

# Advisory Report on Development of an Artificial Intelligence Strategy for Lebanon

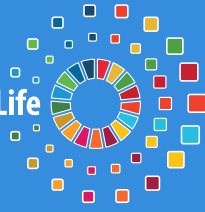


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# التقرير الاستشاري الموجّه إلى: وزارة الدولة لشؤون الاستثمار والتكنولوجيا - الجمهورية اللبنانية

حول: مقترح استراتيجية الذكاء الاصطناعي  
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# Advisory Report on: Development of an Artificial Intelligence Strategy for Lebanon

**December 2019 – February 2020**

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The team from the Economic and Social Commission for Western Asia (ESCWA) would like to express its special appreciation for H.E. Minister Adel Afioni who led many national initiatives when he was in charge of the Ministry of State for Investment and Technology Affairs (MoSITA). Among the relevant initiatives, with the efforts of the Ministry's team during the fall of 2019, is the agreement on a roadmap towards a national artificial intelligence (AI) strategy.



# I. Executive Summary

The present report starts from the prerogative that artificial intelligence (AI) is the driver of the great technological transformation that will impact the human race. It is widely accepted that AI is the engine of productivity and economic growth, however, some predict it will have a disruptive effect on society due to the shift in the jobs market and the societal implications of the disruptive technology on equality, education, and other social dimensions.

This report, requested by the Ministry of State for Investment and Technology Affairs (MoSITA) in Lebanon, is intended to propose an AI Strategy for Lebanon. A strategy that helps Lebanon embraces AI adoption as early as possible, preparing itself for the benefits and challenges of the age of AI.

The report starts by reviewing international and regional best practices in AI strategies, then it identifies the basic infrastructure needed for AI (or pre-requisites) which consists of: the availability of ubiquitous, open and secure Internet and broadband services at affordable prices; the availability of data sets and big data, data centers, and super-computer centers as well as adequate data policies for privacy and security; and finally, the availability of digital competencies and workforce.

The report moves on to identify the components supporting successful AI strategies from around the world, specifically:

- ◀ Ensuring that legislation is innovation friendly and avoid regulating AI before related problems are known and identified;
- ◀ The role needed from government is one of enabler of innovation ensuring that the needed AI infrastructure is available for all. Additionally, governments can be the driver for AI software industry by demanding AI government applications for smart power generation, transport, smart cities, police, and health. Furthermore, governments need to invest and incentivize R&D. Finally, and most importantly, governments must ensure that they attract and retain talents in the country and moreover in Lebanon case, circulate the talents with diaspora.
- ◀ There is a wide consensus that AI will eliminate jobs but not work. Hence countries must update school curricula to include coding skills, as well as those skills that cannot be replicated by machines such as critical thinking, cooperation and team building, and social and emotional skills;
- ◀ Because AI enables machines to take decisions, many countries have started thinking of the ethical dimension of AI and put guidelines for responsible coding;
- ◀ Due to the limitation of human ability to adapt to fast technological change, all countries agree that there is a need to spread awareness within their population on the benefits and challenges of AI. Many have also established continuing education centers for technology adoption for all ages;
- ◀ All countries agree that the AI industry is too broad to standardize, however, few countries are seeking the standardization of a particular aspect of AI systems such as auditing;
- ◀ The key sectors for AI vary from country to another but are mainly based on national competitiveness and priorities.

The report finds that **Lebanon is still in the phase of ensuring the pre-requisites for the AI infrastructure**. There is limited availability of broadband services that remain expensive even in cities; most government entities are not digitized hence data sets are not available; there is a limited number of local IoT or other applications generating big data; there is a dire need for a data center equipped with super computing power; and government spends less than 1% of its GDP on R&D.

On the bright side, **the quality of tertiary education as well as research are high**. The number of students enrolled in STEM subjects is high (29%), so there is a good potential for the availability of digital competencies. Furthermore, **the entrepreneurial eco-system for technology start-ups and knowledge economy sectors was stable and robust** since 2002, disrupted majorly in the last quarter of 2019 with financial and political problems.

The main challenges for Lebanon ICT sector are the brain drain, the overall cost of doing business, government bureaucracy and red tape, political stability, and the access to global markets.

Given Lebanon's AI positioning, the report proposes to fix all possible systemic weaknesses while at the same time, leapfrog to become par with the rest of the AI developed world through candidate vision:

**"Empowered and trained population able to creatively solve societal and economic challenges using AI and other disruptive technologies, positioning Lebanon a player and exporter of solutions globally."**

The policy recommendations under the four strategic goals are:

#### **S1 - Make long-term investments in AI research**

- ◀ Conduct an innovation survey;
- ◀ Incentivize productive linkages between industries and universities;
- ◀ Create strategic partnerships with regional and international research centers;
- ◀ Implement the National Center for Technology Transfer in CNRS;
- ◀ Incentivize private investments in local research and development.

#### **S2 - Address the ethical, legal, and societal implications of AI**

- ◀ Conduct public awareness campaign about the implications of harnessing technology;
- ◀ Promote digital skills and AI awareness throughout society, especially the ethical side of AI;
- ◀ Promote diversity in general, and gender diversity in technology specifically;
- ◀ Enforce open data policies.

#### **S3 - Address AI workforce needs**

- ◀ Establish special digital zones and/or clusters throughout Lebanon;
- ◀ Promote the establishment of AI companies with public procurement;
- ◀ Incorporate coding and 21st century soft skills into the educational system at all levels;
- ◀ Establish continuing education training centers for AI programming languages.

#### **S4 - Develop the ICT sector**

- ◀ Liberalize the telecommunications infrastructure;
- ◀ Complete the digitization of government and deploy GOV-NET and NREN;
- ◀ Encourage seed and other venture funding; rely on Diaspora as needed;
- ◀ Review tax code and incentives for ICT sector;
- ◀ Implement the complete digital legal framework;
- ◀ Implement policies to raise "Ease of Doing Business" (World Bank index) among other indicators.

The above policy recommendations are classified according to the **"Best Practices for AI Policies"** template as well as according to their feasibility: Short Term, Medium Term, and Long Term.

For the governance mechanism of the AI strategy, the report proposes the establishment of a multi-stakeholder **"Technology Council"** under a newly formed Ministry of Technology and Communications (MoTC) responsible of all digital needs of the government. The Technology Council includes representatives of ministries and government agencies players and / or implicated by technology, innovation, sciences, R&D, and education; key universities; representatives from private sector and civil society. It is tasked with the implementation, monitoring and control of all digital strategies including the AI Strategy.

Finally, the report proposes quick wins and priority projects that can be started immediately, preparing for the implementation of the long-term policy recommendations. It is worth noting that adequately planned infrastructural actions will allow Lebanon to leapfrog into the future. The infrastructure includes affordable broadband for all, increase in research and more relevant development grants budget, establishment of a super-computing and data center, and lowering the overall cost of doing business in Lebanon.

# Table of Contents

<b>I. Executive Summary</b>	<b>4</b>
<b>II. Introduction</b>	<b>8</b>
<b>III. Best Regional and International Practices</b>	<b>9</b>
A. Best Practices from Around the World	9
B. Best Practices from the Arab World	10
<b>IV. Pre-requisites for AI</b>	<b>12</b>
A. Ubiquitous, Open and Secure Internet	12
B. Healthy and Vibrant Start-Up Eco-System	12
C. Digital Competencies	13
D. Data Policies and Regulations	14
1. Availability of Data and Big Data	14
2. Legal Framework for Data	15
<b>V. Components of Successful AI Strategies</b>	<b>16</b>
A. Innovation Friendly Legislation	16
B. Government as Enabler of Innovation	16
C. Government as Driver of Demand for AI	17
D. Science Engagement, R&D, and Technology Facilitation	17
E. Attract and Retain Talent	18
F. Job Creation in the Age of AI	18
G. Ethical Dimension of AI	19
H. Awareness	20
I. Standardization of AI	21
J. Meeting the SDGs	21
K. AI Key Sectors	22
<b>VI. National AI Readiness Assessment</b>	<b>23</b>
A. Current Status of AI Pre-requisites in Lebanon	23
1. Ubiquitous, Open and Secure Internet	23
2. Healthy and Vibrant Start-Up Eco-System	24
3. Digital Competencies	25
4. Data Policies and Regulations	25
B. Current status of AI in Lebanon	26
1. Science Engagement, R&D, and Technology Facilitation	26
2. AI Activity in Lebanon	27
3. AI Key Sectors Analysis	28



<b>VII. Lebanon AI Positioning</b>	<b>31</b>
A. Does Lebanon Need a National Strategy for AI?	31
B. SWOT Analysis	32
C. AI Vision for Lebanon and Strategic Goals	32
D. Policy Focus Areas of AI strategy in Lebanon	33
1. Ubiquitous, Open and Secure Internet	33
2. Healthy and Vibrant Start-Up Eco-System	33
3. Digital Competencies	34
4. Data Policies and Other Regulations	34
5. Role of Government as Demand Driver and Innovation Enabler	34
6. Science Engagement, R&D, and Technology Facilitation	35
7. AI Awareness	35
E. Priority Projects Action Plan	36
F. AI Strategy Governance in Lebanon	36
G. Monitoring and Evaluation	37
<b>Annex</b>	<b>38</b>

## II. Introduction

The term Artificial Intelligence (AI) was first used in the 1950s when Alan Turing, a pioneering British codebreaker during the second world war, published a landmark study in which he speculated about the possibility of creating machines that could think<sup>1</sup>. Turing's original vision for AI was to mimic all or most of the things that the human brain can do, including strategizing, social manipulation, hacking, technology development and intelligence amplification. However, current predictions point to the year 2100 or at least 70 years from now for such "broad" AI to be achieved. Many scientists, historians, and philosophers point out that this would be the start of the era of "superintelligence", an era of profound biological and social metamorphoses for the human race as we know it. Ray Kurzweil<sup>2</sup> on the other hand, declares the age of "Singularity" to start in 2045, when the machine will surpass humans. With both predictions, the era of great technological change that will impact our productivity and the way the human race has organized itself into societies so far is decades away.

Today, AI means different things to different people. Broadly, AI describes software that mimics human cognition or perception. AI is already all around us and we use it daily with Google (search algorithms), Facebook (face recognition), Netflix (personalized movies), Siri and Alexa (virtual assistant), chatbots, and much more. More substantial applications supporting the UN sustainable development goals (SDGs) can be found in personalizing healthcare treatments, education curriculums, smart cities, or judicial sentences. AI is also able nowadays to make predictions include the disease a patient is suffering from, the result of a radiology picture, where crime might occur, agricultural irrigation and yields, or the piece of infrastructure that might need to be repaired. Last but not least, there is a need to mention the applications related to the social implementation of natural language processing in applications such as the virtual assistant.

Narrow Artificial Intelligence (intelligence used to solve a specific problem) is the main subset of AI that is being implemented today. One of its main categories is Machine Learning which emanates from Data Sciences to use large sets of data to train the machine to make a decision. For example, image recognition models contain 1.2 million training images hand-labeled with few object categories. Deep learning takes Machine learning (ML) to a new level because it applies artificial neural networks theories and probabilistic decision trees to come up with the final answer, also based on large sets of data. Neural networks are not predictable and cannot be audited rule-by-rule. This obscurity in machine decision making highlights the necessity to reflect on the ethical dimension of AI when used within the society.

Looking forward, the research areas around AI are many. They include<sup>3</sup>: Artificial General Intelligence (AGI), Reinforcement Learning (RL), Generative Models, Networks with Memory, Image Processing and Multi-media Analysis, Robotics and Embedded Systems, Autonomous Vehicles, Neural Networks, Fuzzy Systems, Chaos Theory, Evolutionary Computation, and more.

The industries that are already impacted by AI are the Financial and Stocks Services, e-commerce, Logistics and Supply Chains, Health Care, Human Resources Management, Manufacturing, and Agriculture.

Finally, AI is the amalgamation of several fields and resources; and the result of a virtuous eco-system sustained by government, private sector and NGOs. AI should not be seen independently from Robotic Process Automation - General Automation for repetitive tasks where human involvement can be, in general, completely removed. Also, AI cannot be seen independently of Security, Data Protection, Privacy, Safety, and Data Destruction, as well as, Neuroscience and Quantum Computing.

This report will summarize a few existing AI strategies from around the world, then discusses the pre-requisites for the development of typical national AI sector. Another part of the report, a policy framework is proposed for the development of AI area. Finally, the report discusses the specific set of AI related policies proposed for Lebanon.

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1 <https://www.csee.umbc.edu/courses/471/papers/turing.pdf>

2 [https://en.wikipedia.org/wiki/Predictions\\_made\\_by\\_Ray\\_Kurzweil#2045:\\_The\\_Singularity](https://en.wikipedia.org/wiki/Predictions_made_by_Ray_Kurzweil#2045:_The_Singularity)

3 <https://medium.com/@NathanBenaich/6-areas-of-artificial-intelligence-to-watch-closely-673d590aa8aa>, <http://technoitworld.com/5-artificial-intelligence-fields-changing-way-things-work/>

# III. Best Regional and International Practices

## A. Best Practices from Around the World

**China.** The government has prioritized AI, including its promotion in the 13th Five-Year Plan (which runs from 2016 to 2020), Internet Plus and AI plans from 2016 to 2018, and a “next generation AI plan.” China is aiming to create a domestic AI market of 1 trillion renminbi (\$150 billion) realized in 2020 and “become the world’s premier artificial intelligence innovation center” by 2030<sup>4</sup>.

