

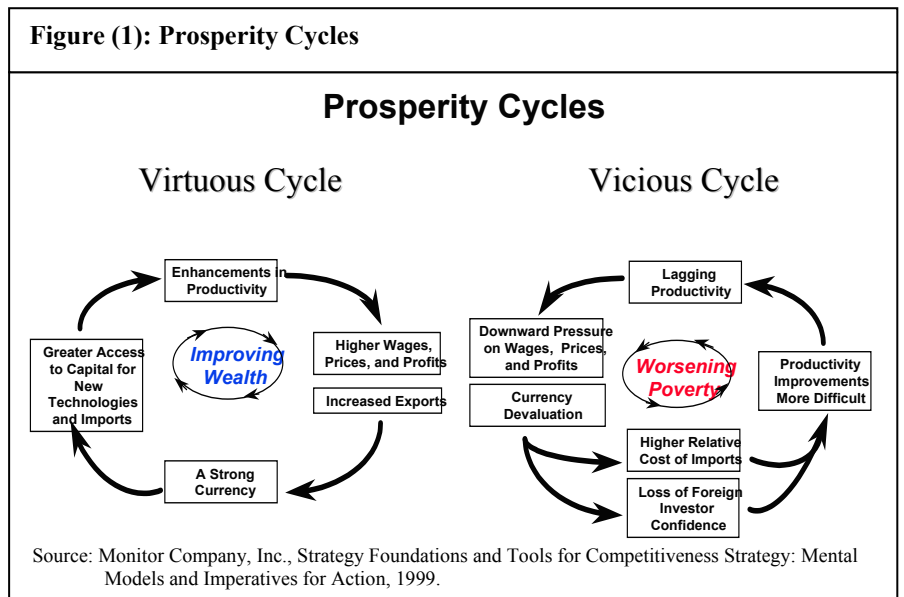
Research and Innovation A Futuristic Vision of Public-Private Partnerships

Introduction

The principle drivers of economic growth in today's fast-paced global economy are scientific knowledge and technological change, and not natural resources. Countries that depend mainly on exporting their natural resources and low value added products are characterized with the low living standards. This is caused by a constant demand for low wages to lower costs, meeting world prices of raw materials in case of fluctuation, lowering prices, narrowing profits, and effect of the exchange rate. Consequently, investors in these countries become hesitant. Therefore, it is difficult to improve productivity, or increase wages. This all affects the country causing a vicious cycle that leads to poverty and low wages.

Dissimilarly, countries exporting high value added products are automatically improving their people's living standards, and this is evident from the productive cycle that leads to prosperity. This is caused by an increase in wages with an increase in productivity, profits, and the following rise in percentages of exports. This all reflects positively on the exchange rate for the country, and consequently the capability of introducing capital to absorb technology transfer. With the introduction of new technology, the productivity scale will proceed forward. Consequently, a productive cycle headed towards prosperity is formed.

Figure (1): Prosperity Cycles



Shifting towards manufactured products with high value-added is gained through capitalizing on R&D and innovation, and linking together the key elements which are vital to transferring knowledge into new products and services for society. At the center of this process are the innovative companies which take products to the marketplace. However, firms must be linked to R&D organizations embedded in a science and technology infrastructure, and have access to highly skilled human resources from universities and colleges to provide the brainpower needed for driving innovation. In addition, government has a key role to play in setting policies and creating an environment conducive to innovation. Finally, finance and investment are needed at all stages of innovation, particularly at the development/commercialization stage.

Considering all the above reasons, it is extremely important to assess the current status of the Jordanian R&D and innovation activities, whilst considering all

stakeholders in formulating a national vision that is to be implemented through an effective public-private partnership. The national vision will act as an instrument to streamline the R&D and innovation activities in Jordan, thus enhance and sustain its competitiveness by allowing policy makers and businessmen to adopt new strategies that include innovation as a core ingredient in Jordan's recipe for success in the twenty first century.

Jordan's Research and Development: The Reality

Examining the status of the R&D activities in Jordan is pivotal in reaching a futuristic vision based on a solid understanding of the strengths and weaknesses of these essential constituents impacting the competitiveness and wealth of the country. The analysis of these activities will be founded on the assessment of infrastructure, financing and the type of research that considers the link between academia and industry a key factor.

I. Infrastructure

Human capital is the main stock in the R&D process; it represents a main constituent to any R&D efforts in any economy. Incessant technological innovation through the pursuit of scientific understanding, application, and R&D reveal the extent to which education is vital in developing essential innovative skills in an economy. Not only should governments ensure continuity to produce world-class scientists and engineers, but also adequate educational grounding is an opportunity to succeed in the technology-based world of tomorrow-a lifelong learning process.

