innovation and technology transfer. In view of the ESCWA/Arab countries' limited research and innovation capabilities, however, the provision of isolated services to enterprises by university research staff should be held to a minimum.

G. HUMAN RESOURCES DEVELOPMENT INITIATIVES

Technology initiatives can be established and run only by experienced teams of motivated individuals. Such teams can be trained most effectively through collective efforts at the national and regional levels; the support of international and regional organizations may also be enlisted.

Initiatives aimed at human resource development, such as distance education projects, are crucial to the dissemination and assimilation of new technological knowledge, and are also a source of opportunities for newly fledged small and medium enterprises. Such initiatives should be assigned priority status in plans for S and T capacity-building in the ESCWA/Arab countries.

Firms with in-house training programmes that are adapted to the needs of the ESCWA/Arab countries are in effect reinforcing existing human resource development efforts, and consequently should be encouraged and supported by governments, non-governmental organizations and international and regional organizations.

Areas of particular importance in such initiatives should include human resource development within a strategic framework, with emphasis on design, research, development and engineering as applied to product and process development. In particular, institutions of higher education should collaborate with business associations to determine profiles for future scientists, engineers, technologists and researchers, in order to ensure that industry's skilled manpower needs are met. Businesses should also host students within specially designed training schemes and applied research programmes.

ESCWA member countries should put more resources into human resource development; spending for that purpose should be regarded as an investment rather than a cost. In particular, education and skill formation are aspects that are of crucial importance for the success of capacity-building initiatives. All components of the education system, at all levels, deserve attention, and, where necessary, radical overhaul.

H. INITIATIVES FOR WOMEN

Studies have shown that there are disparities between men and women with respect to their involvement in the development and use of technology, particularly ICTs, even in the developed countries, including the United States. In the field of education, for example, in the year 2000, the number of bachelor's degrees in computer science conferred on women constituted less than 28 per cent of the total number of such degrees conferred in the United States, down from 37 per cent in 1984.³ It would seem that the current computer culture, the way computer science is taught and the careers that it leads to are not attractive to women. Although women constitute 47 per cent of the workforce in the United States, women hold only approximately 29 per cent of IT jobs and 10 per cent of electrical engineering jobs.⁴ Moreover, men employed in the IT field earn an average of 17 per cent more than women employed in that field. Although demand for IT workers is increasing, the numbers of women seeking jobs in IT have tended to remain static or decline. According to the United States Bureau of Labor Statistics, it is expected that nearly 1.3 million additional IT workers will be needed by 2006.⁵

On the other hand, a majority of ICT users are women. In the United States, over 50 per cent of Internet users and approximately 63 per cent of online shoppers are women. This shows that although women use technology as a means of acquiring information and in their daily tasks, they are not attracted by the technology to the point of becoming ICT developers and professionals.

The situation in the ESCWA countries is no better. In Jordanian universities, for example, the ratio of women specializing in ICTs and related disciplines was 28 per cent in 1998,⁶ while women accounted for just under 27 per cent of the total ICT workforce in that year. The sector with the heaviest concentration of women ICT professionals is education, with 42 per cent, followed by public administration (39 per cent) and health and social work (38 per cent).⁷

Women could alleviate the current shortage of IT skills to some extent if more of them were willing to study computing at university and enter the IT profession. Efforts to change this situation must be directed mainly at the undergraduate level. As an example, a Gender and Learning Technology Group has recently been formed at the University of Michigan at Ann Arbor, with a view to finding ways of bridging the gender gap in the area of computer education and use.⁸

A number of initiatives targeting women and new technologies have been launched, particularly in the past decade. The outcomes of many such initiatives suggests a need to empower women by developing their ICT abilities and inculcating active attitudes, which in turn may lead to legislative changes impacting their position in society, the State and the global community. One such initiative, labeled "taster days", was recently launched in the United Kingdom in partnership with the government, IBM, Sun and Microsoft. Through this initiative, teenage girls learn about the various jobs and careers available in IT directly from female employees.⁹

³ J. Kaiser, "Getting girls to like computers," *Science*, 288, 5465 (21 April 2000), p. 395.

