ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges of Health Technologies in Arab Countries

Ziad O. Abu-Faraj, Ph.D.
Professor of Biomedical Engineering
ETC Consultant

Regional Forum on “National Knowledge and Technology Development and Transfer Systems”
UN House, Beirut, Lebanon
November 27-29, 2017

ESCWA Technology Centre

Table of Contents

ESCWA Technology Centre

Background

- **Health Technology** is the "*application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives.*" Source: World Health Organization
- It consists of a wide spectrum of health-related products to treat diseases or medical conditions affecting humans.
- They range from pharmaceuticals and devices to procedures and organizational systems used in healthcare.

ESCWA Technology Centre

Background

- Founded on STI, recent advances in Health Technology are steered towards improving the quality of healthcare delivered through:
  - Earlier diagnosis
  - Less invasive treatment options
  - Reductions in hospital stays and rehabilitation times
  - Cost reduction
- Currently, healthcare practitioners rely heavily on the innovations in medical technology to:
  - improve diagnosis, advance surgical procedures, and provide better patient care

ESCWA Technology Centre

Background

- Unfortunately, this *magnificent* reality in healthcare is not equitably distributed among the different nations of the world.
- In certain nations, deficiency in healthcare and well-being is often shared with other socio-economic and environmental afflictions:
  - poverty, hunger, education, gender, water and sanitation, energy, economy, industry, infrastructure, peace, justice, and other aspects of life

ESCWA Technology Centre

Background

- In a comprehensive global vision, the United Nations took an initiative to integrate and balance the three dimensions of sustainable development:
  - economic, social, and environmental
- At the onset of 2016, the world officially began the implementation of transformative plan of action based on 17 Sustainable Development Goals (SDGs) to address pressing global challenges over the next 15 years.

ESCWA Technology Centre

Background

- This was delineated in the United Nations 2030 Agenda for Sustainable Development (SD) which mainly focuses on inclusive development and "*Leaving no one behind*".
- It has been described as *"a road map for people and the planet that will build on the success of the Millennium Development Goals and ensure sustainable social and economic progress worldwide*." Source: Ban Ki-moon. In: The Sustainable Development Goals Report 2016.

ESCWA Technology Centre

Background

- The significance of the social and environmental factors on health outcomes and the strong role of the healthcare sector in the industrious and economic development, make the health-related goals a *unique case* that demands on their implementation:
  - intensive interdisciplinary analysis
  - multi-sectoral expertise

ESCWA Technology Centre

Background

- Innovation and development in **Health Technologies** can take place in many forms.
- There are strong dependencies on several factors, including:
  - healthcare professionals, organizations, and systems
  - role of governments in shaping healthcare planning and financing
  - strong legislative mechanisms
  - appropriate relationship between innovation and healthcare costs
  - particular features of mainstream, disruptive, and social innovations

ESCWA Technology Centre

Background

- Today, the healthcare sector in the Arab countries—emerging markets or developing economies—is progressing as a platform where new models on Science, Technology and Innovation (STI) in many spheres of activity are evolving based on vital partnership among public, private, and academic sectors.
- Such spheres include but are not limited to:
  - biotechnology, fine chemicals, information technology, nanotechnology, and solid-state devices

ESCWA Technology Centre

Objectives

- To identify Strengths, Weaknesses, Opportunities, and Challenges (SWOC) for developing the Health Technologies in the Arab Countries.
- This study also addresses the following points:
  - Mapping of Existing Technology Facilitation Initiatives
  - Capacity of Arab Countries for RDI in the Health Sector
  - Science, Technology, and Innovation Role
  - Areas of Synergy and Cooperation on Technology-Related Work

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **Technology Facilitation Initiatives** is a fundamental requirement for meaningful and sustainable *capacity building* and *technical assistance* to the developing countries on technology development, transfer, and deployment.
- Accordingly, the major entities that have played a key role in technology facilitation within the Arab world are described:
  - The Tempus Program (1990-2013)
  - The EU Framework Programmes (FP1-Fp8: 1984-2020)
  - UN-ESCWA Technology Networking
  - Trilateral Cooperation between WHO, WIPO, and WTO
  - Qatar Foundation

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **TEMPUS** is a program developed by the EU that supports the modernization of higher education in the geographical areas that surround the EU.
- This program promotes institutional cooperation between the EU and the following Partner Countries:
  - Eastern Europe, Central Asia, the Western Balkans and the Mediterranean region.
  - The Arab partner countries are: Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, and Tunisia.
- Tempus major aim is on the reform and modernization of higher education systems in the Partner Countries by promoting a *people-to-people approach* through the support of *consortia of institutions* composed mainly of universities, university associations, and non-academic partners.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- At the beginning of the year 2014, Tempus–capacity building activities became part of a new cooperation program called Erasmus+, which provides scholarships to developing country students allowing them to participate in top-level Master courses and Doctorate programs abroad.
- Institution of higher education are considered as the pools of expertise and centers for the development of human resources and, hence, are viewed as key players in an effective transition to a knowledge-based economy and society and they provide the training for a new generation of leaders.
- As part of its networking strategy, Tempus has supported the establishment of National Tempus Offices in partner countries.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- From 1990 till 2006 Tempus has funded 6500 projects, involving 2000 universities from the European Union and its Partner Countries.
- Between 2000 and 2006, 788 *Joint European Projects* and 1492 *Individual Mobility Grants* were funded.
- In addition, during the same period, Tempus supported 270 *Structural and Complementary Measures* across all regions.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- The **EU Framework Programmes** for Research and Technological Development, also known as **Framework Programmes**, are funding programs created by the European Commission of the EU to support and foster research in the European Research Area. **Total Funding: Over € 190 billion in 36 years**
- The specific objectives and actions of these programs vary between funding periods according to the following phases: (FP1-FP8: 1984-2020)

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **FP1 (1984-1987) Total budget: € 3.75 billion** – The main objective of this Framework Program was to define and implement an overall development, research and demonstration strategy at Community level.
- **FP2 (1987-1991) Total budget: € 5.40 billion** – By means of the Single European Act (SEA) of 1986, whose objective was "*strengthening the scientific and technological basis of European industry and encouraging it to become more competitive at international level*", the SEA introduced a new criterion to the FP2: The Community's social and economic cohesion.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **FP3 (1990-1994) Total budget: € 6.60 billion** – The main objective of this Framework Program was to strengthen the scientific and technological basis of the European industry and its competitiveness on a global scale by supporting enterprises, research centers, and universities in their research and development activities.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **FP4 (1994-1998) Total budget: € 13.10 billion** – This Framework Program introduced some major changes to the existing research fields of the previous Framework Programmes; namely, Information and Communication technologies, Industrial technologies, Environment, Life Sciences and Technologies, Energy, Transport, and Targeted Socio-Economic Research.
  - ✓ Three additional horizontal programs have also been implemented: i) the promotion of research, technological development and demonstration (RTD) cooperation with third countries and international organizations – also known as International Cooperation Programme (INCO); ii) dissemination and optimization of results; and, iii) training and mobility of researchers.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **FP5 (1998-2002) Total budget: € 14.96 billion** – This Framework Programme was intended to respond to major socio-economic challenges in a manner that preceding programs have not.

  It aimed at three main criteria: i) Social objectives; ii) Economic development; and iii) Science and Technology (S&T) prospects. In order to maximize its impact, the FP5 only focused on:

  - ✓ **Four thematic programs:** i) quality of life and management of living resources; ii) user friendly information society; iii) competitive and sustainable growth; and, iv) energy, environment and sustainable development.
  - ✓ **Three horizontal programs:** i) confirming the international role of Community research; ii) promotion of innovation and encouragement of participation of small and medium-sized enterprises (SMEs); and, iii) Improving human research potential and the socio-economic knowledge base.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **FP6 (2002-2006) Total budget: € 17.50 billion** – The main objective of this Framework Program was the contribution to the creation of a European Research Area (ERA) by improving, integrating, and coordinating research within Europe that was vastly disjointed at the time. FP6 introduced two new instruments:
  - ✓ Integrated projects that aimed at bringing together a critical mass of resources focused on specific objectives so as to increase the competitiveness within Europe and address its major societal needs.
  - ✓ Networks of excellence that aimed at integrating the critical mass of resources and expertise at a European level by connecting partners around a joint program of activities.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **FP7 (2007-2013) Total budget: Over € 50.00 billion** – This Framework Program was implemented with the intention of meeting the needs of Europe in terms of jobs and competitiveness and maintaining leadership in the global knowledge economy.