In this regard, Jordan's human capital is considered one of the best with an adult literacy rate of (90.3%), youth literacy rate of (99.3%), high secondary enrolment of (76%) and a tertiary enrolment rate in science, mathematics and engineering that is higher than that of Japan.¹

Regardless of the high intellectual capacity of Jordanian graduates, the number of Jordanians involved in pure research and development activities is considered low and lagging behind some Arab and regional countries. The number of research scientists per (1000) working force reached (3) for Jordan, while Kuwait reached (8), Egypt (6), and Turkey (7).

Infrastructure supporting R&D also includes equipment and facilities, information technology that serves as an enabler for product development, as well as the legislative environment that ensures the security of the R&D output.

Country	Research Scientists/ 1000 Working Force
USA	72
Australia	68
Turkey	7
France	61
Japan	110
Kuwait	8
Egypt	6
Jordan	3
Morocco	2
Syria	1
Sudan	0.5

Source: OECD Science and Technology Indicators, 2000.
Source: Science and Technology Indicators UNESCO ESCWA, 1998

¹ Human Development Report 2003, UNDP.

Equipment and facilities for Jordanian researchers are made available through government, universities and the private sector companies. The government supports scientific research through two main umbrellas. The first being the Higher Council for Science and Technology (HCST), offers a myriad of programs to support manufacturers and researchers in the country at large (See Box (1)). The HCST aims at building a national scientific and technological base, and assisting in achieving economic, social and cultural development in the Kingdom. The HCST has been given the authority to ratify the general policy of science and technology in the Kingdom by defining its priorities, drawing up the programs and plans arising thereafter as well as following up on their implementation and evaluation. Additionally, entrepreneurs seeking to establish start-up companies view the Incubator program that was established lately under the HCST as helpful in speeding the move of new technologies from the laboratory to the marketplace.

The second umbrella known as the National Center for Agricultural Research and Technology Transfer (NCARTT) is responsible for coordinating all agricultural research and technology transfer activities in Jordan. The NCARTT disseminates information, provides technical support, technical recommendations as well as training for extension personnel, on-farm trials and demonstration, and provides a mechanism for regular two-way flow of information and feedback between researchers, extension agents and producers.

Universities are considered major contributors to the research and development activities in Jordan, through their facilities, equipment and (4,858) academic staff members. There are (8) Jordanian public universities and (12) private universities constituting an essential element in the infrastructure available for researchers and industries. Moreover, the research facilities available at the industry level are concentrated in the large companies such as the Potash and Phosphate companies, which have very specialized labs for their industry, and in certain sectors such as the Pharmaceutical industry.

However, the currently available R&D centers and facilities still do not meet the expectations of private sector, or the needs of the country. According to the GCR (2002-2003), Jordan's performance in the Quality of the Business Environment Index

Box (1): The Government Research Umbrellas

The Higher Council for Science and Technology (HCST) offers a myriad of programs to support manufacturers, and researchers through its six centers; namely:

- The Royal Scientific Society (RSS): is an independent non-profit institution offering technical services for companies in the manufacturing sector, in addition to conducting in-house applied research. RSS is very responsive to the marketplace and is perceived as the most important provider of technical and certification services within Jordan.
- The National Center for Human Resources Development: is an institution with valuable experience in the education and human resources fields that plays a role in the discussion and implementation of the education policy, where it maintains a very active policy oriented research agenda.
- The National Center for Diabetes, Endocrine and Inherited Diseases: specialized in conducting health related research and how it can be linked to the delivery of health care.
- The National Energy Center:
- The National Information Center
- The National Fund for Enterprise Support (NAFES)

The National Center for Agriculture Research and Technology Transfer (NCARTT): NCARTT is responsible for coordinating all agricultural research and technology transfer activities in Jordan, the research activities accommodate for about (70%) of the time of NCARTT's senior staff by which applied and adaptive research activities are carried out alone or in cooperation with other scientific and technical organizations inside and outside Jordan. In the technology transfer side, NCARTT provides technical support, information dissemination, technical recommendations as well as training for extension personnel, on-farm trials and demonstration, and provides a mechanism for regular two-way flow of information and feedback between researchers, extension agents and producers. Currently, NCARTT has (600) full-time staff of which (200) are full-time researchers holding PHD, Masters and Bachelor degrees, in addition to (37) labs.

(48/80) was weakened by the relatively uncompetitive results attained in the quality of scientific research institutions (54/80). It also ranked (44/56) non-core countries².