The main pillars/focus areas of the plan can be summarized as follows:

- ◀ Identify 17 areas of AI development including intelligent and networked vehicles, identification systems, and service robots;
- ◀ Advancement of AI’s support framework, including intelligent sensors and neural system processing chips;
- ◀ Encourage Intelligent manufacturing;
- ◀ Resources allocation into industry training, standard testing, and cyber-security;
- ◀ Recruit the world’s best AI talent, strengthen training of domestic AI labor force, and lead the world in laws, regulations, and ethical norms;

A plan released by the Ministry of Science and Technology (MoST) identifies a number of “Innovative AI platforms” across the nation to produce AI applications and services. These platforms should be built by enterprises and market mechanisms, local government, AI industry, research institutions and universities, creating an open ecosystem. In principle, every subfield of AI research should have a state-level AI innovation platform.

The private sector is pushing actively for AI, too. Three of China’s internet giants—Alibaba, Baidu, and Tencent—as well as iFlytek, a voice recognition specialist, have joined a “national team” to develop AI in areas such as autonomous vehicles, smart cities, and medical imaging.

**Japan** has realized its strength in advanced manufacturing practices where AI can be used effectively and noticed that Japanese scientific production in AI fields falls below counterparts in the U.S. and China. Hence the first policy they enacted in April 2016 is to establish the “Strategic Council for AI Technology” which is related with the Prime Minister office as part of the “Public-Private Dialogue towards Investment for the Future” to manage five National Research and Development Agencies and coordinate with three research centers specialized in neural networks and AI<sup>5</sup>.

The Strategic Council set a strategy in phases with three objectives “Productivity”, “Health, medical care, and welfare”, and “Mobility”:

- ◀ Phase 1: Utilization and application of data driven AI developed in specific domains by 2020 (manufacturing, healthcare, agriculture, etc.);
- ◀ Phase 2: Public use of AI and data developed across various domains by 2030;
- ◀ Phase 3: Ecosystem is built by connecting multiplying domains reaching a stage where the entire society contributes and benefits from AI.

What is interesting about the approach of Japan is that it is an all-encompassing AI approach to society as a whole with clear roles and cooperation between industry, academia, and the government.

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4 The State Council of the People’s Republic of China, Next Generation Artificial Intelligence Development Plan, July 2017

5 Artificial Intelligence Technology Strategy, Strategic Council for AI Technology, March 21, 2017

UK's strategy entitled "Growing the artificial intelligence industry in the UK" was released in October 2017 and includes plans to supercharge the UK's AI industry – potentially worth USD 814 billion to the UK economy by 2035<sup>6</sup>.

The UK strategy includes 18 recommendations which describe how government, industry and academia should work together to keep the UK among the world leaders in AI. The recommendations are summarized below:

- ◀ Improve access to data;
- ◀ Improve supply of skills;
- ◀ Maximize UK AI research through supporting the Alan Turing Institute of research;
- ◀ Support uptake of AI.

The peculiarity of the UK approach is to concentrate on AI applications for the public good, whereas the state will encourage focusing on important social problems faced by the UK such as "ageing population" and the "future of mobility". In terms of governance, the UK launched in 2018 the AI Sector Deal, a billion-pound joint government and industry deal to put the nation at the forefront of emerging technologies. Two departments (ministries) are responsible for the execution of the AI sector Deal and the Office for Artificial Intelligence<sup>7</sup> has been created for that purpose. The two ministries are the Department for (Digital, Culture, Media & Sport) and Department for (Business, Energy & Industrial Strategy).

The Office for AI established a year later the AI Council, composed of independent experts and business leaders from business, academia and data privacy organizations. This mode of government allows the broader AI community to work together to drive towards solutions and engage in posturing the UK as a leader in the AI and data revolution.

It is interesting to note that in one year, the Office for AI has accomplished the following:

- ◀ Established the AI Council;
- ◀ Established the Centre for Data Ethics and Innovation, a body convened to provide independent, expert advice on the measures needed to enable and ensure safe, ethical and innovative uses of AI and data-driven technologies;
- ◀ Announced 16 new Centers for Doctoral Training at universities across the UK delivering 1,000 new PhDs over the next five years;
- ◀ Offered new AI Fellowships to attract and retain the top AI talent led by the Alan Turing Institute;
- ◀ Confirmed the first wave of industry-funding for new AI Masters places at leading UK institutions;
- ◀ Arranged for five new centers of excellence across the UK for digital pathology and imaging, including radiology and using AI medical advances;
- ◀ Announced new research projects that will consider how AI can be applied in the legal and accountancy sectors;
- ◀ Partnered with the Open Data Institute to explore the potential of data trusts, tackling for example illegal wildlife trade and reducing food waste.

## B. Best Practices from the Arab World

The Arab countries can be divided into three groups according to their level of digital readiness<sup>8</sup>:

- ◀ Level 1- Countries with low to medium digital readiness Iraq, Syrian Arab Republic, Libya, Yemen, Algeria, Comoros Islands, Djibouti, Mauritania, Palestine, Somalia, Sudan;
- ◀ Level 2- Countries with Digital Potential Egypt, Jordan, Lebanon, Morocco, Tunisia;
- ◀ Level 3- Digital Leaders: GCC countries (Bahrain, Kuwait, Oman, Qatar, KSA, UAE).

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6 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/652097/Growing\\_the\\_artificial\\_intelligence\\_industry\\_in\\_the\\_UK.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/652097/Growing_the_artificial_intelligence_industry_in_the_UK.pdf)

7 <https://www.gov.uk/government/organisations/office-for-artificial-intelligence>

8 الاتحاد العربي للاقتصاد الرقمي، الإستراتيجية العربية للاقتصاد الرقمي نحو مستقبل رقمي مستدام، شامل، أمن، 2018، ص 51

It is hence no surprise that the two countries that are leading the AI race come from the digital leaders group.

UAE is the first Arab country with a clear AI strategy. On 25 October 2017, Dubai announced the training of one million Arab youth in programming, in order to keep up with the accelerated advances in computer science, and to contribute to the development of the digital economy. In the same month, UAE created the UAE AI Council and the Ministry of Artificial Intelligence. The UAE has crafted a national AI strategy focused on expanding the role of AI in nine sectors: transport, health, space, renewable energy, water, technology, education, environment, and traffic. But the most important pillar in Dubai's strategy, is that the government is creating a huge demand for AI applications hence is naturally attracting start-ups and investments. The list of government bodies requiring new AI applications includes the Ministry of Health and Prevention (MoHAP), Smart Dubai Office, the Dubai Electricity and Water Authority (DEWA), and the Dubai police.

Saudi Arabia does not have a national AI strategy but went down in history as the first state to give the nationality to a robot named Sophia. Its flagship National Transformation Programme (NTP) alludes to the need for AI-driven tools. In October 2017, the vision for a new city, Neom, was revealed. Neom is a huge connected city built in the desert where "Everything will have a link to artificial intelligence."<sup>9</sup> Hence, as in Dubai, Saudi Arabia will be creating demand to attract AI apps suppliers. Furthermore, Saudi Arabia has established a special agency for data and AI, and the director leading it at the level of Minister<sup>10</sup>.

The challenges in the Arab region in general are hovering around the fact that the government is a solo player to promote new technologies. While this is a necessary condition, it is insufficient, and the private sector should be a partner. Hence, KSA and UAE remain in the early stages of AI investment and policymaking<sup>11</sup>.



9 <https://www.bloomberg.com/news/articles/2017-10-24/saudi-arabia-to-build-new-mega-city-on-country-s-north-coast>

10 <https://www.my.gov.sa/wps/portal/snp/pages/agencies/agencyDetails/SaudiAuthorityforDataandArtificialIntelligence>

11 The Economist Intelligence Unit, Scaling Up the Potential Economic Impact of Artificial Intelligence in the UAE and Saudi Arabia, May 2019

## IV. Pre-requisites for AI

While this report is concerned with identifying the best strategy components for Artificial Intelligence, it finds that it is necessary to separate the AI strategy components from the digital readiness components. Usually when developed countries draft their AI strategies, they would have reached a level of digital readiness that allows them to dwell directly into the drivers that would propel AI development forward. This level of digital readiness is not available in Lebanon and in other countries of the Arab region, hence the report finds it necessary to highlight the digital pre-requisites for the development of AI separately.

### A. Ubiquitous, Open and Secure Internet

While AI is not an Internet technology, the Internet is the core infrastructure of the eco-system on which AI strives. While Lebanon and the GCC countries have high Internet and Mobile Internet penetration rates, the rate of fixed broadband penetration (over 10 million bits per second) remains low (average is 4.7% in the Arab States according to ESCWA vs. 30% in developed countries)<sup>12</sup>. According to the same ESCWA study, fixed broadband in the Arab region is generally slow, is often associated with caps on volumes of allowed traffic, and quite expensive. Internet services in general remain of poorer quality and much more expensive than Europe for the following reasons:

- ◀ The cost of international capacity is tenfold that of North America and Western Europe.
- ◀ Latency is high because 90% of Internet traffic passes over international connections due to the lack of viable Internet Exchange Points (IXPs) in the region. The latency of international traffic is inherently high, impacting the quality of Internet usage.
- ◀ While most governments have aggressive plans for the deployment of mobile broadband (3G, 4G), fixed broadband deployment is slow and over-burdened by regulatory restrictions on the deployment of networks. Both fixed and mobile broadband are equally important, but the cost and speed of the offering is important to realizing the goals of a digital economy.
- ◀ Telecom industry is owned and/or operated by governments through their regulatory authorities who keep a very restrictive regulatory environment on the telecom and service providers. This weakens the competition, and stifles innovation in the provision of ubiquitous access and services such as open access, community networks, liberalization of spectrum, etc.

### B. Healthy and Vibrant Start-Up Eco-System

According to Stanford University “AI Index 2018 Report”<sup>13</sup>, in the USA, from January 2015 to January 2018, active AI startups increased 113%, while all active startups increased 28%. For the most part, growth in all active startups has remained relatively steady, while the number of AI startups has seen exponential growth.

The perfect eco-system has five pillars: risk capital, strong software industry, governments willing to invest, strong universities that generate the break-through ideas and technologies, and last but not least an educated population able to generate the entrepreneurs themselves. The availability of a strong software industry is

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12 ESCWA, Arab Horizon 2030: Digital Technologies for Development, 2017, p.37

13 Yoav Shoham, Raymond Perrault, Erik Brynjolfsson, Jack Clark, James Manyika, Juan Carlos Niebles, Terah Lyons, John Etchemendy, Barbara Grosz and Zoe Bauer, “The AI Index 2018 Annual Report”, AI Index Steering Committee, Human-Centered AI Initiative, Stanford University, Stanford, CA, December 2018

key to the eco-system success, and especially in the Arab World, the ICT sector in general and the software industry in particular are stiffened by over-burdening government regulations, lack of human resources, and strong competition by global players.

### C. Digital Competencies

The second pre-requisite for the advancement of AI is the development of sophisticated algorithms and/or computer programmes and/or mobile apps. This can only happen with talented people who can code and a strong software industry.

Different types of digital competencies are needed for the twenty first century. Several organizations and initiatives have carried through efforts to identify and categorize the digital skills and competencies needed for the future. Despite their different backgrounds, these organizations call for changes to present curricula and encourage a move from teaching for specific jobs towards acquiring skills which allow graduates to adapt to the evolving tasks arising from technological change<sup>14</sup>. UNCTAD classifies the digital skills needed in four levels<sup>15</sup>, the first two are for all people and the last two levels are for ICT professionals:

- ◀ Adoption of technologies: basic digital literacy skills and awareness must be adopted in the primary school. This must include basic understanding of emerging technologies and technology applications and knowledge about digital privacy and security. The idea of this level is to teach children at an early stage to extract the information they need from the Internet with safety considerations, instead of passively being receivers and targets of online advertisements and campaign marketing.
- ◀ Basic use of technology: this category includes teaching coding in intermediate schools (before 12 years of age). However, UNCTAD thinks that basic knowledge of ICTs is now essential for all citizens to solve everyday problems, as well as to engage in community activities. Some non-ICT professionals may increasingly need to develop stronger skills through training, e-learning, and continuing education to function properly in society. Some of these skills include programming skills, data analysis and processing and modelling skills.
- ◀ Creative use of technology with adaptation: include competencies acquired through university specialization in STEM subjects. This category includes fresh graduates employed in the ICT and other digitally related industries.
- ◀ Creation of new technologies: including engineering and sophisticated programming skills and use of complex algorithms such as machine learning. This category of skills should be available to the ICT workforce directly involved in the development of new algorithms and specific advanced software.

