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Technology and innovation in the Arab region: current situation and policy frameworks

Summary

The present document provides an overview of the current situation in Arab countries in terms of information and communications technology and innovation. It proposes a policy framework to harness innovation for sustainable development based on four components: education and training; research and development; regulatory frameworks; and supporting mechanisms for innovators.

The Committee on Technology for Development is invited to discuss the present document and make comments thereon.

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CONTENTS

Introduction

1.   Technologies, including information and communications technologies (ICT) and frontier technologies spreading across the globe today, offer great opportunities to achieve sustainable development. Innovation is crucial for the advancement of technologies, development of applications in various sectors, and for localization and customization of technologies. These opportunities are recognized in global development agendas. The Addis Ababa Action Agenda of the Third International Conference on Financing for Development acknowledges innovation as a major driver of productivity, inclusive economic growth and job creation. It calls for harnessing the potential of technology and innovation towards sustainable development and poverty eradication, while recognizing the need to develop ICT infrastructure and incentivize the creation of new technologies. The 2030 Agenda for Sustainable Development includes innovation and technology as specific elements in Sustainable Development Goals (SDGs) 9 and 17, and recognizes their role in attaining several other Goals. A technology facilitation mechanism, the United Nations Inter-agency Task Team on Science, Technology and Innovation for the SDGs, was created in 2015 to assess technology needs for the SDGs and build capacity in that regard.

2.   In September 2018, the Secretary-General of the United Nations launched his Strategy on New Technologies, which sets forth five principles to promote the use of technologies for achieving the 2030 Agenda: (a) protect and promote global values; (b) foster inclusion and transparency; (c) work in partnership across a range of actors to increase collective knowledge, test ideas and expand dialogue; (d) build on existing capabilities and mandates to preserve the values of the United Nations Charter; and (e) be humble and continue to learn.

3.   The spread and the rapid evolution of technologies might outpace the capacity of societies to adapt to the changes they create. The ability to absorb and contribute to technological development varies among countries. Some developing countries in Asia, as large as China and as small as Singapore, have realized the importance of technology in bridging gaps. They have adopted, since 1990, innovation and technology policies and strategies aimed at transforming their societies and economies. They succeeded in leapfrogging and attaining the level of developed countries in technological fields.

4.   Several Arab countries made serious efforts to integrate technology in their national development agendas and succeeded in building information societies. However, most remain users of technology rather than contributors to its development. The benefits of technology utilization are still subject to improved access to information and services. More should be done to ensure that technology deployment in Arab countries effectively addresses the main challenges that they face. Moreover, the scope of that deployment should be society at large and not fragmented target groups.

5.   Innovation, which is essential for advancing technology and customizing it to local needs, is still weak in the Arab region. This is due to many factors such as limited research and development (R&D), weak links between research institutes and industries, weak legal and regulatory frameworks for R&D and innovation, and inadequate support for researchers and innovators. The relatively low innovation level has affected the development of technology in the Arab region and could hamper the spread of new technologies.

6.   Complementing the document presented to the Committee on Technology for Development at its current session under agenda item 8, which focuses on frontier technologies, the present document examines the current situation in the Arab region in terms of ICTs and innovation. It proposes a policy framework to harness innovation and technology for sustainable development comprising four components: education and training; research and development; regulatory frameworks; and supporting mechanisms for innovators.

I. INFORMATION AND COMMUNICATIONS TECHNOLOGIES

7.   ICTs are an essential tool for modern life; they are essential for connecting people, accessing information and reducing inequalities in any country. They are enablers for R&D and innovation, and form the basis on

which new technologies are created. ICTs are key for Governments to provide services to all citizens, in particular health and education services; offer decent jobs; improve governance; and facilitate the engagement of citizens in decision-making. ICTs are also instrumental for the education of refugees and internally displaced persons. Many reports have highlighted the role of ICTs in achieving the 2030 Agenda and various SDGs,[1] and have underlined their contribution to economic diversification.[2]

8.   The Networked Readiness Index developed by the World Economic Forum is the most recognized tool to measure ICT readiness, use, impact and environment. The table below shows the ranking of Arab countries in its various components, based on a survey conducted in 139 countries in 2016. It also highlights the following findings: (a) the situations of Arab countries are very heterogenous in terms of ICTs; (b) Governments, especially those of Gulf Cooperation Council (GCC), are well ranked in using ICTs; (c) the social impact of ICTs is higher than their economic impact; and (d) affordability is still an issue in many Arab countries, including GCC countries.