  Accordingly, the Framework Program was structured around five main building blocks: i) Cooperation, ii) Ideas, iii) People, iv) Capacities, and v) Nuclear research.

  One significant aspect of FP7 was the "*transnationality*" of several actions, whereby activities had to be conducted by consortia that included participants from different Members States or Associated Countries.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **FP8 or Horizon 2020 (2014-2020) Total budget: Estimated € 80.00 billion** – Horizon 2020 is the largest European Union Research and Innovation program.

  The main focus in FP6 and FP7 was on technological research; while, in Horizon 2020 the main focus is on:

  - ✓ Research
  - ✓ Innovation
  - ✓ Providing faster economic growth
  - ✓ Developing solutions to end users, mainly governmental agencies.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- It was evident from FP6, FP7, and Horizon 2020 that the European Union is actively supporting research in the Health Sector with an ultimate goal: "*better health for all*".
- Arab Partner Countries that participated in FP7 projects are: Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, Syria, and Tunisia.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **UN ESCWA Technology Networking –** ESCWA is committed to developing a region-wide networking and partnerships platform with stakeholders from the public and private sectors so as to foster Science, Technology, and Innovation (STI) within the region.
- Among the tools that have been mobilized are the promotion of technology transfer, and science diplomacy and technology matchmaking.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- ESCWA has been implementing since 2015 the UN-Development Account project toward the "*Establishment of National Technology Transfer Offices (NTTO) in selected ESCWA member countries*":
  - Egypt, Lebanon, Mauritania, Morocco, Oman, and Tunisia.
- This project aimed to enhance national innovation system capacity through updating related legislations and policies, as well as the establishment of NTTO linked to universities and research institutions so as to facilitate the partnership among the research community, economic development sector, local industry, chambers of industry, incubators and science parks, innovative funding agencies, entrepreneurship and civic society, investments platforms, and relevant governmental actors in those selected countries.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **Trilateral Cooperation between WHO, WIPO, and WTO**

  Public Health has been fundamentally a worldwide challenge and, hence, takes on a pressing priority for international cooperation.

- International cooperation on public health may be realized in different forms.

  Over the recent years, increased attention has been given to the role of **medical technologies** in both:

  - The innovation processes that lead to new technologies
  - The means by which these technologies are disseminated in health systems

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- Today, the focus in *Public Health* has shifted to a broader range giving consideration as to:
  - How to promote the requisite innovation
  - How to address neglected health needs
  - How to ensure equitable access to all vital medical technologies, including medicines, vaccines, and medical devices
- WHO, WIPO, and WTO have been identified to take a leading role in implementing such international cooperation via intensified interagency collaborations on matters associated with public health, intellectual property, and trade.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- The result of this venture is a study entitled "*Promoting Access to Medical Technologies and Innovation – Intersections between Public Health, Intellectual Property and Trade*" and published in 2012.
- The study came as a response to a growing demand, particularly in developing countries, "*for strengthened capacity for informed policy-making*" in areas at the juncture amongst health, intellectual property, and trade and focusing on "*access to*" and "*innovation of*" medicines and other medical technologies.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **Qatar Foundation** – Ever since its establishment in 1995, Qatar Foundation has been committed to motivating a culture of innovation and creativity so as to fulfill its overarching mission of unlocking human potential.
- During the past 20 years, Qatar Foundation has developed centers and joint ventures across its fundamental areas of education, science and research, and community development.
- Today, more than 50 Qatar Foundation institutions working in tandem to help realize the **Qatar National Vision 2030** of transforming the nation from a hydrocarbon- to a knowledge-based economy.

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- **Qatar Foundation**, through its education and research initiatives, is now leading the human, social, and economic development of Qatar.
- Qatar Foundation R&D has directed the science and research mission across the four research priority areas determined by the *Qatar National Research Strategy* that was launched in 2012.
- The four priority spheres include:
  - i) Energy and Environment; ii) Computing and Information Technology; iii) Health; and, iv) Social Sciences, Arts and Humanities

ESCWA Technology Centre

Mapping of Existing Technology Facilitation Initiatives

- Several initiatives and national organizations demonstrate Qatar Foundation's pledge to the formation of a healthy and contented society, these include:
  - Qatar National Research Fund
  - Qatar Science & Technology Park
  - *Sahtak Awalan* by Weill Cornell Medical College in Qatar and the Supreme Council of Health
  - Qatar Biobank for Medical Research

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- In surveying the Arab Countries' capacity relevant to Research, Development, and Innovation in the health sector, four entities ought to be considered:
  - Preparing the Biomedical Engineer of Tomorrow
  - University Hospitals and Medical Centers
  - Medical Firms
  - National Research Centers
- The MIT High-Tech Medical Technology Model is then used as a benchmark against which the union of these entities may be compared.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- **Preparing the Biomedical Engineer of Tomorrow** – According to Whitaker Foundation, Biomedical Engineering is "A discipline that advances knowledge in engineering, biology and medicine, and improves human health through cross-disciplinary activities that integrate the engineering sciences with the biomedical sciences and clinical practice. It includes:
  - The acquisition of new knowledge and understanding of living systems through the innovative and substantive application of experimental and analytical techniques based on the engineering sciences.
  - The development of new devices, algorithms, processes and systems that advance biology and medicine and improve medical practice and health care delivery."

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- As an acclaimed field in science and technology, **Biomedical Engineering** has propelled the advancements in medicine and biology.
- Since the late 1950s, biomedical engineering education has been evolving and proliferating around the world.
- By the year 2010, biomedical engineering education has shown to manifest a global healthy growth in that 704 programs are offered in 6.73% of the universities in the world.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- Based on a comprehensive study of the literature on innovation in learning sciences and technology as well as on ***curriculum philosophies*** of VaNTH , the Whitaker Foundation, and ABET, a research work entitled "*Project Alexander the Great*" supported by an empirical study was launched by Abu-Faraj in 2007 and aimed to quantify the overlap/differences between existing biomedical engineering curricula in the Arab world within MENA region so as to uphold first-class biomedical engineering education.

ESCWA Technology Centre

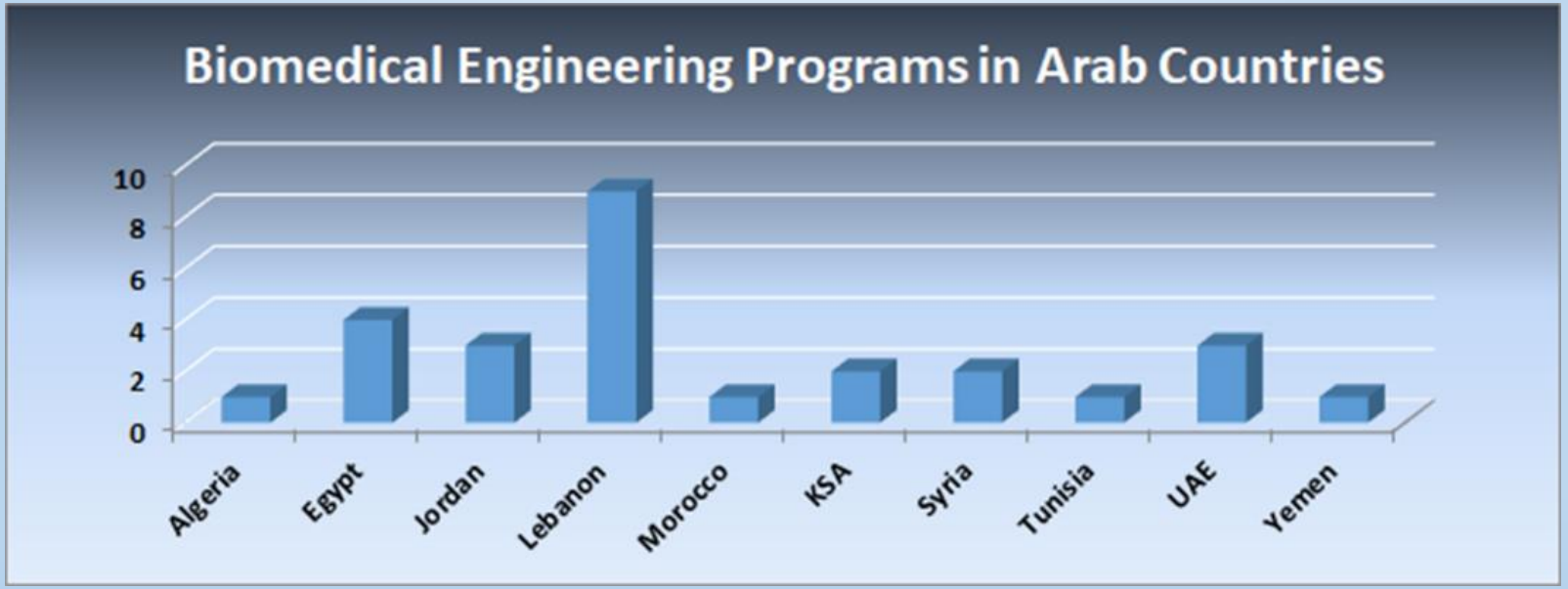
Capacity of Arab Countries for RDI in the Health Sector

