FINAL REPORT

Workshop On

THE ORGANIZATION, MANAGEMENT AND EVALUATION OF
APPLIED SCIENTIFIC & TECHNOLOGICAL RESEARCH
SYSTEMS IN ARAB UNIVERSITIES

Arabian Gulf University, Bahrain
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of Scientific Research and Transfer of Technology
(STEMARN)

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EXECUTIVE SUMMARY

The UNESCO Cairo Office (UCO) collaboratively organized with the Arabian Gulf University (AGU) in Bahrain a workshop on “The Organization, Management, and Evaluation of Applied Scientific and Technological Research Systems in Arab Universities”. This workshop, held on the premises of the AGU during the period between November 16 and 20, 1996, represents the last activity of the STEMARN Phase I Programme launched by the UCO in 1994 in response to a critical need for comprehensive training in R&D management.

The activity was offered at a top management level, where senior officials in charge of university research across the Arab world were invited. The attendees -from 15 Arab countries - totaled 42, representing the workshop participants, the STEMARN Supervisory Committee, and the workshop Organizing Committee. Three experts from Australia and Jordan moderated the workshop, in addition to a Keynote Address and 12 presentations on the different models for research management, organization, and evaluation prevailing in a number of Arab universities.

The workshop was carried out over 5 days and constituted 17 sessions. The plenary sessions featured 13 formal lectures, a panel discussion and interactive dialogues. In addition, the focal activity of the workshop centered around a case-study aimed at developing a research management plan for a hypothetical university (‘Futureland’) within a carefully defined socio-economic environment typical of many Arab States. For this exercise, small group syndicates were formed to seek various ways of resolving the management dilemmas posed by the case-study.

This final report presents a concise summary of the topics and issues that emerged throughout the workshop. It seeks to capture the essence of the issues confronting research managers in universities in the Arab region as universities worldwide adapt to changing roles and public expectations. In particular, it seeks to present some of the options and approaches emerging from the workshop that research managers in the Arab region might apply to the organization of research in the 21st Century.

It is hoped that the findings and lessons learned from this workshop will be further pursued to initiate more in-depth and comprehensive reviews, thereby inducing the aspired beneficial changes.
ACKNOWLEDGMENT

The workshop on the Organization, Management, and Evaluation of Applied Scientific and Technological Research Systems in Arab Universities constituted the last activity in Phase I of the STEMARN (Science and Technology Management Arab Regional Network) Programme launched by the UNESCO Cairo Office (UCO) in 1994. It was collaboratively organized with the Arabian Gulf University (AGU) in Bahrain. The workshop programme was developed by the UCO in collaboration with the STEMARN Supervisory Committee and the Workshop Organizing Committee. Additional input to the development of the programme was provided by the Centre for Research Policy, University of Wollongong, Australia.

The Arabian Gulf University, where the workshop was held for five days, provided all the logistical support to convene and offer this event. Special thanks are due to the AGU staff for their genuine efforts and hospitality.

The workshop was moderated by Drs. Tim Turpin, Heather Spence, the University of Wollongong Centre for Research Policy, and Subhi Qasem, the Office for Integrated Agricultural Development in Jordan. Further the summary and synthesis of topics and issues emerging throughout the workshop and presented in this report were prepared by Dr. Turpin. The valuable contributions of these distinguished experts are greatly appreciated.

Thanks are due to the Arab Fund For Economic and Social Development for being a full partner on the STEMARN Programme. The sustained support of this establishment was reaffirmed by the attendance of its representative, Dr. Badr Malallah, and his active participation in the deliberations of the Supervisory Committee meetings taking place during the course of the workshop.

Last but not least, the papers presented by the workshop participants and the lively discussions through each session have all contributed to the enrichment of this event.
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1. INTRODUCTION

Preamble

The social, industrial and economic environments in which universities have operated throughout the latter part of the 20th Century have changed dramatically. Substantial growth in university systems around the world have ushered in a competitive era where universities must now compete, in some cases quite fiercely, for both students and for institutional funding to carry out their core activities. Where previously universities had a comparatively secure and certain funding base for their teaching and research activities, they now operate in a far more uncertain environment. Further, funding sources, whether private or public, are now demanding far more accountability for their investments in higher education and research.

In many ways, universities have responded to their changing environments in much the same way as many other enterprises operating in other sectors. They have become more diverse in terms of the range of activities they offer, they have become more innovative and entrepreneurial in adapting their strengths and capabilities to prevailing market conditions, and they have become more international in their activities. University organizational structures, traditionally built around disciplinary based faculties, schools or departments are now often built more around programs, institutes or centers.

Rapid and extensive development in communication technology have increased the potential for university collaboration to occur almost instantaneously anywhere in the world. Further, universities have begun to mirror the internationalization of many enterprises in the industrial sector and begun to emerge, as ‘global enterprises’.

The imposition of these forces of change, however, have produced considerable challenges for the sustainable development of scientific research. On the one hand, fields of research, previously considered to be somewhat peripheral to the main activities and missions of universities, have now become deeply embedded in the core activities of universities. Yet, the other side of the coin is that some of the more basic fields of research activity have remained on ‘the endangered species’ list and become the focus of struggles to maintain laboratories and programs within imperfect university market economies.

In this context, universities, almost without exception, have been compelled to seek new, creative and effective ways of organizing, managing and evaluating research programs, practices and processes. Universities, however, are traditionally not well placed to confront the incursion of market forces into their worlds of research and education. Further, while there are clearly global trends that can be observed in the changing academic research world, there are also local socio-economic factors that demand quite unique university responses. As a result, there are few prescriptive models that can be applied to the complex task of managing university research policies and programs.

It is within the realm of the issues above, and placing focus on the specifics pertaining to the Arab Scene, that the vision for this workshop was conceived. It was basically designed to examine various models for organizing and managing university research systems in industrialized countries, as well as the newly industrializing economies and in the Arab context. A particular emphasis for the workshop was to explore the relationship between academic research systems...
and national policies for economic and social development. The November 1996 workshop, held on the premises of the Arabian Gulf University in Bahrain, represented the last activity in Phase I of the STEMARN Programme launched by the UNESCO Cairo Office (Regional Office for Science and Technology for the Arab States; ROSTAS) in 1994 in response to a critical need for comprehensive training in R&D management. Previous activities featured by the Programme include:


The STEMARN Programme has been implemented jointly by the UNESCO Cairo Office (UCO) and the Arabian Gulf University, and has been co-sponsored by the Arab Fund for Economic and Social Development in Kuwait. The Islamic Development Bank in Saudi Arabia provided travel grants for some of the participants taking part in the training activities of the Programme.

**Theme and Objectives**

The principal aim of the workshop was to strengthen the contribution of research at Arab Universities to social and economic development in the Arab countries. More specifically, the workshop aimed to upgrade and increase the efficiency and effectiveness of applied scientific research systems in Arab Universities with emphasis on changes that need to be instituted in the Arab region based on existing priorities, and building on the experiences drawn from successful models in North America, Europe and South East Asia as well as from the region. As such, the main objective of the workshop was two fold:

- To review the role, purpose and benefits of university research to society and development, to examine successful models for organizing and managing the various components of university research systems in industrial countries, newly industrialized countries as well as the Arab countries, emphasizing relationship to national policies, economic and social development as well as public and private institutions.

- To identify those essential organizational and managerial requirements and policies which could enable Arab universities to fulfill this research mission in the most cost effective manner. Special attention was paid to those generic elements that are valid worldwide as well as to the emerging new issues both internationally and regionally that will impact future role and successful management of research in Arab universities.

**Preparation and Organization**

The selection of the workshop topic and the managerial level of the participants were made by the STEMARN Supervisory Committee during its fourth meeting in December, 1995. Nominations for potential participants at the level of senior officials in charge of academic and technological research were solicited from a large number of Arab universities as well as from the UNESCO National Commissions in the region. Recommendations for prospective speakers and moderators were also sought from several concerned organizations and individuals. The
final list of participants and workshop moderators was finalized by the workshop Organizing Committee in June, 1996.

In total, 30 participants and 2 observers from 15 Arab countries (an all-time high for the STEMARN Programme) attended the workshop, in addition to the speakers. Present were also the members of the Supervisory Committee of the STEMARN Programme and the workshop Organizing Committee. Appendix A provides a categorized list of the attendees showing their names, affiliations and addresses.

The moderators and principal instructors for the workshop were Drs. Tim Turpin, Subhi Qasem, and Heather Spence. Tim Turpin is an Associate Professor and Director of the Centre for Research Policy, University of Wollongong, Australia, which is a national centre for investigating and reporting on key issues associated with the relationship between science, culture, industry, and government institutions and policies. Dr. Turpin has carried out during the past five years a wide range of national and international studies on managing the production and communication of scientific knowledge. Recent projects have included national studies into research links between industry and universities, and into developing indicators for assessing the impact of research for achieving sustainable development.

Subhi Qasem was trained in agricultural sciences in his native Jordan before continuing his scientific studies at Kansas State University and the University of Minnesota in the USA. Dr. Qasem joined the University of Jordan in 1965 where he progressed rapidly through the ranks to become the founding Dean of the Faculties of Science, Agriculture, and Graduate Studies. Dr. Qasem served his country as Minister of Agriculture in 1991 and then in 1992 established himself as a full-time consultant. His work in the area of S&T education and R&D has been carried out for numerous organizations. He is the author of a recent publication for UNESCO on S&T indicators in the Arab States.

Heather Spence is Research Fellow at the Centre for Research Policy, University of Wollongong, and is currently the Programme Manager for the Science and Technology Policy Asian Network (STEPAN) programme. Over the past 20 years, Dr. Spence has acquired a great deal of field experience in a number of countries throughout Asia, particularly Viet Nam, Malaysia, Thailand and China. She has had an extensive experience in the design and maintenance of information management systems and in programme management.

In addition to the moderators’ contributions, a Keynote Address was delivered by Prof. Osama El-Kholy, Emeritus Professor, Cairo University. Furthermore, case studies on research management, organization, and evaluation in Arab universities were presented by a number of participants.

Technical Programme

The workshop program was developed jointly by the UNESCO Cairo Office and the STEMARN Workshop Organizing Committee. Additional input to the development of the programme was provided by the Centre for Research Policy, University of Wollongong, Australia. Appendix B provides a detailed account of the workshop program.

The content of the workshop was focused around four core activities. Firstly, an international
perspective on contemporary university research management systems was introduced through invited papers and workshop discussion. The international perspective was provided through a series of papers and presentations by Drs. El-Kholy, Turpin, and Spence.

In his Keynote Address, Prof. El-Kholy set the context for future discussion. The message in his address, Changed Universities for a Changing World, was that universities are not only undergoing a major cultural change, but are becoming ‘big business’ requiring new modes of management. This observation was reinforced through most of the workshop proceedings that followed.

This overview of global change, in relation to universities, was followed with some descriptions of changing policies and practices for managing applied scientific research in various parts of the world. Four papers covering university research management experiences in South East Asia, Australia, North America and Europe were prepared by Dr. Turpin in collaboration with his colleagues from the United States, Canada, Thailand, Indonesia and Europe. These papers illustrated many of the common experiences of universities as they have responded to global socio-economic pressures. However, they also drew attention to the salience and relevance of local issues. In particular, they served to illustrate the wide variety of options through which governments, and universities have sought to adapt university research systems to solving what are often quite unique socio-economic problems.

The second core component of the workshop concerned the specific situation of universities in the Arab States. A regional perspective and discussion on university research management experiences was generated through invited presentations from participants from a range of different Arab States. Dr. Subhi Qasem provided a far reaching overview of research in the Arab universities. His presentation illustrated the depth to which global changes in universities have penetrated into the research activities throughout the Arab region. Unprecedented growth in higher education systems, unrelenting demands on universities to seek alternative forms of funding for scientific research and new expectations on accountability and performance are all appearing as common features in Arab universities. At this level, Dr. Qasem’s overview identified the extent to which many research management issues are truly international. His overview, however, also contained a warning not to assume thatinternational models will always solve local problems.