NETWORKED READINESS INDEX RANKING BY PILLAR, ARAB COUNTRIES, 2016

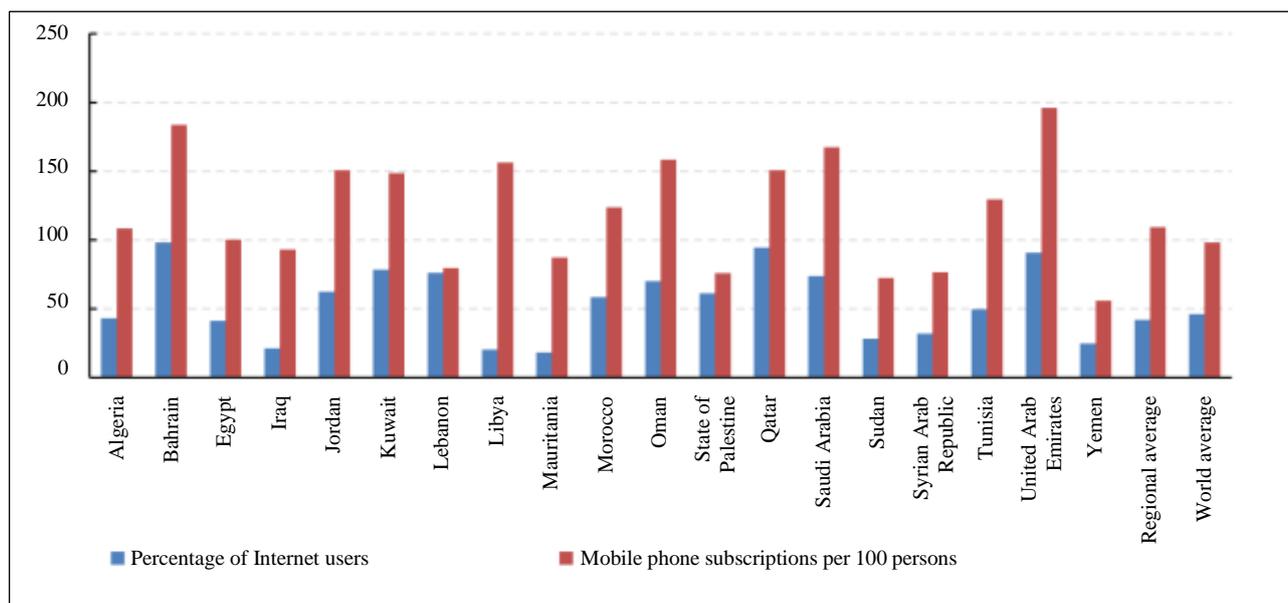| Country	Environment		Readiness			Usage			Impact	
	Political and regulatory	Business and innovation	Infrastructure	Affordability	Skills	Individual	Business	Government	Economic	Social
United Arab Emirates (26)	25	13	28	116	22	19	27	2	26	2
Qatar (27)	18	15	29	120	5	23	25	5	28	10
Bahrain (28)	36	26	31	40	31	14	37	3	48	13
Saudi Arabia (33)	29	25	36	101	49	21	42	11	40	36
Oman (52)	53	58	46	96	76	39	94	34	95	46
Jordan (60)	39	38	92	94	59	70	41	47	61	53
Kuwait (61)	63	72	30	89	77	32	72	81	102	84
Morocco (78)	70	87	102	20	110	67	105	41	110	59
Tunisia (81)	90	112	82	24	85	78	107	55	93	78
Lebanon (88)	126	49	77	109	55	46	97	124	83	114
Egypt (96)	102	113	97	47	111	80	129	67	58	103
Algeria (117)	123	133	80	99	89	103	133	130	124	132
Mauritania (136)	135	135	136	118	138	118	135	134	116	134

Source: Data from the World Economic Forum, available at http://reports.weforum.org/global-information-technology-report-2016/networked-readiness-index (accessed on 5 February 2019).

Notes: Global rankings are given in brackets in the first column. Arab countries affected by conflict, such as Iraq, Libya, the State of Palestine and the Syrian Arab Republic, were not included in the survey.

9.   The ICT infrastructure in the Arab region is relatively well developed (figure 1). Mobile subscriptions are very high, above 100 per cent. The regional average reaches 106.4 per cent, above the world average at 103.5 per cent. Internet subscriptions are lower than mobile subscriptions, with the regional average of 43.7 per cent falling slightly below the world average of 48 per cent. However, broadband penetration is still weak, except in GCC countries. The average Internet bandwidth per Internet user in the region is only 39 kbit/s, while reaching 53 kbit/s in developing countries and 140 kbit/s in developed countries.