Nonetheless, the government of Jordan has undergone efforts over the past few years, to develop the information and communication capacity of the country; *one of the elements supporting the innovation process*. In fact, successes were achieved on the government's part but still extra work is needed in areas such as the level of personal computers penetration and number of internet hosts, which negatively affected Jordan's overall rank in the ICT sub-index (50/80) of the GCR.

In addition, Jordan has taken a number of steps to ratify much legislation related to R&D to be aligned with international standards and create an environment conducive to innovation. The achievements in this regard-although satisfactory earning Jordan a rank of (35/80) in Intellectual Property Protection-are still far from other countries such as Israel and Ireland.

Table (2): ICT Sub-Index/ Rank (50/80)

Indicator	Jordan's Rank
Internet Access in Schools	33/80
Quality of Competition in the ISP Sector	20/80
Government Prioritization of ICT	14/80
Government Success in ICT Promotion	16/80
Laws Relating to ICT	31/80
Cellular Mobile Phones, 2001	56/80
Internet Users, 2001	52/80
Internet Hosts, 2001	63/80
Telephone Lines, 2001	55/80
Personal Computers, 2001	58/78

Source: Global Competitiveness Report, WEF, 2002-2003.

II. R&D Finance

Jordan's R&D spending is comparatively low as a percentage of GDP and does not exceed (0.36%), which is almost one third of the international standard of (1%) of GDP for developing countries. Furthermore, almost all expenditure is made by the government while the private sector's contribution does not exceed (4%). The government's contribution is made through its direct support to the governmental research centers and the research

Table (3): Expenditure on R&D Activities, US\$ Millions, and as a Percentage of GDP

Country	Total Expenditure on R&D (US\$ Million)	Total Expenditure on R&D (% of GDP)
USA	282,293	2.8
Ireland	1,148	1.2
Turkey	1,280	0.641
Malaysia	440	0.489
India	3,743	0.843
Brazil	4,623	0.874
Israel	2,841	2.788
Jordan	25	0.361
Arab Countries	1,100	0.2

Source: World Competitiveness Yearbook, IMD, 2003.

conducted through public universities. The Higher Council for Science and Technology receives the highest government contribution followed by the National Center for Agricultural Research and Technology Transfer. The (8) public universities allocate around (US\$ 4.5 million) for research, conferences and periodicals in their annual budgets.

Finance for the private sector's research and development is encouraged through policy instruments used to promote private sector innovation. A 1% levy on public shareholding firms is utilized whereby such firms are required to invest 1% of its net

² According to the GCR, core innovators are countries with more than 15 US utility patents registered per million population annually, otherwise the country is referred to as non-core innovator or economy.

profits in “in-house” R&D or the development of its human resources. Monitoring and implementation of the levy is the responsibility of the Ministry of Industry and Trade (see Box (2) and Annex (1)).

In addition, direct grants from the Industrial Research Fund operated by the HCST are made available for firms conducting research and development projects. The annual budget for this fund has been (JD 300,000) per year since the funds inception in 1994, with equal shares being provided by the Government, via the HCST Budget, and a few large firms in the private sector.

Box (2): The Companies Law No. 22 of 1997 and its amendments

Article (188): Allocation of 1% of the Profits to Support Scientific Research and Vocational Training

"A Public Shareholding Company should allocate not less than 1% of its annual net profits to be spent for supporting scientific research and vocational training in it, and to spend this allocated reserve, or any part thereof, on scientific research and training. If this amount or a portion thereof is not spent within the three years of each deduction, the balance should be deposited into a special fund to be set up in accordance with a regulation issued for that purpose. The regulation shall specify the method and basis of payment, provided that it shall not be extend beyond the intended purpose of this Law."

Regardless of the above laws and incentives, private sector companies are still lagging behind in financing in-house R&D activities. This can be construed from Jordan’s uncompetitive GCR (2002-2003) rank in Company Spending on Research and Development (68/80). Thus, according to the GCR, innovation doesn’t play a crucial role in generating revenue for Jordanian firms, which is not surprising considering the companies' relatively low expenditure on R&D reflects the private sectors' uninterest in absorbing new technology. Moreover, the industry's weak interest in R&D activities is evident from the budget of the Scientific Research Fund, which often tends to maintain a significant surplus.

Additionally, venture capital; an important source of funds used in the formation and expansion of small innovative companies, is almost unavailable in the Jordanian economy. Currently, about three private companies are working in this field with limited resources and tight budgets. However, a new project is being formulated in the Euro Jordanian Action for the Development of Enterprise (EJADA) to create a well-established venture capital and development fund targeting start-ups and small enterprises seeking expansion and development. Moreover, and due to the high risk associated, none of the Jordanian commercial banks’ strategies include the finance of R&D projects.

