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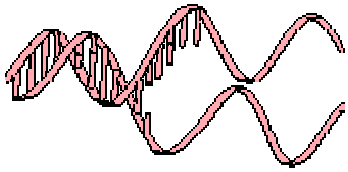

Current and Future Research Priorities (Applied vs. Basic Research)

Presentation Outline

- What type of research should be supported? Basic? Applied? Both?
- Who should support research? Government? Industry? Citizenry?
- What percentage should be spent on basic research vs. applied research?
- Based on recommendations, what will happen in the future?

Introduction

- Research and development (R&D), Science and technology (S&T). These words are inexorably linked in the minds of scientists and policy makers.
- The acronyms S&T and R&D are as much a part of the modern lexicon as USA or HIV; understanding their relationship helps to define their essential roles in our culture and how they impact informed public policy making.
- Decisions on funding, which will direct our nation's scientific and technological future and provide support for various aspects of the R&D process, set priorities not only for the success of our nation, but also for the evolution of our culture.
- In order to maintain country's level of scientific excellence, it is thus desirable and necessary that R&D investments become a common top priority.
- These developments on an international level are now confronting the universities with two important challenges.

    - In many countries, government funding for basic research is stagnating and, in addition, a considerable share of it is now provided on a contract basis, conditional on specific, measurable short-term objective.

    - This will eventually impinge on academic freedom and creativity due to the workload caused by such short-term projects—creativity

requires a maximum degree of independence as well as a reasonable assurance of stable, long-term funding.

- The dilemma between the objectives of additional funding versus the objective of academic freedom is a point of concern for nearly every modern university laboratory.

- Many governments now have created specific programmes to encourage partnerships between academia and industry to facilitate technology transfer and to provide an additional source of funding for basic research. These findings have raised some important questions:

  - Should universities adopt stronger conflict-of-interest guidelines, not only to meet the traditional university mission, but also in order to protect the sustainable progress of basic research?
  - Should universities enforce rules with respect to personal engagements of academic staff in industry?
  - Should universities maintain the balance between basic and applied research in each of their research groups?

- These significant economic developments in recent years have affected the research-related mission of the academic sector.
- Universities are still at a loss as to how best to react to these changes and are becoming more diverse in structure and more orientated towards social and economic challenges. But this is sometimes at the expense of basic research, the most important task of academia and its true strength.
- These trends raise many questions concerning new balances between research and knowledge transfer as well as between industrial partnerships and academic freedom.
- Those universities that face these challenges and actively manage these balances will maintain their unique position as important players in long-term basic research and are likely to be the most successful ones in the future
- Traditionally, basic and applied research were seen as activities of a different nature, carried out by different institutions and financed from different sources.
- But in the 1970s and 1980s, the information and communication technologies (ICT)—later reinforced by biotechnology—started a trend in which it became increasingly important to turn scientific research into concrete products.

Developing National Research Priorities

- Research plays a critical role in establishing and maintaining the wealth and well being of countries.
- Research is essential to meet emerging economic, social and environmental challenges.
- Countries with smaller economies need to maintain a strong programme of international collaboration, awareness and technology transfer.

- A diverse and strong research system ensures that the country is able to respond to the many challenges facing it

Key areas in which countries expect research to play critical roles in meeting national aspirations are:

- *The economy* – promoting long-term growth and new jobs in knowledge intensive products and services.
- *The society* – developing increasingly sophisticated health, commerce, communication, education– understanding and addressing emerging social issues arising from rapid economic change
- *The environment* – understanding and managing environmental systems to provide sustainable economic growth and environmental amenity.

What is Basics (Fundamentals) Research

- Refers to study and research on pure science that is meant to increase our scientific knowledge base, discovering new facts about natural phenomena, or to elaborate or test theories.
- This type of research is often purely theoretical with the intent of increasing our understanding of certain phenomena or behavior but does not seek to solve or treat these problems.
- Is an essential foundation for undertaking applied research focused on specific outcomes.
- Is key role in innovation.
- It has also has intrinsic merit. It is a powerful tool for research training, expands our knowledge, and contributes to an understanding of our cultural identity and place in the world.