However, and according to UNCTAD, digital skills are not enough to adapt to the changing demands of labour markets. There is an increasing call for strengthening uniquely human skills that cannot be easily replaced by machines through developing the following skills in schools and for the entire population: complex problem solving, critical thinking, creativity and design mindset, sense making, collaboration and team building, social intelligence, cross cultural competencies including gender awareness, transdisciplinary thinking, communication and new media, and virtual tools for work and collaboration.

According to ESCWA report<sup>16</sup>, Arab countries ranked low on mathematics and science attainment, according to indicators such as Trends in International Mathematics and Science Study (TIMSS). Based on UNESCO data, the expected number of schooling years in Arab countries in 2017 was 11.9 years. Finally, and according to the 2018 Human Capital Index (HCI), Arab countries ranked (out of 157) as follows: Bahrain (47), United Arab Emirates (49), Oman (54), Qatar (60), Saudi Arabia (73), Kuwait (77), Jordan (79), State of Palestine (82), Lebanon (86), Algeria (93), Tunisia (96), Morocco (98), Egypt (104), Iraq (129), Sudan (139), Yemen (145), and Mauritania (150). These data indicate a disconnect between education system outcomes and local markets' needs. When

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14 World Economic Forum 2016, "The Future of Jobs: Employment, Skills, Workforce Strategy for the Fourth Industrial Revolution"

15 UNCTAD 2019, "Building Digital Competencies to Benefit from Frontier Technologies"

16 ESCWA, Impact of the Fourth Industrial Revolution on Development in the Arab region, 2019

companies in Arab countries were surveyed, they most frequently cited the following skills as being in high demand by 2022.

- ◀ Analytical thinking and innovation;
- ◀ Active learning and learning strategies;
- ◀ Creativity, originality and initiative;
- ◀ Technology design and programming;
- ◀ Critical thinking and analysis;
- ◀ Complex problem-solving;
- ◀ Leadership and social influence;
- ◀ Emotional intelligence;
- ◀ Reasoning, problem-solving and ideation;
- ◀ Systems analysis and evaluation

In summary, in order to ensure that the next generation of the work force and policy makers is tech savvy, it is necessary to put in place long-term educational strategies, such as providing children access to coding and computer science courses starting from primary school, and extending into university or vocational courses.

## D. Data Policies and Regulations

### 1. Availability of Data and Big Data

The algorithms that power AI run on data, and today's world is deluged with it. Since the onset of the digital era, the actions of people and machines all over the world, mediated by smartphones, sensors and other devices, are continuously recorded and stored in electronic databases as large sets of unorganized data called Big Data. According to Domo's 2018 Data Never Sleeps bulletin<sup>17</sup>, the Internet receives 3,138,420 GB of data every minute. This huge collection of diverse data provides the raw material for training algorithms.

To a certain extent, AI is only as good as the data behind it. Hence, the first question to be asked when developing an AI strategy is "what data do we have?". According to Mohammed Bin Rashed School of Government survey conducted in 2017<sup>18</sup>, 98% of smart phones owners use social media apps on their mobile phones, followed by 55% for multi-media, gaming, news, etc. This means that there are no substantial sources of user generated data from the region emanating from local mobile apps.

According to ESCWA<sup>19</sup>, the region is seeing an increased growth in big data infrastructure, with more data centers being established and with the market size in this area to reach \$3.2 billion by 2020. Best examples are the C5 Accelerator in Bahrain helping regional startups scale through cloud computing; and Geomatic (Morocco) through big data analysis and visualization.

The second source of data is automation systems. For example, the big agricultural giants like Monsanto, John Deere, and DuPont pioneers have a wealth of data on agriculture in the United States. According to ESCWA, the largest investors in automation in the region have been Governments (20.4 per cent), the financial sector (19.2 per cent) and telecommunication companies (13.3 per cent)<sup>20</sup>.

The third source of big data is from IoT devices. For example, in the United States, the Taser company sells police a body camera that can search a crowd for outstanding warrants using real-time face recognition. The data that was used to train the Taser software comes from surveillance cameras scattered all over the

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17 <https://www.domo.com/blog/data-never-sleeps-6/>

18 Mohammed Bin Rashed School of Government in collaboration with bayt.com 2017, "The Arab World Online"

19 ESCWA, Impact of the Fourth Industrial Revolution on Development in the Arab region, 2019

20 ESCWA, Impact of the Fourth Industrial Revolution on Development in the Arab region, 2019



streets. Examples of connected devices used in IoT include sensor-based devices that monitor daily activities such as eating and sleeping; home appliances; and sensor devices for improving agricultural productivity. These devices provide data sets of measurements: temperature, soil fertility, noise level, traffic jams locations, garbage bins capacity, sleeping patterns, and more kind of data that can subsequently be used to train the software of ML.

The Arab region is still in the early deployment phases of IoT applications, except in the GCC where the IoT solution market is expected to reach \$11 billion within the next decade, with the largest sectors being utilities, public administration, retail and wholesale, housing and construction, and transport and logistics<sup>21</sup>.

There is no evidence of large Big Data collections in the Arab region. There are some of course, but, in most cases, the collected data is stored outside the region. However, while there are no strong applications to gather big data through IoT and other local apps, there is an opportunity not only in the 'Arabization' of content technology, but also in 'localizing' technologies addressing unique problems and challenges that consider the local cultural, political, social and legal contexts.

Open data can also be a great source for data sets that can be used in AI applications. When e-Government systems are in place, data sets can be generated from the various databases and made available to the public through a national Open Data portal such as data.gov.uk which hosts over 50,000 data sets today. The UK ranks joint-first with Canada in the World Wide Web Foundation's global rankings for public access to official data<sup>22</sup>. Open data can be the fuel to start-ups, innovators, and AI coders who can use it to develop new services, applications, and train the machine for AI applications. For example, the app CityMapper has been possible because of the open data that the Department for Transport has published. Furthermore, Transport for London (TfL), claims that more than 600 apps used by 42 percent of Londoners are now being powered by its selection of over 80 open data feeds, which are available through a unified API, and claims that provision of this data adds up to £130 million a year to London's economy.

Last but not least, AI needs computers with high computational and processing power due to the need to manipulate large data sets and scan all possibilities for every decision. While computational power is rising exponentially (a mobile handset in 2019 had more computational power than a NASA computer in 1969), AI needs cheap computational power such as the ones available in large data centers. The super-computers need to be available to programmers, along with affordable hosting in data centers, and cloud strategies.

## 2. Legal Framework for Data

According to the same MBR School of Government survey, the three technological advancements that Arab people are most concerned about are AI based technologies in general, followed by autonomous vehicles and unmanned aerial vehicles (UAVs). In total 59% of internet users in the Arab region are concerned about AI and its applications.

In order to ensure data privacy and security, laws are needed. The EU set the international legal framework for this when it published the General Data Protection Regulation (GDPR) that sets the guidelines for the collection and processing of personal information for its citizens and residents in 2016.

The international community is still debating the legal framework for the ownership of data since most of the data gathered on people around the world is owned today by a handful number of companies. Governments are aware that data has become the hot asset of the twenty first century and are looking for solutions to ensure privacy and security, as well as the availability of unbiased data sets to feed the ML algorithms.

Finally, there is the ethical aspect of AI that need to be regulated and that will be the focus of a subsequent section.

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21 ESCWA, Impact of the Fourth Industrial Revolution on Development in the Arab region, 2019

22 <https://www.computerworld.com/article/3427838/what-is-the-uk-government-s-open-data-strategy.html>

# V. Components of Successful AI Strategies

## A. Innovation Friendly Legislation

It is not international best practices to regulate AI at an early stage. The example most commonly used is the example of the car that was invented in England before the Ford company manufactured it in the USA. England at the time put heavy regulations on the car regarding its safety features for example requiring a special person to run in front of the car to warn the by-passers. Eventually, the industry picked up where the regulations were friendlier in the USA.

Eventually, once the AI industry matures, the ownership of AI needs to be clearly defined through legislation; does AI belong to companies, individuals, or the machine itself that created it. Ownership is necessary in order to attribute the liability in the case of security accidents, deaths due to machine action, or threats to humanity.

Furthermore, effective regulation should address transparency, understandability, predictability, and accountability of AI algorithms, risk management, data protection, and safety.

Good regulation can take many different forms, and appropriate regulatory responses are context dependent. There is no one-size-fits-all for AI regulation, but it is important that such regulation is developed through an approach that is based on human rights and has human well-being as a key goal.<sup>23</sup>

## B. Government as Enabler of Innovation

Best practices from around the world demonstrate that government role is to be the enabler of innovation and the patron who enhances the entire innovation eco-system. That means successful governments are those that provide a vision yielding public policies promoted with other stakeholders. Government policies can include setting research councils, establishing research centers and public universities, soliciting Foreign Direct Investments (FDI), lowering the cost of doing business, others.

A concept that has been instrumental in building the Internet is the one of “permission-less innovation”<sup>24</sup>. Adam Thierer of George Mason University translates this disposition into a 10-point checklist that policymakers can follow to achieve that goal:

- ◀ Make permission-less innovation as the default policy;
- ◀ Remove barriers to entry and innovation;
- ◀ Protect freedom of speech and expression;
- ◀ Retain and expand immunities for intermediaries from liability associated with third-party uses;
- ◀ Rely on existing legal solutions and the common law to solve problems;
- ◀ Wait for insurance markets and competitive responses to develop;
- ◀ Push for industry self-regulation and best practices;
- ◀ Promote education and empowerment solutions;
- ◀ Adopt targeted, limited legal measures for truly hard problems;
- ◀ Evaluate and reevaluate decisions based on benefit-cost analysis.

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23 IEEE, Ethically Aligned Design – Version II, 2017

24 <https://permissionlessinnovation.org/what-is-permissionless-innovation/>

## C. Government as Driver of Demand for AI

When the innovation eco-system is weak, the government can generate demand for AI by becoming the customer “anchor tenant”. This in turn forces companies and start-ups to rise to fulfill the demand, hence the government would play a role in jump-starting the pickup of AI companies.

Smart Dubai, the agency leading Dubai’s AI roadmap, has invested heavily in creating a viable ecosystem for companies and other public sectors companies committed to AI. Other examples from Dubai are the Police department who is committed to using AI for all operations, including security, crime forecasting, and accident response. Another example is the Ministry of Transportation who announced that 25 percent of all transportation in the city to transform to autonomous modes by 2030. Estimated investments to reach 100 Million USD by 2021<sup>25</sup>.

## D. Science Engagement, R&D, and Technology Facilitation

Europe has consistently been the largest publisher of AI papers — 28% of AI papers on Scopus in 2017 originated in Europe. China comes in second place, where the number of papers published in China increased 150% between 2007 and 2017. The third place goes to the USA that publishes about half the papers issued by Europe<sup>26</sup>. This said, USA AI authors are cited 83% more than the global average. AI papers in China are more focused on applied AI in Engineering and Technology and Agricultural Sciences and are mainly government sponsored. AI papers in the U.S. and Europe tend to focus on Humanities and Medical and Health Sciences and are corporate sponsors.

The following countries lead on percent of spending on R&D in % of GDP<sup>27</sup>:

- ◀ Around 4%: South Korea
- ◀ Around 3%: USA, EU and most EU states, Japan
- ◀ Around 2%: China, Norway, Singapore, World average

Middle East and North Africa average is 0.93%, when excluding the oil producing countries, it becomes 0.33%. Arab countries average is 0.53%. Another revealing number is the total reported employment in research and development in Arab countries at about 128,000, which is less than the Netherlands alone<sup>28</sup>. In Lebanon, the number of researchers is 4,500, i.e. 1,100/million inhabitants, slightly under the world average of 1,500 researchers/million inhabitants.

Developing countries need specific policies for technology development, transfer and deployment. Many UN agencies provide technology facilitation programmes that i) build or strengthen the capacity to identify technology needs, to facilitate the preparation and implementation of technology projects and strategies that foster sustainable development; ii) stimulate technology cooperation; iii) Support the design and establishment of country-tailored policies spurring technology transfer and enabling frameworks for transfer of technology iv) Build capacity in public and private institutions to deliver technology transfer services v) Facilitate regional and global peer learning, exchange, and training programmes.

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25 [https://thedubaiadvantage.com/wp-content/uploads/2018/10/Artificial\\_Intelligence\\_InvestmentOpportunityBrief.pdf](https://thedubaiadvantage.com/wp-content/uploads/2018/10/Artificial_Intelligence_InvestmentOpportunityBrief.pdf)

26 Sandford University 2018, “AI Index 2018 Report”

27 <https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS>

28 ESCWA, Impact of the Fourth Industrial Revolution on Development in the Arab region, 2019

## E. Attract and Retain Talent

A previous section discussed the various levels of digital skills required in the digital age. This section discusses best practices in talent development and retention for the AI age. There are three groups of talents that need to be developed for the development and adoption of AI:

- ◀ AI researchers who drive fundamental advances in AI;
- ◀ a larger number of specialists in software engineering and data sciences and in the application area;
- ◀ and the entire population who is familiar with AI technologies in order to operate those applications reliably.