Clearly, superior long-term rates of economic growth depend on emphasizing the high value added portions of supply chains. Achieving this objective will require significantly larger amounts of R&D investment than are currently being made. Industry has not been effective in responding by steadily increasing its investment in applied R&D, which currently amounts to (4%) of the country’s total R&D expenditure. In addition, the composition of publicly funded R&D should be reassessed to ensure industry is being provided with adequate technology platforms for the range of emerging technologies needed by the Jordanian fairly diversified economy. Moreover, duplication in terms of funding the same R&D projects through different funding sources, such as the universities and HCST, should be prevented.

III. Research Output

Countries targeting innovation should traverse a three phase approach, starting from adapting and transferring technology, to the ability to create new technologies (i.e. to

innovate), and then to adopt and diffuse the innovation by using it profitably. According to the GCR, innovation doesn't play the role it should in Jordan, which is evident from Jordan's weak performance in the innovation and technology transfer sub-indices [Innovation Sub-Index (57/80), and the Technology Transfer Sub-Index (30/56)], as a result of its weak performance in the R&D specific indicators. However, the scarcity of innovative R&D projects impedes the production of patents, which only amounted to (0.58) utility patents per million population for Jordan in 2001. In contrast, Israel reached (163.32) utility patents per million population for the same year. This can be attributed to many reasons:

- Public universities in Jordan, which represent a large fraction of the research performed in the country given the high proportion of full-time faculty members with advanced graduate degrees mostly from prestigious European or North American universities, perform research that arises from the need of faculty members to produce research results for advancement in their academic careers rather than the initiation of independent research programs. In other words, research in universities is conducted to attain credits for promotion, while incentives driving research agendas linked to the Kingdom's social and economic problems are rare or even lacking.
- Confusion amongst Jordanian universities pertaining to their role in the knowledge-based economy exists. The overall educational institutions' approach emphasizes traditional teaching and research whereas the concept of commercialization is not in the least incorporated in the mission statements of many Jordanian universities, thereby impeding the execution of joint research projects with industries. Not surprisingly, there is little evidence of direct University spinouts. This calls for positive policy toward the concept of commercialization, which only started to evolve during the last decade.
- There exists an obvious mismatch between the expectations of academia and the owners of small and medium sized enterprises (SMEs) and vice versa, particularly regarding funding, tasks, and results. Currently, substantial efforts aimed at encouraging networking and better understanding of mutual problems facing industry and academia, are made in the form of conferences, seminars and

Box (3): Example of a Jordanian University Mission Statement

“The University has been established to actively participate in comprehensive national and regional development through quality education and its relevance to keep abreast of changes within an atmosphere of democracy, freedom, creativity, opportunity, and lifelong interactive learning. The University attempts to be responsive to international educational standards and engages in research activities, which are inline with national and regional development plans. It attracts students from local, regional, and international areas seeking higher education. The University provides interaction amongst students with the local community and at the international level. It also concentrates on the preparation of well-trained manpower capable of contributing to solving society's problems through projects and academic research.”

Box (4): Initiatives for Academia-Industry Cooperation- University of Jordan

The Engineering Partnership Council with Industry

The goal of establishing this partnership council is to bridge the gap between the expectations of the industry and the academia. The council attracts (15) members from the private sector enterprises to brainstorm for new ideas, proposals and new joint research projects.

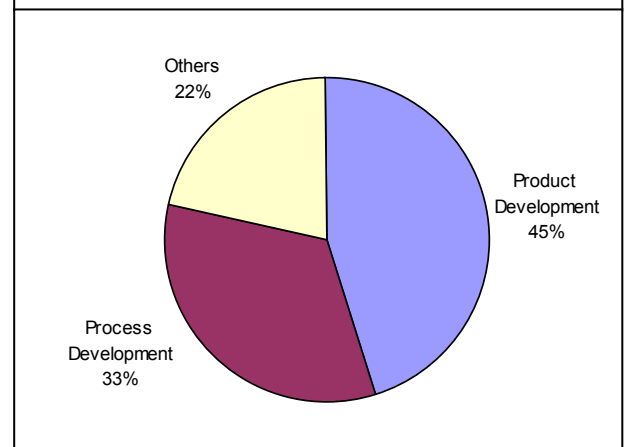
Faculty-for-Factory Program

The goal of this program is to assist the Faculty of Engineering and Technology members in establishing results in the development and expansion of small and medium size enterprises. The program provides incentives to attract leading practitioners to develop and help such enterprises. The faculty members are expected to develop, define and conduct recognized practical projects that have development potential related to the needs of the enterprises.

joint councils. Nevertheless, such initiatives are new thus their fruits are yet to be harvested.