What is Applied Research

- The investigation is conducted with a view to obtaining information directly useful in producing objects with commercial or practical utility.
- Applied research is used to **find solutions** to everyday problems, cure illness, and develop innovative technologies.
- Psychologists working in human factors or industrial/organizational fields often do this type of research
- The distinction between basic and applied research isn't always clear.
- It sometimes depends on your perspective or point of view
- One way to look at it is to ask the following question: "How long will it be before some practical application results from the research?"
  - If a practical use is only a few years away, then the work can be defined as strictly applied research.
  - If a practical use is still 20-50 years away, then the work is somewhat applied and somewhat basic in nature.
  - If a practical use cannot be envisioned in the foreseeable future, then the work can be described as purely basic research.

The role and contribution of research

- Because Palestine has a relatively small economy with limited public resources, it cannot expect to be at the leading edge in areas of research.
- However, as a result of the international nature of basic research and of the explosion in the use of the Internet, research findings in a wide area of disciplines diffuse quickly to those countries that maintain a strong program of international collaboration, awareness and technology transfer.

Investment in Research

- Empirical studies show that a 1 per cent increase in the stock of R&D leads to a rise in gross domestic product (GDP) of 0.05 per cent to 0.15 per cent
- Expenditure (or investment) on R&D varies in the Organization for Economic Co-operation and Development (OECD) from around 1.3 per cent to 3 per cent of GDP.

Components of the research system

- Research is carried out in both the private and public sectors; in institutions, businesses and universities; and is funded by federal, state and territory governments.
- The strengths of s research system include its responsiveness to the requirements of end-users, the interests of researchers and the need for excellence.
- Emerging challenges include the increasing cost of research facilities and international competition for quality staff.
- The relative balance between the types of research varies among the institutions.
- An emerging challenge is a growing dependence on multidisciplinary projects that require capabilities outside the traditional expertise of existing organizations.
- A proper mix of basic and applied research can be a large contributor to local economies, creating high-quality jobs as well as revenues both for universities and society.
- The opportunities for industrial contracts and partnerships have increased dramatically.
- In some cases, academic institutions have gradually transformed themselves into partially or largely self-financed 'profit' centers.

Research excellence and contributions to innovation go hand in hand

- The notions of ‘excellence’ and ‘benefit’ are fundamental to identifying research priorities.
- A focus on excellence is critical to ensuring internationally competitive outcomes from research.

- A focus on benefit to the community is a pre-condition for achieving maximum return on the investment in research.
- Collaboration is a two-way process. Palestine must be able to contribute to international research if we are to be acknowledged as participants in the global research community.

Current governmental funding and priorities

- When research money becomes tight, basic research often suffers, as corporations become more risk averse.
- When the economy is prospering, private sector research money is abundant and both basic and applied research thrives.
- The private sector relies on government-funded basic research from universities and government laboratories to provide the supporting data for their own applied research that will lead to the development of marketable products.
- Most large corporations cannot leverage basic research because of the constant pressure from stockholders, but small startups can often do as well as government laboratories in filling the vital role of transferring the results of basic research to applied research for industry.
- Medical problems strike close to home and many middle-aged policy makers have first-hand experience with cancer, heart disease, or other health problems.
- It is evident within NIH's own budget priorities, where breast cancer research far outstrips spending on other diseases.
- Decreasing funding not only throttles back research, but also scares away prospective researchers as students flock toward those disciplines with the greatest promise of funding and future jobs.
- Sustained and balanced funding for basic and applied research and technology development in all scientific fields will help to ensure that the most challenging problems faced by society will continue to inspire scientists, and will feed the creativity and innovation that is the hallmark of our culture.

Current research framework and recommendations for future form, scale, and synergies

- After reviewing the wide variety of research funding mechanisms, the strongest aspect is ability to leverage commercial interests and to collaborate with private-sector organizations and national laboratories to rapidly develop new technologies.
- Meeting the needs will require even closer collaboration among government, industry, and academia in its interactions with the intelligence community (IC).
- Certain enhancements would help make the research program more effective and responsive to these changing needs:
    - R&D Coordination.
    - Leadership role in funding research.

- A significant increase in research funding through existing or new programs will be necessary for to build a national research infrastructure and then draw upon this established base to fulfill its vision.