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[1] See, for example, E/ESCWA/TDD/2015/3, chapter 11.

[2] See, for example, E/ESCWA/TDD/2017/2.

Figure 1. Internet and mobile penetration in Arab countries, 2017

10.   ICT affordability is still problematic in Arab countries, as service costs are high. This makes it difficult for citizens to keep up with new technological trends. The implications can be greater inequality and reduced options to access information and services, and both would negatively affect social and economic well-being.[3]

11.   E-government is an important application of ICTs; it is the provision of electronic services and information by government to citizens, or by citizens to government for the latter. ICTs and associated e-government services are the basis of government transformation to digital government, which enhances openness, transparency and accountability. In this context, the Economic and Social Commission for Western Asia (ESCWA) has developed a framework for fostering open government in Arab countries and supporting the achievement of SDG 16.[4]

12.   The region has recently seen an increase in e-government services. According to the United Nations E-Government Development Index (EGDI), the scores of Arab countries were higher in 2018 compared with 2016 (figure 2). However, most rankings have decreased in the same period, revealing slower e-government development than in other world regions.

13.   Generally, businesses in the region show weak ICT adoption. They also do not supply adequate quantities or quality of ICT goods and services, due to lack of skills and links with R&D.

14.   The term "digital economy" describes the pervasive use of ICTs in social and economic projects, leading to expanded opportunities, economic growth and improved public service delivery. The digital economy has the potential to overhaul the way people live and work. It can also significantly change how private companies carry out their business, how public authorities offer services to citizens and how citizens interact with government. The digital economy can, however, create challenges if transformation towards it is not properly managed, including rising inequalities and unemployment, dominance of the market by a small number of economic actors, and privacy and security risks affecting individuals and public data and infrastructure.

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[3] See E/ESCWA/TDD/2017/1.

[4] See E/ESCWA/TDD/2018/TP.1.

Figure 2. E-Government Development Index scores of Arab countries, 2016-2018
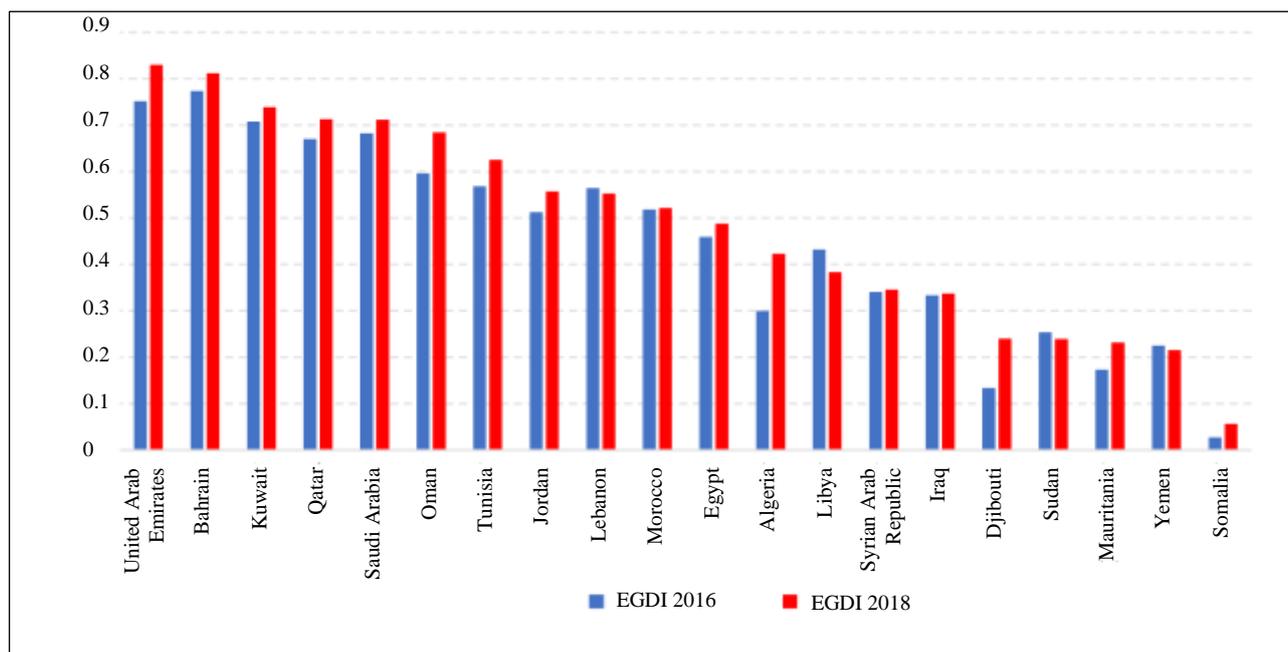
15. These challenges point to the need for proper policy stewardship to augment the positive impact of ICTs and mitigate associated risks. Developing digital economy policy should be an inclusive process that involves all stakeholders. However, the lack of reliable statistics on the digital economy makes it difficult to elaborate well-informed policies, and to monitor and evaluate them. The size of the informal sector is relatively large, making measurement even more difficult.

