Industry 4.0: case of startups of the Middle East and North Africa

الثورة الصناعية الرابعة: دراسة حالة المؤسسات الناشئة بمنطقة مينا

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ملخص :

الهدف من هذا البحث هو تقديم الثورة الصناعية الرابعة من خلال محتوياتها وأصولها وآفاقها المستقبلية ، حتى نتمكن من فك نشاطات وميادين ممارساتها من خلال عينة من 110 شركة ناشئة في 17 دولة من منطقة الشرق الأوسط وشمال إفريقيا استنادا على نتائج (2017) للمنتدى الاقتصادي العالمي ومؤسسة التمويل الدولية حيث تهدف المبادرة إلى جمع أهم شركة ناشئة من العالم العربي، وتعمل على رسم المستقبل في إطار الثورة الصناعية الرابعة.

توضح النتائج الرئيسية لهذا التحليل على تصدر دولة الإمارات كرائداً في المواجهة الاستباقية لتحديات الثورة في هذا المجال ، أما بقية الدول لم تجتاح بعد الميادين الأكثر تطورا كالذكاء الاصطناعي والواقع المعزز ،إنما تركز مؤسساتها الناشئة على الأنشطة المتعلقة بالشبكات والمنصات الإلكترونية

الكلمات المفاتيح: الثورة الصناعية الرابعة، المؤسسات الناشئة، منطقة مينا، المنتدى الاقتصادي العالمي

تصنيف JEL: M13

Abstract:

The object of this paper is to present the fourth industrial revolution through its contents, its origins and future prospects, in order to be able to decipher the practices of them related to the latter on 17 countries of the area MENA through a sample of 110 startups.

The principal results of this analysis emphasize the prevalence of the United Arab Emirates in the field, as well as the activities related to the electronic networks and platforms, the orientation of the opportunities of the 4th revolution in the MENA region is more in the form of platforms, than revolution through the exploitation of the potential of the twelve disruptive technologies

Key words: Industry 4.0, Startups, MENA, World Economic Forum

Jel Classification Codes : M13

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Introduction:

The Industrial Revolution (1750-1850) disrupted production and profoundly transformed societies. Hydraulic power and steam have accelerated productivity, wage labor has emerged, and freight transportation has been considerably simplified. At the dawn of the twentieth century, the second industrial revolution with electrification sees the work in the chain and mass production. Finally, the 1970s and the birth of information technology (IT) triggered a third revolution. This is not over yet that the fourth industrial revolution has already begun: this great trend called "Industry 4.0" is based on the Internet of Things and Services that is currently established in the processing industry.

The whole of the industrial sector entered a phase of deep change who sees digital technologies being integrated in the middle of the industrial processes. This fourth industrial revolution gives rise to a new generation of factory. That it is called "**Cyber-factory**", "**Integrated Industry**", "**Innovative Factory**" or "**Industry 4.0**".

Looking at the growing interest in the fourth industrial revolution, a question arises: **which applications (spheres of activities) of the 4th industrial revolution by the Arab startups in the Middle East and North Africa?**

This paper tries to answer this question by analyzing **110 Arab startups** were s**elected** by the **World Economic Forum** (2017) and the International Finance Corporation in collaboration with the region's leading authorities on the entrepreneurship ecosystem, including Wamda, Flat6Labs, Kawar Investments and Leap Ventures (Dusek, 2017).(1)

I- A historical overview of industrial revolutions:

According to the Cambridge Dictionary, the term industrial revolution is initially defined as: "the period of time during which work began to be done more by machines in factories than by hand at home" (Cambridge University Press).(2)

In the following a brief overview of the four industrial revolutions:

I-1- The first industrial revolution – 1765:

The first revolution spans from the end of the 18th century to the beginning of the 19th century. This global phenomenon is associated with other upheavals: demographic (very strong increase of the population), social (migrations and progress of the poverty), economic (important progression of the global wealth produced), political (struggles for the democracy) and ideological (triumph of liberalism). But the industry in the sense of mass production with low cost finished products would never have been possible without scientific and technical progress.

The highlights of this period are: the improvements made in 1705 by Thomas Newcomen to the steam engine and the extension of its use to the industry; the first use of coke instead of wood to melt iron ore (Abraham Darby in 1709), the development of the flying shuttle which increases the speed of weaving (John Kay in 1733), the first mechanical weaving machine with hydraulic motor (Richard Arkwright in 1769); still the improvement of the steam engine (James Watt in 1769), the first test of a steam locomotive (1804). Mass extraction of coal along with the invention of the steam engine created a new type of energy that thrusted forward all processes thanks to the development of railroads and the acceleration of economic, human and material exchanges. It witnessed the emergence of mechanization, a process that replaced agriculture with industry as the foundations of the economic structure (Rouquet, 2017). (3)

I-2- The second industrial revolution – 1870:

It was in this regard that the inventions after 1870 were different from the ones that preceded it. The period 1859-1873 has been characterized as one of the most fruitful and dense in innovations (David C. Mowery, 1989 p. 22).(4) It was a period of growth for pre-existing industries and the expansion of new ones; such as the steel, oil and electricity fields. The development of new technologies led to the introduction of two things that would change the world: public transport and planes.