- Clearly appreciates the value of both basic and applied research, as well as the need for a trained and educated future workforce both for its own needs and for those of the nation.
- Demands have implications for the whole educational research infrastructure, from universities and colleges to commercial companies and government agencies.
- although undirected basic research has high potential payoff, and therefore is beneficial to support.
- Create a permanent coordinating committee with representative internal and external membership, tasked with seeking out, supporting, and coordinating R&D that contributes toward vision and needs
- This coordinating committee could evaluate research process itself: comparing strategies, creating triage lists and priorities, selecting topics for each Broad Area Announcement (BAA), and debating about those strategies that would best suit different types of research.
- A coordinating committee could also produce a road map for future strategic research planning.

- <u>The principal advantages of such a committee would be to</u>

  - (1) increase the proportion of projects that move from basic to applied;
  - (2) raise awareness of the importance of research in achieving vision;
  - (3) help build and coordinate the broader collaborative and incorporates its differing needs into research planning.
  - (4) eliminate redundancy by helping to ensure links among groups doing similar research within and outside the government.

- <u>such a committee could</u>

  - (1) lead to security problems (few academics, for example, hold the clearances necessary to assist such a committee),
  - (2) run the risk of discouraging “outside-the-box” thinking in research,
  - (4) involve international partners in projects better left in-house,
  - (5) dilute research efforts being directed from the top as national priorities.

  - While such a standing R&D coordination body could provide some sort of high-level peer oversight
  - ”Peer review “can increase the quality and credibility of the scientific information

<u>Recommendation</u>

- Establish peer review processes whenever possible in order to enhance the effectiveness of the research proposal process.
- This should include but not be limited to review of solicitations, review of grant proposals, and review of cooperative research and development agreement and partnership deliverables.
- Yet businesses and academia have different and more subtle roles to play than simply fulfilling the specifications of a contract,
- Not the least of which are educating the next generation of experts and creating market-driven technologies.
- Effective coordination could save money, reduce effort, increase the likelihood of success, and reduce the risk of high-risk research projects.
- research is to meet the needs of its future customers, efforts must be directed toward reducing the barriers between research and development.
- This effort will have the benefit of reducing the time gap from research project to working technology.

Character of work for R&D

- Statistics on funded R&D generally make distinctions among basic research, applied research, development, and R&D facilities and capital equipment-terms that describe the "character of work" in R&D programs.
- There will be wide variation depending on industry. Automotive, pharmaceuticals, software, and a few profitable biotechnology companies are increasing their R&D investments.
- Computer and networking equipment manufacturers, telecommunications, and chemical and process-related industries are closely controlling spending.
- Industrial R&D, while still dominated by in-house development work, is increasingly turning to collaborative programs, as opposed to outsourcing, with supply chain partners, universities, federal laboratories, and even competitors.
- Such joint efforts are now viewed as necessary to gain more rapid access to technologies, not simply to cut costs.

Global innovation strategies

- Countries all over the world are taking a close look at their innovation systems, tuning or revamping them, to insure economic security.
- Those that recognize and plan for a global economy are most likely to thrive.

Priority on a future research agenda would have the completion of:

- Health-related biological research.
- The Status of Transportation.
- The region's hot and primarily dry climate.
- Agricultural Research Management.

- Computer and Information Science and Engineering.

Strategic Goal 1 - Enhance Economic Opportunities for Agricultural Producers.

■ Research efforts in this area would promote the development of new or improved agricultural products and expand their uses to fill market needs
■ Targeted areas would include developing scientific knowledge to enhance productivity, efficiency, and quality of plant and animal production systems through agricultural genomics.

Strategic Goal 2 - Support Increased Economic Opportunities and Improved Quality of Life in Rural Areas.

■ Research would assist rural residents and community and business leaders gain and use knowledge and skills to help their communities thrive in the global economy.
■ Funding would include support for research and analysis in order to better understand the economic, demographic, and environmental forces affecting rural regions and communities.

Strategic Goal 3 -Improve the Nation's Nutrition and Health.

Research activities in this category would focus on scientific and socioeconomic research and nutrition education programs that would help people make informed food choices, reduce disease prevalence, obesity, and enhance quality of life.

■ Strategic Goal 4 - Protect and Enhance the Nation's Natural Resource Base and Environment.

Enhance the capability for forecasting response of ecosystems to multiple environmental changes such as climate, atmospheric chemistry, and land use management.