For example, as Qasem pointed out, funding allocations for R&D in terms of national levels of GDP in the Arab States has traditionally been well below international comparisons. Funding has traditionally been dominated by government allocations and research has not generally been viewed by staff as a high priority or indeed an activity that is particularly rewarding, either financially or socially. These sorts of structural features of various Arab research systems continued to direct discussions toward seeking appropriate options for managing these systems.

A series of presentations on the experiences of individual universities in the region continued this theme. These sessions provided an opportunity to discuss various local experiences in the context of the broader global perspectives that emerged from the international experiences. What became clear was that while there are indeed deep seated global changes occurring in university systems everywhere, these are not only intersecting with some uniquely Arab region issues, but they are also intersecting with issues that are quite specific and varied across different States in the region. In other words, while there is no ideal international model for managing applied

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scientific and technological research systems, neither is there likely to be an ‘ideal’ Arab model. The various presentations from Jordan, Bahrain, Kuwait, Saudi Arabia, Algeria, Tunisia, Egypt, Oman, Sudan, Syria and Lebanon clearly showed that while there may be some common features to management systems, they will need to be adaptable and flexible to deal with quite different and continually changing socio-economic contexts.

A third activity was developed around a case-study developed specially for the workshop. For this exercise, small group syndicates were formed to seek various ways of resolving the management dilemmas posed by the case-study. The case-study was developed by Dr. Subhi Qasem with some assistance from the international participants. Each syndicate group developed a research management plan for a hypothetical university (‘Futureland’) within a carefully defined socio-economic environment typical of many Arab States. The task, therefore, carried discussion toward a research system that was now common to all participants. Developing a management plan for Futureland provided an opportunity for all participants to focus on developing practical management option and processes in an environment that was to some extent removed from their own day-to-day experiences. These syndicate exercises provided the basis for the fourth workshop activity. This fourth activity was in the form of a reporting exercise that generated discussion for defining ‘critical issues’ and ‘mechanisms and priorities’ for future action. The conclusions reached through this syndicate exercise are included in Appendix C to this report.

The remainder of this report provides a summary and synthesis of the topics and issues that emerged throughout the workshop. It seeks to capture the essence of the issues confronting research managers in universities in the Arab region as universities worldwide adapt to changing roles and public expectations. In particular, it seeks to present some of the options and approaches emerging from the workshop that research managers in the Arab region might apply to the organization of research in the 21st Century.

Summary of Key Observations and Lessons Learned Through the Workshop

It is impossible to adequately summarize all of the issues and observations that were covered through the full five days of the Bahrain Workshop. However, there were some recurring themes that emerged through the discussion sessions and through the Syndicate Case-study Exercise. The following summary seeks to capture the essence of these.

Changing Systems

The papers and discussion throughout the workshop underscored two overriding important points. First, the research environment in which universities must operate through into the 21st Century has changed dramatically through the past two decades. There will be major constraints in terms of time and finances and very few universities will be in the position to conduct excellent research in all fields. Strategic decisions will need to be made in order to identify ‘niches of research excellence’. The research management process, therefore, cannot escape interaction with the changing expectations, values and perceptions within industry, and in the community generally, about what the university can or should offer.

A second overriding point that emerged was that research managers have little option but to seek to develop and nurture systems that are accessible to a wide range of community based clients. This broader base for research clientele also carries with it the need to become more accountable
and more ‘transparent’ in their strategic objectives. In short, it calls for increased relevance in the context of increased accountability.

**Balancing Traditional Expectations with New Demands**

Many of the participants emphasized the need to generate closer links between research and production. On the one hand, it was noted that universities must fulfill their mission to produce highly trained scholars, scientists, technicians and engineers. However, at the same time, the mission of universities is changing and there is a need to balance the traditional expectations and demands with new missions and new modes of organization.

**Organizational Structures for Knowledge Based Systems**

A consequence of the reorganization of science and knowledge production is that industry and university collaborative activities, previously rather peripheral to the main missions of universities, are now deeply embedded in the core of academic activities. The key issue, or potential point of tension, is therefore not so much tensions between the sometimes differing demands of basic or applied research, but more the status and management of the *industry/community interface*.

Consequently, it was resolved that options for managing applied scientific research activities should take into account the need to have a system wide and integrated approach to the universities diverse range of activities. An overwhelming observation throughout the workshop was that management initiatives for linking university and industry activities should not be considered as independent linking mechanisms, but rather more as necessary components for the development of *knowledge-based systems*. Such systems rely on the integration of appropriate technical training, advances in science and technology and marketing and business knowledge.

A major task for university managers in the future will be to recognize the need to provide a wide range of possible alternatives for supporting cooperative links with industrial enterprises. Financial incentives, project funding and cooperative institutional structures can all play an important part in developing knowledge systems.

**Long Term Planning**

The implication for management processes for applied research and community interface is that building trust and long-term cooperation between academic researchers and industrial or community enterprises must become a high priority. Evaluation criteria, for example, must ask more than: ‘did the research project deliver the technology or solve the problem? or ‘was the project cost effective?’ It must also ask: ‘did the project contribute toward a longer standing collaborative relationship between the university and industry?’

An important observation was that far reaching scientific and technological advances have been made from minimal input, but many have also demanded long term planning and financing. At the same time, many long term research programs have delivered little for their input. Difficult questions will always emerge as to when a project must, financially, be abandoned. Such decisions should ideally take into account a range of criteria - but irresistibly such decisions will need to be made. Yet it was generally accepted that the more clearly articulated were the grounds on which such decisions should be made, then the more certainty there would be for research project
and program managers in setting long term plans, milestones and self-evaluation. Ultimately
the resolution was that research systems needed flexibility in this financial management sphere.

**Research Centers and Matrix Based Organizational Models**

The emergence of new organizational forms, such as research centers in Arab Universities, are
producing organizational challenges for management processes. In some cases research centers
are able to provide a focal point for services to smaller enterprises. But these sorts of structures
are challenging the traditional ways of organizing research and teaching. Thus matrix based
research centers or institutes are can potentially disrupt traditional faculty based structures that
previously organized research. A task for management processes and systems of the future will
be to develop structures that adequately take into account and reward the diverse range of activities
which characterize the modern university.

**Recognition and Reward**

One of the recurring issues raised through the workshop sessions was expressed as the lack of
social recognition attached to academic research. For example, some participants lamented the
fact that research is not perceived as a rewarding activity except it relation to promotions. Many
research centers have been built almost solely around the reputation of key individuals. It was
resolved that one of the most important tasks for research management systems concerns how
to integrate - and maintain- the reputation of excellence ascribed to individuals into research
groups or centers.

**Local and Global Issues**

The workshop identified a number of common global features to the systems for managing
applied scientific and technological research. However, it also identified the importance of
some quite divergent local issues. So, there is unlikely to be an ideal universal model for the
management of applied scientific research. It will depend very much on the local culture and
local conditions.

**Regional Forums**

The workshop resolved that exploring various case studies does provide a valuable way to explore
and understand organizational change in Universities. It was noted that they provide insights
into the different expectations of various stakeholders involved in regional knowledge based
systems of innovation and learning.

Following this observation, it was also noted that regional based forums such as the present
workshop have the potential to identify those issues that are unique to some countries, those that
have particular regional characteristics, and those that are part of broader global trends.
2. THE CHANGING ROLE OF UNIVERSITIES IN THE 21\textsuperscript{ST} CENTURY

Although the social contexts throughout the economies of the world are politically, industrially and culturally different, there are similar patterns that can be observed concerning the reorganization of university research systems. Environmental pressures have intervened and are disrupting the structures that previously organized academic research. In these changed environments, academic research is becoming connected to industrial activities in quite new and different ways.

A common feature across most environments is that a significant and far reaching change in the organizational cultures of universities is taking place. Industry, business and service activities that were previously rather peripheral to the main missions of universities are becoming deeply embedded in the core of academic activities. Universities are no longer simply the providers of specialized knowledge through research and education. Rather, they are becoming core components in complex knowledge networks. This situation demands new and creative ways to manage the cultural change within universities.

There are five major areas of change that have had a deep influence on the reorganization of academic research. These are: the growth in university systems; the decline of the centralized laboratory; the ascendancy of small and medium sized enterprises in using advanced technologies; changing patterns of government funding; and new and emerging academic research structures. Together, these factors are contributing toward a deep-seated change in the way universities define, plan, perform and evaluate their academic activities.

Growth in University Systems

Growth in higher education during the 1980s is perhaps the most noticeable feature of change during the past decade. In the international literature, this has often been referred to as the massification of higher education.\textsuperscript{2} In the Arab States, higher education student numbers have more than trebled during the past two decades and over a third of Arab universities are less than 15 years old. In Australia, the overall size of the system expanded from 19 universities in 1987 to 38 universities in 1996.

Even more pronounced is the growth rate of higher education in the newly industrializing economies (NEIs) of the Asia Pacific region. Through the 1980s Thailand’s economy grew at double digit growth rates for several years. Over the period 1985-1994 the economy recorded the highest growth of GNP per capita in the world (8.2%). The growth coincided with a transformation of the economy toward manufacturing and a growing shortage of infrastructure and human resources. In this context, the development of research systems has been characterized by mismatches in S&T human resource capabilities, low levels of R&D investment and growing, but still insufficient information technology system. University and industry linkages have been targeted by universities and governments as a key strategy for overcoming these problems. In particular, they are seen as a means for accelerating and deepening the growth of S&T capabilities.

by enhancing the relevance of courses; supporting the more efficient use of resources; increasing
the supply of technical services and supporting mutually beneficial cooperative research and
technology transfer endeavors.

A feature of the growth, however, is the disproportionate growth in some fields of study. In
Australia, among the highest growth areas are fields associated with industry professions, such
as business, nursing, and engineering. Between 1982 and 1992, for example, annual student
enrollments in business in Australian universities increased from 59.5 thousand to 117.1 thousand,
an increase of 97%; engineering enrollments increased from 26 thousand to 43.6 thousand students
(an increase of 68%), and nursing enrollments increased from 2.7 thousand to 34.4 thousand.
Humanities and the social sciences have also shown significant growth, while the physical,
agricultural and medical sciences have grown at a far more modest rate. These features are
common to the pattern of university enrollments in many other countries.

While these figures to some extent illustrate general growth in the system, they also show that
the most significant growth has been in areas where industry has a specific interest in the nature
of the courses being offered. These data reflect a generally more vocationally oriented university
system. They also reflect a trend toward more structured cooperative relationships between
universities and industry and efforts to drive university research systems toward more applied
research and national socio-economic objectives.

The Decline of Centralized Laboratories

One of the ‘disorganizing’ factors in research environments through the past decade has been
the general shift away from the centralized laboratory, in large corporations, toward smaller
research units with flexible and adaptable research alliances. Among different cultural and
political systems the idea of the centralized laboratory, strategically managed by long-term
Corporate strategies, appears to be giving way to more fragmented approaches to R&D investment
involving complex arrangements of devolved alliances and networked activity.

In the United States, for example, there has been a trend through the past decade toward the
devolution of R&D strategic management to business divisions. Surveys carried out recently
have revealed that approximately half of all major firms expected to increase their participation
in various forms of alliance or joint ventures. In Australia, almost half of industrial R&D active
enterprises are investing R&D funds with external organizations and in Japan a recent survey
indicated that over 60% of major firms expected to be ‘highly dependent’ on external technology
sources.