II. INNOVATION

16. Innovation is a continuously developing process or change that leads to value creation. The definition of the Oslo Manual 2018 on Guidelines for Collecting, Reporting and Using Data on Innovation[5] is broad: it considers innovation as the result of advanced R&D leading to new industrial products and services, in addition to new marketing or work organization methods in business practices. Innovation can also be something new or improved in a given market, country, organization or context; it is thus not necessarily a result of advanced research. It can be a product, a service, a policy, a programme or a process.

17. Innovation and technology are strongly linked. Innovation is essential for advancing all technologies and deriving applications and solutions from them. Innovation also plays an important role in the customization of technologies to local conditions and contexts, and in the development of local solutions. In turn, technology is crucial for innovation: many of today's innovations are technology-based or technology-oriented.

18. Innovation should not be restricted to academia, industries and businesses; it is also essential in the context of government and civil society. Innovation is vital to enhance administrative processes, improve services, ensure funding for development programmes and advance engagement and collaboration with stakeholders. In turn, the role of government is critical for ensuring a suitable ecosystem for innovation.

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[5] Organisation for Economic Co-operation and Development (OECD), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th ed* (Paris, OECD Publishing, 2018).

19.　Arab countries are aware of the importance of innovation as a catalyst for economic growth and social welfare, and a means to address environment challenges and improve governance. Several of them, including Egypt, Jordan, Morocco, Oman, Saudi Arabia and the United Arab Emirates, have adopted innovation initiatives or included innovation in their science or ICT strategies.[6] However, innovation is still weak in some of the region's countries, and there is still much room for improvement in terms of innovation ecosystems in all.

20.　The 2018 Global Innovation Index (GII) ranks the Northern Africa and Western Asia region (which includes Arab and other countries) fourth out seven world regions.[7] GII takes into account the innovation environment and creative outputs resulting from innovation. Of the 12 ESCWA member States included in it, the United Arab Emirates ranked highest at 38, followed by Qatar, Kuwait, Saudi Arabia and Tunisia, ranking at 51, 60, 61 and 66 respectively. Egypt showed the largest improvement between 2017 and 2018, advancing its rank by 10 places. Figure 3 shows the innovation scores achieved by Arab countries in 2017 and 2018. Most scored lower in 2018 than in 2017, with only Egypt, Jordan, Oman and Tunisia improving their scores. GII 2018 also identified Tunisia as an "innovation achiever", i.e. a country that performs at least 10 per cent above its peers in gross domestic product (GDP) level. Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates perform 10 per cent below other countries with the same GDP level.[8] Jordan, Lebanon, Morocco and Tunisia are closer to the global average than other Arab countries when GDP is reflected in the calculation.[9]

21.　There are various innovation models that can be adopted by stakeholders to achieve development or growth in the business environment.[10] The classic one is the linear model, in which discovery is a sequenced process consisting of different phases starting with basic research, followed by applied research and development, and ending with the production and diffusion of a product, process or service.[11] However, there are other models, especially in the development of applications and customized solutions to development problems.

22.　Mission-orientated innovation is a process through which a specific problem arising in a specific context is solved. This approach might involve stakeholders from different sectors, requiring collaboration. Collaboration between stakeholders can be of a specific nature to resolve a certain issue, but it could spill over and resolve other related issues in the same sector or among the same stakeholders. There are many examples showing the importance of mission-oriented innovation in the water, environment and food sectors, where problems and solutions are interrelated.

23.　Grassroots innovation is a process where systems of individuals and organizations cooperate to come up with new, bottom-up solutions to development problems. Such solutions are built starting from the people impacted by the challenge and looking for a solution. Grassroots innovation thus builds on local needs, and considers the local interests, values and culture of the targeted community. It requires committed activists to social change, environment protection and development. Bottom-up innovation can be effective on a small scale and for a specific community but if it is not scaled up, sustainability and social well-being cannot be reached. Therefore, special attention is needed from local government to consider promising grassroots innovations and provide the appropriate environment for scaling them at the local, regional and national levels.

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[6] E/ESCWA/TDD/2017/1.

[7] Data available at https://www.globalinnovationindex.org/analysis-indicator.