⁴ J. Disabatino, "Glass ceiling for women in IT persists," *Computerworld*, 34, 20 (15 May 2000), p. 12.

⁵ C. Edwards, "Scientist works to give women a voice in Cyberworld", *Black Issues in Higher Education*, 17, 5 (27 April 2000), p. 64.

⁶ Directorate of Studies and Researches, Council of Higher Education, *The Annual Statistics Report on Higher Education in Jordan for the year 1998/1999* (Amman, Jordan: 2000).

⁷ The National Information Centre of Jordan, *ICT initiatives in Jordan: Needs and aspirations, with emphasis on SMEs*, a study conducted for ESCWA in April 2001.

⁸ "Michigan research group seeks to boost female use of software and computers," *Black Issues in Higher Education*, 17, 26 (15 February 2001), p. 32.

⁹ A. Maitland, "A solution to the IT skills shortage: women in computing", *Financial Times*, London, 22 February 2001, p. 13.

Initiatives aimed at the development of women's technological skills will enable them to participate in the knowledge-based economy, becoming productive members of society and accessing a wide range of opportunities to contribute to socioeconomic development. Advances in ICTs are making teleworking and e-commerce a reality in everyday life, so that women are now able to work from their homes and shoulder more responsibilities in the information society, whether by working in a production environment or by managing enterprises.

The Women's Learning Partnership (WLP), an NGO that works for co-operation among women to protect human rights, facilitate development and promote peace, is encouraging the use of ICTs by women in order to empower them and increase their leadership role in society.¹⁰ In pursuit of these objectives, WLP advocates new ways of learning, leading and acting, based on ICTs. Collaborative actions on a global level that will be useful in this connection include exchanging ideas over the Internet and seeking solutions for common problems. The more readily information can be collected and exchanged, the more cross-cultural dialogue will be enhanced and the better the prospects for the advancement of women will be.

Government tax initiatives that facilitate the acquisition of basic ICT equipment and Internet access can leverage women's status in technology. Initiatives to provide home Internet access will also help to close the gender gap in ICTs, enabling women to develop their skills and become teleworkers in their fields of expertise. This can only be beneficial for the economic development of society as a whole.

Centres where women entrepreneurs can have access to modern ICTs and e-commerce tools are a promising type of initiative. Such centers will enable women to offer a variety of services, using new technologies, and obtain needed counsel in enterprise creation, including legal and financial aspects. Initiatives of this kind will also allow women to obtain the necessary training in management, marketing and finances to be able to run a sustainable enterprise. As the case of the United Arab Emirates has shown,¹¹ suitable environments lead to the emergence of women entrepreneurs who can play leading roles in technology-related ventures and in the national economy.

In rural areas, the establishment of multipurpose telecentres can also help women play a more effective role in the economy. Through these centres rural women can learn how to use new business tools, including ICT tools, to find information, communicate, and develop their own businesses in the context of their own environment. This will help rural communities improve their economic conditions through the use of basic e-commerce tools and methods, and will eventually lead to the development of rural entrepreneurship in the ESCWA/Arab countries.

I. SPECIFIC ROLES IN CAPACITY BUILDING-INITIATIVES

1. *Role for governments*

As discussed above, governments can play a major facilitating role in the development of capacity-building initiatives, and can enhance their prospects for success by various means, the most important of which are:

- (a) To encourage movement toward a digital knowledge-based economy through special initiatives, including the introduction of incentives for foreign investment;
- (b) To improve telecommunications infrastructure and create better links to knowledge sources and international networks;
- (c) To launch free zone initiatives for information technology and media-related enterprises;

¹⁰ S. Balaghi, "Cultural Boundaries and Cyber Spaces", *Middle East Women's Studies Review*, XV, 3 (Fall 2000).