This has had enormous implications for university research systems because in many countries
the ‘outsourced’ research is now carried out in applied research laboratories. Carrying out applied
research activities on a commercial basis for industrial clients has become a key activity of
universities around the world. In some cases, industrial funded research activities are carried
out by commercial companies owned and managed by universities and in some cases such research
is carried out directly by academic departments or faculties. The structures vary, but the trend
toward increased shares of industry funding in the overall research efforts of universities is
pervasive and unlikely to change in the foreseeable future.
Science and Smaller Enterprises

Another disorganizing factor in the research environment has been the ascendancy of small and medium sized enterprises (SMEs) within national research systems. Some countries have developed policy initiatives specifically intended to link SMEs to science and technology capabilities. Chinese Taipei, for example, has responded to development challenges by establishing an Industrial Technology Research Institute to support the growth of small firms with a lack of internal R&D capacity. In Indonesia, small scale industry has been prioritized for government support. In Australia, the emergence of cooperative research centers has encouraged the formation of research alliances between SMEs and larger industrial enterprises and research institutions.

The increased growth across the economies in the Asia-Pacific region together with increased access to scientific resources has enabled many SMEs to move beyond their traditional commercial or production base as local ‘suppliers’ to become successful enterprises in national and regional economies. Their success has placed them in direct competition with large companies for scientific, technological and human resources. The secret to their success, in many cases, has been their capacity to build strategic alliances, rather than monopolize big science.

Increasingly, small firms are demonstrating the capacity to innovate and generate leading edge technological capabilities. SMEs in the Taiwan economy grew fast during the 1970s and it was only after this period that they were able to compete successfully with the larger firms. A recent study has shown that these smaller firms were able to advance during the 70s because they were equipped with a more flexible set of technologies, and were more adaptive to the external environment than their larger counterparts.

Similar observations can be made in Australia. A recent innovation survey found that the larger the firm, the more likely it was to engage in innovative activities, but the nature of innovation was more dynamic among the smaller firms. The survey showed that the pace of innovation among small firms was faster and less capital investment. For small firms (less than 20 employees), the median time to reach commercialization was 6-12 months, whereas for firms with over 100 employees, the median time was one to two years. The median cost for small firms was lower, $10-50,000, compared to over $100,000 per innovation activity for large firms.

In China, the dominance of large state owned enterprises in the industrial environment is now being challenged by a rapidly growing private sector, in particular by the phenomenal growth of township/village enterprises (TVEs). More than half of China’s economic output is currently being produced by these enterprises. With an annual growth rate of over 30% over the past 10 years, they comprise the fastest growing sector in China’s economy (Research Centre for Rural Economics, 1995). As these smaller independent enterprises turn to science for competitive advantage, they are introducing new options, and new imperatives, not only into collective relationships with industrial partners, but also into R&D relationships with research institutes, universities and government agencies.

This trend also has major implications for applied university research systems. No longer can ‘big science’ (supported by a small number of large corporations) provide the core funding for single large scale research programs. In applied research terms, the ‘clientele’ is widely dispersed.
It is the universities now that have to develop the critical mass of research capability. The pressure is on them rather than the commercial enterprises to build applied scientific and technological capabilities of a strength and standard that will attract the support of many enterprises within a particular industrial niche.

The Changing Role of Governments in University Research Systems

With increases in the size of university systems and increased competition for government funding to support research, the result has been that universities and academics have been pressed to look beyond governments for funding to support their research programs. The effect has been to push academic research into increasingly competitive economic markets.

In the increasingly competitive market, it is not so much that government has withdrawn from supporting the university research system, but that it has changed its role in the way it supports research. In many cases, it has done this by strengthening the role of the agencies that intervene between the state and academic researchers.

In Australia, for example, nearly 40% of the funding for all academic research now comes from sources other than university recurrent grants. But much of this funding is still public money; distributed competitively through separate funding agencies. These new intermediary layers in the research funding process are playing a formative role in the emerging industry - university collaborative structures. They carry their own imperatives for steering research and these are not necessarily aligned with the research priorities of individual departments or universities.

These changes are not just country specific. The Chinese government has also retreated from directly steering academic research. The gap has been filled by industry with the market becoming the dominant force. A recent survey in China has shown that industry is now taking a more active role in initiating university collaboration. Similar events are occurring in Indonesia.

Meanwhile, in Canada, the structure of the local economy has also changed dramatically. As a result of global pressures, there is a growing awareness among university administrators, industry managers and government policy advisers that it is the status and management of the university/industry interface that will be a critical factor in adjusting to the demands of the 21st Century.

Not surprisingly, as universities are driven toward becoming more competitive, in the context of tightly stretched public funding resources, the local environment within which they operate provides a key for transforming their activities into longer term strategic plans. The Universities of Saskatoon and Saskatchewan in Canada, provide interesting examples of how universities can perform a critical role as partners in knowledge networks for industrial and economic development. The important factor in such networks is not so much the academic status of science or industrial development but the management systems for linking applied research capabilities to local development opportunities.

In the US, research priorities, have been articulated in terms of national goals for at least the last two decades. More recently, the policy emphasis is on the development of management practices to link programs to the national goals. Again, this is a similar trend where the role of government in supporting academic research has shifted away from directly supporting science and shifted more toward creating collaborative environments. In the 1990s the emphasis is less on the
development of lists of ‘critical technologies’ and more on the mechanisms to coordinate the development of national policy. One aspect of this is the recent attempts from within the NSF to broaden the science peer review system to include industry based peers involved in the application of research outcomes.” Again, it is the interface between industry and universities that is receiving this organizational attention.

The UK experiences reflect the policy difficulties of maintaining a strong fundamental science base and at the same time linking this base to planned socio-economic outcomes. The UK Technology Foresight Program (TFP), for example, was built around assumptions that panels of experts can provide the steering device to integrate the science base with national objectives. The composition of the foresight panels include representatives from industry and universities and a small representation from other sectors.\(^3\)

In the Netherlands, the emergence of pressures to make basic research more ‘strategic’ gained momentum during the 1970s. These pressures were partly a response to economic demands for cuts in certain areas of research and national pressures to be a part of the ‘technology race’. Thus, the 1980s and beyond have been characterized by policies directed toward increased selectivity and concentration in research funding and toward increasing the commercial or technology transfer activities of universities.

The Netherlands, in common with many other countries, experienced an increase in the emergence of horizontal links between basic research and industry/other socio-economic agencies. Again, in common with many other countries, the Netherlands situation is characterized by a retreat by the State in its role of directly setting the directions of science and making executive decisions. The vacuum left by the State’s withdrawal is becoming filled by government supported programs that involve also major contributions by industrial firms.\(^5\)

**New Academic Research Structures**

One of the fastest growing academic structures during the past decade, in many countries, has been the university Research Centre. In Australia, there was a dramatic rise through the 1980s in the number of research centers in the university system. In some cases their development was promoted through government research policies seeking greater research concentration. In other cases, their development was influenced by the various market opportunities and research niches emerging through greater business investments in R&D.

These experiences are not unique to Australia but are part of a global trend toward new forms of academic structure. In the US, the research center has been described recently as the fastest growing academic unit in American universities. These sorts of centers provide a structure that is neither dominated entirely by university administration nor by outside commercial or government interests. Rather, they rest somewhere between the two. Centers carry the potential to draw academic staff and postgraduate students away from traditional departmental structures.

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\(^5\) Ibid.
and funding arrangements, leading to further concentrations in research areas further removed from undergraduate teaching. In at least two Australian universities, all research and all postgraduate research activities are required to be channeled through centers. As these transformations deepen, universities may need to become accustomed to a more matrix-orientated structure, in which academic staff will continue to teach their disciplinary-defined modules and carry out their scholarly and research functions in ‘research entities’ that cut across their faculty and departmental structure.

While research centers have been transcending and challenging traditional departmental and faculty structures, they are also transcending the disciplines themselves. A recent Australian study of 600 industrial enterprises in Australia showed that the fields of research identified by industry respondents as their ‘most important field’ were applied sciences, information sciences, and engineering. In each of these fields, six or more additional fields were identified as also being important. This is not a surprising finding from industrial enterprises, but what is interesting is that these same patterns of cross-disciplinary input are being transferred into academic settings. Thus, the boundaries between scientific fields within universities are no longer as clear cut as they once were.

In the US, the economy’s dependence on technology, and higher education generally, has been a major factor in raising policy concerns about promoting closer links between industries and universities. The higher education system in the US is also vast, and like the economy, has considerable influence in higher education in other parts of the world. Both sectors are more decentralized and more autonomous than the systems elsewhere so the market forces that steer cooperative arrangements are often very much to do with quite local conditions.

In the immediate post-W.W.II era, industry support for academic research was considerably weakened. This was partly because of the push toward ‘big science’ at the time and a high concentration on defense-related research. More recently, US science policy decisions have been based on the recognition that an ability to carry out incremental innovation in parallel with competitors rather than through ‘big bangs’ or breakthroughs are the key to achieving a sustainable innovation climate. As a senior US commentator noted recently, ‘It is much more difficult to benefit from legal monopoly protection, where incremental innovation of complex technologies are involved.’ The message there is clear; strategic alliances in the whole process of innovation, rather than in segments of the process, is driving universities and industry into closer strategic relationships.

It is, therefore, not surprising to note that cooperation between industry and universities during the past two decades has increased considerably. What is particularly interesting is that there are two dimensions to the cooperative process. On the one hand, there is a powerful global imperative for industry and universities to cooperate across a whole range of activities including basic and applied research, providing general and specialized higher education degrees, and across a wide range of consulting and service activities. Yet, at the same time, such cooperative activities have a strong local component. Ultimately, it is the capacity of the cooperative partners to capture

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6 Ibid
and integrate global science and industry advances and adapt them to their local environment that is so important.
3. MANAGING UNIVERSITY RESEARCH LINKS

Structures for Managing the University-Industry Interface

There is now strong international evidence that transfers between academic research and private enterprise commercialization of research are led by the movement of people and the establishment of broad-ranging personal networks. The links that can be observed in case studies from around the region reflect this pattern of ‘informal’ cooperation. But, at the same, time there is evidence that more formal cooperative arrangements are emerging that link together both university and industry organizational structures. These more formal linking mechanisms are not replacing informal cooperative arrangements, but are rather inter-related and to some extent dependent on them. The trend toward this duality in research management systems is evident across a wide range of countries. The actual management processes and practices, however, vary according to different local conditions. Industry structure, national development strategies and priorities, local scientific and financial resource capabilities, all very much affect the local situation.

Some case studies serve to illustrate the point. Since 1990, the Cooperative Research Centre (CRC) Program has become the dominant vehicle of linking university research to industry and other users, and of creating a context of application and commercialization within which top research is to be conducted. The essence of the CRC is that it must involve participants drawn from the universities, government research agencies and industry, or other users. Yet even in the same national environment, management practices across centers varies immensely.

The concept underlying the CRC program in Australia was:

- to create a system of world-class applications-oriented research centers by linking together outstanding research groups from the public and private sectors;
- to enable each participating group to retain its separate institutional affiliation, but each Centre to constitute a collaborative integrated research team;
- to focus the research on challenging research fields and areas which underpin existing or emerging industry sectors;
- to co-locate the groups participating in each Centre, wherever possible, to promote effective cooperation and to enable expensive facilities to be used efficiently and without unnecessary duplication;
- to locate the Centers on, or adjacent to, University campuses wherever possible, so as to encourage precinct development around Universities and enable the Centers to contribute as fully as possible to the strengthening of educational programs;
- to involve research users in the planning and operation of each Centre so as to enhance the effective utilization of the research results; and
to ensure that each Centre was led by a Director who would be an experienced and highly regarded researcher with appropriate management skills.\(^8\)

Management styles, processes and structures adopted in these centers relate directly to the way in which centers have responded to the immediate environment and their entry points into the innovation cycle. It is still too early to ascertain if these styles of management are evolving merely as adjuncts to the existing Australian research system or if they represent radically new ways of conducting research. Organizational management styles and decision making processes now evolving are interlocking in response to particular phases of innovation undertaken within each center. Irrespective of the institutional backgrounds of partners, the steering mechanism for organizational management processes chosen is determined by the vision of the Chief Executives in centers. As the various structures evolve, it will be interesting to learn how they safeguard against carving research, education and commercial development activities into separate niches.