[8] Ibid.

[9] E/ESCWA/TDD/2017/Technical Paper.1.

[10] For more information about innovation models, see Decision Innovation, "Innovation model", n.d., available at https://innovation-management.org/innovation-model.html; and ESCWA, "Technology and innovation with a focus on the 2030 Development Agenda: community-based innovation for improved social well-being" (2017). Available at https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/community-based-innovation-agenda-2030-en.pdf.

[11] Decision Innovation, "Innovation model".

Figure 3. Global Innovation Index Scores of Arab countries, 2017-2018
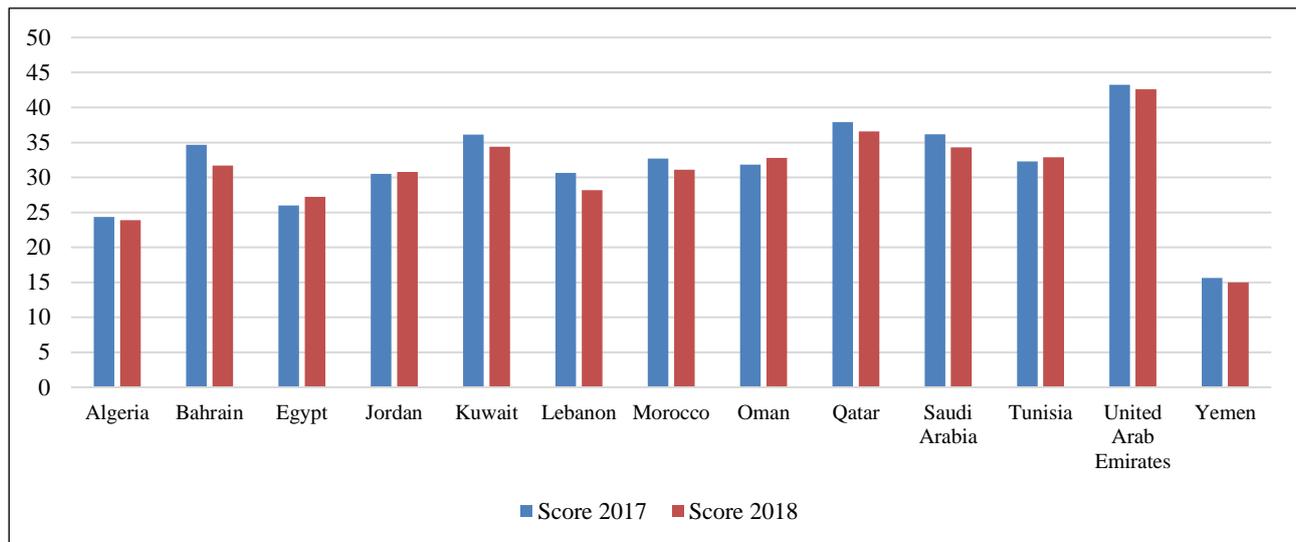
Source: Compiled   by   ESCWA   based   on   Global   Innovation   Index   data,   available   at https://www.globalinnovationindex.org/analysis-indicator (accessed on 1 November 2018).

24.   Social innovation[12] is a process through which novel solutions directly linked to a specific social need are created. It targets social, cultural, environmental and economic challenges and looks for solutions benefiting both the community and the environment, and forming and spreading social value.[13]

25.   There are other innovation models, such as frugal innovation, disruptive innovation and incremental innovation.[14] They can all be applied at any level of an organization, government institution, public enterprise or community. The integration of different innovation approaches is as useful as the integration of various technologies to find solutions for specific challenges.

III. TECHNOLOGY AND INNOVATION POLICY FRAMEWORKS

26.   Policies and strategies are essential to harness technology and innovation for sustainable development. As indicated in the United Nations World Economic and Social Survey 2018,[15] there is no guarantee that new technologies will serve the most pressing needs of humanity; policies and institutions will remain paramount in ensuring that technologies are widely diffused and adopted.

27.   Arab States have started to set regional technology and innovation policy frameworks. They adopted the Arab Strategy for Scientific and Technical Research and Innovation in March 2017, in which they voice their belief that innovation and technology are key for inclusive sustainable development. Moreover, the outcome document of the thirtieth ESCWA session, entitled "Beirut Consensus on Technology for Sustainable Development in the Arab Region", affirms that innovation and technology can provide creative solutions to

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[12] Geoff Mulgan and others, "Social innovation: what it is, why it matters and how it can be accelerated", Skoll Centre for   Social   Entrepreneurship   Working   Paper   (London,   The   Young   Foundation,   2007).   Available   at http://eureka.sbs.ox.ac.uk/761/1/Social_Innovation.pdf.