Strategic Goal 5-Directorate of Emergency Preparedness and Response:

- This directorate coordinates all federal assistance in response to disasters (including natural disasters) and domestic attacks, and folds in the former Federal Emergency Management Agency (FEMA).
- Strategic Goal 6 -Behavioral and Social Science Research.

Strategic Goal 7 - Networking and Information Technology Research and Development.

- In January 2006, resolution EB117.R13 of WHO's Executive Board highlighted:

- The importance and relevance of priority setting, reflecting the growing consensus that setting priorities for health research is as critical as conducting the research itself.

Setting priorities for health research: lessons from low- and middle-income countries

■ Each country should develop a strong national plan to conduct research on both country-specific and global health problems, and that each country should set its own national priorities for research.
■ One of the main strategies adopted by the Global Forum for Health Research was to promote more evidence-based priority setting; it developed the Combined Approach Matrix as a tool that can be used for this purpose.
■The matrix has been applied by the Global Forum for Health Research "to a range of settings, including global program and national plans, communicable and noncommunicable diseases, risk factors and vulnerable groups".

A country-driven activity

To identify the most important problems in health, health systems and health policy for which research might provide solutions.
This has provided national decision-makers with a solid foundation for negotiating with donor agencies to support national research.

Both a process and a tool

It is important to differentiate between the process of selecting priorities and the tools used in that process.
n The process is the mechanism by which constituencies are involved in and decide on research priorities,
n while the tools are the instruments that allow the information needed to set priorities to be collected, organized and analysed.

An evidence-based activity

- The trend is towards a more rational approach in which the collection and use of information (on what is needed and what is possible through research) has become crucial.

■ International organizations have made significant contributions to developing and refining methods for collecting and analysing information and thus facilitating the development of priority setting as an evidence-based activity
■ Challenge: serious obstacles to evidence-based priority setting include a lack of quality data, particularly about health systems and health research systems, and weak national (and subnational) capacity to collect and analyze relevant information.
■ These obstacles have raised questions about the reliability and credibility of outcomes.

■ The development of the Health Metrics Network, which brings together the producers and users of health information, represents a promising effort to strengthen national health information systems.
■ It has the potential to make a significant contribution to the use of evidence in priority setting.

A participatory and transparent process

■ The recognition that the mix of stakeholders participating in priority setting is a key determinant of the selection of research and development priorities has significantly influenced practices.
■ Now make conscientious efforts to involve all constituencies or stakeholders– researchers, decision-makers, health workers and community members – in some or all phases of the process.

A contribution to the development of health research systems

■ Priority-setting activities have stimulated countries to critically review their health research to identify systematically its strengths, weaknesses, gaps and opportunities, and to address related issues.

The process

Most countries have defined priority setting as an iterative process, organizing it in phases such as preparing and planning, collecting data, consulting and involving stakeholders, organizing national events, aligning resources, etc.
■ The process has tended to be organized geographically, moving from the district, province and region to the national level.
■ This bottom-up approach increases the chances that a more context-sensitive and culturally sensitive process of priority setting will occur.

A value-driven activity

■ Identifying, selecting and ranking specific criteria give the process of priority setting a more objective and transparent character.
■ Such ranking also emphasizes the fact that setting priorities means making choices, and those choices must refer to defined underlying values (for example, equity versus cost-effectiveness).
■ Questions that deserve urgent attention and action include
- How to operationalize equity as a criterion for priority setting,
- What information to collect and how, as well as how to establish the political will to actually use the criterion of equity.

Recap and suggest the threads which must enter into a new Arab social science agenda for the 21st century

■ *Communication and electronic media research.* These involve patterns, processes and trends, and impact on listeners as well as viewers.

■ Participation of the dispossessed and marginalized groups in public life. This particularly affects women, youth, the poor, the disabled, ethnic and minority groups.