So far it is possible to distinguish three types of management practices in cooperative research centers in the Australian context: Corporate; Research and Integrated. Each of these types are uniquely focused on differing service and content orientation. An analysis of the 34 established cooperative research centers in the Australian study indicates that management styles are predominantly of the ‘research’ type followed by ‘integrated’ and ‘corporate’ types. At this stage, a range of viable approaches is evolving based on flexible management concepts and the vertical integration of research, education and commercial development activities. The decision making processes adopted in these organizational models follow a combination of ‘executive’, ‘consensus’ and ‘authoritative’ styles. According to the study, the ‘integrated’ organizational model shows a strong consensus-based decision making process. In collaborative research, decision making styles were found to be linked with the organizational management models adopted and the phase of innovation in which centers are already actively engaged.\(^9\)

The task for university managers is to recognize the need to provide a wide range of possible alternatives for supporting cooperative links with industrial enterprises. A variety of linking mechanisms are needed to respond to the different demands of different industries and size of firm.

**Promoting University Applied Research-Links**

A recent study in the Philippines has sought to identify, from the point of view of universities and industry representaties, what they perceive to be the most important mechanisms for managing research cooperative structures. From the industry perspective, research centers recorded a very high priority for the issue of promoting industry-university linkages. On the other hand, administrative arrangements such as Manufacturing Linkage Offices, Science and Technology parks or Industrial Research Institutes were identified as the most important

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mechanisms for strengthening linkages. Thus, the more informal groups appear to be promoting or leading the formation of links but administrative structures provide the infrastructure. This is a familiar pattern across many other countries.

Case studies from across the Asia-Pacific region suggest that successful companies, as well as many universities and research institutions, are embracing alternatives to strategic management with alliances emerging as a central strategy in achieving competitive advantage. While these alliances are, in some cases, located in quite tightly structured forms such as university joint ventures or other such similar arrangements with industrial partners, they are often also emerging as loosely knit organizational networks largely unbound from their university and industrial antecedents. They, are, or at least are becoming, new organizations with their own ‘culture’ and expectations.

In the Australian context, with the growing pressure on government funding and a considerable fascination in the potential of high technology-based industries and businesses, universities have turned primarily to two mechanisms to generate new streams of revenue. The first of these, designed to promote linkages with industry and commercial returns, was the science or technology park. A number of universities, with the support of their State Governments, have provided infrastructure for S or T parks, and related property developments. Through this sort of infrastructure, university researchers are exposed directly to the requirements of industry and equally, industry is exposed to the S&T capabilities of university researchers. The experience, however, has been fairly sobering: it takes a quite considerable time, and never less than seven years, for such a park to become effectively established and operating solvently in Australia.

The second approach has been through the formation of a university company or commercial arm, which proliferated in the early 1980s. These were generally given the tasks of managing university-industry links, promoting commercialization of research, managing intellectual property, and providing support for spin-off companies. These enterprises intervene directly between academic researchers and the commercial world towards which an increasing proportion of the university research is directed. In Australia, there are over 100 such enterprises owned and operated by less than 40 universities.

**Reorganizing Academic Research**

It is now clear that technology is complex and multi-dimensional. Not only is more than one scientific ‘discipline’ involved in problem solutions, but so too are different kinds of knowledge, both codified and tacit. For example, these may concern production or market parameters, or knowing how to connect ideas from other fields and discourses, and so on. Collaboration provides an important and necessary stimulus to technological and organizational learning. Industrial firms are increasing their investment in academic R&D in the US, Germany and Japan, and the number of scientific and engineering papers co-authored by industry and academic contributors has grown significantly.

Many support the view that these developments indicate a dramatic shift in the role of academia in innovation, and that a new model for innovation may be emerging that breaks down institutional

barriers and opens up new ways of transferring science and technology.” The difficult task for university research management is to develop structures and management processes that overcome constraints and provide opportunities to link their applied science capabilities to various forms of socio-economic development.

A recent Thai study concerning modes of industry and university interactions has shown that research systems in that country face a number of ‘inherent’ constraints. These were defined as:

- ingrained attitudes and skepticism from both sides (a significant ‘credibility gap’);
- bureaucratic regulations and attitudes that continue to influence the university sector in a number of areas;
- continuing tendencies for academics to pursue private sector work through personal contracts;
- weaknesses in the intellectual property rights system;
- lack of adequate channels for communication; and
- the existence of goals that are unrealistic and not achievable at this time.\(^\text{12}\)

Interestingly, these issues are not unique to universities in the newly industrializing countries. The modes of response, however, vary according to different economic, industrial and social environments.

A consequence of the reorganization of science and knowledge production is that industry and university collaborative activities, previously rather peripheral to the main missions of universities, are now deeply embedded in the core of academic activities. By tracing the development of applied research systems in some countries, it is possible to identify three distinct phases in this process.

Phase one is largely individualistic, and driven by the objectives of individual researchers. It is shaped by their network of industry contacts. Business activities associated with research across the two sectors rested very much with entrepreneurial flair of those involved directly with the research process.

Phase two is characterized by the trend toward the formation of commercial arms. Commercial arms, established by universities to manage and promote links with industry, were largely formed to obtain commercial return on intellectual property. They largely provided centralized broker service and were at arms length to mainstream university activities. Across many institutions going through this phase, it is possible to identify sources of tension around how, and to what extent business related activities should be linked to the main academic mission of the university.

More recently a third phase can be detected. This is where planning and management procedures and relationships are negotiated more centrally within the structures of the university. The operations, however, are decentralized to faculty or school level or the research center; even right down to the level of the individual.

\(^{11}\) Gibbons et al, op cit.

A feature of this phase is that there has been an integration of three different modes of industry and university collaboration. Teaching, research and consultancy activities are now more closely integrated in practice. Training centers also engage in research. Research centers also run specialized training programs and science parks and commercial arms of universities engage in consulting activities, teaching and support major research facilities. In other words, the boundaries between teaching, research and the commercial application of applied research outcomes are far less distinct than they were just a decade ago.

What then are the new demands on universities and how might they be expected to respond in the future?

Three mechanisms for managing applied scientific research and technological cooperation between universities and industry stand out. Firstly, there are links that have been developed through contractual arrangements between industrial enterprises and academic institutions or individual academics. Second, there are links that are built around contracts or grants supported through government programs or other intermediary funding agencies. Third, there are linking mechanisms that create new organizational forms involving both sectors as cooperative partners such as in joint ventures or cooperative centers.

With each mechanism, links are maintained at two levels: on one level they are maintained through individual and generally unstructured relationships; and at another, they are maintained through formal institutional contractual agreements or management plans. The outstanding observation is that these should not be considered as independent linking mechanisms, but rather more as necessary components for the development of knowledge-based systems. Such systems rely on the integration of appropriate technical training, advances in science and technology and marketing and business knowledge.

The Asia-Pacific region is culturally, politically, industrially and economically diverse. Different forms of university and industry links are therefore evolving in different contexts. However, through the process, there are some underlying patterns emerging. This evolution has affected the ways that universities manage industry relationships, which are now seen as part of the ‘core business’ of the university.

Case-studies through the region emphasize the importance of developing balanced inter-relationship between project-based funding and longer term funding programs that underpin a concentration of expertise and facilities. In some cases this occurred through a combination of center-based funding and contract money attracted directly from industry, or through a combination of industry and government funding. This ‘centralized’ focus is often described by industry respondents as ‘desirable’ because it simplifies their scanning and planning activities. For the universities, however, multi-disciplinary centers or institutes are providing significant administrative challenges.

The present review of university experiences in various countries reflects the intricate nature of research and educational links and the complexity of alliances that support them. Industry-university research links are interwoven within a wide complex of links that connect different firms and different universities to the knowledge-generation and innovation process.

The task for university managers is to recognize the need to provide a wide range of possible
alternatives for supporting cooperative links with industrial enterprises. Financial incentives, project funding and cooperative institutional structures can all play an important part in developing knowledge systems. They can also support the information exchange which may assist in initiating links. Further, a variety of linking mechanisms are needed to respond to the different demands of different industries and size of firm.

Training, research and development and other consultancy services should no longer be considered and monitored as separate activities: they need to be managed as integrated components of knowledge systems. It follows therefore that there is a growing need to develop information systems to monitor and respond to the growing needs of university/industry knowledge systems. The very rapid uptake of the ‘World Wide Web’ by industry and universities in Australia is an example of this trend.

Arab Regional Issues

The international experiences and the issues confronting universities generally are also reflected in the experiences of research managers in the Arab region. Papers presented at the workshop by Professor El-Kholy and Dr. Subhi Qasem, while acknowledging much of the global nature of changes in Arab research systems, introduced many quite specific local issues for the management of applied scientific research.

Professor El-Kholy, for example, noted that the pressure on governments to reduce public spending has increased the pace of privatization among many Arab universities. Dr. Qasem noted that while Arab universities, like their counterparts in many other countries, are coping with continuing increases in student numbers, funding and staffing capabilities are under considerable pressure to keep pace with the present level of growth. Thus, there are conflicting pressures: those that on one hand promote growth but at the same time there are those that inhibit growth.

Student numbers have increased rapidly: from 884,000 in 1975 to over 2.5 million in 1995 in 152 institutions. The growth, however, has not been even across all fields of study and as Qasem has pointed out elsewhere, the spectrum of growth has been toward homogeneity in the basic sciences, engineering and agriculture rather than diversity. The implication for research is that in some areas there is intense competition, whereas in others, there is comparatively little activity. Teaching consumes more than 95% of the resources of the vast majority of universities. Full-time academic staff numbers grew in the region by around 10% per year between 1985-92. Research academic staff grew at a substantially lower rate (4%).

Research in the Arab States is highly concentrated in government supported research institutes. This is in direct contrast to countries such as Japan, Germany or the United States (see Table 1). Of the research that takes place in universities, only a small portion is funded by industry (see Table 2). One of the major issues for the further development of applied scientific research is, therefore, to change this structure. Some economies, such as Australia, have confronted a similar issue with some success. In Australia, for example, a range of government incentives have been introduced through the past decade with the intention of promoting research expenditure in the private sector. Although it is difficult to evaluate the specific contributions of such schemes, the

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result has been that private R&D expenditure has increased considerably and a large part of the increase has been expenditure directed through universities.

Table 1: Proportional Share of Total R&D Expenditure for Arab States Compared to Selected Other Countries: 1992

<table>
<thead>
<tr>
<th>Country</th>
<th>Industry</th>
<th>University</th>
<th>Research Institute</th>
<th>Non-profit Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>72</td>
<td>16</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Germany</td>
<td>70</td>
<td>14</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>69</td>
<td>17</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Israel</td>
<td>47</td>
<td>33</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Turkey</td>
<td>21</td>
<td>69</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Arab States</td>
<td>1</td>
<td>30</td>
<td>69</td>
<td></td>
</tr>
</tbody>
</table>

Source: S. Qasem, 1996

Table 2: Proportion of University Research Funding by Sources of Funds

<table>
<thead>
<tr>
<th>Country</th>
<th>Univ. Budget</th>
<th>Govt.</th>
<th>Industry</th>
<th>Non-profit</th>
<th>International</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>63</td>
<td>29</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Israel</td>
<td>30</td>
<td>39</td>
<td>6</td>
<td>6</td>
<td>18</td>
<td>100</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>20</td>
<td>65</td>
<td>7</td>
<td>8</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Arab States</td>
<td>90</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

Source: S. Qasem, 1996

A notable feature of Arab universities is that they are, by international standards, young institutions. Over a third of all Arab universities are less than 15 years old and almost one half of the colleges within the universities were established during the past eight years. The institutional cultures are still at early stages of development and many institutions have yet to develop a research culture.