The National Science and Technology Council of the Office of the President of the United States report<sup>29</sup> discussed the diversity challenge in finding and retaining AI talent. AI training is inherently interdisciplinary, often requiring a strong background in computer science, statistics, mathematical logic, and information theory. These are fields where women account for less than 20% of the graduates. The report focused on the importance of AI being produced by and for diverse populations. Doing so helps to avoid the negative consequences of narrowly focused AI development, including the risk of biases in developing algorithms, by taking advantage of a broader spectrum of experience, backgrounds, and opinions. Research has shown that diverse groups are more effective at problem solving than homogeneous groups, and policies that promote diversity and inclusion will enhance the ability to draw from the broadest possible pool of talent, solve toughest challenges, maximize employee engagement and innovation, and lead by example by setting a high standard for providing access to opportunity to all segments of society. In addition to ensuring that the national workforce has the digital skills required, some countries have policies for attracting and retaining international talent.

## F. Job Creation in the Age of AI

There is an increasing call for strengthening unique human skills that cannot be easily replaced by machines through developing the following skills in schools and for the entire population: complex problem solving, critical thinking, creativity and design mindset, sense making, collaboration and team building, social intelligence, cross cultural competencies including gender awareness, transdisciplinary thinking, communication and new media, and virtual tools for work and collaboration.

Predicting future job growth is extremely difficult, as it depends on technologies that do not exist today and the multiple ways they may complement or substitute for existing human skills and jobs. In the case where AI technologies would complement human skills, there is a wider belief that employment requiring manual dexterity, creativity, social interactions and intelligence, and general knowledge will thrive. Hence, new jobs will be created to replace old ones while increasing economic growth and productivity. In case AI technologies would substitute human skills, future employment would be restricted to the below four categories as examples:

- ◀ Engaging with the AI technologies throughout the process of completing a task. For example, IBM Watson may improve early detection of some cancers or other illnesses, but a human healthcare professional is needed to work with patients to understand and translate patients' symptoms, inform patients of treatment options, and guide patients through treatment plans.
- ◀ Development of AI applications for practical use by highly skilled software developers, engineers, data scientists, etc.
- ◀ All roles related to the monitoring, licensing, and repair of AI. For example, ensure the safety and quality control of autonomous vehicles on the roads.
- ◀ Management of paradigm shifts created by AI technologies. For example, the advent of self-driving cars may result in higher demand for urban planners and designers to create a new blueprint for the way the everyday travel landscape is built and used. Paradigm shifts will be created by AI in many fields such as education, social sciences, and cybersecurity—demanding, for instance, new methods of detecting fraudulent transactions and messages—that will necessitate new occupations and more employment.

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29 Executive Office of the President of the United States, Preparing for the Future of Artificial Intelligence, 2016

In the USA<sup>30</sup> some predict that almost 50 percent of occupations are threatened by new automation technologies, the labor market impact will still depend on a country's institutions and policies. Policy plays a large role in shaping the effects of technological change in productivity, increase in income inequality, labor force participation, etc.

OECD has similar conclusions about the effect of digitization on the future of jobs<sup>31</sup>. Some jobs are being lost to automation, others will change in their nature and tasks. As the digital transformation unfolds, and increasingly affects other industries that are at present less impacted, the need for solid cognitive skills combined with a good endowment of social skills will continue to increase and extend to the rest of the economy. There is no substitute to sound policies and investments in knowledge, talent, and skills.

ESCWA also has similar conclusions on the future of jobs in the Arab region due to the fourth industrial revolution<sup>32</sup>: there will be a shift in demand as some occupations will be eliminated and others will be transformed into new types of jobs. This means that technological advancements "eliminate jobs, not work". The report looks at the type of skills as well as the types of jobs existing. Regarding the available skills, the ESCWA report concludes that the region is facing a demand and supply mismatch between market needs and the skills of graduates. Hence our education systems must adapt to better prepare graduates to meet the wave of demands for the new jobs.

Regarding the existing types of sectors, the report stipulates that agriculture and industry are more susceptible to automation than services. Given that the manufacturing sector contribution to most economies of the region has been stagnant with an average of 10 per cent over the past 10 years, on average 46.5 per cent of the jobs in each Arab country are at higher risk of partial automation because they fall under services or agriculture sectors.

The region can therefore be positioned in a satisfactory spot to leapfrog into the jobs of the future, if an enabling ecosystem and environment are put in place. The sectors expected to realize growth are technology development, education, and services.

The region must also prepare for expected demand in health care and social services due to projected shift in demographics. Within this context, there is an obligation to protect the most vulnerable countries and most vulnerable within society, and prepare all population segments (older persons, women, refugees, etc.) for the shift already taking place, in line with SDGs 8 and 10.

## G. Ethical Dimension of AI

Several ethical questions arise to the surface related to AI applications:

- ◀ What if the data set is bias? As previously mentioned, in ML, large data sets are hand labeled and taught to a machine to "learn" from.
- ◀ How does the machine decide "right" from "wrong", such is the case of the trolley problem applied to a self-driving car unable to stop and must decide to hit a person or another crossing the street?
- ◀ Who is responsible when the decision is taken by a machine rather than by a law-abiding person? This is particularly the case with Lethal Autonomous Weapons Systems (LAWS). How will human rights be applied in such a case?
- ◀ Neural networks or any (statistical) technique for that matter is unpredictable. Even if historical data is analyzed, an unseen input might give an unpredictable result. How to audit AI system to know that it is aligned with societal values?

Without direct human intervention and interrupting control, smart systems today conduct dialogues with customers in online call-centers, steer robot hands to pick and manipulate objects accurately and incessantly,

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30 The Executive Office of the President of the United States, Artificial Intelligence Automation and the Economy, 2016

31 OECD Science Technology and Industry Scoreboard 2017, the Digital Transformation

32 ESCWA, Impact of the Fourth Industrial Revolution on Development in the Arab region, 2019

buy and sell stock at large quantities in milliseconds, direct cars to swerve or brake and prevent a collision, classify persons and their behavior, or impose fines.

Furthermore, neural networks used in Deep Learning software are not predictable and do not follow a well-documented algorithm that can be audited rule-by-rule. On the contrary, they can be extremely complex and difficult to understand, even for those who program and train. Some ML systems iterate and evolve over time and may even change their own behavior in unforeseen ways. Finally, a specific prediction or decision is not necessarily repeatable because it depends on specific conditions and data available in the neural network only at the time of decision.

Several International Organizations including the UN (CCW, Geneva), ITU (AI for Good), ACM (Conference on AI, Ethics, and Society) have convened conferences on the urgent issue of ethics in AI. Companies such as IBM, Microsoft and Google's DeepMind have established their own codes of AI ethics and joined forces in creating broad initiatives such as the 'Partnership on AI' or 'Open AI'. Others such as the EU, IEEE, and the Future for Life Institute have started researching and reporting on the ethical use of AI. The subject requires a separate survey and report due to the abundance of discussions and policy recommendations. The European Group on Ethics in Science and New Technologies (EGE) published an ethical framework that proposes a set of fundamental ethical and democratic principles<sup>33</sup> that AI jeopardizes and whether new governance and regulatory instruments are required to deal with the following issues:

- a. Human Dignity
- b. Autonomy
- c. Responsibility
- d. Justice, equity, and solidarity
- e. Democracy
- f. Rule of law and accountability
- g. Security, safety, bodily and mental integrity
- h. Data protection and privacy
- i. Sustainability

## H. Awareness

Public understanding related to development of AI technology is necessary at a societal level because, according to Mary Meeker, "human adaptability to adapt to technological change is not keeping pace with the speed of scientific and technological innovation"<sup>34</sup>. People are:

- ◀ Worried about the negative impact especially loss of traditional jobs;
- ◀ Not sure how to use their capabilities to the fullest extent to become digital citizens;
- ◀ Not sure whether AI can make human society a better place;
- ◀ Not sure whether AI technology brings benefits to the economy and industries;
- ◀ Not sure whether AI should have, or could develop, any sense of ethical behavior.

What is clear that the current levels of AI technical understanding, applications, and expertise must be raised through awareness campaigns conducted by governments, the private sector, and NGOs. Technology awareness and understanding of social, cultural, and ethical issues of AI are the new literacy skills society must embrace if AI applications are to be accepted and trusted as an integral part of modern living, transforming society for the better in the coming decades.

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33 European Group on Ethics in Science and New Technologies, Statement on Artificial Intelligence, Robotics and 'Autonomous' Systems, 2018

34 [https://www.vox.com/recode/2019/6/11/18651010/mary-meeker-internet-trends-report-slides-2019?fbclid=IwAR17AVIT4tRzZ0rVYGy0V\\_sgpLOS\\_mZblQSiZwRdDZX\\_VbPonEda71d9mYM](https://www.vox.com/recode/2019/6/11/18651010/mary-meeker-internet-trends-report-slides-2019?fbclid=IwAR17AVIT4tRzZ0rVYGy0V_sgpLOS_mZblQSiZwRdDZX_VbPonEda71d9mYM), slide 156/333

Furthermore, special awareness programmes must target policy makers, because governing AI and related technologies requires a dutiful level of technical expertise that most in governments currently do not possess. Policy makers are advised to understand and analyze the interactions between AI technologies, programmatic objectives, and overall societal values. The general present levels of technical understanding and expertise, policies and regulations may fail to support innovation, adhere to national principles, and protect public safety<sup>35</sup>.

At the same time, the AI personnel should not only possess a necessary technology knowledge, but also receive adequate ethical training, and have access to other resources on human rights standards and obligations, along with guidance on how to make them a fundamental component of their work.

## I. Standardization of AI

Standards provide requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that AI technologies meet critical objectives for functionality and interoperability, and that they perform reliably and safely. Adoption of standards brings credibility to technology advancements and facilitates an expanded interoperable marketplace<sup>36</sup>.

There is no evidence from the literature review that standardization of AI as a whole is possible due to its broad scope of application. However, standards and guidelines have been and should continue to be developed in specific AI areas. ITU, IEEE, and NIST<sup>37</sup> are leading in this area. Such standards and benchmarks would be useful for the certification of systems involving AI for example.

Standards, guidelines, and benchmarks for AI could be developed through engaging the AI community. For example, the Text Retrieval Conference (TREC) which was started by NIST in 1992 to provide the infrastructure necessary for large-scale evaluation of information retrieval methodologies, included more than 250 groups.

For the “Arab Thought Foundation”, AI standards, as well as risk management and data protection are needed in order to identify algorithms of synthetic, as well as lethal quality. AI systems need to be certified as industrial counterpart priori to their usage. The organization calls for an approach to be adopted to guarantee the safety of AI systems, as well as protect the societal aspects of the business sector<sup>38</sup>.

## J. Meeting the SDGs

The United Nations issues an annual report about how agencies are using AI and which Sustainable Development Goals are impacted by their AI projects<sup>39</sup>. This report inspires governments to demand through their agencies, AI applications that help them fulfill the UN SDGs.

Big data and the Internet of things can contribute to achieving the Sustainable Development Goals<sup>40</sup> when applied to Agriculture, health, water distribution, reducing energy consumption for sustainability using smart meters and smart grids.

Furthermore, many countries have included in their strategies AI applications that meet the SDGs such as: USA (AI for the Public Good), UK (strategy for ageing society and the future of mobility), and Japan (healthier society). These countries are also investigating the negative effects of adopting an AI strategy on the SDGs (for example, Data Centers generating a large carbon footprint is detrimental to climate change).

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35 IEEE, version II (more details)

36 [https://www.nitrd.gov/PUBS/national\\_ai\\_rd\\_strategic\\_plan.pdf](https://www.nitrd.gov/PUBS/national_ai_rd_strategic_plan.pdf)

37 National Institute of Standards and Technology (USA)

38 Fikr Arabi (more details)

39 United Nations Activities on Artificial Intelligence (AI) 2019 (more details)

40 UNCTAD, Foresight for Digital Development, 2016

## K. AI Key Sectors

The AI adoption by industry and functions according to Stanford University and McKinsey Research is by order of industries: Telecom, High tech, automotive and assembly, financial services, resources management of power and natural gas, healthcare, retail, education, professional services, travel and logistics, pharmaceutical<sup>41</sup>.