- This endeavor was done so as to establish the foundation and environment through which the various stakeholders in the field of Bioengineering/Biomedical Engineering can communicate interactively.
- The collected data of the said study is fundamental, comprehensive, and is valuable not only to practitioners, research scientists, faculty, and students as target audience, but to other closely-related entities, including industry, professional societies, academic institutions of higher education, accreditation agencies, ministries of higher education, and other governmental agencies.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- Twenty-seven of these programs are offered in Arab countries' universities in the Middle East and Northern African (MENA) region.

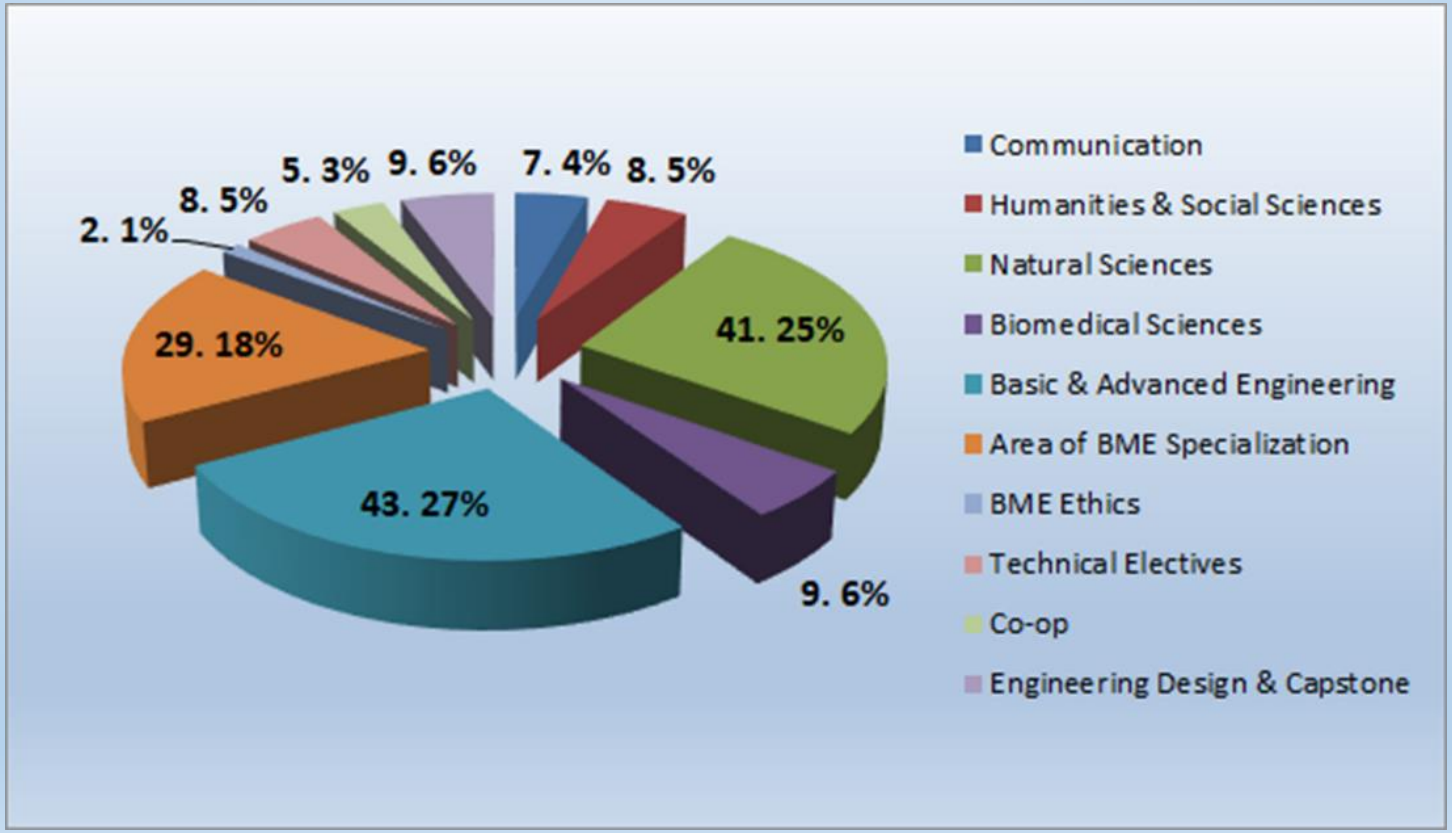


Source: Abu-Faraj ZO. Project Alexander the Great: An Analytical Comprehensive Study on the Global Spread of Bioengineering/Biomedical Engineering Education. Trends in Materials Science. Vienna, Austria, EU: Intech Open Access Publisher, pp. 549-564, 2010.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

The results obtained from this study of the Biomedical Engineering curricula offered in the MENA region are presented as averaged percentage breakdown by domain.



ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- The programs of these curricula—to a certain degree—are compliant with the requirements of the aforementioned three ***curriculum philosophies*** in that:
  - 43% of the programs' credits are given to '*Basic & Advanced Engineering*'
  - 41% to '*Natural Sciences*'
  - 29% to '*Area of Biomedical Engineering Specialization*'
  - Remaining percentages are distributed among the other domains
- It is worth noting that five programs are accredited by the Engineering Accreditation Commission of ABET.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- It can be deduced that there is a healthy growth and interest in this field within the MENA region.
- What is currently needed is the strengthening of Research, Development, and Innovation practice within the identified institutions in order to be compatible and on a par with the global advancements in Science, Technology, and Innovation related to this field.
- More interaction between institutions of higher learning and industry is needed to promote the quality of healthcare and to further contribute to the advancement of knowledge in biology, medicine, and engineering.