Most research in the Arab States is carried out in government institutions or universities (30% universities and 69% institutes). Further, academic research tends to be concentrated within a small number of universities. Only 30-35% of all universities in the region are substantial

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research universities. In the Arab Region, 80% of funds are spent in about 20% of the total number of institutions. This level of concentration is, however, not unusual by world standards. In the USA, 81% of total R&D funds are concentrated in the top 100 universities (15% of all universities). In Australia, 70% of the total R&D funds are spent in the top 9 institutions (25% of all institutions).

The growth of SMEs is also a feature of most Arab economies, not only in producing new products, but also as a source of knowledge. Thus, strategic alliances with smaller enterprises are increasingly important. However, building research links with smaller enterprises requires a rather different set of strategies than do links with large enterprises. For example, the research needs of small firms are more diffuse and less clearly articulated; their capacity to make major investments in research is limited and it is often difficult for them to engage in long term strategic planning.

A pressing organizational issue therefore revolves around the structure of research units. The academic department is the most common structural organizational unit for teaching. Research, however, is organized within a wide variety of forms, but predominantly around staff research projects, research programs or research centers. According to 1992 data, of all research carried out in Arab State universities, 14% was carried out in research centers. In 1992, there were 41 research centers in 150 universities.

Research centers provide a structural base for the development of interdisciplinary activities. However, some universities, for example the King Fahd University of Petroleum and Minerals, are developing programs and divisions for research based on a matrix structure. In these arrangements, multi-disciplinary teams are brought together for specific projects. After completing projects, the teams are disbanded and reformed around new projects or research problems. These sorts of models are emerging in many other countries around the world. The structural response is remarkably similar. This is not surprizing given the pervasive nature of international research environments. What is different is the different mix of disciplines and industrial strategies that make up the various matrix approaches.

The emergence of these organizational forms are not without their organizational difficulties. Arab Universities, like their counterparts elsewhere, are experiencing similar structural difficulties in managing these new and challenging structures. In some cases, research centers are able to provide a focal point for services to smaller enterprises. But these sorts of structures are challenging the traditional ways of organizing research and teaching. Contract appointments and consulting contracts are used by staff to supplement incomes. Thus, matrix based research centers or institutes are challenging the traditional faculty based structures that previously organized research and today continue to dominate teaching activities.

Perceptions about Research

One of the recurring issues raised through the workshop sessions was expressed as the lack of social recognition attached to academic research. For example, some participants lamented the fact that research is not perceived as a rewarding activity except its relation to promotions.

15 Ibid p. 6.

Dr. Qasem’s paper referred to a recent study during the late 1980s that revealed that research declined substantially, the longer the period of academic appointment. This study showed that research was at its highest ebb shortly after graduation, but after 8-10 years, publication output dropped off dramatically.

Discussion on this issue suggested that there were two forces at work: firstly social perceptions about the value of research, and secondly, teaching and administrative pressures that left little time available for research.

It was generally agreed that the competitive environment for research funding required academic staff to seek external sources for funding research activities. But, unless new incentives emerge to promote such activity, it is increasingly likely that few universities will be able to improve their overall research output. As some participants put it: ‘new rules are needed to provide incentives for staff to carry out research for outside consultants’. Incentives, as well as structural cooperative instruments, will increase the efficiency and widen the scope of the complementarities which may be constructed.17

This issue was explored in some depth Syndicate Case-study. It was agreed through these sessions that new research environments required universities to establish comparative advantage in national strategies and seek to build on these strategies. This implies bringing together, in some sort of forum, the various stakeholders involved in universities and their associated socio-economic activities.

From a similar perspective, it was noted that there is a need to match academic research capabilities to the demands and opportunities outside the university. Generally, this was viewed as requiring a number of steps:

- allocation of resources;
- establishing linking mechanisms to other researchers and to research ‘users’ effective monitoring and accountability processes; and
- program evaluation throughout the life of programs rather than at the end of a period of activity.

However, as noted through the Syndicate Exercise:

Researchers have not taken full advantage of opportunities available in Futureland to carry out meaningful R&D activities. There is also large room to improve researchers’ accountability and to deliver an R&D output relevant to Futureland’s needs.18

17 See Qasem, S., Syndicate Case-study Summary in Appendix C.
18 Ibid.
Setting Research Priorities

The proportion of research funding provided by non-government sources is increasing. Consequently, a contract model of research management is replacing a more traditional approach to the allocation of research funds. Research topics through the contract model are determined by market demands and output is subject to client restrictions to the dissemination of research results. Management of the contract model requires a new set of ‘checks and balances’. For example there is a need to generate a range of long term sponsors in order to build up longer term research projects and programs. There is also a need to generate a balance between publication output directed toward the needs of clients and maintaining a regular output of scholarly publications in major national and international journals.

In some of the Arab States, and indeed in many other parts of the world, government research allocations are still made outside the context of broader national science policy objectives. Many of the participants at the Bahrain Workshop emphasized the need to generate closer links between research and production. On the one hand, it is clear that universities must fulfill their mission to produce highly trained scholars, scientists, technicians and engineers. However, at the same time, the mission of universities is changing and there is a need to balance the traditional expectations and demands with new missions and new modes of organization.

Universities throughout the Arab States need to develop long term planning. Research priorities must be linked to national strategies for socio-economic development, but unless the national strategy is well articulated, it remains difficult for universities to link their programs to national objectives. This raises an important role for university research managers. That is, to seek ways of productively contributing to national S&T priority setting processes. In some countries, there are forums that provide for the university sector to make major inputs to national science policies. In others, such forums are less developed or more diffused.

The prescribed role of most universities are usually described in varying proportions as contributing to three activities: teaching, research and community service. While teaching is the dominant activity in Arab Universities, demands to become more community focused and to undertake research that will contribute to national socio-economic development are changing, and competing, with the demands for teaching output. But, it is not just a pressure to carry out more research that research managers are experiencing. There is also a pressure to engage with research that is perceived to be of value by the community. In other words, it is as much ‘the community’ that is defining what research is useful as it is the academic community (or peer review). These pressures are not unique to the Arab State Universities, but are experienced almost everywhere. The question for Arab research managers is ‘what are the specific local or regional demands for research and how can I meet these demands with other expectations and priorities’?

The workshop participants noted that long term planning requires a good understanding of regional issues, thus forums such as the Bahrain Workshop provide a good opportunity do this.
Centralized or Decentralized Administration

One of the newly emerging international structures in universities during the past few decades has been the idea of the research office or centralized research administrative unit. Typically, these units are headed by a Vice-Chancellor or (Research) Vice-Rector for Research and staffed by research administrators. Such offices both administer research funds and support efforts of researchers to win external contracts as well as generating institutional research policy - across all disciplines. Arab universities, like their overseas counterparts, have been developing similar structures. In the early 1980s for example, Kuwait University instituted a ‘Directorate of Research’ under the administrative control of a newly established Office of Vice Rector for Research. The mandate for the Office was to ‘promote, support, and sustain Faculty research in all disciplines’.19

A major issue identified through the workshop, on this topic, was that for most universities, there is a need to develop such supporting agencies, within their administrative structures, without undermining the flexibility and entrepreneurial spirit of the individuals and groups across the university. This is entirely consistent with similar issues being articulated in other parts of the world.

Stages of Development in Research Management

The international experiences discussed above, in this report, illustrated three phases of development in the mechanisms for managing science and technology research linkages with industry. The experiences of Arab Universities that have been established for 30 or more years reflect similar phased developments, but with a specific local variation. Kuwait University introduced their own interesting example.

In their case, the first phase was characterized by research efforts being purely voluntary and ad hoc with an absence of any organized institutional mechanism for coordinating or supporting research. For Kuwait university, this was described as typical of the period 1966-79. The second phase was characterized by the emergence of a centralized system of grants. This more systematic management system incorporated the formation of an Office for Research and the development and articulation of a research strategy. This second phase covered the period 1980-85.

A third Phase, from 1985-1990, was characterized by a dramatic growth in sponsored research. together with a parallel growth in research publications. During this period, the research budget at Kuwait university doubled. Information technology increased the capability to establish, address and monitor research priorities. A fourth stage for Kuwait University, followed in the aftermath of the Gulf War. During this phase, research support and regulations became more standardized and a contract Research Office was established to promote links between Faculty based research and community needs. Further, joint cooperation with international institutions increased and further advances in information technology provided Internet access to the rest of the world.

19 Presentation delivered by Dr. Adel Khalid Al-Sabeeh, Office of the Vice President for Research and Graduate Studies, Kuwait University.
It is this fourth phase that is so characteristic of university research management systems in other parts of the world. These developments bring the practice of applied scientific research right into the heart of university faculty activities. Through consulting activities, they bring industry and the community into the day to day teaching, research or administration of Faculties. Thus basic and applied research become less clearly defined or even separable. Consulting, previously carried out on an ad hoc basis or through commercial arms along side the university, becomes integral to the daily working of faculties. The implications for management and organization of research systems, therefore, are that they are neither highly centralized nor entirely centralized, but rely on a symbiotic interaction between centralized policy and priority setting and devolved project and program management at the faculty level.
4. CRITICAL ISSUES AND FUTURE DIRECTIONS

Managing Change In University Research Cultures

Managing the organization and evaluation of applied scientific and technological systems requires managing changes in the research cultures of universities. But not only does it require managing change within the university structure, the task implies managing change beyond the university. The research management process cannot escape interaction with the changing expectations, values and perceptions within industry, and in the community generally, about what the university can or should offer. Accessibility, therefore, is one of the critical issues confronting research the designers of research policies and systems.

The issue of accessibility is not just a matter of ensuring research facilities and technical expertise are available to potential clients, but it implies an increased level of public scrutiny. As the presentation from Sultan Qaboos University in the Sultanate of Oman put it:

...development of the research arm must, first and foremost, make a contribution to the Omani population, in general. This must remain the key ingredient, but must also be exposed to added scrutiny. Any growth component can become inhibitory - its closed nature limits the ability of the system to function...20

Research managers have little option but to seek to develop and nurture systems that are both accessible to a wide range of community based clients. This broader base for research clientele also carries with it the need to become more accountable and more ‘transparent’ in their strategic objectives. In short, it calls for increased relevance in the context of increased accountability.

While universities can develop strategies to link their activities more closely to community and industry requirements, they can only be effective if academics view this as a worthwhile exercise. Changes in research cultures therefore require efforts to change perceptions about the value of research. Such change requires incentives. Proportional rights of ownership of intellectual property and including industry and community involvement in criteria for promotions have been introduced in some universities in efforts to introduce incentives for applied scientific research.

Another feature of cultural change that was described as ‘critical’ was concerned with the notion of trust. The management of applied research requires trust at a number of levels. It requires trust between industrial and academic partners. For interdisciplinary applied research, trust and cooperation is often required between departments, faculties and often different institutions. Disciplinary cultures and their unique languages have in the past often created obstacles for cooperation, and industry and university research cooperation often failed through lack of understanding of the differing sectoral obligations and expectations. While these sorts of changes can only be made gradually, it was reinforced, on many occasions, that they must occur. The implication for management processes for applied research is that building trust and long-term cooperation between academic researchers and industrial or community enterprises must become

20 Presentation by Dr. Taher A. Razik, ‘Trends & Futuristic Approach to Research at Sultan Qaboos University’ Sultan Qaboos University. Sultanate of Oman.
a high priority. Evaluation criteria, for example, must ask more than: ‘did the research project deliver the technology or solve the problem? or ‘was the project cost effective?’ It must also ask: ‘did the project contribute toward a longer standing collaborative relationship between the university and industry?’