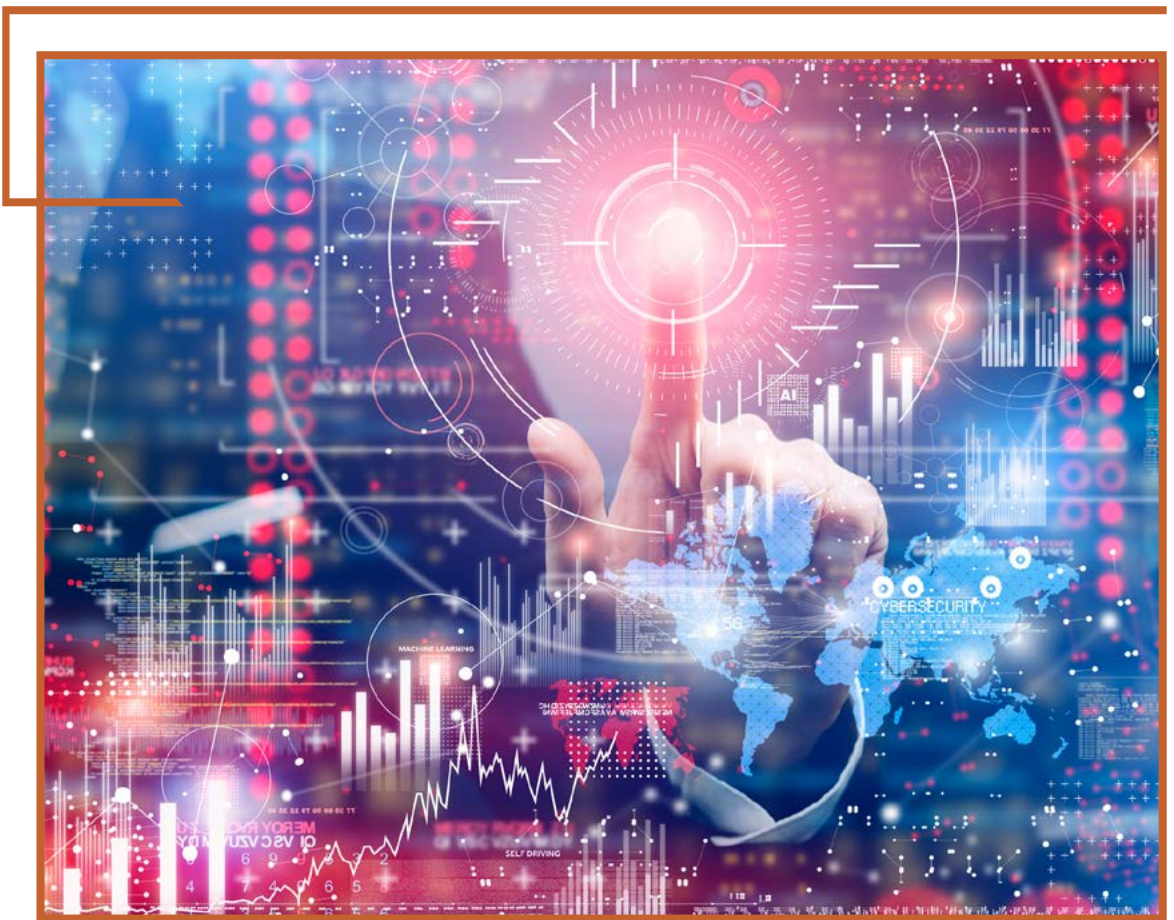
The functions needing AI are: Service/operations, product/service development, marketing and sales, manufacturing, supply chain management, and risk management.

For the Arab region, the sectors most prone to AI adoption are utilities, public administration, retail and wholesale, housing and construction, and transport and logistics<sup>42</sup>. Other sectors expected to realize growth are technology development, education, and services. The UAE has crafted a national AI strategy focused on expanding the role of AI in nine sectors: transport, health, space, renewable energy, water, technology, education, environment, and traffic.

From the literature, national AI strategies recommend application sectors based on:

1. The competitive advantage of sectors
2. Difficult societal needs such as aging, power consumption, health, education, others
3. Alignment with SDGs especially in countries going through development phase.

This said, higher automation level in a sector implies more readiness for AI adoption.



41 McKenzie, 2017 <https://www.mckinsey.com/~media/McKinsey/Industries/Advanced%20Electronics/Our%20Insights/How%20artificial%20intelligence%20can%20deliver%20real%20value%20to%20companies/MGI-Artificial-Intelligence-Discussion-paper.ashx>

42 ESCWA, Impact of the Fourth Industrial Revolution on Development in the Arab region, 2019



# VI. National AI Readiness Assessment

## A. Current Status of AI Pre-requisites in Lebanon

### 1. Ubiquitous, Open and Secure Internet

Lebanon's regional and international standing from external independent sources show:

- ◀ ICT Development Index (IDI) 2017<sup>43</sup> published by the United Nations International Telecommunication Union (ITU); Lebanon is in 65th position worldwide, and sixth in the Arab Region after Bahrain, Qatar, UAE, Saudi Arabia, and Oman. In the region, Lebanon's position is stable but in the worldwide position, it fell from 52nd to 65th since 2012.
- ◀ According to ITU Measuring the Information Society Report 2018<sup>44</sup> – Volume 1, Lebanon ranked 74/138 countries in the fixed broadband basket. The affordability of fixed and mobile broadband remains high.
- ◀ According to the World Economic Forum Global Information Technology Report 2016<sup>45</sup>, the Network Readiness Index (NRI) showed Lebanon's rank 88/139 (page 126) with improvement from 94/144 in 2013. The insufficient action from the government remains a roadblock for Lebanon to become more competitive in the global market, where Lebanon scored 134/139 (used to be 144th from 144 countries in 2013) in the "Importance of ICTs to gov't vision" indicator of the Network Readiness Index. In comparison, Lebanon scores an impressive high 6/139 in the Quality of math & science education.
- ◀ According to the World Bank report of 2014, Broadband Networks in the Middle East and North Africa<sup>46</sup>, prices in broadband remain high as compared with the region (Lebanon has one of the highest mobile broadband prices in the region, after Djibouti, Syria and Libya).

The improvement of the International ratings in the last 10 years are the result of Ministry of Telecommunications (MOT) financing infrastructure improvements (national fiber project 2010), mobile data usage (3G 2013), and currently the deployment of optical fiber and fixed-LTE in the access network by Ogero, who is also undergoing a nationwide modernization of the infrastructure with enhancement of the core network with IP/Multiprotocol Label Switching, and migration of telephony to the IP Multimedia Core Network Subsystem framework.

Lebanon has a regulatory regime that can be more effective, and compliant with international best-practices. The lack of true competitive dynamics in the supply of services represents a disincentive to the attainment of supplier and market efficiency. The government is playing the role of regulator and service provider instead of policy maker and enabler. The result is that the telecommunication and regulatory environment in Lebanon is limiting the growth of the ICT sector given the high costs and regulatory restrictions imposed in the telecommunications sector.

All essential telecommunications services are currently provided through assets owned by the Republic of Lebanon and managed by the Ministry of Telecommunications. As a result, all investment must presently be funded by government.

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43 <https://www.itu.int/net4/ITU-D/idi/2017/index.html>

44 <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/misr2018.aspx>

45 [http://www3.weforum.org/docs/GITR2016/WEF\\_GITR\\_Full\\_Report.pdf](http://www3.weforum.org/docs/GITR2016/WEF_GITR_Full_Report.pdf)

46 <https://www.unh.edu/broadband/sites/www.unh.edu.broadband/files/media/pdf-general/9781464801129.pdf>

Political controversies have blocked the enactment of law 431/2002 and the independent functioning of the Telecommunications Regulatory Authority (TRA). Today, major suppliers of services are not subject to licensing and the private sector only has 5% share of the telecom market, limited in the provision of DSL and wireless Internet services. Lately, the private sector was allowed to pilot FTTH deployment in one area of Beirut. Lebanon is among the few countries in the world where the government owns the mobile operators.

Countries of the region, which introduced competition in access, have a better performance on penetration and quality of services. With absent competitive market structure that can serve the demand for access and quality of ICT and broadband services, Lebanon is deprived from the full benefits of its potential for economic development derived from ICT services and broadband that other countries in the region and the world are already enjoying.

## 2. Healthy and Vibrant Start-Up Eco-System

Lebanon ranked 143 among 190 economies in the World Bank Ease of Doing Business report. The rank of Lebanon deteriorated to 143 in 2019 from 142 in 2018, and 101 in 2008. Lack of modern laws, and bureaucratic red tape are the main causes for this decreasing score that indicates that it is more difficult for private sector to operate viable businesses in Lebanon. However, in the start-ups space, Lebanon ranked fourth worldwide in Total Early Stage Entrepreneurial Activity, according to the Global Entrepreneurship Monitor 2017/2018 Global Report<sup>47</sup>.

The Lebanese start-up eco-system started in 2002 with the establishment of the first technology incubator Berytech. Lebanon's entrepreneurship landscape has since "leapfrogged" in August 2013, when Banque du Liban (BDL) released Circular 331 that authorized Lebanese banks to invest USD400 Million in the knowledge economy. While circular 331 is mainly tailored towards growth stage startups, a surge of early-stage entrepreneurs has been noted as a result of BDL 331. The pre-growth section of the eco-system is made of: incubators and accelerators; support organizations such as UK Tech Hub, MIT Enterprise Forum for the Arab Region; Angel funds and other early stage funding such as iSME, IM Capital; and couple of fab labs. Executive Magazine estimates that USD 40 Million is the amount of money available in the pre-growth eco-system section<sup>48</sup>.

What is peculiar in the Lebanese eco-system is a tenfold difference in the availability of startup funding in the later downstream stage versus the early upstream stage. Usually, to spur innovation such as AI, funding is needed more in early stage funding where a prototype and a business model have not yet been devised. Except for few initiatives mainly iSME and IM Capital, there is no money for the dreamers that have big ideas.

The other peculiarity of the eco-system is the absence of universities and government. If one takes the MIT Regional Entrepreneurship Acceleration Program (REAP) framework as a reference, the main five pillars of any eco-system are: entrepreneur, risk capital, corporates, universities, and government. AUB, ESA, and BAU have entrepreneurship centers but there is no evidence of their connection with the key researchers in universities. Government main involvement has been in three initiatives that have all ended: BDL Accelerate Networking Event (BDL), Circular 331 (BDL), and iSME (Kafalat). In 2018, MoT launched MIC Ventures, a \$48 million fund, to invest in and empower the ICT sector and related services startups.

With no systematic reporting in place, there is little evidence for any major success to date. However, the first results should start to appear this year (2020), seven years after starting BDL circular 331 funding.

Taking a step back and looking at the entire Innovation Eco-System, ESCWA report identified<sup>49</sup> two critical points that hinder the productivity of such system. First the evident disconnect in coordination between government bodies and other private initiatives; and second the vast number of micro-initiatives both from the government and private sector sides. The overall picture is one of inefficiency and poor communication. Hence Lebanon needs direly to consolidate and come up with efficient national point of coordination.

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47 <https://www.gemconsortium.org/report/gem-2017-2018-global-report>

48 <https://www.executive-magazine.com/entrepreneurship/lebanons-entrepreneurship-ecosystem>

49 [https://www.unescwa.org/sites/www.unescwa.org/files/page\\_attachments/lebanon\\_ntto\\_book.pdf](https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/lebanon_ntto_book.pdf), p73

In the same ESCWA report (2017), and as in the other classifications, Lebanon scored very poorly in the political environment and stability sub-indexes (127 and 137/144 respectively), but scored high in the quality of the human being sub-indexes such as tertiary education (25/144), pupil-teacher ratio (9/144), and cultural and creative services export (8/144).

### 3. Digital Competencies

According to UNESCO<sup>50</sup>, Lebanon is one of the 43 countries who did not meet the 15% education financing benchmark as percent of GDP (Lebanon spends 8.5%).

Also, according to UNESCO, there are 200,000 students enrolled in universities across Lebanon, and 40,000 graduates per year. Those enrolled in Science, Technology, Engineering, or Math (STEM) subjects are 44,720 (29% of total), which is a very high percentage worldwide. International student population account also for about 10-15% of the student enrolment and consists mainly of Arab nationals enrolled at AUB and BAU. Women enrolment is 52% and is the highest in the Arab region.

This said, the latest Industrial Innovation Survey conducted by the CNRS and funded by the World Bank revealed that there is a mismatch between the university curricula and the market needs<sup>51</sup>.

However, IT and coding have not become a core part of the educational curriculum. In both private and public schools, IT and/or coding are introduced in the secondary school, whereas in many other countries they are introduced at an earlier stage.

Furthermore, the ICT sector companies are reporting the inadequacy of university graduates to be ready for technology innovative jobs. They are generally labeling “university graduates are not employable”. They are demanding university curricula in Computer Sciences and Technology to be adjusted, and new degrees such as Software Engineering to be added.

To compensate this gap, NGOs such as SE Factory and Codi are providing basic coding bootcamps for recent grads of universities and vulnerable youth. However, these efforts are producing far less than the market requires and the total number of cohorts is still very low. There are no numbers to be found on the spread of digital skills in society.

Finally, and perhaps more importantly, the skill that impacts all future technologies including AI seems most lacking in educational and professional institutions, in Lebanon and elsewhere, is the skill of critical thinking. As such, a more focused approach beginning at the education level towards harnessing this skill is of paramount importance.

### 4. Data Policies and Regulations

Laws issued in 1946, 1996, and 2000 and the copyright sector make up the Intellectual Property (IP) Rights Legal Framework. The Ministry of Economy and Trade combats counterfeiting and piracy through the Consumer Protection Bureau.