The second industrial revolution finds its bases in electricity, mechanics, oil and chemistry. We can add the appearance of means of communication (telegraph and telephone) and the success of public transport thanks to the development of railways or steamboats. The means of communication and transport favor international exchanges. We are not electric power, we have a long time. The invention of the Belgian Zénobe Gramme, the magneto Gramme, presented on July 17, 1871 at the Paris Academy of Sciences, is the major cause of the production of electricity becomes mechanical. It is a rotary machine driven by a crank. His later improvements made an industrial dynamo (1873) generating direct current and DC motor, from the alternator to polyphase alternators to the two-phase and three-phase induction motor that took place in all the factories. Associate to the Distribution of Current, the invention of Zénobe has become an essential industry.

In 1878, Thomas Edison encountered the incandescent lamp. No more electric arc lamps, kerosene and gas lamps for public lighting. In 1881, Lewis Howard Latimer, engineering company Edison. Pierre Hugon patented an engine of the same type, but running on gas. The German Nicholaus Otto made in 1876 the first internal combustion engine. This will be the departure of truly automotive engines.

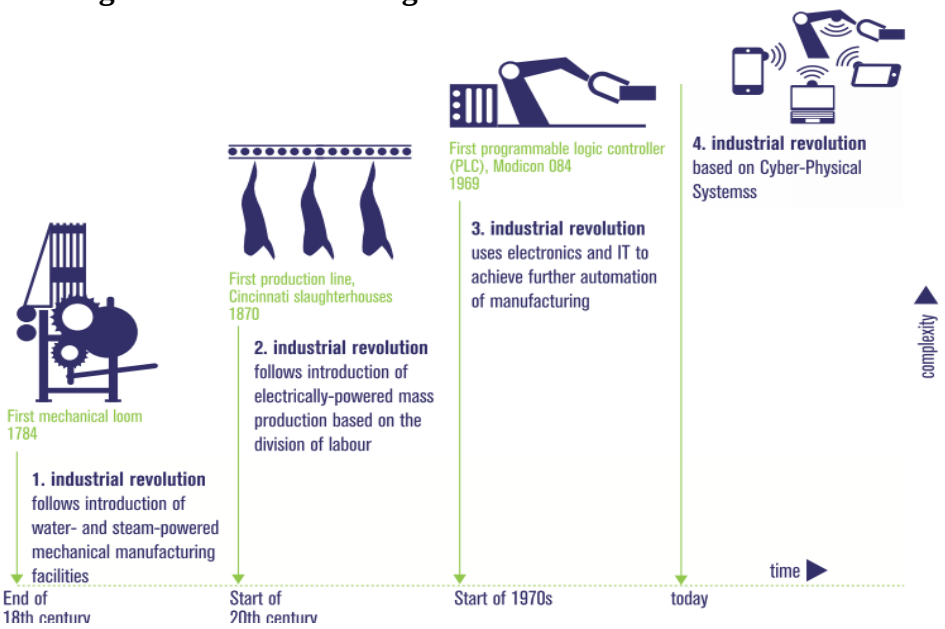
At the same time, the engineer Frederick Winslow Taylor invented, in 1911, Taylorism, a scientific organization of work which makes it possible to manage the productivity of the employees, and Henry Ford, the installer of the assembly, the assembly of his model of time T of 6 hours to 1 hour 30. The worker becomes static and assembles the pieces that parade in front of him.

II-3- The third industrial revolution – 1969:

Nearly a century later, in the second half of the 20th century, a third industrial revolution appeared with the emergence of a new type of energy whose potential surpassed its predecessors: nuclear energy. This revolution witnessed the rise of electronics—with the transistor and microprocessor—but also the rise of telecommunications and computers. This new technology led to the production of miniaturized material which would open doors, most notably to space research and biotechnology. For industry, this revolution gave rise to the era of high-level automation in production thanks to two major inventions: automatons—programmable logic controllers (PLCs)—and robots

The third industrial revolution began in the1960s. It is usually called the computer or digital revolution because it was catalysed by the development of semiconductors, mainframe computing (1960s), personal computing (1970s and 80s) and the internet (1990s) (Elena Vladimirovna USTYUZHANINA, 2017 p. 5). (5) Again, this revolution is not over: more than half of the world's population does not have internet access today (The International Telecommunications Union said that 3.9 billion people do not have home or mobile internet access).