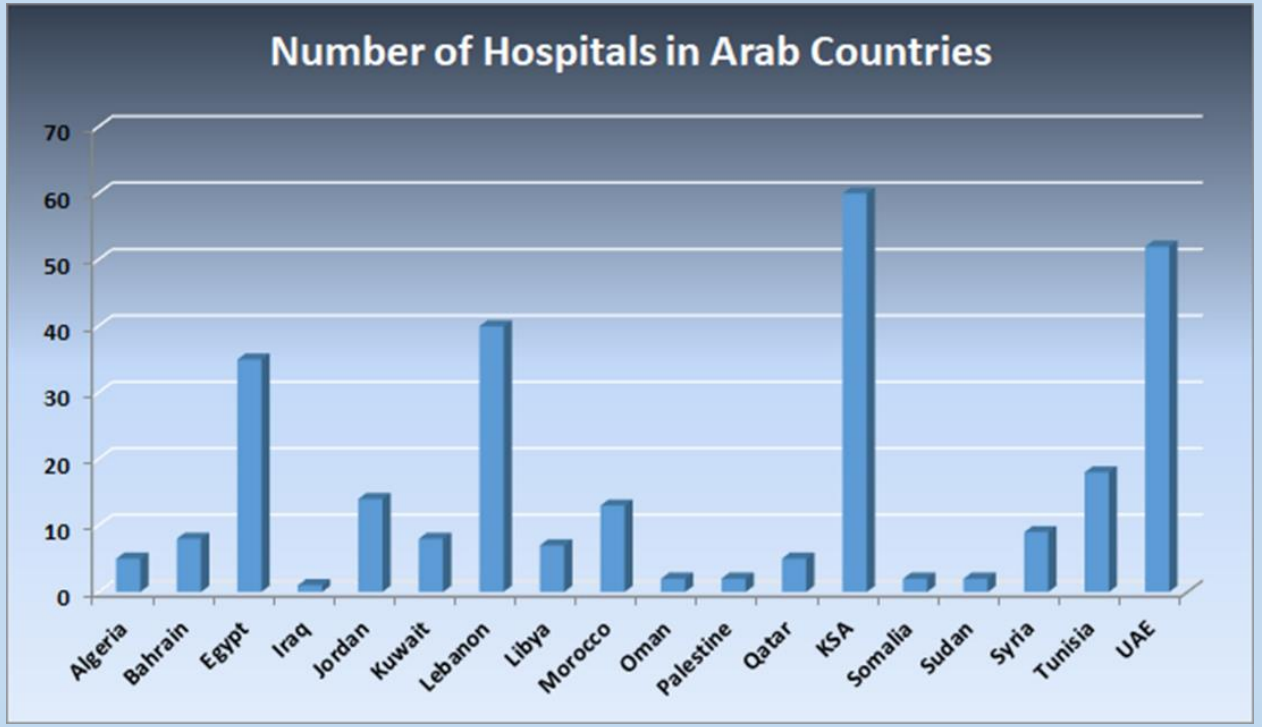
ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- **University Hospitals and Medical Centers** involved in Research, Development, and Innovation provide:
  - A means for the identification of relevant contemporary problems related to healthcare
  - A platform upon which innovative Health Technologies developed to address these problems could be validated
- Accordingly, 283 hospitals were identified in 18 countries in the Arab world using the "*Ranking Web of World Hospitals*" of the Cybermetrics Lab; a credible public research body in Spain.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector



This investigative search is intended to obtain a preliminary idea about the regional healthcare map and its potential contribution to RDI related to Medical Technologies, 8 University Hospitals were identified from among the 283 Arab world hospitals: 2 in KSA, 5 in Lebanon, and 1 in Syria.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- **Medical Companies** available in the Arab world mainly provide *sales* and *maintenance* of Medical Technologies from internationally recognized medical products manufacturers.
- These technologies fall into many categories, the most commonly used are:
  - Medical Devices
  - Medical Imaging and Nuclear Medicine Machines
  - Molecular Biology and Medical Laboratory Technologies
  - Dental Supplies and Laboratories

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- A few of these **Medical Companies** provide:
  - Customized solutions to specific problems encountered at a clinic, laboratory, or hospital.
  - Rehabilitation solutions to individuals with disabilities; such as, spinal cord injury, stroke, cerebral palsy, and other neuro-musculo-skeletal disorders.
  - Prosthetic limbs—ranging from simple prostheses to state-of-the-art myoelectric ones.
  - Conversions of ambulances to high-tech paramedic units.

ESCWA Technology Centre

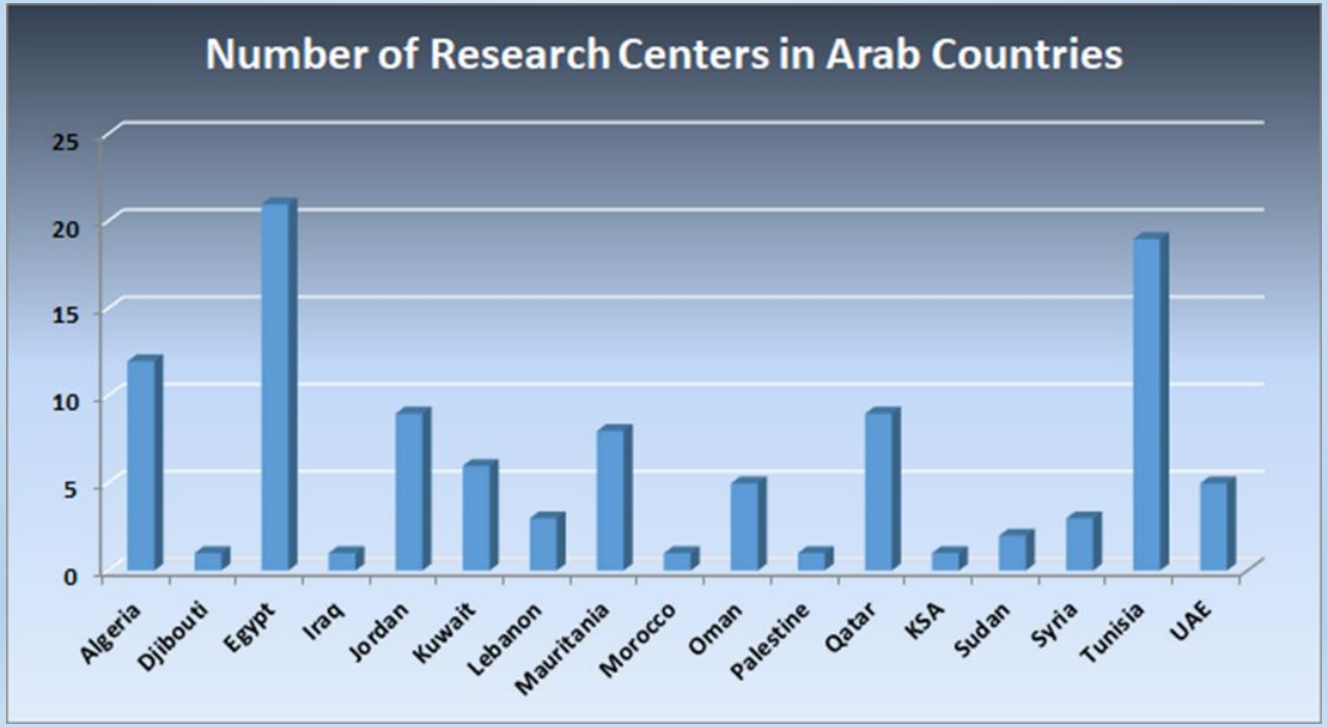
Capacity of Arab Countries for RDI in the Health Sector

- **National Research Centers** involved in Research, Development, and Innovation in the fields of Human Biochemistry, Biology, Biotechnology, Medicine and Biomedical Engineering complement the work of the aforementioned University Hospitals and Medical Centers.
- They also contribute to providing:
  - A means for the identification of relevant contemporary problems related to healthcare
  - A platform upon which innovative Health Technologies developed to address these problems could be validated

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- Accordingly, 102 Research Centers were identified in 17 countries in the Arab world using the "*Ranking Web of World Research Centers*" of the Cybermetrics Lab in Spain.



ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- To obtain a preliminary idea about the regional healthcare map and its potential contribution to RDI related to Medical Technologies, a search was done to single out those research centers involved in any of the previously-mentioned disciplines that might relate to healthcare:
  - 2 in Algeria, 1 in Djibouti, 4 in Egypt, 1 in Iraq, 4 in Jordan, 5 in KSA, 2 in Kuwait, 3 in Lebanon, 1 in Mauritania, 3 in Morocco, 1 in Palestine, 5 in Qatar, 2 in Sudan, 3 in Tunisia, and 2 in UAE