- It is very evident that there are weak linkages between academic institutions and businesses. Although there are initiatives to overcome these gaps (See Box (4)), clearly defined proactive-roles that are to be assumed by the government and businesses in creation of innovative R&D applications and augmentation of competitiveness are needed.
- In addition, Jordanian manufacturers spend little time or money on R&D because they increasingly focus on commodities rather than on new personalized and higher quality products. This is evident from the type of projects that received support from the Industrial Research Fund since its inception in 1994, which shows a high proportion reaching (44.9%) of the total allocations directed to existing product development rather than the exploration of new possibilities or new product innovations. Furthermore, (22%) of the fund sources were directed to projects not directly related to enhancing the capability of industries in terms of R&D activities instead these amounts were utilized in infrastructure development which is not covered in the Fund's objectives and eligibility criteria (e.g. the Jordanian-Japanese HAPPI program, training, and the Technology Incubator Project).

Figure (2): Industrial Research Fund: Types of Supported Projects



- On the other hand, around (10%) of the Industrial Research funds were directed to the pharmaceuticals sector. Most of the research conducted in the Jordanian pharmaceutical sector focuses on developing new formulas for already patented drugs. In addition to the Jordanian pharmaceutical companies that conduct in-house research regarding the formulation and stability studies, bio-equivalence studies and clinical trials are taking place in a research center located in the RSS premises. These research studies absorb an average of less than (0.1%) of the allocations from net sales from this sector.

IV. Summary

To sum up, it is evident that Jordan is not fully capitalizing on existing potential in the field of R&D and the amount of funds available for innovation activities and the incentives provided by the Government are not fully utilized by the private sector. Furthermore, innovation still doesn't play a crucial role in generating revenue for Jordanian firms. This is mainly due to companies' unresponsiveness in absorbing new technology coupled with their relatively low expenditure on R&D. This form of behavior can be attributed to many interactive factors, the most important of which are the following:

- An innovation culture is lacking among individuals and firms in Jordan.

- Firms do not recognize the positive impacts of R&D in enhancing competitiveness.
- Financial institutions are still reluctant to provide loans for R&D purposes, and venture capital availability is still low.
- Linkages between universities and businesses are weak.
- Although Jordan is rich in terms of its human capital, brain drain is proof of the country's weakness in recognizing the potential and capabilities of its researchers and scientists.

Nevertheless, efforts were made to support the R&D base in the country and create a more conducive environment to innovation. Such efforts include working to improve the information and communication capacity of the country and the alignment of R&D related legislation with international standards through the introduction of the Intellectual Property Rights Legislations and the Competition Law.

In matters of R&D finance, one project aiming to create a well-established venture capital and development fund for entrepreneurial start-ups and small enterprises seeking expansion and development, is underway in EJADA.

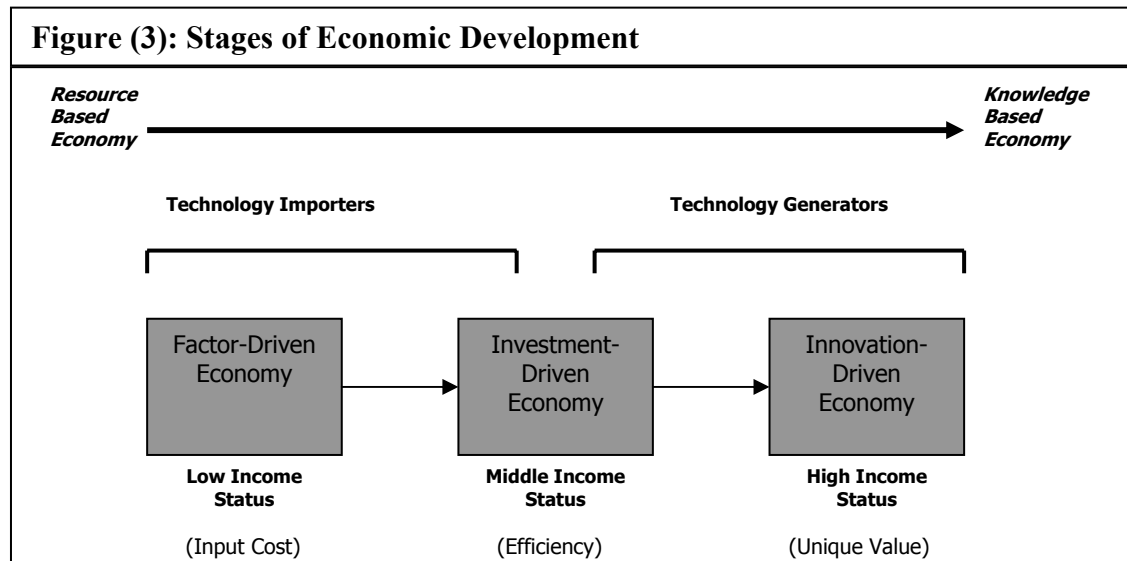
These are just a few efforts being undergone in the Jordanian economy aiming to fully capitalize on available R&D resources and simultaneously create and enhance an innovative environment for firms and individuals to operate in. This of course, is notwithstanding the conferences and seminars regularly held to increase awareness and strengthen the link between Jordanian universities and enterprises in the economy.