[13] Colin Combe and Fernando Mendez Navia, Social innovation case studies (Dex Europe for the INNOVATE project, January 2014).   Available   at   http://www.fomentosansebastian.eus/donostiainn/images/Servicios_proyectos/descargas/Innovate-Social-Innovation-Case-Studies.pdf.

[14] ESCWA, "Technology and innovation with a focus on the 2030 Development Agenda".

[15] United Nations Department of Economic and Social Affairs, *World Economic and Social Survey 2018: Frontier Technologies for Sustainable Development* (New York, 2018). Available at https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESS2018_full_web.pdf.

achieve people-centred, sustainable and inclusive development. It stresses the need to consider technology and innovation as pillars of transformation in national development plans and highlights the importance of local innovations to address the indigenous challenges of the Arab region.

28.   The Beirut Consensus identifies activities to be undertaken by member States in order to strengthen the role of technology and innovation in achieving sustainable development in the Arab region, including: (a) formulating national and regional policies to develop technological ecosystems adapted to the socioeconomic, environmental and political context of the region; (b) maximizing the availability and accessibility of affordable quality education in science, technology, engineering and mathematics; (c) enhancing digital skills in all education levels; (d) promoting assistive technology to guarantee full inclusion of persons with disabilities, in line with international standards; and (e) leveraging technology to adopt smart government practices, enhance public transparency and accountability, improve access to information and provide open data. Other areas of work envisioned in the Beirut Consensus include leveraging technology for environmental sustainability, conflict mitigation and disaster risk reduction, and financing technology for sustainable development.

29.   The Consensus concludes with recommendations to the ESCWA secretariat to continue its work on ensuring emphasis on technology and innovation, in particular through the following: (a) providing evidence-based policy advice; (b) raising awareness on technologies for the inclusion of youth, older persons and persons with disabilities in education, employment and access to services; (c) sharing best practices in technology transfer; (d) providing support in reducing the legislative and regulation vacuum on unregulated frontier technologies; (e) supporting member States in adopting green technologies, and (f) supporting networking and creating a participatory platform for cooperation among Arab States on frontier technology issues. The ESCWA secretariat has developed an action plan on the Beirut Consensus and has started implementing it. It will be presented under item 10 of the provisional agenda of the current session of the Committee on Technology for Development.

30.   At the country level and according to an ESCWA review,[16] national science, technology and innovation (STI) ecosystems differed in the way they were organized but shared some key characteristics. Three categories of STI ecosystems were identified based on the prevailing R&D environment:

        (a)   Large R&D ecosystems, such as in Algeria, Egypt, Morocco and Saudi Arabia: Iraq and the Syrian Arab Republic would have been part of this group were it not for the destruction of their research systems because of conflict. The growth of such large ecosystems is slower relative to others and focuses on consolidating existing international collaborations. Except for Morocco, research is generally focused on mining and petrochemicals;

        (b)   Small, dynamic and integrated R&D ecosystems, such as in Jordan, Lebanon, Tunisia, and, to some extent, Kuwait. These systems tend to have a proportionally large scientific production, with niches of innovative activities despite low overall innovation;

        (c)   Small but rapidly expanding R&D ecosystems, such as in GCC countries. Due to an active R&D policy, those countries aggressively leverage their resources to develop strong technopoles. This is the case of Bahrain, Qatar, the United Arab Emirates and, to some extent, Oman. Other counties in the Arab region tend to have small and less integrated R&D ecosystems.

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[16]   E/ESCWA/SDPD/2018/TP.1.

31. The above categories of ecosystems generally share the following characteristics:

(a) There is little overall coordination of scientific production among universities, with collaboration between universities and businesses still in early stages;

(b) Except for a small number of flagship projects, the various research centres operate in silos and have few programmes in common.

32. The ESCWA secretariat examined national innovation systems in Egypt, Lebanon, Mauritania, Morocco, Oman, the Sudan and Tunisia. It provided policy recommendations for their enhancement, some of which were already implemented. It also prepared reports on the establishment of national technology transfer offices in those countries.[17]

33. Policy analysis shows weakness in national innovation system policies, stemming from unclear visions and goals, insufficient coordination among stakeholders, and shortcomings in implementation and follow up. As shown in a framework for innovation policy tailored to the needs of the Arab region (figure 4), technology and innovation policies should be based on a clear vision, which formulates and communicates political will. The vision should include an implementation process with a timeline and entities responsible for oversight. In addition, the vision should set clear objectives for the policy, linked to the national development goals and the SDGs, with targets and indicators of achievement. The role of various stakeholders, including government, academia, private sector and civil society, should be determined, as well as mechanisms to ensure coordination among them.