ESCWA Technology Centre

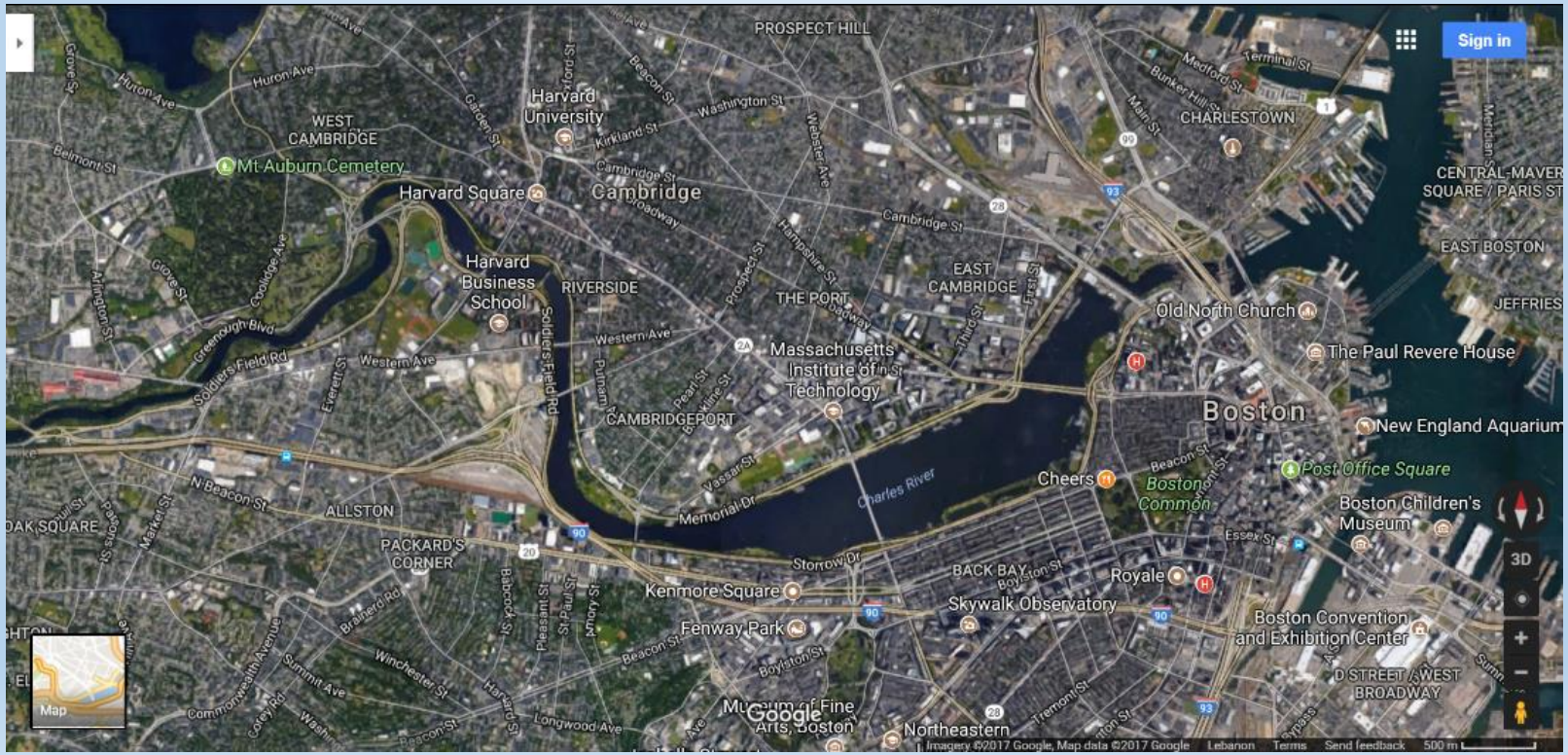
Capacity of Arab Countries for RDI in the Health Sector

- The **MIT High-Tech Medical Technology Model** is introduced herein as a benchmark against which the union of the aforementioned entities—Biomedical Engineers, University Hospitals and Medical Centers, Medical Companies, and National Research Centers—may be compared.
- The ***MIT High-Tech Medical Technology Model*** in Cambridge, MA, USA, is an efficient existing exemplary model where numerous Boston-Area Hospitals , Microelectronics Industry, and Biomedical Companies are clustered around a high-tech institute offering biomedical/bioengineering education and RDI in Medical Technologies.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- Accordingly, MIT is a hub located in an optimal position that permits it to engage in collaborative endeavors with its healthcare neighbors, and in empowering the innovation economy with the research, start-ups, and talent pool that it generates.



ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- Two prominent divisions—among others—have contributed to this exceptional reality; these are the **Medical Electronic Device Realization Center (MEDRC)** and **Harvard-MIT Division of Health Sciences and Technology (HST)**.
- Within the MEDRC, research activities are cooperatively delineated by faculty, physicians and clinicians, and industrial partners.
- Concurrently, the MEDRC regularly hosts visiting scientists—from microelectronic and medical device firms—to provide their industrial viewpoint in the project definitions, and partake in the realization of the technology.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- In this respect, prototype system architectures that can be employed in clinical tests early in the project to assist in guiding the research technology that is being developed at the same time are established.
- As such, the MEDRC serves as a central point for large business, venture-funded startups, and the medical community.
- Additionally, the MEDRC fosters the production of prototype devices and its associated Intellectual Property, and strategically plans to serve as the catalyst for the deployment of innovative Health Technologies that will reduce the cost of healthcare in both the developed and developing world.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- The **Harvard-MIT Division of Health Sciences and Technology** (HST) joins the Massachusetts Institute of Technology (MIT), Harvard Medical School (HMS), Harvard University, and Boston area teaching hospitals in a distinctive alliance that integrates science, medicine, and engineering to strategically solve problems related to human health.
- Over 300 graduate students majoring in science, medicine, and engineering perform their training abreast at HST.
- Additionally, faculty members of HST—selected from a wide range of departments at MIT and Harvard—lead these students into vital careers.

ESCWA Technology Centre

Capacity of Arab Countries for RDI in the Health Sector

- Such an interdisciplinary tactic to biomedicine is steered towards striking innovations.
- To conclude this section, The MIT High-Tech Medical Technology Model is an amalgam of several factors—vision, expertise, infrastructure, venture, and circumstances *et al.*—that have been mixed together to create a successful juggernaut for RDI in Health Technologies.

ESCWA Technology Centre

Science, Technology, and Innovation Role

- Science, Technology, and Innovation (STI) have been acknowledged as an essential prime mover behind productivity increases, and a key long-term enabler of economic growth and prosperity.
- In the framework of the UN 2030 Agenda for Sustainable Development, and for the achievement of the Sustainable Development Goals (SDGs), STI plays an even more fundamental role.

ESCWA Technology Centre

Science, Technology, and Innovation Role

- STI has been accentuated in:
  - SD Goal 9: “Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.”
  - SD Goal 17: “Strengthen the means of implementation and revitalize the global partnership for sustainable development.”
- Additionally, the Addis Ababa Action Agenda (AAAA)—an important part of the UN 2030 Agenda—has identified solid policies and actions, including STI, as support for realizing the SDGs.

ESCWA Technology Centre

Science, Technology, and Innovation Role

- Furthermore, during the negotiations of the “2015 United Nations Climate Change Conference”, the negotiations addressed STI issues, particularly:
  - Highlighting the idea that cooperative action is crucial to facilitate and promote technology.
  - Recommending a framework for enhanced action on technology development and transfer.

ESCWA Technology Centre

Science, Technology, and Innovation Role

- In particular, the AAAA acknowledges that "*the creation, development and diffusion of new innovations and technologies and associated know-how, including the transfer of technology on mutually agreed terms, are powerful drivers of economic growth and sustainable development*".
- It further adopts "*science, technology and innovation strategies as integral elements of our national sustainable development strategies to help to strengthen knowledge-sharing and collaboration*".

ESCWA Technology Centre

Science, Technology, and Innovation Role

- The AAAA also emphasizes the following selected points related to STI:
  - “The role of new innovations, technologies and associated know-how, including the transfer of technology on mutually agreed terms, as powerful drivers of economic growth and sustainable development”.
  - “The need to craft policies that incentivise the creation of new technologies, that foster research and that support innovation in developing countries”.

ESCWA Technology Centre

Science, Technology, and Innovation Role

- “The importance of an enabling environment at all levels, including enabling regulatory and governance frameworks, in nurturing science, innovation, the dissemination of technologies, particularly to micro, small and medium-sized enterprises, as well as industrial diversification and value added to commodities”.
- “Knowledge-sharing and the promotion of cooperation and partnerships between stakeholders, including between governments, firms, academia and civil society, in sectors contributing to the achievement of the SDGs”.