The e-transactions and personal data privacy law passed as Law 81 on 10/10/2018 but is still awaiting the issuing of its implementation decrees for enactment. This law is not compatible with the international GDPR standard.

The Right of Access to Information passed as Law 28 on 16/02/2017, but the Presidency of the Council of Ministers officially refused to start applying it on 28 June 2017 (decision number 869/ص) before issuing its implementation decrees and establishing the National Commission for Fighting Corruption<sup>52</sup>. This law could help the generation of data sets and other data from government databases.

There is a lack of data and data sets available in Lebanon since most mobile and IOT applications are owned and managed by foreign companies.

Eqlim, a local start-up specializing in the gathering and processing of big data, closed its doors after five years of operations.

Finally, there is a lack of Data Sciences specializations in Lebanon. Few universities, such as AUB, offer a master’s in data science, Intelligent Systems, and Computational Engineering.

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50 UNESCO, Global Education Monitoring Report 2019 <https://unesdoc.unesco.org/ark:/48223/pf0000265866>

51 [https://www.unescwa.org/sites/www.unescwa.org/files/page\\_attachments/lebanon\\_ntto\\_book.pdf](https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/lebanon_ntto_book.pdf)

52 <https://al-akhbar.com/Community/275842>

## B. Current status of AI in Lebanon

### 1. Science Engagement, R&D, and Technology Facilitation

Research and Development are positioned at the center of AI innovation. Stanford is located at the heart of Silicon Valley; MIT and Cambridge universities have generated their own mega-entrepreneurial eco-systems. Google, Facebook, and Skype are few examples of innovations born in universities. The theories that AI is being built on (neural networks, chaos theory, fuzzy systems, image processing, etc.) are all being conceived in universities.

In Lebanon, the government entity mandated with encouraging scientific research is the National Council for Scientific Research (CNRS-L), which was established in 1962. The CNRS-L supports scientific research through the award of grants from the “Grants Research Program (GRP)”, as well as support future human resources development through the “PhD Scholarships Program”. The CNRS-L reports to the President of the Council of Ministers and established four specialized research centers:

- a. The National Center for Marine Sciences;
- b. The National Center for Remote Sensing;
- c. The Lebanese Atomic Energy Commission;
- d. The National Center for Geophysics.

Starting 2009, CNRS-L initiated the development of Associated Research Units (ARUs) where researchers from different disciplines and institutions work together on a theme of national importance. In 2017, CNRS-L initiated the Joint Grant Research Programs and the Joint PhD Scholarship Programs. The goal is to enhance partnerships, cooperatively establish priorities, jointly select proposals based on international review criteria and increase allocations through co-funding.

16 universities signed agreements with the CNRS-L for the implementation of the joint programme. This solidified a public-private partnership within national research priorities, and almost doubled research funding (both in the number of projects accepted, average funding per projects, and the total budgets of the programme). In parallel, the agreements signed for the PhD Scholarship Program and CNRS-L required that at least 50% of a PhD candidates’ research is conducted in Lebanese Institutions, hence a dynamism for ensuring a link to local challenges, ensuring national return and enhancing local human development. Within this new format, PhDs granted scholarships have tripled between 2008 and 2018.

CNRS-L total budget represents 0.014 % of GDP, while informed estimates (no official figures) on public spending in research average 0.1 % of GDP (including the CNRS-L, LARI, and the Lebanese University). If further estimates of research in Lebanese Private Universities are included, this increases to 0.2% of GDP; which is still way below the world average of 2% of GDP. Noting that 82% of the total budget of CNRS-L is utilized in programmes and funding of research, with universities and research centers as primary beneficiaries.

Other government research institutions are the Lebanese Agricultural Research Institute (Ministry of Agriculture) and the Industrial Research Institute (Ministry of Industry). However, they do not support or invest in university research.

Lebanon has a small but diverse scientific community mainly based around twelve (12) universities who have a science or technology and engineering faculty. Precise data on the number and distribution of doctoral candidates do not exist at the national level. However, according to Technopolis Group who published a “Study on the Organization of Doctoral Programs in EU Neighboring Countries – Lebanon”<sup>53</sup>, there is an estimated 2100 doctoral candidates in Lebanon, and the number is increasing according to the Central Administration of Statistics (CAS).

According to the CNRS, there are 4,500 researchers in Lebanon, i.e. 1,100 researchers/million inhabitants when the world average is 1,500. This said, Lebanese researchers publish 3,000 papers per year, i.e. 0.66% publishing rate that is higher than the World average.

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53 [http://www.tempos-lb.org/sites/default/files/lebanon\\_doctoral\\_studies.pdf](http://www.tempos-lb.org/sites/default/files/lebanon_doctoral_studies.pdf)

Given that the R&D space is crowded by many small players and disparate micro initiatives, the first recommendation of the ESCWA report on National Technology Development and Transfer System in Lebanon<sup>54</sup> was to establish a central technology transfer office under the CNRS. The National Center for Technology Transfer in Lebanon is expected to maximize the benefits of various existing programmes and activities, to consolidate resources, and coordinate with the various stakeholders such as universities and government institutions involved such as the patent office of the Ministry of Economy and Trade.

## 2. AI Activity in Lebanon

There is no evidence of AI activities in Lebanon beyond ML. Many activities take place at the American University of Beirut (AUB):

- ◀ The Maroun Semaan Faculty of Engineering and Architecture (MSFEA) offers a master’s degree in Data Science, Intelligent Systems, and Computational Engineering.
- ◀ MSFEA has ML lab.
- ◀ The department of mathematics received recently a USD 1million grant from Google AI to use AI in water irrigation.

Other universities that implement a Data Sciences and Analytics programmes are the Lebanese American University (LAU), Antonine University, and AUST’s Center for Learning and Development.

According to the workshop held at ESCWA on 30 January 2020, to discuss this report, one of the biggest challenges is brain drain of technically competent youth and the solution would be strengthen the start-up ecosystem in Lebanon to attract or at least retains talents.

The same workshop also identified the need for government funding for the basic infrastructure of research through grants, and for super-computer centers. Big data simulations are taking weeks to run on university computers, putting Lebanese researchers at a disadvantage compared to their international colleagues.

According to the ESCWA workshop discussions<sup>55</sup>, sample AI companies in Lebanon:

Name	Application	City	Funding (USD)
Cedarman	Precise Agriculture	Batroun	N/A
Cloudfish	Big Data	Beirut	undisclosed
dox	e-Vehicle Maintenance	Beirut	undisclosed
Eqlim	Big Data	Beirut	425,000
Fig	Chatbot	Beirut	undisclosed
Foo	Data Analytics	Beirut	20,000
Giftlivery	right gift	Beirut	undisclosed
Hello Harold	Big Data	UK and Beirut	undisclosed
Intelligile	Integrated Management	Tripoli	undisclosed
Lexium	NLP for legal text	Beirut	undisclosed
NAR	Drone Inspections	USA and Beirut	undisclosed
Neotic	FinTech	Tripoli	undisclosed
Net Energy NES	Energy saving / smart grid	USA	Acquired by Cedrus
(Nexgen (NXN	Smart cities	(Dubai (Lebanese Owner	undisclosed
Quadra	Agrytech sorting fruits	Beirut	100,000
Rational Pixels	Digital Ads	Barcelona and Beirut	30,000
RAY	Collaboration tool	Beirut	undisclosed
Seez	Select the right car	Beirut	1,800,000
Ubility	Mobile intelligence	Tripoli/Marseilles	undisclosed
Yakshof	Big Data	Beirut	undisclosed

54 [https://www.unescwa.org/sites/www.unescwa.org/files/page\\_attachments/lebanon\\_ntto\\_book.pdf](https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/lebanon_ntto_book.pdf)

55 <https://www.nanalyze.com/2019/03/artificial-intelligence-lebanon/>  
<https://en.annahar.com/article/784244-prominent-artificial-intelligence-startups-in-mena>

### 3. AI Key Sectors Analysis

The AI adoption by industry and functions according to Stanford University and McKinsey Research is by order of industries: Telecom, High tech, financial services, professional services, power and natural gas, healthcare, automotive, retail, travel and logistics, pharmaceutical. The functions needing AI are: Service/operations, product/service development, marketing and sales, manufacturing, supply chain management, and risk management.

In the Lebanese context, 90% of the companies are small companies employing under 50 employees, and 5% are medium enterprises employing less than 100 employees. Hence, and according to the Ministry of Economy and Trade<sup>56</sup>, 95% of the companies in Lebanon are Small and Medium Enterprises (National Center for Technology Transfer in Lebanon) with limited resources and ability to invest in R&D, new technologies such as AI, etc. These companies would use AI technologies if they are available “off the shelf” at a relatively low cost compared to their operations.

Furthermore, Lebanon SMEs strategy indicates that 56.8% of the companies are in the Wholesale, Retail Trade and Repairs sector; 11% in Manufacturing<sup>57</sup>; 14% in Real Estate; 3.9% in Transport and Logistics; and 4.8% in Construction. Hence, selecting suitable sectors for AI technologies from a supply side is problematic at best because AI technologies are not suitable for non-productive sectors that make up the bulk of the Lebanese economy.

Lebanon on the other hand, has already defined sectors that benefit from government incentives through subsidized loans (through BDL and Kafalat), tax incentives (through IDAL), and guaranteed equity investment (through BDL circular 331). These sectors are:

Sectors	BDL Subsidized Loans	IDAL Tax Incentives	BDL 331 <sup>58</sup>
Industry	Yes	Yes	No
Agriculture	Yes	Yes	No
Tourism	Yes	Yes	No
Traditional Crafts	Yes	No	No
ICT and Technology	Yes	Yes	Yes
Media	No	Yes	Yes
Other K-Economy	No	No	Yes

The table clearly shows that the ICT sector has access to multiple government incentives. The question remains why so many government incentives have failed to create jobs and boost the ICT sector of Lebanon, which should be the subject of a separate report. According to a workshop held at ESCWA on 30 January 2020 to review this report, the audience was resolute about the following challenges faced by the sector that are either created by government or could be resolved by government:

- ◀ Overall cost of doing business remains high (cost of opening and closing companies, employment and social charges, electricity, rent, and import fees). Government can apply WB recommendations for Ease of Doing Business
- ◀ Global markets for ICT products are difficult to penetrate due to a variety of reasons including standards compliance, reputation of Lebanon, etc. Government can play a crucial role in identifying and opening global markets through its diplomacy and various agencies such as IDAL. ICT companies simply cannot scale unless given access to global markets. Many cited diaspora networks such as LEBNET (based in San Francisco) to help in the export of Lebanese technologies.
- ◀ Local markets for ICT products are scarce with government poor digitization

56 Ministry of Economy and Trade, Lebanon SMEs Strategy, 2014 ([https://www.economy.gov.lb/public/uploads/files/6833\\_5879\\_4642.pdf](https://www.economy.gov.lb/public/uploads/files/6833_5879_4642.pdf))

57 Electrical machinery and apparatus make up 9.7 per cent of the manufacturing sector

58 To ensure the circular is appropriately used and that it serves its intended purpose, BDL laid down ground rules for qualifying.

- ◀ The import of specialized technology equipment or prototyping components is difficult due to heavy customs regulations, high tariffs, and red tape.
- ◀ Tertiary education curricula must adapt to reflect the needs of the market

Finally, if one looks at AI to solve societal problems in Lebanon, the following issues would need to be addressed:

#### ◀ **Electricity distribution**

One of the problems of the Lebanese electricity crisis is that 15% of total production is lost in the distribution and transportation networks. With total deficit of EDL being 1.2 – 1.8 USD Billions per year depending on fuel price, 15% could amount to substantial savings. AI technologies can be used to make the electricity grid smarter and minimize losses. This is even more relevant as EDL already installed smart meters.

#### ◀ **Agriculture**

Lebanon has dense population on decreasing amount of farm land. AI technologies are used to increase productivity by increasing yields, protecting crops from weeds, controlling pests, monitoring soils, etc. Other techniques involve drones, automated irrigation systems, crops monitoring, and more. Finally, urban farming practices - such as such as rooftop gardens, community greenhouses and vertical farms - are needed alternatives to rural farming. All use an indoor-growing technology component to produce optimal water and light conditions through AI algorithms.

#### ◀ **Smart Cities: buildings and public transportations**

Beirut air pollution index has surpassed 83 which is very high (50 is the threshold). Two main sources of air pollution are cars and buildings. AI technologies are readily available to optimize carbon emissions from both. A truly unique AI application would be needed to organize public transportations in Lebanon and minimize traffic jams due to the chaotic aspect of privately owned “services” and “mini-vans”. Solutions for smart cities could be funded by the citizens themselves if such conditions are coupled by recipients of subsidized housing loans.

#### ◀ **Security**

Even though the global landscape is over-crowded with AI applications for security, various sources point that security is the main challenge for all businesses worldwide. Given the broad spectrum of security issues, Lebanon can find a security niche to specialize in such as fintech security focusing for example on fraud detection on financial transactions. Another source of demand is the Lebanese Army that has its own budget to demand AI security applications.