In conclusion, be that as it may, Jordan still lacks a clearly well-defined vision and adequate action plan to enhance the kind of research and innovation that is supportive of future prosperity and improved living standards.

Research and Innovation: A Futuristic Vision Led by an Effective Public Private Partnership

I. The Vision

Formulating a vision for Jordan will largely depend on understanding its stage of economic development, since countries face very different challenges and priorities depending importantly on their stage of economic and technological development as they move from resource-based to knowledge-based economies. The principal factors that contribute to the innovative capacity of the country will differ for economies at different levels of development.



Jordan is a developing nation with a low-income³ status classified as a non-core country (i.e. technology importer). As a low-income country, Jordan is still in the process of shifting from being a factor driven economy- where economic growth is determined primarily by the mobilization of primary factors of production (land, unskilled labor, and primary commodities)- to an investment driven economy. In this latter phase, efficiency in producing standard products and services becomes a dominant source of global competitiveness. The products and services produced become more sophisticated but technology and designs still largely come from abroad. Therefore, economic growth is increasingly achieved by harnessing global technologies accessed through licensing, joint ventures, foreign direct investment and imitation, to local production. Nations in this stage not only assimilate foreign technology, but they also develop the capacity to improve on it, whilst company spending on R&D becomes important. The national business environment supports investment in efficient infrastructure and modern production methods. Gradually, companies extend capabilities in the value chain.

In brief, the investment-driven stage depends on a high rate of investment in products, processes, and the acquisition of technology. Additionally, improving demand conditions are important to pressure improvements in producer quality, and full cluster development is needed to support higher levels of efficiency.

Based on the above, Jordan's proposed Research and Innovation Vision emerges from the development transitional status the Jordanian economy currently maintains. Subsequently, the vision should be:

"To build an effective national innovation system via public-private partnerships that reinforce Jordan's ability to acquire new and sophisticated technology through a strong and vibrant research and development community seeking the achievement of two broad goals - the advancement of knowledge and national economic prosperity"

³ According to the GCR, low-income countries are those countries with a GDP per capita at purchasing power parity, below US\$ 6,500. Jordan's GDP per capita at purchasing power parity for the year 2001 only amounted to US\$ 4,080.

functioning in an environment conducive to innovation, to attain a better quality of life for all".

II. Action Plan

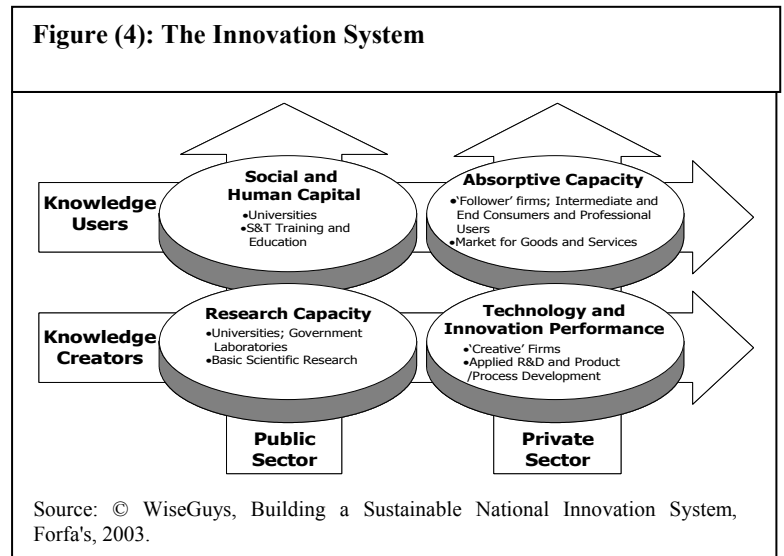
Achieving the above stated vision for Jordan requires the adoption of an initiative in the form of an action plan that highlights priorities or lines of action for all R&D stakeholders in the country. The plan should be guided by a strong and vibrant public-private partnership, as no amount of strategy, co-ordination or focus can succeed if corporate executives and government officials do not rise above the individual firm, university, association or organization and establish a selfless culture of R&D

leadership. Moreover, given the necessity to adopt an innovation system approach, the action plan should be able to provide solutions to a number of factors pertaining to science and technology needed to develop the innovative culture. These include:

- a. A strong research base achieved by means of long term investment in knowledge creation- mainly through public sector investment.
- b. Focused targeted strategic research investments in areas of wealth generation (such areas should be identified depending on needs, capacity and potential).
- c. Highly qualified human resources to power the knowledge economy- which is recognized internationally as becoming more important than physical and natural resources.
- d. Availability of national research facilities and infrastructure.
- e. Effective partnerships between the university, government and private sector communities.
- f. Regional, national and international networks with strong interconnections.
- g. A modern knowledge and information infrastructure.
- h. Appropriate and effective support mechanisms for innovative technology based firms, including financial support.
- i. A focus on technology transfer and entrepreneurship, with a variety of flexible tools and approaches to reduce the innovation gap.

Achieving the above will require policy solutions to restructure the scattered R&D investment activities of different sectors in the economy, advance the human capital capabilities in addition to strengthening the legislative environment conducive to innovation. Above all, it is vital to change the mindset of the society and foster the innovative culture through strong networks and collaboration efforts between the public and private sectors.

The Jordanian Innovation system strategy should emphasize the creation of partnerships between industry, government, and supporting laboratories and institutions to accelerate technology research, development and deployment, through



cooperation with the industry to jointly decide and implement the future direction of R&D in the country.

However, a public-private partnership at all levels; local, national and global, delivers many benefits, which should be important pillars in Jordan's innovation strategy. To begin with, it boosts private sector investment in R&D, reduces cost and risk, and provides access to ongoing R&D programs, expertise and facilities. It also involves the private sector in setting the national priorities. This effort increases the leverage achieved with the government R&D funds. All those involved in R&D will be contributing to Jordan's ability to create a more competitive economy in an increasingly competitive world. Hence, there should be an initiative for establishing an Innovation Forum with representatives from both the private and public sector, to draw the R&D roadmap and pool resources and expertise, share risks and costs, and enable the success of larger projects with public and private interests.

In addition, promoting the creation of R&D networks amongst the industry players, research institutions and universities by establishing systems for co-operation at the R&D stage and competition at the subsequent production stage, will result in a social welfare optimum. Policy decisions can resolve any obstacles that may hinder such constructive initiatives through the adoption of effective incentive systems, provision of subsidies and the subsequent protection of intellectual property rights.

Furthermore, linking all the innovation system stakeholders via modern communication and high speed broad band research networks, will allow researchers in government, universities and the private sector to rapidly access the world of innovation pool of information, resources and project partners.

Fostering the innovation culture is the main pillar for establishing the Jordanian innovation system. However, the human dimension of innovation is as important as the technological one. In other words, an effective innovation culture not only requires an ample supply of new technologies, and a legal, financial and regulatory environment which supports the development of new market players to exploit them. But also, Jordanian industries must have access to an adequate pool of entrepreneurial talent; personnel with advanced technical and managerial skills, a 'can-do' approach to problem-solving, and a willingness to take and cope with risks.

Box (5): EUREKA

EUREKA is a Europe-wide network promoting collaborative market-driven research and development (R&D) projects in most fields of advanced civilian technology. The network was created in 1985 and has attracted 29 full members

Objective:

EUREKA's objective is to help raise the productivity and competitiveness of European industries and economies. Together Europe's industries have the resources to match those of their competitors. However, unlike them, they are separated by language barriers and legal and cultural differences. The EUREKA initiative acts as an "enabling network", helping project participants to find partners to cooperate. The mechanism itself complements individual national R&D programmes and those of the European Commission.

EUREKA projects are market driven and "bottom-up", The partners themselves not only define the project content, time scale and costs, but also maintain control. They decide which partners are to be let into the project. The project participants keep the full Intellectual Property Rights of the developments created. Resources and expertise are pooled; risks and costs are shared, enabling larger projects to be established. EUREKA projects benefit from easier access to national funding.

Umbrellas:

Umbrellas are thematic networks within the EUREKA framework which focus on a specific technology area or business sector. The main goal of an umbrella is to facilitate the generation of EUREKA projects in its own target area. Umbrella activities are coordinated and implemented by a working group consisting of EUREKA representatives and industrial experts. The working group meets on a regular basis.