ESCWA Technology Centre

Science, Technology, and Innovation Role

- “The important role of public finance and policies in research and technological development, as well as the use of public funding to enable critical projects to remain in the public domain, and open access to research for publicly funded projects”.
- “The need to step up international cooperation and collaboration in science, research, technology and innovation, including through public-private and multi-stakeholder partnerships, and on the basis of common interest and mutual benefit, focusing on the needs of developing countries and the achievement of the SDGs”.

Source: Giovannini E, Niestroy I, Nilsson M, Roure F, and Spanos M. The Role of Science, Technology and Innovation Policies to Foster the Implementation of the Sustainable Development Goals: Report of the Expert Group “Follow-up to Rio+20, notably the SDGs”. Directorate-General for Research and Innovation, European Commission, 57 pp., 2015.

ESCWA Technology Centre

Science, Technology, and Innovation Role

- To sum up, the UN 2030 Agenda for Sustainable Development and its SDGs present a new long-term vision on global development that needs to be embedded within a policy framework that incorporates all dimensions of Sustainable Development; and, that needs to be strongly engrained in decision-making of governments, businesses, and people.
- STI are essential constituents of such a paradigm shift since they permit improved efficacy in both economic and environmental perspectives by:
  - i) “developing new and more sustainable ways to satisfy human needs”; ii) “overcoming historical divides”; and, iii) “empowering people to drive their own future.” Source: Giovannini E *et al.*

ESCWA Technology Centre

Science, Technology, and Innovation Role

- The aforementioned pragmatic vision on global development could be implemented in ESCWA Member Countries, most of which have not adequately exploited science and technology within their local capacity for enterprise and socio-economic development. This resulted in:
  - Present capacity not being fully utilized
  - Local production systems are delivering marginally competitive marketable products and services.
- Hence, there is a need to reconfigure a formal role for STI to re-engineer the local problem solving methods and the planning for an ideal economic cycle.
- Such has been the role of the National Technology Transfer Offices (NTTO) in selected ESCWA member countries.

ESCWA Technology Centre

Areas of Synergy and Cooperation on Technology-Related Work

- Several technology-related areas exist where synergistic and cooperative work could be established. These are:
  - Bioelectromagnetism; Bioethics; Biomaterials; Biomechanics; Biomedical Instrumentation; Biomedical Sensors; Bionanotechnology; Biotechnology; Clinical Engineering; Medical and Bioinformatics; Medical and Biological Analysis; Medical Imaging; Neural Engineering; Physiological Modeling, Simulation, and Control; Prosthetic-Orthotic Devices and Artificial Organs; Rehabilitation Engineering; and, Tissue Engineering.

ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges

- The next step in the "*Mapping of Health Technologies Development and Transfer in Arab Countries*" is to identify, by priority, the Strengths, Weaknesses, Opportunities, and Challenges (SWOC) of the strategic objective of developing the Health Technologies in Arab Countries.

Strengths, Weaknesses, Opportunities, and Challenges

- **Technology Facilitators:** UN-ESCWA National Technology Transfer Offices (NTTO), World Health Organization (WHO), World Intellectual Property Organization (WIPO), World Trade Organization (WTO), World Bank, European Commission-Education, European Commission-Audiovisual and Culture Executive Agency (EACEA), European Union-Framework Programmes for Research and Innovation, Ministries of Trade and Industry, International Professional Organizations, Qatar Foundation, Incubators and Accelerators.
- **Funding Agencies and Countries:** United Nations Specialized Agencies, European Union, Central and National Banks, Islamic Development Bank, Private Funds.
- **Research, Development, and Innovation:** Biomedical Engineers, Universities, Ministries of Education and Higher Education, Ministries of Public Health, National Research Centers.
- **Intellectual Property—Quasi Strength:** World Intellectual Property Organization (WIPO), Paris Convention for Protection of Intellectual Property, United States Patent and Trademark Office, Arab Society for Intellectual Property (ASIP).

ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges

- Intellectual Property (IP) protection has been considered in this study as a Quasi-Strength, while in reality it has a shy presence within the Arab Countries.
- There is a legitimate reason behind such a coerced choice; to be specific:
  - It is required in disputing a more significant Challenge, namely Competition.
  - There are serious attempts within several Arab Countries to legislate IP protection through Governmental Organizations, such as Ministries of Economy and Trade, or NGO's, such as Abu-Ghazaleh Intellectual Property, but they are not fully taken advantage of on behalf of inventors.
  - IP Rights could be obtained from abroad, such as from the United States Patent and Trademark Office. Hence, while this endeavor reaches its full operational maturity, it can be bypassed to address more serious Challenges.

ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges

- **Networking and Communication:** Liaisons among stakeholders is fragmented. Dissemination of Information does not reach all stakeholders. Role of Embassies and Consulates is not defined. Though Regional Forums, Conferences, Symposia, and Workshops are being held, they still need to involve all stakeholders.
- **Number of University Hospitals:** Although the number of Hospitals in the Arab World answers the needs of its populations in terms of Healthcare, the number of Hospitals involved in RDI in Health Technologies is not enough.
- **Graduate Programs:** Although the number of Curricula in Biomedical Engineering within the Region is up to par, these curricula focus mainly on Undergraduate Programs. The number of Graduate Programs and their engagement in RDI related to Health Technologies needs added attention.
- **Specialized Medical Firms:** This is a fundamental weakness within the Arab Countries, in that Medical Firms offer mainly Sales and Supports of Medical Equipment and Simple Solutions to Hospitals. Little or no attention is given by Medical Firms to Health Technologies.
- **Medical Device RDI:** While initiatives exist in Universities under Undergraduate Senior Design and MS Theses Projects, these initiatives are fragmented and do not constitute sustainable plans towards the production and commercialization of Health Technologies.

ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges

- **Advances in Science & Technology:** Science and Technology are leapfrogging one another, advancement of one promotes the advancement of the other and vice versa. Today's rapid advancements in these areas can be harvested to promote the Research, Development, and Innovation in Health Technologies in the Arab countries.
- **Affiliation Agreements and Consortia:** Affiliation agreements and consortia among institutions of higher learning in developed and developing countries is an endeavor that promotes exchange of knowledge and transfer of technology among these institutions. It can serve as a catalyst to the realization of RDI in Health Technologies in the Arab world.
- **Capacity Building:** Create merit scholarship for potential Engineers to develop their RDI skills at leading academic institutes specialized in Health Technologies.
- **Outsourcing and Free Trade:** One way to take advantage of the identified competing markets in Eastern Asia is to outsource the development of Health Technologies after being designed, developed, and patented in the Arab countries. Another frontier in this scope is to promote the establishment of free trade between the two regions for exchange of raw material and prototyping machinery.

ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges

- **Political and Economic Instability:** The region of the Middle East and Northern Africa has been witnessing constant political disturbances within and among Arab Nations and their surrounding environments. Such political instability might reflect drastically on the social and economic balance within these countries.
- **Travel Bans:** Due to regional instability and political disputes that threaten the Arab countries, travel bans to certain Arab countries—regionally and internationally—have become more frequent in the past few years. Such measures might become impediments to business ventures and large-scale project initiatives.
- **Embargo and Sanctions:** During the past decades, some Arab countries have experienced embargo—a complete ban on all commercial activity—by some Western countries, while others are facing sanctions—more limited in scope and prohibit trade in certain types of goods or transactions with particular individuals and entities. Among such sanctions is the import of solid-state electronic devices and transfer of funds.
- **Competition:** The region of Eastern Asia has been renowned not only for its advancement in solid-state devices and electronic technologies, but also for the low costs of these products. Competing with this region in Health Technologies offers a big challenge.
- **Corruption:** Petty, Massive, and Political corruption in the Arab world are impediments to business ventures and large-scale project initiatives.