■ *Patterns and political economies of conflict.* Human and material resources have been wasted on intra-state and inter-state conflicts.
■ *Post-conflict reconstruction.* Very little research has taken place in the area of conflict management and resolution. That gap must be filled. It should be complemented by research initiatives on post-conflict reconstruction on the inter-personal, inter-groups, and inter-state levels.
■ *Social casualties of socio-economic change.* With the massive structural economic adjustment, integration in global economy, and the anticipated stiffening competition on world scale, there are bound to be far more social casualties than we have already seen in the 1980s and 1990s. Appropriate safety nets will have to be among the priorities of policy research.
■ *Gender and human security research.* Although issues of women's victimization and marginalization, and women's quest for empowerment have become increasingly prominent in the 1990s, much research is still needed in the general area of gender, with particular emphasis on the interactive patterns between the sexes, from childhood to old-age, as well as across classes.
■ With the changing age structures of the Arab population, *numbers of older women will probably increase proportionately.* Since most Arab women are not part of the organized formal labor force, they will be outside the "social security" (pension) schemes. Modalities to cope with this eventuality must be anticipated by policy and action-oriented research.
■ *Water politics research.* Water is still the most scarce natural resource in the MENA region. By the mid-1990s, the price of a liter of purified drinking water was more than a liter of processed oil. Water management and/or conflict over water are already and bound to be even more prominent issues in the next century. The social and community-related dimensions of water-sharing should find an easy place on the research agenda of the MENA region. This is also an area of research in which foreign funding does not cause controversial debates.
■ *Civil society and democratization.* Already appropriating part of the Arab research agenda in the 1990s, the processes of civil society and democratization are bound to increase in the new century. Reversals are also expected. Both advances and setbacks deserve as much research attention. Work in the area overlaps research on the quests for inclusion, participation, and conflict resolution.
■ *Research institutions.* Research on research institutions may sound like a tautological luxury. Far from it. To carry out the above-mentioned, nine new research priorities - along with continuing research agenda from the 20th century - new breeds of social research institutions must be developed.

Recent Trends in Science Research

- Some critics fear that financial dependence on private sources will diminish the independence of the university and its scientists (*Nature*, 2001).
- Others see conflicts of interest in publishing results that can be developed into potential products, and fear that private stakeholders will eventually undermine some basic principles of research.
- The potential benefits to be gained from private and public co-operation in the academic world.
- Indeed, this new strategic attitude promises to create advantages both from a general economic point of view as well as royalties that can be re-invested into research and thus strengthen the universities' research base.

Possible Future Trends in Basic and Applied Research

- Many scientists are greatly concerned that, in the next 40 years, the population of our planet will increase so dramatically that the earth will no longer be able to support our current standard of living.
- As more and more countries become industrialized the problems associated with this lifestyle - overuse of raw materials, energy consumption, and pollution - will also increase.
- Scientists are worried that the planet will reach an unsustainable level of use.
- Science research may be able to help solve these problems.
- This would require funding for long-term applied research - - research geared not toward creating products to help us compete with other industrialized nations, but rather research focused on sustainable use of our planet's resources.
- Solving problems of global sustainability will probably require a multi-disciplinary approach, that is, teams of scientists from different research areas working together.
- Multi-disciplinary projects utilize the *expertise* of scientists in different fields (e.g., biology, geology, chemistry, and physics).
- It also opens new lines of communication among researchers.
- Joint research projects of this type are more likely to *receive funding* from agencies such as the Department of Energy, the National Institutes of Health, and the National Science Foundation.

Scientists doing basic research

This group receives most of its money from government funds.
- The results of their research add to the knowledge and understanding of the world.
- This research does not produce new goods or services.
- Without it, however, applied scientists might not be able to develop new products and services in the future. (For example, Human Genome Center)

Scientists doing applied research

this group receives funding from both industry and government.

- The products of its research change our lives and benefit business. These scientists help make their countries more competitive in the global marketplace. (For example, Advanced Light Source, Genentech

Government employees

Individuals charged with deciding how to spend the money put aside for research.

- They allocate funds for different areas of both basic and applied research that will best help meeting the above goals. (For example, see National Academy of Sciences, National Institutes of Health)

Environmental groups

Members are interested in solving environmental problems such as air, water, and land pollution.

- This group thinks moneys for both basic and applied research should be used to solve these problems first.
- They argue that, unless these issues are solved, the planet will not be able to sustain itself for future growth. (For example, The Ecosystem, "Our Environment")

Health care professionals

doctors, nurses, and other health care givers and researchers interested in solving serious health care issues, such as cancer.

- These problems cost millions of dollars in medical treatment.
- This group wants basic and applied research funds to be used to solve these problems first.
- They argue that effective prevention will free money now spent on health care for other purposes in the future. (For example, Centers for Disease Control)