34. Priority technologies should be specified, with an emphasis on ICTs due to their key role in achieving sustainable and inclusive development. In this day and age, setting priorities is a complex task. It is, however, important to guide research and development in the country, direct technology transfer and technology acquisition, and help the Government to set the appropriate incentives to encourage R&D in the private sector and among young entrepreneurs. It is understood as well that the policy should address basic infrastructure, such as electricity and transport systems.

35. The innovation policy framework is built on four components: education and training; R&D; regulatory frameworks; and support measures for innovators.

36. Education and training are essential for the development of human capital. Education systems should focus on quality; learners' curiosity and critical thinking should be enhanced through improved teaching methods. At higher education levels, focus should be placed on developing generic skills, which would make it easier to acquire specific skills later or on the job, geared towards technology development and innovation. Developing mid-level skills in the form of vocational training and lifelong learning is also crucial for Arab countries, as it might answer urgent needs and fill existent gaps in education and training. Special attention should be devoted to countries in crisis, where many young people have been left without an education. Arab States should also address issues related to brain drain.

37. The second component of the innovation policy framework is R&D, which plays an essential role in technological development and is critical for innovation. R&D investment remains lower than 0.5 per cent in most Arab countries, with only a few exceptions, namely Tunisia, Egypt, Morocco, Saudi Arabia and the United Arab Emirates (where such investment ranges from 0.6 per cent to 1.0 per cent).[18] Additionally, R&D is disconnected from socioeconomic needs in almost all Arab countries, with very little contribution from the private sector or links to innovation networks. Although all R&D activities should be encouraged in Arab countries across all sectors, the technology and innovation policy might stress on R&D related to specific

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[17] Reports available at https://www.unescwa.org/sub-site/44121/resources.

[18] 2018 data from the UNESCO Institute for Statistics, available at http://uis.unesco.org/en/news/rd-data-release (accessed on 12 February 2018).

technologies or specific sectors, in line with the vision and the objectives of the policy. Incentives for research in specific technology, such as big data, artificial intelligence or the Internet of Things, would help the development of applications that address specific challenges.

Figure 4. ESCWA innovation policy framework
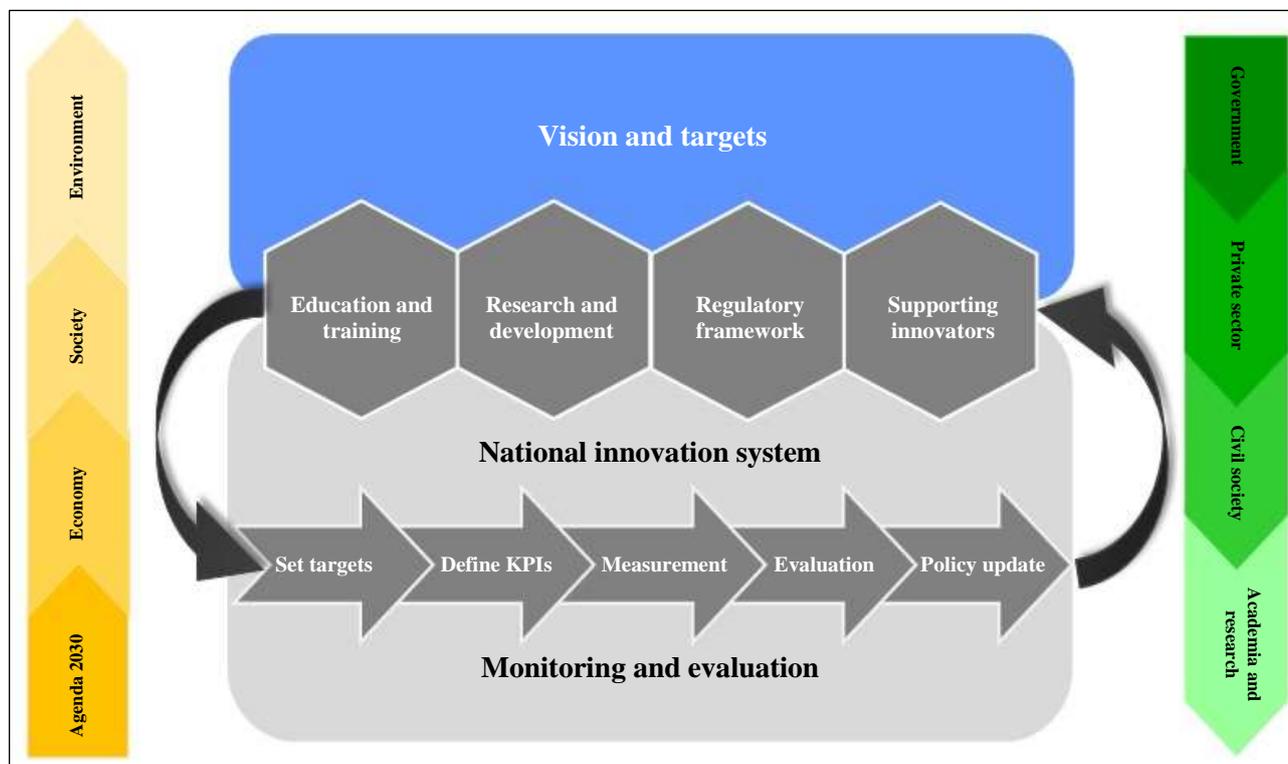
38.   In addressing R&D issues, it is important to focus on improving spending on R&D and aligning at least some of the R&D activities in universities and public institutions with the sustainable development needs of countries. Research centres or universities working on green technologies, for examples, might collaborate with ministries of environment to implement national programmes for recycling or waste management. A special fund could be allocated for collaborative research programmes between public institutions and research centres. Incentives such as awards could be created for researchers whose work supports SDG realization. Promoting R&D in the private sector could be achieved through tax exemption or incentives for small- and middle-sized enterprises or industries that allocate a percentage of their profit to R&D. Lastly, facilitating technology transfer is crucial, as well as strengthening the linkage between the private sector, and universities and research centres.[19] Lastly, linking Arab research centres to international research networks is of high importance for improved collaboration and transfer of technologies.