ESCWA Technology Centre

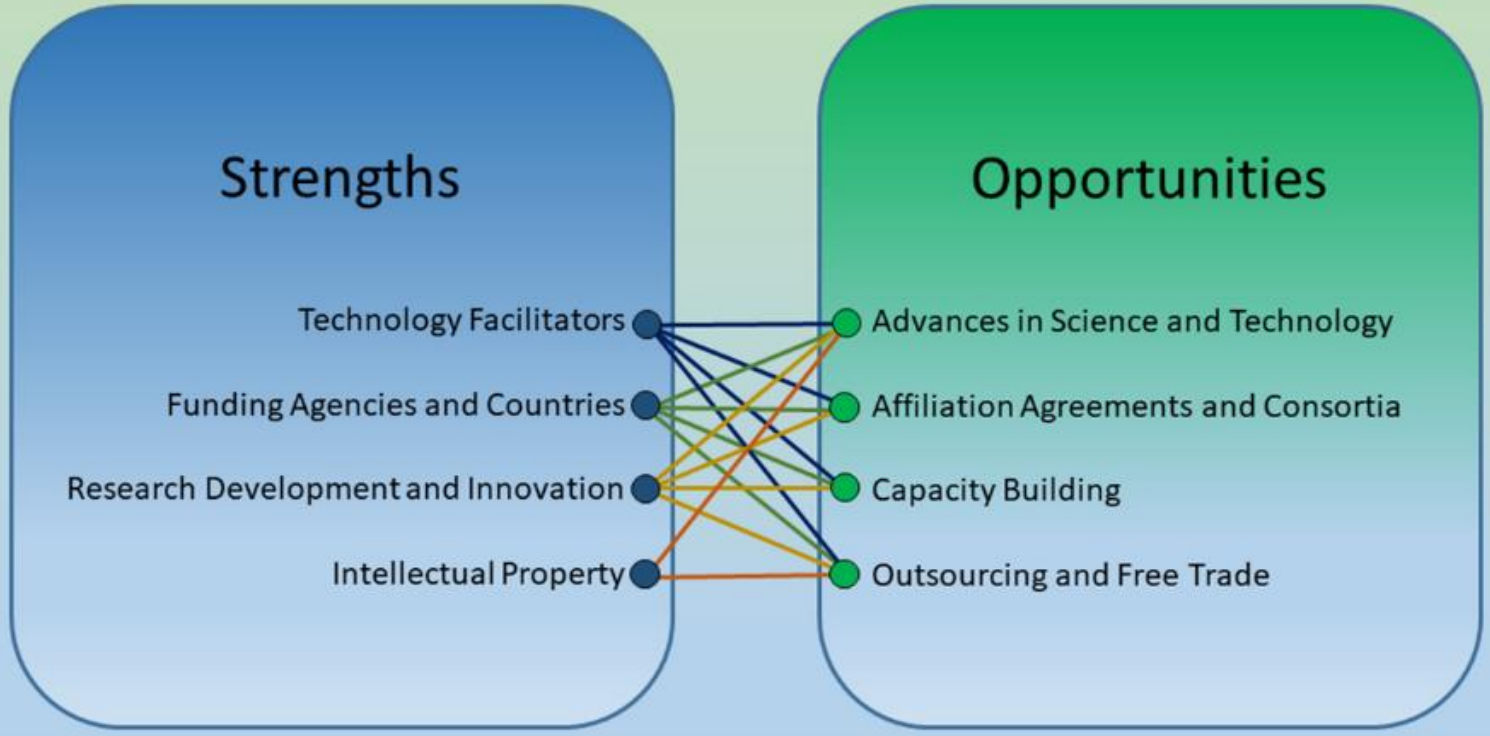
Strengths, Weaknesses, Opportunities, and Challenges

- Four important questions need to be addressed while referring to the four components: Strengths, Weaknesses, Opportunities, and Challenges.
  - How can the Strengths be used to take advantage of the identified Opportunities?
  - How can the Strengths be used to overcome the identified Challenges?
  - What needs to be done to overcome the identified Weaknesses in order to take advantage of the Opportunities?
  - How can the Weaknesses be minimized to overcome the identified Challenges?

ESCWA Technology Centre

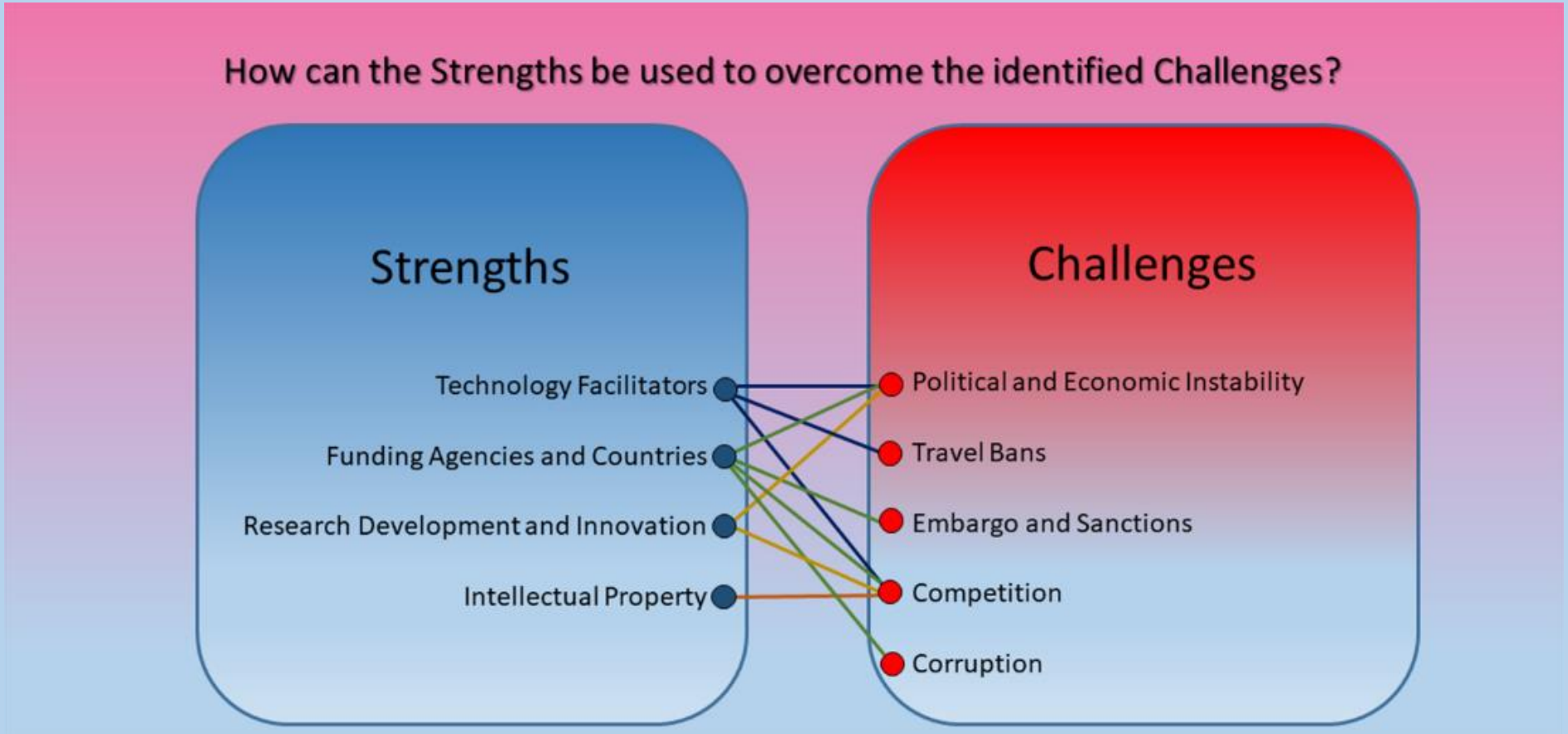
Strengths, Weaknesses, Opportunities, and Challenges

How can the Strengths be used to take advantage of the identified Opportunities?