#### ◀ **Marketing**

This playing field is dominated by the “FAANG” (Facebook, Amazon, Apple, Netflix, and Google) but due to the size of this global market, Lebanon could be able to provide a niche for quality AI applications in the digital marketing field due to its national marketing sector sophistication.

#### ◀ **Refugees management**

Lebanon has the highest percentage of refugees per capita and suffers from population concentration. AI could be used to match refugees to a given location by their needs, skills and the number of available resources and opportunities available significantly improving the conditions for refugees and wider hosting community<sup>59</sup>. Such applications could be funded by UNHCR and other international donor agencies focused on humanitarian aid.

#### ◀ **Health and Medical care**

Lebanon was leading in the provision of medical services in the Middle East before the civil war of 1975 and is still known for the quality of its medical doctors in Lebanon and abroad. Furthermore, there is evidence of advanced medical research conducted in Lebanon. Applications of AI in innovative medical services provisioning could be further developed.

◀ Potentially, the sectors of Industry and Tourism could be candidate sectors for AI adoption given a Public-Private Partnership as both sectors are already incentivized by government and have strong private sector leadership.

◀ **Others**

The following is a non-exhaustive list of other industries or topics that AI applications can benefit in the short, medium or long term, in Lebanon:

- Statistical Data Collection and Analytics;
- Financial and Legal Institutions, including Taxation and Fraud Detection;
- Safety and Security (whether environment or cybersecurity);
- Travel and Tourism;
- Food Waste;
- Expanding the base of available employment opportunities;
- Transport/public transport systems;
- Detection of inappropriate use of AI. For example, using AI for cyber-attacks;
- Gender issues and Diversity in Tech.





## VII. Lebanon AI Positioning

### A. Does Lebanon Need a National Strategy for AI?

Given the importance of AI globally and regionally, and its huge potential in creating economic growth, Lebanon cannot overlook and stay behind this transformational technology.

Given also that Lebanon's main resources are the people, it is understandable that Lebanon should invest in R&D and digital skills in order to be able to compete in the second half of the twenty first century. By 2030, our lives will be entirely dominated by AI and its applications. Even in the advent of exploitation of oil and gas, all jobs will require digital skills and AI understanding.

AI could also maximize opportunities for sustainable development especially coupled with IoT applications targeting critical sectors such as electricity distribution, water, and agriculture. AI hence could bring solutions to Lebanon's persistent social problems.

However, as seen in the previous section, Lebanon is still in the digitization phase, lacking the foundations to be fully in the AI phase: data sets, IoT applications, e-Government applications, computational power, open data policy, and digital skills.

**The positioning of Lebanon's AI strategy should be to fix all known systematic weaknesses while at the same time, aim to leapfrog in order to become par with the rest of the developed world with AI.**

This is why, there is no need to imitate other countries AI strategies, but to choose for Lebanon few key objectives that would put it on the right track for the adoption and development of AI.



## B. SWOT Analysis

<p><b>STRENGTHS</b></p> <ul style="list-style-type: none"> <li>• Quality of the Lebanese human capital with analytical and critical spirit due to a history of diversity and freedom of expression</li> <li>• Important cultural and creative services export</li> <li>• Good tertiary education</li> <li>• Quality of math &amp; science education as well as high enrolment in Science, Technology, Engineering, or Math (STEM) subjects</li> <li>• Stable entrepreneurial eco-system for technology start-ups and knowledge economy sectors</li> </ul>	<p><b>WEAKNESSES</b></p> <ul style="list-style-type: none"> <li>• Very low government expenditure on education and R&amp;D as percent of GDP</li> <li>• A few programming schools or institutes for AI languages</li> <li>• Limited access to global markets</li> <li>• Slow, expensive, and unreliable Broadband connectivity</li> <li>• Rare availability of data sets emanating from: IOT applications or local mobile apps; e-government apps</li> <li>• Lack of super-computer centers</li> </ul>
<p><b>OPPORTUNITIES</b></p> <ul style="list-style-type: none"> <li>• Top Lebanese researchers in leading international universities and research centers</li> <li>• Lebanese publications most (in region) quoted internationally</li> <li>• AI applications can solve society problems: transportation, electricity, agriculture, and refugees</li> </ul>	<p><b>THREATS</b></p> <ul style="list-style-type: none"> <li>• Political instability due to 2019 financial, economic, and social crisis</li> <li>• High cost of doing business; Government ICT regulator and service provider</li> <li>• Lebanon weak “Importance of ICTs to gov’t vision” indicator of the Network Readiness Index</li> <li>• Lebanon falling behind in global Innovation indices</li> </ul>

## C. AI Vision for Lebanon and Strategic Goals

Due to the lack of natural resources, the choices of Lebanon are limited to capitalize on its human resources to build a new economy based on knowledge; to improve its innovation performance; and adopt a shared vision founded on freedom of intellectual and academic debate.

An appropriate vision for Lebanon would be:

**“Empowered and trained population able to creatively solve societal and economic challenges using AI and other disruptive technologies, positioning Lebanon a player and exporter of solutions globally.”**

This vision is even more important when Lebanon needs to move from a “rentier economy” to a “productive” one and AI has the potential to transform economies in the next decades. Artificial intelligence (AI) is a transformative technology that holds promise for tremendous societal and economic benefit.

The Strategic objectives are:

### 1. Make long-term investments in AI research

There is a critical role of government investments in mid/long-term research noting the long, unpredictable incubation period—requiring steady work and funding—between initial exploration and commercial deployment, which can take up to ten years.

### 2. Address the ethical, legal, and societal implications of AI

A societal debate needs to start on the reliability, dependability, and trustworthiness of AI Systems.

### 3. Address AI workforce needs

There is already a shortage of AI experts worldwide. Lebanon must ensure it grows and retains a generation of AI experts from different fields of studies due to the nature of AI applications and research.

#### 4. Develop the ICT sector

AI is one component of the ICT sector where pervasive broadband connectivity remains the main prerequisite infrastructure. When the ICT sector strives, it is easier for AI and other disruptive technologies to pick up and establish themselves.

### D. Policy Focus Areas of AI strategy in Lebanon

From all the best practices from around the world, this section lists only the policy areas relevant to the Lebanese vision and strategic objectives listed in the previous section. In this section, S1, S2, S3, and S4 refer to the above four strategic goals. ST, MT and LT refer to Short, Medium, and Long term respectively.

**While it is government role to instate policies, this report advocates that government role need to an enabler and demand driver. The government will make sure that the rules of the game are known in a transparent way and that the playing grounds are fair for all. This report also advocates that government policies should be negotiated and implemented through private sector, academia, and civil society to the extent possible.**

In a subsequent section, the report will shed the light on non-governmental short-term priority projects that can jump start AI.

The recommended policies needed to implement the AI Strategy for Lebanon are:

#### 1. Ubiquitous, Open and Secure Internet

- (S4) [ST] Allow foreign private investment in the telecommunications market in order to supply citizens and business with a wide choice (full range such as Triple play, FTTX, etc.) of quality telecommunication services at an affordable price which will enhance the attractiveness of Lebanon to AI and other investors. Given that fast, affordable, and reliable broadband is the infrastructure of the AI and innovation eco-system, it is imperative to apply law 431 that was issued on 22/7/2002 to liberalize the sector.
- (S4) [ST] Restore TRA role and independence and allow it to license all operators, including Government-owned suppliers.
- (S4) [ST] Implement GOV-NET and automation of ministries through e-Government.

#### 2. Healthy and Vibrant Start-Up Eco-System

Creating a healthy and vibrant Start-up eco-system is the best way to reverse the severe brain drain that is confronting the country and youth.

- (S1) [ST] Create linkages between industries and universities to bring together industrialists and researchers. The lack of synchronization between university curricula on one hand and the market needs on the other hand, seem to be a known and common problem across the Middle East. Given resources, government scale up the Lebanese Industrial Research Achievements (LIRA) programme that was implemented by the Ministry of Industry and the Association of Industrialists since 1997.
- (S4) [ST] Lower government red tape and lengthy procedures for Seed, Venture and Private Equity funding. The ICT sectors, excluding telecommunications, have, internationally, represented popular (attractive) areas for investment. The role of investors in the early stages or start-up of Digital Economy (areas) businesses have particular significance. The diaspora could be looked upon as one source to provide financial resources, expertise and mentoring.
- (S3) [MT] Establish special digital zones and/or clusters in most Lebanese regions, focusing on ICT subsectors such as AI, Media, Creative Industries, etc. McKinsey report identified such clusters as flagship projects for the Vision of Lebanon report under the title "Beirut Knowledge Center"<sup>60</sup>.
- (S4) [MT] Promoting the establishment of AI software companies for AI in Lebanon.
- (S4) [MT] Government to conduct a formal review of the level, ways and means by which tax and other revenues are derived from the ICT sector especially small enterprises and start-ups. The review will ensure that revenues essential to the operation of the State, be fairly based and their negative impact upon the development of start-ups should be minimized.

- (S1) [LT] Extend current government incentives (IDAL and others) to institutions and companies (international and national) investing in research and development.
- (S3) (S4) [LT] Lebanon could aspire to become the leading Knowledge Hub for the Middle East, serving as the region's Knowledge Process Outsourcing and Business Process Outsourcing (KPO/BPO) destination and the number 1 tech ecosystem according to McKinsey report on the Vision for Lebanon.

### 3. Digital Competencies

- (S3) [ST] The Ministry of Education and Higher Education must ensure that ICT literacy and access are engrained in the fabric of the Lebanese future workforce by incorporating ICT skills, knowledge, and coding into the educational system at all cycles. Furthermore, schools must provide the necessary soft skills that are needed in the age of AI (prepare them for jobs that cannot be replaced by machines) such as complex problem solving, critical thinking, creativity and design mindset, sense making, collaboration and team building, social intelligence, cross cultural competencies including gender awareness, transdisciplinary thinking, communication and new media, and virtual tools for work and collaboration.
- (S3) [ST] Encourage the opening of extra curriculum continuing education training institutes and/or programmes for C#, Python, JSON, R, and other AI programming languages.
- (S1) (S4) [MT] The Lebanese National Research and Education Network started by the Ministry of Education and Higher Education need to be completed, linking all Lebanese schools and making coding and learning material available to students in the classroom.
- (S2) [LT] Public awareness of the implications of harnessing technology must be enhanced, and utilizing up-to-date education, training and awareness will motivate all involved - policymakers, private businesses, academicians, students, researchers and citizens - towards AI applications and their impact on sustainable development. Therefore, it is crucial to have both awareness campaigns on AI and its implications on society as well as centres for re-learning and re-skilling.

### 4. Data Policies and Other Regulations

- (S2) (S4) [ST] A legal framework should be put in place to support the development of a viable IT and AI sector and encourage the use of IT. The legislative framework should include, but not be limited to:
  - » e-Transactions and data privacy (law exist needs to be enacted). This would foster the transformation towards digital government in public sector<sup>61</sup>;
  - » Rights to Information (law exists needs to be enacted and updated to make more data available);
  - » Product safety protections including AI applications;
  - » Sound doing business practices;
  - » Compliance with international data protection and security norms such as GDPR;
  - » International obligations, must be met in relation to cyber-crime.
- (S2) (S4) [MT] Enforce open data policies through decrees issued by the Council of Ministers based on the Right to Information law.
- (S4) [MT] Enforce cloud policies for government data based on the level of national sovereignty.
- (S1) (S4) [MT] Implement the national data center project proposed by Ogero and the Higher Council of Privatization but add to it a super computer center to facilitate and speed the processing of AI algorithms.

### 5. Role of Government as Demand Driver and Innovation Enabler

While government has the role of settings policies, there is a general direction that government should not be the sole implementer of its own policies. Furthermore, too much government actions hinder innovation and productivity because all governments are bureaucratic and slow by definition. Hence, the government's role should be limited to ensure minimum infrastructure, support and stability.

- (S4) [ST] Implement policies that would raise Lebanon's rank in the "Ease of Doing Business" World Bank

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61 e-Government implementation is a priority project but falls under the DIGITAL TRANSFORMATION programme already formulated by Government.

index. This would mean first speed up and reduce the costs of company opening and closing procedures at a minimum. IDAL should be tasked immediately to identify and open new markets for entrepreneurs both nationally and internationally; and raise the profile and acceptance of the “made in Lebanon” brand. Objectively, the overall cost of doing business in Lebanon needs to be lowered.

- (S3) (S4) [ST] Government investments are needed in the basic automation of ministries as a pre-requisite for AI in order to secure data sets that can be used subsequently for AI technologies
- (S3) [MT] Government investments are needed in demanding AI applications to solve Lebanon’s societal problems such as electricity distribution, agriculture, smart cities (buildings and transportations), and refugees management.
- (S3) [LT] Attract investments from private sector to fund AI applications in Medical care, Industry, and Tourism.