Financial Management and Evaluation

Following from a recognition of the need to respond to a broader based set of industry and community expectations than ever before, universities are also subject to new perceptions about ‘reputation’ and about ‘performance’. On the one hand, university research systems for the 21st Century demand the efficient management of financial resources. However, productivity measures of successful research output cannot be adequately measured simply on cost benefit economic models. It was noted that many far reaching scientific and technological advances have been made from minimal input, but many have also demanded long term planning and financing. At the same time, many long term research programs have delivered little for their input. Difficult questions will always emerge as to when a project must, financially, be abandoned. Such decisions should ideally take into account a range of criteria - but irresistibly, such decisions will need to be made.

This topic continued to emerge throughout the workshop discussions. Ultimately, the resolution was that research systems needed flexibility in this financial management sphere. Yet, it was generally accepted that the more clearly articulated were the grounds on which such decisions should be made then the more certainty there would be for research project and program managers in setting long term plans, milestones and self-evaluation.

Reputation

Research reputation has been the traditional cornerstone for success for academic researchers. Reputation has generally hinged around peer recognition based on published research results. However, the new mode of knowledge production has introduced new reputation issues, particularly for researchers involved with applied scientific and technological development. Applied scientific research tends to involve teams rather than individual scientists. In many cases, it is the reputation of the team that is critical to the further development of the university’s applied scientific reputation. Publications remain important for individual members of the team, but increasingly it is the capability of the group (often highly interdisciplinary) that carries the reputation for the researchers involved.

This is not to say that individuals and their academic reputations are not crucial for the effective development of research groups. Many research centers have been built almost solely around the reputation of key individuals. What is important for research management systems, however, is how to integrate - and maintain- the reputation of excellence ascribed to individuals into research groups or centers.

Global and Local Issues

Two issues that always remained to the fore of discussion were the issues of globalization and local development. At first glance, these issues appear to be somewhat in opposition. On the one hand, respondents emphasized the impact of global changes including information technology,
the changing role of universities throughout the world and the emergence of universities as ‘global enterprises’. Indeed, many of the research management issues, articulated above by the Arab respondents, were typical of the issues raised by university research managers in many other countries around the world.

Yet, at the same time, while there appeared to be common global features to the systems for managing applied scientific and technological research, the workshop also identified some divergent local issues. Intellectual property rights, for example, are dominated by global agreements and reflect international trade and economic agreements. Consequently, the intellectual property statutes being developed by universities around the world (in most universities only through the last 10 years) all bear remarkable resemblance in terms of consistency in relation to patent, copy-right and design legislation. However, at the local level, much is different. Some universities claim 100% ownership of any patentable idea developed by an academic staff member. Other institutions are far more liberal and permit academic researchers first right to ownership of such commercial potential. The important point is that whatever model is chosen by a university to enshrine in its statutes, it will be effective in promoting innovation in research only to the extent that it is consistent with locally accepted expectations, values and obligations. In other words, there is no ideal universal model for the management of university intellectual property. It depends very much on the local culture and local conditions.

New Technologies

New information technologies are having an impact in the ways that collaboration is developed and maintained. Such technologies not only provide new tools for establishing cooperation, but make cooperation more efficient and geographically dispersed. However, at the same time, it is also clear that localism is important. Perhaps somewhat paradoxically, as science and communication have become more global, there is growing imperative to adopt local, or regional approaches to industry and university linkages.

Second, the case studies here emphasize the need for universities to promote their capabilities with industry and for locally based industries to clearly articulate their firm’s needs as well as their current talents. In many cases, universities tend to focus on their international reputations at the expense of their local strengths and potential contributions to unique forms of regional development.

Third, there is a growing demand for intermediary agencies or organizational structures to fulfill a role halfway between traditional university activities and the traditional activities of business or government. In the past, outreach offices or agents have operated at arms length from universities or the business they represent. There is evidence that the culture of universities and industrial enterprises are changing. University structures must adjust to these changes. That does not mean uncritically accepting new ways of operating - but it does call for a critical appraisal of how things have functioned in the past - and how well they will serve the future.

The Role of Government

Another issue concerns the role of government. Government policies and infrastructure support can either undermine or reinforce efforts to adjust to new environments. The case studies discussed through the workshop illustrate just how important government action can be in creating an
environment for productive cooperation. However, they also suggest that appropriate roles for government depend very much on local factors. In some cases, the role may be quite immediate to specific project areas. In others, the role may ideally be far more removed. Clearly, there are no universal prescriptions. Ultimately, the task will be to read the environment and seek to develop long term plans for sustainable cooperative activity.

The papers and discussion throughout the workshop underscored two important points. First, the research environment in which universities must operate through into the 21st Century has changed dramatically through the past two decades. There will be major constraints in terms of time and finances and very few universities will be in the position to conduct excellent research in all fields. Strategic decisions will need to be made in order to identify 'niches of research excellence'. The syndicate exercise findings underscored this issue by identifying research topics, strategic planning and mechanisms for managing the research of Futureland Universities as part of a national system.

The second point is that universities will need to work closely with governments, but in a different way from the past. Universities cannot expect public funds to support all of their research activities and they can expect very little public funding for applied scientific and technological research. Governments can work to provide environments conducive to private research investment. Universities can therefore perform an important role in proposing policy options. They can carry out a monitoring and evaluating role that will not only inform their institutional strategies, but can also inform government policy.

This suggests perhaps the most far reaching issue for the organization of research systems in universities. It suggests that universities must develop research offices that not only promote and support their own institutional research activities, but that also contribute to national research policies. This proactive role is perhaps the greatest challenge for universities everywhere. But ultimately, if academic research systems are to endure in the 21st Century, they must fulfill strategic roles in national and international research systems.
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APPENDIX A

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The attendees are listed under each
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APPENDIX B

WORKSHOP TECHNICAL PROGRAMME
PRE-WORKSHOP DAY, FRIDAY NOVEMBER 15, 1996

18:00   20:00   Welcome Reception
          Holiday Inn Hotel

WORKSHOP DAY 1, SATURDAY NOVEMBER 16, 1996

S.1.1  08:15   09:00   Inauguration & Opening Speeches

09:00   09:45   Keynote Address: Changed Universities for a Changing World
                Dr. Osama El-Kholy

09:45   10:00   Break

10:00   10:30   Workshop Introduction
                Dr. Amr S. Azzouz

S.1.2  10:30   12:00   Managing Knowledge Networks Across Changing Academic
          Research Cultures
                Dr. Tim Turpin

12:00   13:30   Lunch

S.1.3  13:30   15:00   Research Links Between Universities and Industry: Case
          Studies of North American Experiences
                Dr. Tim Turpin

15:00   15:30   Break

S.1.4  15:30   17:00   Formation of Syndicate Groups & Defining the Role and
          Objectives of the Syndicates and the Exercises to be Undertaken
          over the Remainder of the Workshop
                Dr. Subhi Qasem
WORKSHOP DAY 2, SUNDAY NOVEMBER 17, 1996

S.2.1 08:30 10:00 Managing Academic Research in the Context of Government Science Policies: European Experiences
Dr. Tim Turpin

10:00 10:30 Break

S.2.2 10:30 12:00 An Overview Of University Applied Scientific & Technological Research Planning, Management, and Evaluation in the Arab Region
Dr. Subhi Qasem

12:00 13:30 Lunch

S.2.3 13:30 15:00 King Abdul-Aziz City for Science & Technology Drs. Abdallah Al-Rasheed & Abdulrahman Alabdula’aly Modalities & Practices at King Saud University
Dr. Khaled Al-Hamoudi
The Management & Organization of Research in Saudi Arabian Universities:
Part I: KFUPM Reserach Model of Academic Departments Dr. Abdullah Abdul-Gader
Part II: KFUPM Reserach Model of Research Institute Dr. Abdallah Dabbagh

15:00 15:30 Break

S.2.4 15:30 17:00 Meeting of Syndicates

WORKSHOP DAY 3, MONDAY NOVEMBER 18, 1996

S.3.1 08:30 10:30 Managing Academic and Industry Research Cooperation: Case Studies from the Asia Pacific Region
Dr. Tim Turpin

10:30 11:00 Break

S.3.2 11:00 12:00 The Science And Technology Policy Asian Network (STEPAN) and its Role In Promoting S & T Throughout Asia
Dr. Heather Spence
12:00 - 13:30  Lunch

S.3.3  13:30 - 15:00  Scientific & Technological University Research System in Algeria: Current Situation and Perspective
Dr. Mounir Barrah
An Overview of the Current Status of Science and Engineering Research at the American University in Cairo
Dr. Amr Abdel-Hamid
Current Research Programs and New Initiatives at KFAS
Dr. Jasem Abdul-Salam
Scientific Research in Tunisia
Dr. Youssef Mlik

15:00 - 15:30  Break

S.3.4  15:30 - 17:00  Meeting of Syndicates

WORKSHOP DAY 4, TUESDAY NOVEMBER 19, 1996

S.4.1  08:30 - 10:30  Scientific Research at Jordanian Universities
Drs. A. Tanimi & M. Awwad
Kuwait University Model
Dr. Adel Al-Sabeeh
Trends & Futuristic Approach to Research at Sultan Qaboos University
Drs. Taher A. Razik and Saleh Al-Alawi
Scientific Research in Lebanon
Dr. Hafez Kobeissi

10:30 - 11:00  Break

S.4.2  11:00 - 13:00  Panel Discussion on the Main Issues Presented and their Potential for Adoption in Arab Universities. Proposals for Reform and Guidelines for Change

13:00 - 14:30  Lunch

14:30 - 19:00  Free Afternoon

19:00 - 21:00  Workshop Banquet
Sheraton Hotel
Banquet Speaker: Mr. Yousef Al-Sherawy
WORKSHOP DAY 5, WEDNESDAY NOVEMBER 20, 1996

**S.5.1** 08:30 10:00 Finalization Of Syndicate Reports

10:00 10:30 Break

**S.5.2** 10:30 12:00 Reports of Syndicates

**S.5.3** 12:00 13:00 Recommendations, Plans of Action, Concluding Remarks and Closing Arguments

14:00 15:30 Lunch & Departure
APPENDIX C

THE SYNDICATE EXERCISE

FUTURELAND
STRATEGY FORMULATION TO ENGAGE THE UNIVERSITY RESEARCH SYSTEM IN THE OVERALL NATIONAL R&D EFFORT

1. Introduction:

Futureland is an average size developing state which has several features characteristic to the Arab Region. Futureland is in the midst of its economic, social and political adjustment programs to improve its performance and to ultimately achieve better economic and human development indicators.

The declared strategic goals of Futureland include the following:

1. Stabilize the national foreign exchange rate of national currency through all instruments consistent with other economic, social and financial objectives,

2. Maximize national exports of goods and services through better management, less barriers, higher capacity of competitiveness and better use of Futureland comparative advantages.

3. Minimize trade deficit to manageable levels through liberalization of the economy, export promotion, abrogating subsidies and elimination of non-productive activities.

4. Minimize government control or participation in the production of all goods as well as in services in which no comparative advantage exists. Maximize the participation of private sector in the production of goods and services.

5. Create the maximum number of jobs to keep unemployment in manageable levels. Priority is to be given to small and medium productive enterprises, private sector entreprenurships and foreign investment in local industrial, agricultural and service sectors.

6. Utilize national natural resources in a manner consistent with a good level of indicators and programs to ensure sustainability of resource productivity.

7. Participate in regional and global R&D activities which serve national strategies in the medium term (next 25 years) and/or those that have clearly identified impact on the strategies of participating parties.