ESCWA Technology Centre

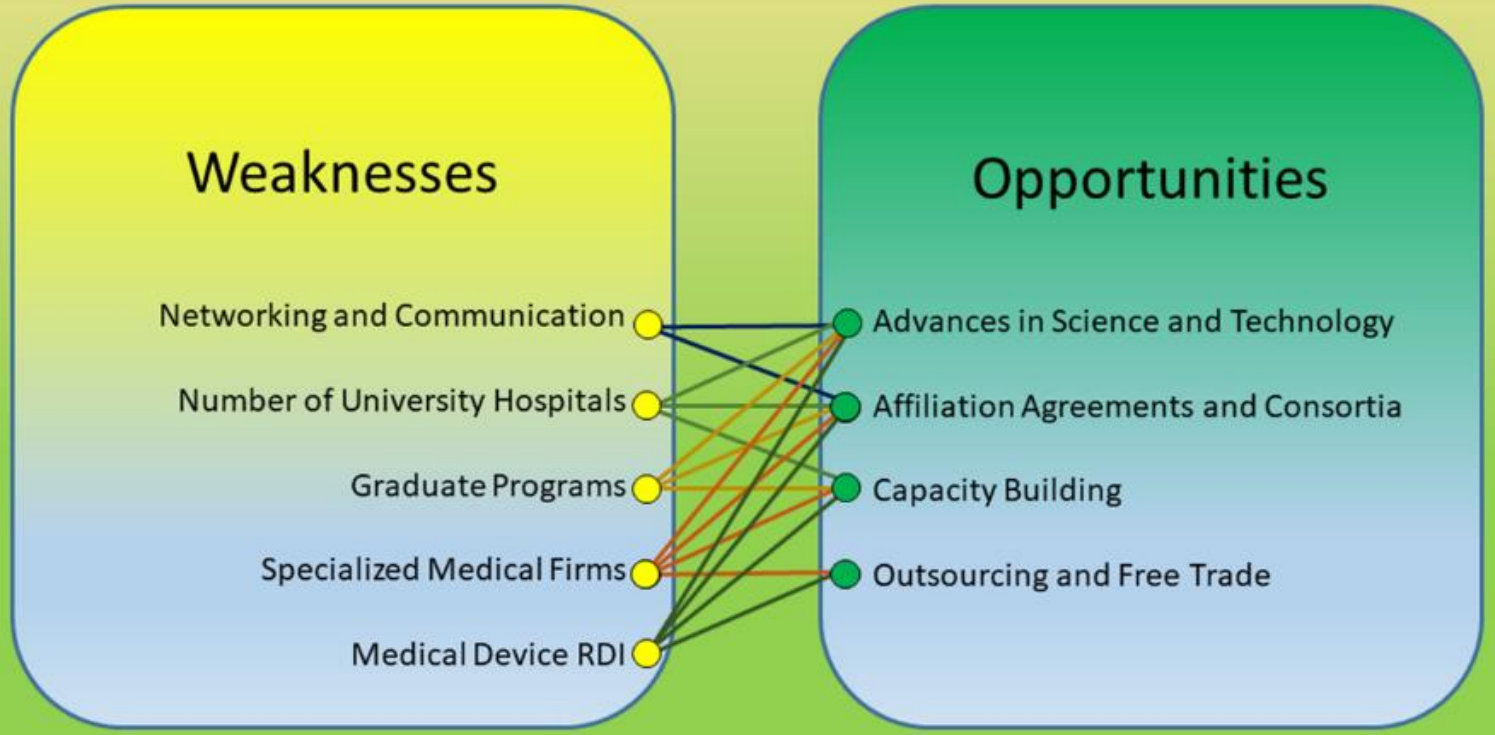
Strengths, Weaknesses, Opportunities, and Challenges



ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges

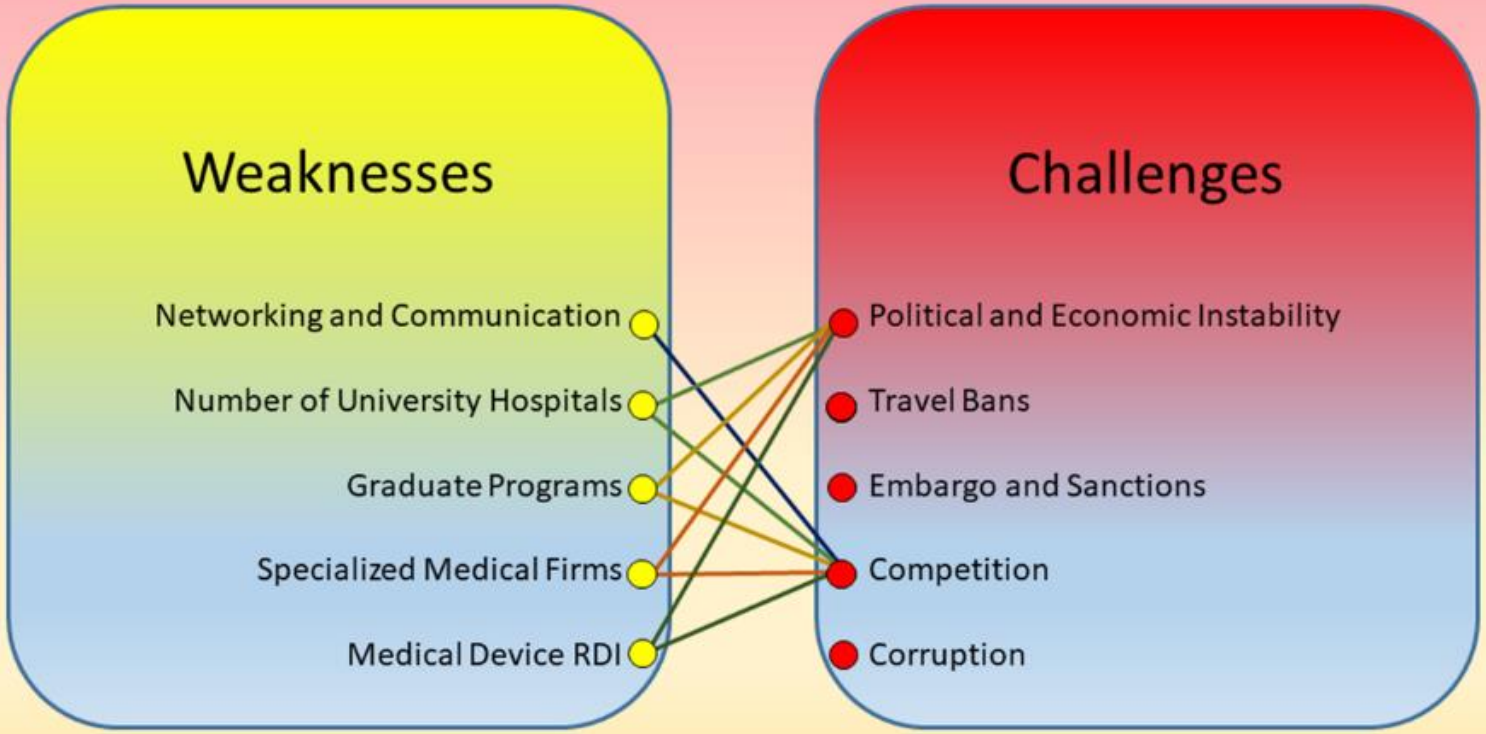
What needs to be done to overcome the identified Weaknesses in order to take advantage of the Opportunities?



ESCWA Technology Centre

Strengths, Weaknesses, Opportunities, and Challenges

How can the Weaknesses be minimized to overcome the identified Challenges?



ESCWA Technology Centre

Conclusive Remarks

- The Strengths, Weaknesses, Opportunities, and Challenges (SWOC) for developing the Health Technologies in the Arab Countries have been identified:
  - Opportunities could be harvested to be added to the Strengths.
  - All Weaknesses could be resolved while some of the Challenges will continue to remain as they require greater consensuses by and between governments.
- The Arab World should be able to work hand-in-hand with ESCWA NTTOs to re-engineer the local problem solving methods and the planning for an ideal economic cycle.

ESCWA Technology Centre

Conclusive Remarks

- The Arab World has the necessary elements for creating a paradigm shift and become a global partner in the development of Health Technologies rather than being a passive consumer.
- The Arab World is ready to create "***The Arab High-Tech Medical Technology Model***" that will:
  - i) create more job opportunities; ii) improve local economies; and, iii) improve healthcare services and cost.
- The Arab World is ready for embarking in the United Nations' 2030 Agenda for Sustainable Development to help achieve its SDGs related to Health Technologies.

ESCWA Technology Centre

Thank You!

Ziad O. Abu-Faraj, Ph.D.
ETC Consultant
Dean, Faculty of Engineering
Professor of Biomedical Engineering
American University of Science and Technology
Alfred Naccache Avenue, Block A, Room 804
Achrafieh, P.O. Box 16 6452
Beirut 1100-2130, LEBANON
dean-foe@aust.edu.lb