## 6. Science Engagement, R&D, and Technology Facilitation

- (S1) [ST] Speed up the implementation of the National Center for Technology Transfer in Lebanon under the CNRS to coordinate and facilitate the registration then commercialize Lebanese Intellectual Property (IP).
- (S1) [ST] Conduct an innovation survey to uncover all areas of strengths in Lebanese research, including nationals and diaspora research, for all fields. Detailed number of graduate students per area of research activity must be documented.
- (S1) [MT] Strategic partnerships should be built with International research centers, notably Arab and European ones. Alternatively, strengthen the CNRS’s ARUs programme so that universities consolidate their AI research activities. The new ARU programme should encourage both intra and inter-institutional collaboration. Looking at the same problem from different fields and points of views spurs innovation. Public Private Partnerships should also be considered.
- (S1) [LT] Government budgets shall be defined and allocated to encourage Research and Development, especially in what concerns partnership with industry for the commercialization and technology transfer of concepts and innovative ideas. In due time, when the economic crisis has cleared, private sector, Multi-National Corporations (MNC), and international non-governmental organizations can also fund R&D spending. **Basic research is a critical vehicle known today that allows innovation breakthrough.**

## 7. AI Awareness

- (S2) [ST] Promote diversity in general, and gender diversity in tech specifically, as well as promoting multi-stakeholder collaboration. All stakeholders – private sector, civil society, and academia, must be invited to solve problems collectively. Because AI is an amalgamation of many fields, diversity is an essential component for spurring innovation as shown by international best practices.
- (S2) [MT] Promote digital skills and AI awareness throughout society. Associated programmes of public and business awareness about the benefits and challenges of AI, especially the ethical side of AI, should be carried out by civil society.

## E. Priority Projects Action Plan

Project	Description	Implementation Agency
Innovation Survey	Commission an innovation survey to uncover the areas of strengths in Lebanese research and put a plan to subsequently be able to support them. All universities and research centres in Lebanon must be surveyed as well as diaspora undergoing research outside Lebanon.	CNRS/Private sector
Digital Zones	Establish digital zones in Tripoli, Nabatieh, and Zahle (others) similar to BDD where broadband is available as well as co-working spaces with access to a business development expert.	Private sector/Civil Society
AI and Ethics Opportunities and Challenges	Awareness Campaign to cover the entire territory on AI and its implications on society.	Civil Society
Coding for youth	Expand youth after school training on coding through NGOs (SE Factory and Codi) and vocational institutes	Private Sector/Civil Society
Ideations, Hackathons, and competitions	Organize ideations, hackathons, and start-up competitions across universities in the presence of private investors	Universities
Crowdsourcing for AI	Use existing crowdsourcing platform to promote AI projects, where individuals can contribute describing their pain points or needs for automation and AI	Civil Society
Diaspora Events	Organize forums with diaspora to help the Lebanese ICT sector with skills, know how, and access to markets	Civil Society
Internships	Organize internships with foreign companies such as LAU's BMW programme	Universities

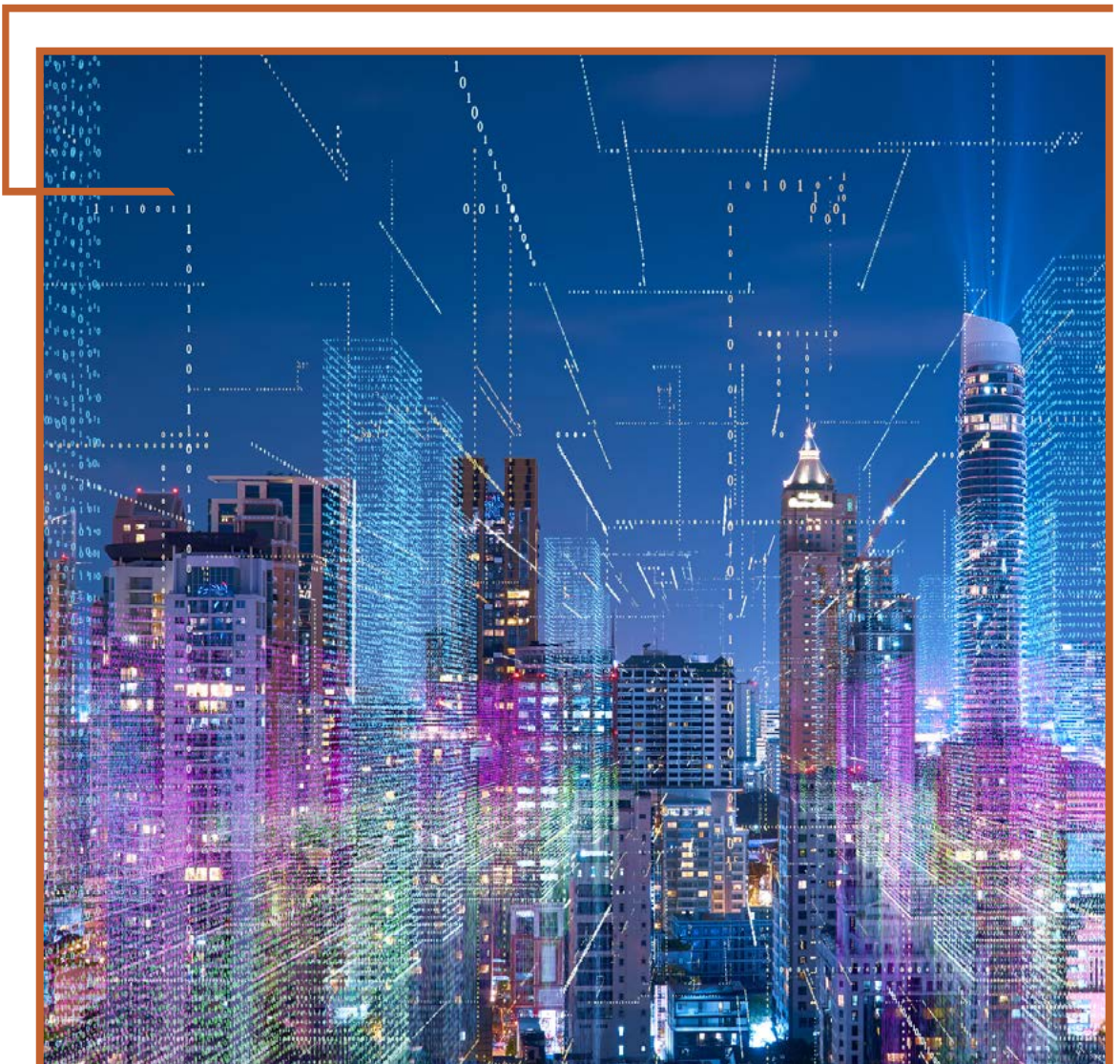
## F. AI Strategy Governance in Lebanon

- ◀ The Ministry of Telecommunications assumes full responsibility for policy making and promotion of the entire technology sector of which ICT, digital broadcasting, and digitization are subsets. Consistent with this expanded mandate, the Ministry can be renamed **Ministry of Technology and Communications (MoTC)**. The ICT policy functions available in several ministries can be consolidated into the new MoTC. MoTC responsible to drive AI adoption as one component of the digitization strategy.
- ◀ Formulate a clear 5-year national plan, supported by the highest political constituencies. Even in countries that follow a decentralized approach to ICT governance, the government sets the national agenda and rolls out regulations and policies that create the right enabling environment for ICT advancements.
- ◀ Put into place as soon as possible all policies, laws and organizational arrangements necessary to facilitate the execution of the national plan, through coordinated action by relevant ministries and agencies. The policies should include the encouragement of the use of ICT by consumers and small businesses, ICT and coding are taught as part of the educational system, and that eGovernment programmes be given due priorities, especially that only when government is automated can it start demanding AI applications.
- ◀ Establishment of the “Technology Council” under MoTC, a body of heads of government agencies implicated by innovation, sciences, R&D, and education; key universities; private sector representatives; and civil society representatives. The aim of the newly established council should be to confirm Lebanon as a center of excellence in the region, with more aggressive participation in AI and the global information age, ensuring effective coordination, establishing partnerships, and pushing for the implementation of Programmes and Projects by the various stakeholders (public sector, private sector, civil society and academia).

## G. Monitoring and Evaluation

The following are suggested indicators to be tracked by the MoTC or any government agency responsible for the implementation of the AI strategy:

- Number of PhD Students in AI and AI related fields;
- Amount of research grants awarded to AI and AI related fields in number and value;
- Number of AI related start-ups vs. total number of start-ups;
- Number of research centers partnerships and their scientific production;
- “Technology Council” established with all stakeholders on board;
- National AI 5-year plan approved by COM;
- Curriculum for AI awareness developed;
- Number of people trained in AI awareness;
- Coding taught in all schools starting in intermediate level;
- Number of people trained in AI languages as part of their continuing education.



# Annex – Participants in the Focus Group Meeting (31 Jan 2020)

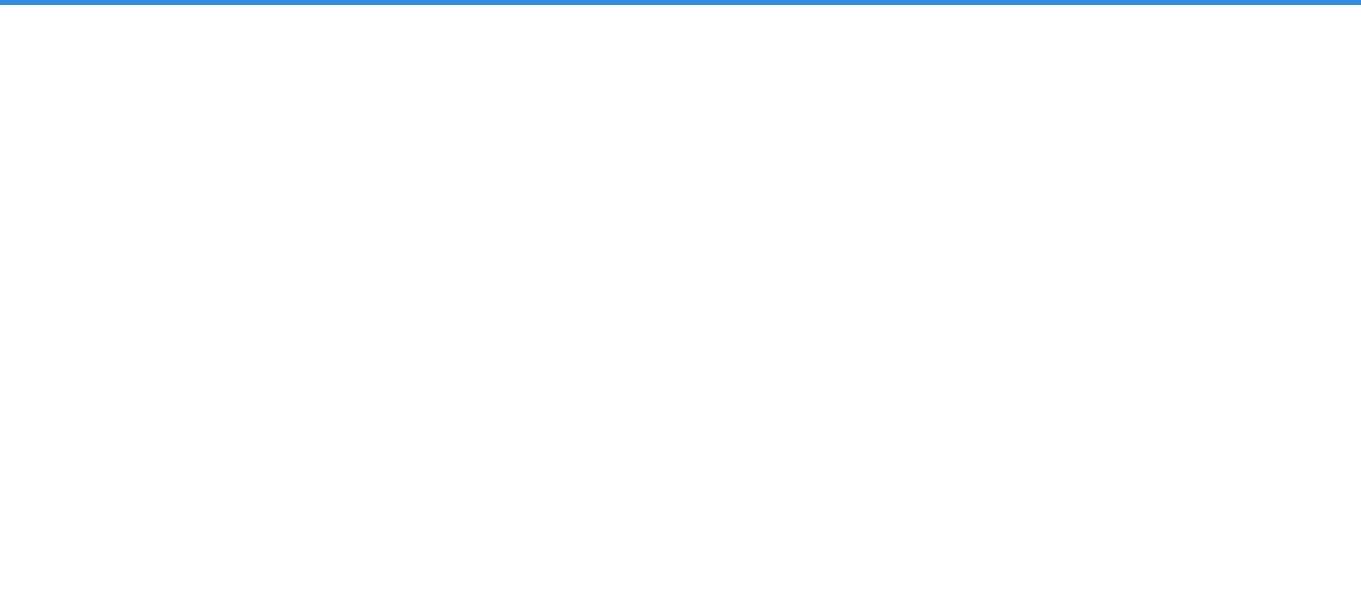
## Invited Experts

<b>H.E Adel Afouni</b>	Ex. Minister	Ministry of State for Investment and Technology Affairs (MoSITA)
<b>Amin Jbeili</b>	Advisor	Ministry of State for Investment and Technology Affairs (MoSITA)
<b>Oussana Ziade</b>	Advisor	Ministry of State for Investment and Technology Affairs (MoSITA)
<b>Bassel Al Ayoubi</b>	Director General	Ministry of Telecommunications
<b>Naji Andraous</b>	Director General	Ministry of Telecommunications
<b>Maher Hasanie</b>	CEO	FIG Startup
<b>Joe Tekli</b>	Professor	Lebanese American University
<b>Mariette Awad</b>	Professor	American University of Beirut
<b>Bechara Albouna</b>	Professor	Antonine University
<b>Jana Sukkarieh</b>	CTO	Neuron Startup
<b>Tamara El Zein</b>	Director	National Council for Scientific Research
<b>Rula Atweh</b>	Programme Officer	National Council for Scientific Research
<b>Joseph Abikhalil</b>	CEO	Yellow pages Lebanon
<b>Imad Elhajj</b>	Professor	American University of Beirut
<b>Claude Tabar</b>	Mechanical Eng.	Tabar Investment
<b>Joulan Abed ElKhalek</b>	Economist	World Bank

## ESCWA Team

<b>Juraj Riecan</b>	Leader of the "ESCWA" cluster on "Statistics, the information society and technology"
<b>Fouad Mrad</b>	Senior Programme Manager
<b>Nawar Al-Awa</b>	Regional Adviser
<b>Salam Yamout</b>	ESCWA Consultant
<b>Nibal Idlebi</b>	Senior Programme Manager
<b>Ayman El-Sherbiny</b>	Senior Programme Manager
<b>Mirna Barbar</b>	Programme Officer







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