This case study exercise is designed to achieve the following three objectives:

1. Assess the resources available for research and development (R&D) activities in the university

2. Suggest a package of adjustment measures designed to improve university capacity to carry out R&D activities consistent with national R&D demands.

3. Chart an integrated and comprehensive course of action to improve the university role in the overall national R&D effort.

More specifically, the exercise should lead to three specific outputs:

a) The development of an “Institutional Research Management Plan” for the University(ies).
b) The development of a **Commercial Activities Business Plan** for building and managing Futureland’s university’s commercial activities.

c) The development of an **Information System Plan** in order to strengthen linkages among researcher, institutions, clients government officials and other stackholders.

2. **Futureland Socio-Economic Indicators:**

1. The population of Futureland was 12 million in 1995 with average rate of growth of 2.8% per year.

2. The State GDP in 1995 was 21.6 billion US dollars, with an average GDP per capita of 1800 US dollars per year. The contribution of various sectors to GNP in 1995 was as follows:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Contribution to GDP%</th>
<th>% average annual growth 1991/1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>14</td>
<td>3.6</td>
</tr>
<tr>
<td>Industrial and Manufacturing</td>
<td>22</td>
<td>2.1</td>
</tr>
<tr>
<td>Services</td>
<td>64</td>
<td>1.5</td>
</tr>
<tr>
<td>Total/ average</td>
<td>100</td>
<td>2.0</td>
</tr>
</tbody>
</table>

1. The growth of various sectors has fluctuated during the last 10 years with varied degrees with agriculture having the highest degree of fluctuation followed by manufacturing and services,

2. The State suffers from a trade deficit of almost 25%. Deficit is met through loans, grants and remittances of nationals working abroad. The largest deficit is in food and agriculture followed by manufactured goods.

The number of industrial, service and regulatory institutions is growing in response to government policies to promote productivity (Appendix 1).

3. **Opportunities and Constraints:**

1. The Futureland has several comparative advantages. They include low cost labor, a liberal economy, government policies to promote exports and a technical and scientific manpower qualified to engage in productive activities. The infrastructure of services is modest but may be with small size financing improved,

2. The State faces several constraints which include:

   - Scarce water resources which constitute the major limiting factor of food and agricultural production. The water resources suffer from a substantial percentage of losses due to traditional methods of irrigation as well as, inefficient methods of M&I transport and distribution system.
   - Poor management of natural resources
   - Low labor productivity indicators
Many manufactured goods are produced but most suffer from low competitiveness both in domestic and export markets. Standards and quality specifications of produced goods are of varied levels. Low quality of goods and variable standards appear to be a major constraint for export.

Productivity levels in agriculture, manufacturing, tourism and government services are low compared with indicators in several world regions.

4. Higher Education and R&D Institutions:

Futureland has a host of S&T institutions which include four public sector universities, two of which are comprehensive while the other two have liberal arts, sciences and management colleges. It also includes one agricultural research center, one industrial research and technical services center and a number of multifunctional departments and centers. These include health, education and environment (Appendix 2). All department as well as the agricultural research centers are organized under the respective ministries while the industrial research center is autonomous governed by a board representing public as well as private sector stakeholders.

In recent years, the government has established Futureland S&T Academy which was in charge of formulating, monitoring and evaluating S&T policy. The Academy has a small unit in charge of providing financial support to R&D proposals submitted, on a competitive basis, by R&D units in the country.

5. Opportunities and Constraints of R&D Activities in Futureland:

Several positive changes are taking place in Futureland which have an impact of R&D activities. These changes include the following:

1. Futureland is undergoing a privatization program in which government role in productive as well as several service sectors will be downsized.

2. The State passed a law exempting 15% of all industrial and service companies profits if they are allocated to R&D activities either within their own R&D unit, or in contract with a national R&D institution.

3. The National Planning Council in the State has declared that support for R&D activities is a priority in the national agenda. R&D activity is to become part and parcel of all measures designed to promote productivity in all sectors of production and services. Financial allocations to these activities are not clearly defined in the State budget. The Prime Minister, however, has ordained that clearly defined R&D activities which are supported by productive and service sector may receive priority consideration in funding.

4. Several opportunities for R&D funding do exist in Futureland both from national and foreign sources. Funding of any R&D activity, however, must meet several conditions among which are: a) R&D proposal must be demanded by an identified client. The client may be from the public or private sector institution or firms, and b) the funding proposal must conform to a form which shows among other things objectives, impact of project on productivity and ways and means of implementation.
On the other hand, the R&D activities suffer from a number of constraints which include:

a) Weakness of R&D clients to articulate these demands of R&D output.

b) Ambivalence of researchers to allocate the effort needed to articulate, identify and formulate R&D projects consistent with clientele demand.

c) Low level of funding of R&D activities both from core budget of R&D institutions as well as government sources.

d) Teaching load of potential researchers in universities is high and leaves little time to be allocated to serious and productive R&D activities

e) Incentives to generate additional income through additional teaching load are available to university scientists inside and outside universities.

f) Dialogue among R&D stackholders in Futureland (i.e. clients, scientists, decision-makers and finance providers) is not institutionalized. Existing form of dialogue are not structured to produce effective results.

g) Available reports prepared by higher commissions formulated by the Prime Minister Office to investigate the opportunities and constraints of R&D activities in Futureland has shown the following:

- The demand for information both by industrialists, farmers, small and medium business is growing. Much of the demand for R&D output is being transferred from abroad with varying degrees of success.
- Substantial number of problems faced by R&D clients in the State require a long range commitment from competent R&D units in order to produce the output consistent with demanded information.
- Coordination and cooperation among potential elements of an effective national R&D system are weak.
- Much of the R&D activities carried out in the State institutions lack focus on specific problems, are designed in absence of a defined demand, are poorly financed and are not guided by an effective instrument to maximize congruency between information supply and demand.
- All parties and stackholders of R&D activities (government senior officials, R&D clients in private sector, researcher and business executive) suffer from varying degrees of frustration due to the weak and slow progress achieved in the performance of R&D system in Futureland. Most if not each and every party voice complaints with regard to the seriousness with which the other party views R&D activities in the State. Officials accuse the scientists of lack of focus in their activities and that their research activities are not relevant to national needs. On the other hand, scientists claim that authorities in charge of financial resources do not allocate budgets sufficient for an effective research. The finding of commissions also report some isolated positive signs emerging in the relationship between some clients and researchers. The common elements of the positive situations are: well identified objective of R&D activity, the activity is regulated by a contract between the parties, often a third party is involved in the activity and is usually providing financial support.
6. Suggested Course of Discussion and Conclusion of the Exercise:

Keeping the objectives of this exercise (outlined in point 1), how would you go about charting a course of action for Futureland university in the overall R&D demands of the country.

1. What type of research would you consider i.e. mission research, problem solving research, researchers training research.

2. How would you go about defining priorities of university involvement. This includes priority setting and priority determination techniques. In this respect what linkage vehicles would you use to strengthen clients participation in priority identification.

3. What is the comparative advantage of the university is involving itself in the national effort.

4. Organizational considerations of R&D program: Centers, programs, departmental, resident scientist, individual research project cooperative.

5. What approaches and instruments would you consider to strengthen University linkage with stackholders in R&D activities

   - Participation in desision-making workshop, boards, periodic reports, financial commitments ..etc.
   - Identify stackholders with whom linkages are essential
   - Empowerment linkages to mobilize funds
   - Permanent linkages with clients to articulate demand
   - Program linkages to improve relevance to demand
   - Inter-University linkages to promote interest, support and cooperation
   - Linkage with other implementing agencies inside and outside the State.
   - Measures to increase R&D competitiveness with other functions i.e. teaching, direct technical services, professional private practice, etc.

6. Resource allocation techniques to ensure consistency between various element of program implementation i.e.:

   - Priorities and resources available
   - Comparative advantages and resources available
   - Resources available and sufficiency of program budget.
   - Program resources and achievement of program objectives.

7. Implementation and monitoring procedures, project documents, reports, workshops, etc.

8. Evaluation and feedback mechanisms: periodic, external, internal mid-term review, corrective measures, final review

9. Conclusion and output: What are the mechanisms of information to stackholders with regard to output: Reports, publications, demonstrations, workshops, training production of goods.
APPENDIX I. MAJOR INDUSTRIAL FIRMS, SERVICE INSTITUTIONS, REGULATORY ORGANIZATION, FINANCIAL INSTITUTIONS AND OTHER ORGANIZATIONS IN THE PRODUCTIVE AND SERVICE SECTORS OF FUTURELAND.

Futureland has about 150 public shareholding companies and more than 1500 corporate companies (i.e. family business or companies of limited number of shareholder with a capital not exceeding 1 million US dollars).

<table>
<thead>
<tr>
<th>TYPE OF INSTITUTIONS SHAREHOLDING</th>
<th>PUBLIC LIMITED</th>
<th>CORPORATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Manufacturing and processing:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining of industrial minerals</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Pharmaceutical manufacturing</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Chemical manufacturing including</td>
<td>28</td>
<td>136</td>
</tr>
<tr>
<td>petrochemicals and petroleum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food and beverage processing</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>Clothing and leather goods</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Fertilizer manufacturing</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Construction materials including</td>
<td>45</td>
<td>120</td>
</tr>
<tr>
<td>ceramics, metal pipes, aluminum,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>steel and wood manufacturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical, mechanical and</td>
<td>6</td>
<td>201</td>
</tr>
<tr>
<td>electronic household appliances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural input production</td>
<td>1</td>
<td>49</td>
</tr>
<tr>
<td>Others (Tobacco, packing,</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>educational materials, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. Financial and Insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>institutions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial banks</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Industrial credit banks</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Insurance companies</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Agricultural credit institutions</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>III. Service sector companies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea, air and land transportation</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>Tourism facilities including</td>
<td>6</td>
<td>48</td>
</tr>
<tr>
<td>chain hotels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitals: public sector</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>Hospitals: private sector</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Communication</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Energy (electrical )</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
IV. Private sector organizations:

- Businessmen Associations: 3
- Chamber of Commerce: 1
- Chamber of Industry: 1
- Farmer's union: 1
- Professional Association: Engineers, doctors, etc.: 8
- Exporters Association: 2
APPENDIX II. S&T INSTITUTIONS IN FUTURELAND.

Futureland has four universities and 12 R&D institutions. All institutions are engaged in R&D activities in addition to other functions. R&D expenditure in Futureland fluctuates from one year to another but amounted to 7 million US dollars in 1996.

The major features of S&T institutions in Futureland may be summarized as follows:

1. Futureland Academy of Science and Technology: In charge of S&T policy including R&D policy and in particular responsible for the following:
   • Coordination of R&D activities in the country
   • Propose R&D plans and strategies for the Cabinet of Ministries approval
   • Provide financial support to R&D activities implemented by national institutions
   • Establish R&D centers which fill gaps in Futureland R&D system
   • Propose measures to improve R&D performance in the country.

   In 1996, the Academy allocated 0.5 million US dollars to support R&D activities by national institutions. In 1995, only 50% of the 0.8 million US dollars were committed in support of R&D activities.

2. The University of Futureland (UOF): Located in the capital, the UOF is the oldest and largest university in the country. The UOF is organized in 12 colleges namely include liberal arts, sciences, business, law, theology, education, sciences, engineering, agriculture, medicine, pharmacy and dentistry. The university offers programs which lead to BSc degree in 50 disciplines representing all of the 12 colleges, MSc degree in 45 disciplines representing the 12 colleges and PhD degree in 15 disciplines representing liberal arts, education, basic sciences and agriculture. The UOF has a modest line budget of 200 thousand US dollars in support of R&D activities within the university.