39.   Collaboration in R&D among research centres at the national and regional levels should be reinforced. Many Arab countries face similar developmental challenges. They could transfer technological solutions among them, especially given the low number of researchers in the region. It is thus recommended to enhance South-South collaboration and exchange of best practices, support networking and create a participatory platform for collaboration, namely on new technologies.

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[19] See ESCWA, the Lebanese National Council for Scientific Research and Institut de Recherche pour le Développement, "The Broken Cycle: Universities, Research and Society in the Arab Region – Proposals for Change", available at http://search.shamaa.org/PDF/Reports/le_aub_2014_a23672_hanafis_eng.pdf; and E/ESCWA/TDD/2017/1.

40.   All innovation models should be encouraged. Open science should also be promoted, as it improves efficiency by avoiding effort duplication, enabling more research on the same data, creating knowledge spillovers and new hypotheses through more data exploration, and helping to address shared challenges through sharing reliable data. Arab countries can join the movement, both as contributors and beneficiaries of publicly available research results and data.

41.   Proper technology transfer and development through trade, foreign direct investment (FDI) and foreign technology licensing are critical to help Arab countries to catch up technologically. Regulatory and legislative frameworks are key in that regard, including protecting intellectual property rights and ensuring fair competition to nurture nascent innovative companies. FDI inflows are still weak in high technology sectors, and national technology and innovation policies should consider channelling FDI towards specific technologies and sectors. Regulation should be enhanced to simplify business-related procedures, reinforce and deepen regional economic integration, and improve data collection on FDI. Governments should also work with the private sector and international donors to establish funds targeting technological innovators.

42.   The national innovation policy should specify supporting mechanisms for technology innovators, entrepreneurs, start-ups and micro and small businesses. To ensure the success of start-ups and guarantee the sustainability of innovation, it is important to provide business services, information services, financing for firms and support for the creation of clusters and networks of enterprises and people around specific elements to strengthen innovation ecosystems. The public sector should consider establishing public-private partnerships with specialists to offer business services to young innovative companies. The impact of incubation structures should be improved, and better evaluation metrics (in the form of key performance indicators) should be set for science and technology parks. Information services for small enterprises are scattered and States should set up one-stop centralized information portals. Early-stage financing of innovative companies should be considered in public policy through the development of public venture capital funds; the provision of public guarantee instruments in cooperation with the banking sector; and the promotion of business angel networks to support companies with high growth potential in their early development phases.

43.   A technology and innovation policy should be complemented by an action plan to ensure implementation. It should also specify tools for monitoring implementation progress and measuring outcomes. Monitoring and evaluation are a very important component of any policy; they enable identification of gaps. Measurable indicators should be identified, such as R&D expenditure, exports of high-tech products, number of patents, number of graduates in technical and scientific disciplines and quality of their learning. The chosen indicators should be based on the policy objectives and may differ from country to country.