Criteria:

Participants may initiate or participate in any EUREKA projects. A project needs at least one other partner from another EUREKA member country to become endorsed as EUREKA project. Partners may also include major users providing project input or beta-site facilities, research institutes or universities. The R&D content of the project must concern development or application of innovative technologies within the EUREKA scope. The project must result in a marketable product, process or service and the partners must show that they have the resources to manage the project successfully.

The emergence and diffusion of new ideas, products and production techniques entails a continuous process of 'creative destruction'. Accelerating technological change places a premium on up-to-date technical skills in the labor market, and on the knowledge and attitudes necessary for high levels of participation and responsibility. The Action Plan for Innovation should stipulate the adjustment of course content and teaching methods at all levels of the educational system, in order to foster a culture of creative enterprise and innovation.

The central role of human factors should be clearly recognized in the Innovation Action Plan for Jordan. It should place the issue of 'Fostering an innovation culture' (i.e. addressing education and training measures, the mobility of scientific and technical personnel, and innovation management at company level) first; ahead of the other two key priorities of 'Creating an environment conducive to innovation' and 'Gearing research to innovation.'

A System of Innovation includes all the important factors in the surrounding environment that influence the development, diffusion and use of innovations. In this regard, Jordan should maintain Intellectual Property Rights legislation on a par with the World Trade Organization and NAFTA to provide a level playing field, globally, for R&D investments in Jordan. Furthermore, instruments to inform and help SMEs and universities in the event of disputes should be utilized. Additionally, the harmonization of legislations to take account of developments linked to the technologies of the information society, as well as supplement legislations on design protection and employees' inventions should be completed.

Moreover, in order to increase the accessibility of R&D funds, the government should streamline the administration of government support funding for research, especially to industry and academic stakeholders, improve the links between community research and risk capital particularly through the provision of information and guidance services for stakeholders and investors, make greater efforts to direct "patient" capital towards risk investment and improve tax incentives for R&D investment.

The Jordanian government should also bear the responsibility of establishing contacts with international research communities to increase accessibility to the pool of research and innovation funds and capabilities available abroad, thus help the private sector enhance its skills. In this regard, Jordan can negotiate an R&D agreement with the European Community to attain the same status as Israel, which is regarded as an associated country thereby enabling its researchers to fully participate in consortiums for different research activities and receive higher amounts of funds available in the Sixth Framework Program (see Annex (2)).

Gearing research to innovation will emerge primarily when firms realize the need to invest directly or indirectly in new knowledge, whether they wish to be industry leaders, or merely keep up. Inter-firm rivalry thus drives important elements of the innovation process. At the same time, the success with which firms participate in the innovation process has an important bearing on their competitiveness. Since Jordan is moving toward the investment driven economy, efforts should be directed towards

enhancing the ability of firms to acquire new knowledge and technological achievements.

This can be achieved by providing support to innovative firms through innovation tax credits and technology assistance to small and medium enterprises (SMEs). For example, an Industrial Research Assistance Program can be established to provide advice and limited yet targeted R&D funding to help small firms, which constitute the larger portion of the Jordanian economy, access and apply technology to improve their competitive position. Existing programs should be enhanced not only with greater funding but with new initiatives to provide complementary business advice and guidance and address the pre-commercialization stage in product development. Nonetheless, national R&D institutes and funds should play a key role in technology development, and be able to provide technology support services especially to SMEs, in order to increase their competitiveness in meeting the market needs.

In addition, attracting multinational corporations to invest in Jordan will help acquire new knowledge. Such firms are usually regarded as an important source for technology transfer, upgrading, and capacity building for research and development. Moreover, outsourcing and subcontracting can be utilized to facilitate the process of technology transfer as they help reduce the costs and risks involved, thus they eliminate the need for a country to acquire in one stroke comprehensive technological capabilities. The Jordanian government should also play a key role in fostering the development of industrial clusters at a regional level as a basis for creating a knowledge-based economy.

At the other end of the innovation spectrum- the development of innovative products and services- the Jordanian innovation system should be based on the establishment of core competences in key technology areas by adopting an initiative in the form of a National R&D project. This project should work as a catalyst in strengthening the country's R&D efforts. The creation of the Jordanian R&D niche will enable universities to assign researchers rather than instructors that act as disseminators of new ideas and applied research through research directed toward industry needs. Finally, a culture based on cooperation in R&D will be enhanced through solid sectoral and inter-sectoral technology platforms. Success in identifying and implementing the Jordanian R&D national project will help reverse the adverse effects of brain drain and attract Jordanian talent back to the country.

Annex (1)
Scientific Research and Vocational Training Fund

Annex (2)
The Sixth Framework Program