3. The Southern University of Futureland, Futureland Northern University of Arts and Sciences and Futureland Eastern University of Arts and Sciences: The Southern University is smaller than the UOF but has the same range of colleges and offers B.Sc in 45 disciplines and M.Sc in 35 disciplines. It does not offer programs which lead to Ph.D degree. The university was established in the second largest city in the country located in the Southern region. Similar to the UOF, the Southern University has a small R&D budget which did not exceed 150 thousand US dollars at any one time.

   The other two universities are smaller than the other two comprehensive schools. Each has the range of colleges in liberal arts, basic sciences, business and economics and law. They both offer BSc in about 25 disciplines but MSc in four liberal arts disciplines.

4. The Institute of Agricultural Research (IAR): Governed by the Ministry of Agriculture, the IAR suffers from several weaknesses among which are:
   • Inadequate research staff with regard to MSc and PhD holders but has a large of BSc holders.
   • Fluctuating financial support

64
Extensive organizational structures as well as several stations and regional centers in the six major regions of agricultural production in the country

Low output of information demanded by farmers

5. The Industrial Research and Technical Research Center: The Center also suffers from several weaknesses which include:

- Inadequate linkages with other institutions
- Non clarity of R&D strategy and how it differs from R&D services demanded by clients
- R&D activities are not demand oriented for the most part

6. The Departments of Research and Technical Services: These include the following:

- The department of Health and Nutrition Research, Ministry of Health
- The Department of Standards and Specifications, Ministry of Industry
- The Department of Marine Biology, Research Ministry of Agriculture (MOA),
- The Department of Natural Resource and Geological Research, Ministry of Energy and Natural Resources
- The Department of Soils and Water Research, Ministry of Water and Irrigation
- The department of Veterinary Research and Technical Services (MOA)
- the Department of Arid lands, Range and Forestry Development, Ministry of Education
- The National Center for Education Development, Ministry of Health
- The National Center for Public Health Studies, Ministry of Industry
- The Department of Environmental Protection
SYNDICATE EXERCISE: CONCLUSION REPORT

1. Introduction:
Participants in the workshop were divided into two groups to facilitate active discussion. Each group held five sessions to discuss their response to Futureland Prime Minister request on how to formulate a strategy to “Engage Futureland Universities Research Systems in the Overall National R&D effort”. Each group was represented by 16 officials, the vast majority of which were Deans or Vice Presidents of Research of Arab Universities in 14 Arab States. The major focus of all discussions was the improvement of research management as means to maximize research efficiency and productivity.

The participants discussed in details the various issues regarding the importance of engaging universities in national research and ways and means of improving university role in serving development and productivity.

2. The participants viewed the initiative of the Prime Minister with high regard:
In reviewing the status of R&D activities in Futureland, the participants underscored the following:
- Most if not all R&D stakeholders in Futureland are to be blamed for the weaknesses of R&D activity.
- Researchers in the universities have not taken full advantage of opportunities available in Futureland to carry out meaningful R&D activities. There is also large room to improve researchers accountability and to deliver an R&D output relevant to Futureland needs.
- Participants stressed the fact that researchers in Futureland universities should utilize R&D facilities at hand and minimize their demands for additional resources. They also recognized the importance of carrying out R&D activities under Futureland constraints. In other words university researchers must not resort to conditional prerequisites before any R&D activity to be carried out and must be positive in their response to the Prime Minister.

3. R&D stakeholders in Futureland:
The participants identified R&D stakeholders in Futureland to include the following major groups: University researchers, University officials, Prime Minister’s Office, Futureland Government Authorities, Futureland Parliament, Futureland mass media institutions, industrialists, business community at large, financial institutions, R&D Government institutions, Chamber of Commerce, Chamber of industry, Farmer’s unions, potential research donors inside and outside Futureland and last but not least all research target groups and individuals in the country.

Strategies and plans of R&D activity must consider the interests and concerns of all of these groups. The fifteen groups fall into four major categories, namely R&D managers, R&D doers, R&D financiers, R&D clients or beneficiaries.
4. The Comparative advantage of Futureland universities to engage in national R&D efforts:

The participants discussed the elements which give Futureland universities a comparative advantage to carry out R&D activities especially under present and medium range future prevailing conditions. The fact that Futureland has a limited and perhaps scarce human resources qualified to carry out meaningful research was also highlighted. The elements which give Futureland universities an edge over other R&D institutions in Futureland include the following:

- The two major universities (i.e. UOF and SOUF) have substantial human resource base which includes large number of staff who are potentially capable of carrying out research in most fields. The qualifications of the staff are also consistent with potential demand of agriculture, industry and service sectors.

- The fact that the two large universities in Futureland do have graduate studies programs, presents an opportunity to engage graduate students in the national research program.

- The infrastructure which exists in the two universities, as well as other facilities, place the two institutions in a favorable position to add additional resources required by research, such as equipment and materials, but at a very low cost. In view of the small size of funds which are allocated in support of research in Futureland, the possibilities to launch new research activities in response to demand are very high indeed.

- The fact that ministry controlled research centers, autonomous centers and departments suffer from shortages of qualified manpower, but appear to have facilities which may be utilized for research cooperative programs in which universities may engage the involvement of universities in cooperative programs with government institution, will lead to a potentially effective use of research resources available in the two groups of institutions and may prove to be in the best interest of the country. However, incentives as well as structured cooperative instruments, will increase the efficiency and widen the scope of the complementarities which may be constructed.

5. Priority setting and priority of university intervention:

Participants took note of the problems facing Futureland and how the university may intervene to help improve the performance of economic and social sectors. Among the most urgent priority areas identified were improvement of quality control practices of manufactured goods, the maximization of resource utilization efficiency especially water, the ways and means of improving competitiveness of goods and services and ways and means of utilizing Futureland comparative advantages both in domestic and export markets.

The participants charted a strategy of how universities should intervene but in cooperation and concert of major stakeholders in each area.

Research efforts of both universities of Futureland (UOF) and Southern University of Futureland (SOUF) should focus on the following priorities:

a) Service sectors: This includes all form of energy, water supply and use, telecommunication, tourism, transportation, health, education, housing, marketing, finance and insurance.

b) Industry and manufacturing: This includes chemical manufacturing, petroleum, petrochemicals, construction materials, electrical appliances, mechanical appliances,
electronics, food and beverages, clothing, leather goods, pharmaceutical and agricultural input production.

c) Agricultural production: This includes: irrigation, soils, plant protection, animal health and husbandry, horticulture, agriculture economic and agricultural marketing.

The identification of research topics, financing of research activities and evaluation of research output are to be carried out jointly between universities and the groups of stakeholders concerned in each of the priorities. Stakeholders concerned in the area like food and beverages, for example, include UOF, SUOF, Health and Nutrition Department, Agricultural Research Center, Industrial Research Center, Standards and Specification Department, Business Association, Engineers Association, Chamber of Commerce and Industry and Farmers Union.

6. Research linkages and their mechanisms:

6.1 Research is an activity that is greatly influenced by a number of groups or individuals in the society. Research financiers, research clients, research doers, research evaluators, legislative bodies, university officials, government senior officials, researchers in various institutions, are among those who either influence research performance or are influenced by research. Linkages between the university on one hand, and these groups on the other, are a must for the success of research activity.

6.2 Program identification linkages: In view of the low degree of consistency between demanded research and what is actually being implemented at present in the country, linkages between researchers and clients are crucial for the identification of research topics which are relevant to needs. Linkages between university and R&D planners have proven, in other countries experiences, to be effective in guiding the researchers to identify topics consistent with national objectives.

Instruments and mechanisms which are recommended to Futureland include the following:

a) Resolution of R&D Plan and Strategy: National consensus on R&D priorities and identification of areas in which research support is available is a good instrument to produce closer congruency between what is demanded and what is implemented. Therefore it is essential, at this stage of Futureland development, to declare a clear cut R&D Plan which identifies priorities in a detailed and clear manner.

b) Introduce a research identification procedure which requires clientele approval of research projects as a condition for research project support.

c) Permanent scientist from university to be placed in industry or other client institutions. The major function of this scientist is to identify areas demanded by these clients and articulate.

Also, the clients whether they are industrialists, farmers union, businessmen associations which are present in Futureland, will do well to place a qualified person in the university to sensitize researchers for their research demand, on one hand, and carry back to their own groups the capacities available in the university to carry out research.

d) Institutionalization of the direct contact between researchers in the university and potential clients.
e) The institutionalization of structured meetings between university research community and clients. This includes workshops, short courses and invitation to board memberships.

6.3 Linkages of research fund mobilization: The financial resources allocated to research in Futureland are small. However, there are several promising sources from which research funds may be mobilized. Some of the vehicles to mobilize funds are the following:

a) Increase credibility and accountability of research performers through contract research and agreements which ensure productive research performance. In brief take all measures to ensure credibility of the university to deliver targeted output. These include monitoring and evaluation procedures, improving researcher environment and providing research incentives.

b) Provide matching funds from university core budgets for researchers who generate their own financial support from sources outside university.

c) Change the laws and procedures which discourage researchers to seek funding from outside sources. This includes the removal of laws or regulations which deny researchers remuneration’s or financial income from funds generated in support of research.

d) The establishment of research trust fund, research chairs, plan for recognition of research donors, are among the measures which may be taken to promote mobilization of research funds from the public at large.

e) Maximize the competitive capacity of the university to attract research funds. These include cases in which the university will provide matching funds with those provided by donors, provide research facilities with no changes or with minimal charges to outside parties which donate research funds and removal of regulatory measures which obstruct the effective use of outside funds.

f) Proper utilization of sabbatical leaves to ensure that it is devoted to research.

6.4 Linkages to increase inter institutional cooperation within and outside Futureland: Since there are several research institutions in Futureland, linkages among the universities and these institutions are to be promoted in order to integrate and pool the resources and eventually optimize their use. Among these linkages are:

a) Institutionalize meetings and visits between the two groups of research institutions i.e. the universities and government institutions.

b) Establish funds specifically devoted to provide support to cooperative projects.

c) Remove regulatory barriers which prevent researchers from other institutions to participate in university activities like graduate student supervision, use of research facilities and sabbatical leaves.

d) Remove all administrative and routine barriers which prevent outside research support to be extended to universities.

6.5 Consider the feasibility of establishing a university research office and university science parks. The objective of these two mechanisms is to facilitate R&D linkages.
7. Organization of research in Futureland and Futureland Universities:

There are several points which the group would like to stress to the Prime Minister of the Country. These are:

a) The researcher is the most important component of research and no matter what R&D organization will take place in Futureland, all regulations and measures should stress the creation of favorable environment for research productivity.

b) The academic department should be the home for research management unless the nature of the research topic dictates other organizational structures. However, research implementation should remain in the academic department. Whenever other structures are to be involved in research management (like a center at the level of the College, a center at the level of the university and/or an umbrella program) they are to be in charge with functions like monitoring and evaluation but not research implementation.

c) All financial support coming from outside university budget should be managed on contractual basis. Whenever possible, all provided research support should be distributed on a competitive basis based on transparent methodology and conditions. The new Academy of Science and Technology in Futureland should manage government support outside university budget.

d) Staff members should be free and encouraged to compete for outside funding.

e) Under all circumstances, regulatory and contractual conditions should focus on accountability, credibility and orientation of research. However, the researcher should be given a large degree of freedom in implementation and fund dispersal once it is approved.

8. Resource allocation:

Research funds in Futureland are small. They appear to continue to be scarce, and therefore must be subjected to stringent and transparent resource allocation criteria. The following points are advised with regard to research resource allocation:

a) Quantity of allocated resources must be consistent with the ranked research priorities.

b) Allocated resources to each research project must meet a set of conditions:

- Adequate and sufficient amounts for implementation
- Sustained support to ensure project completion.