¹¹ M. Janardhan, *Rights-UAE: slowly, Arab women break traditional mould*, Interpress Service, 21 March 2001.

(d) To take the lead in developing S and T capacity-building initiatives that will increase productivity and competitiveness at the local or national levels, sharing the risks involved in launching and running such initiatives with other concerned stakeholders;

(e) To introduce regulatory measures in key technology sectors, especially the information technology sector;

(f) To promote and encourage:

(i) Partnerships and foreign technology-based investment;

(ii) The drafting and adoption of legislation designed to encourage local, regional and international financial institutions to set up venture capital support and invest in start-ups and incubation schemes;

(iii) The creation of financial mechanisms, including financial markets on which stocks of technology-based enterprises may be floated, to provide additional financial resources.

(g) To update and revise codes of commercial practices as radically as may be necessary;

(h) To modernize national tax systems and associated incentive schemes to bring them into line with contemporary needs;

(i) To develop, launch and provide special support for initiatives aimed at the introduction and dissemination of e-government. In this connection, governments should devote greater attention to the formulation of coherent policy directives by way of co-ordinating ministries' and stakeholders' efforts to deal with a host of economic, business, and social issues that are critical to the implementation of e-government initiatives. Such initiatives are likely to be a useful means of:

(i) Catalysing other S and T initiatives;

(ii) Cutting red tape and offering people more convenient services, thereby encouraging the widespread use of more effective technologies and more satisfactory management practices in general.

Governments should take the lead in promoting national knowledge equity by targeting the creation of knowledge and skills, setting an example for non-governmental organizations and the private sector follow.

2. Role for civil society institutions

Civil society institutions, including professional associations, business federations and chambers of agriculture, industry and trade can and should play a more active role in the formulation of S and T policies and a variety of national and local S and T capacity-building initiatives, including the establishment of special technology promotion and dissemination bodies, networks, and extension and bridging institutions. Committees dedicated to development of the IT sector should be constituted, to lobby for a legislative and regulatory environment that is conducive to the development and dissemination of IT.

Reform is also required at the level of individual firms, and concerned civil society institutions should support them in their efforts to introduce essential changes. Plans to motivate employees, create loyalty and reduce up-front costs should be treated as priority issues.

3. Role for United Nations organizations and international agencies

United Nations organizations and other concerned regional organizations could act as a clearinghouse, providing specialized services and advice on prospective S and T capacity-building initiatives, taking into account the welfare of humankind regardless of race, creed or sex.

A new commitment is needed by the specialized agencies and organizations of the United Nations system, particularly those with mandates focusing on general economic and social development as well as such more specific areas as industrial, agricultural, trade and human resource development, S and T capacity building and environmental amelioration. These agencies and organizations should co-ordinate their efforts and co-operate more effectively with national and regional bodies, including NGOs involved with technology transfer and knowledge dissemination and NGOs involved with enterprise development. Targets for improved co-ordination and co-operation should include:

- (a) Development of frameworks for the launching and management of S and T capacity-building initiatives;
- (b) Pooling of expertise and resources;
- (c) Improving public perception of the role of science and technology for sustainable development;
- (d) Encouraging participation by women in design, research, development and engineering activities.

ESCWA, in co-operation with other United Nations organizations and specialized agencies on the one hand, and with concerned regional and national institutions on the other hand, has an important role to play in launching S and T capacity building initiatives. As a first step, it might be useful to study various approaches to the tasks of launching such initiatives and managing them for optimal performance.

In this context, ESCWA has launched an initiative aimed at identifying and implementing schemes adapted to the ESCWA member countries, incorporating the necessary studies, training and technology transfer and the creation and networking of appropriate institutions for capacity-building. The framework of this “ESCWA initiative for technology parks, incubators and high technology clusters” is set forth in detail in appendix 5 below.