Figure n°1: The four stages of the industrial revolution



Source: DFKI (Wahlster, 2011) [6]

III –Methods and Materials:

III -1- The fourth industrial revolution:

The whole of the industrial sector entered a phase of deep change who sees digital technologies being integrated in the middle of the industrial processes. This fourth industrial revolution gives rise to a new generation of factory. That it is called "Cyber-factory", "digital Factory", "Integrated Industry", "Innovative Factory" or "Industry 4.0", this major technological rupture offer an extraordinary field of innovation, progress and of growth. Characterized by the fusion of the virtual world of the delocalized Internet and the real world of industrial facilities, industry 4.0 becomes the reference impossible to circumvent for industrial production (Abbal, 2013 p. 1).[7]

The McKinsey Global Institute frames the fourth industrial revolution as the age of "cyber-physical systems" (Manyika, 2013) [8] systems that integrate computation, networking and physical processes.

Since the beginning of the Industrial Revolution more than 250 years ago, the economy has been on a steep growth trajectory propelled by a series of technological progress. Steam engines that replaced water electric factories, telephones, automobiles, planes, transistors, computers, and the internet, every new wave of technology has caused productivity and economic growth, enabling new and effective methods existing tasks and giving rise to entirely new types of enterprise. Certain technologies, particularly those for general use such as steam or Internet that can be applied across economies, have massive and disruptive effects.

Table n°1: Twelve potentially economically disruptive technologies

Entitled	Technology	Explication
	Mobile Internet	Increasingly inexpensive and capable mobile computing devices and Internet connectivity
	Automation of Knowledge work	Intelligent software systems that can perform knowledge work tasks involving unstructured commands subtle judgments
	The Internet of Things	Networks of low-cost sensors and actuators for data collection, monitoring, decision making, and process optimization
	Cloud technology	Use of computer hardware and software resources delivered over a network or the internet, often as a service
	Advanced robotics	Increasingly capable robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans
	Autonomous and near-autonomous vehicles	Vehicles that can navigate and operate with reduced or no human intervention
	Next-generation genomics	Fast, low-cost gene sequencing, advanced big data analytics, and synthetic biology (“writing” DNA)
	Energy storage	Devices or systems that store energy for later use, including batteries
	3D printing	Additive manufacturing techniques to create objects by printing layers of material based on digital models
	Advanced materials	Materials designed to have superior characteristics (e.g. strength, weight, conductivity) or functionality
	Advanced oil and gas exploration and recovery	Exploration and recovery techniques that make extraction of unconventional oi and gas economical
	Renewable energy	Generation of electricity from renewable sources with reduce harmful climate impact

Source: (McKinsey Global Institute, May 2013 p. 4)

III -2- Research sample:

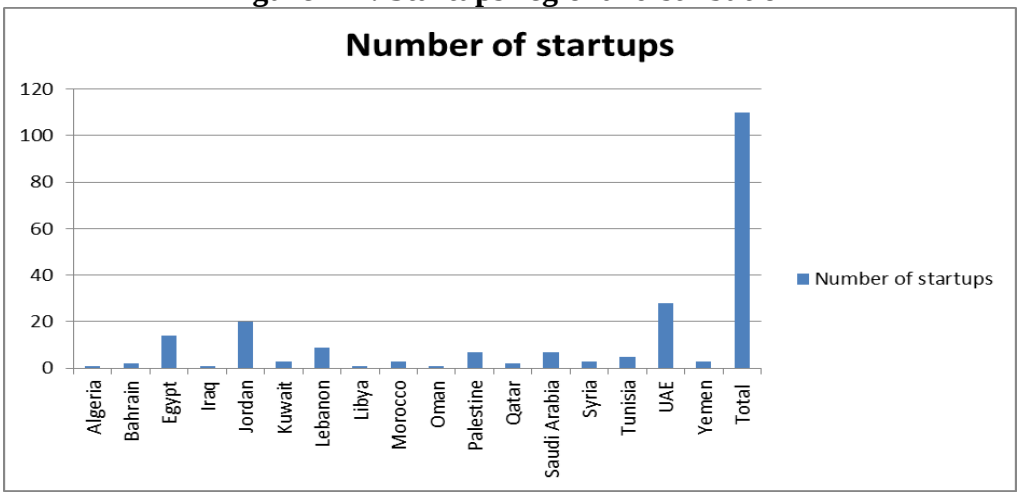
The population of study for the topic of the fourth industrial revolution on the Middle East and North Africa was selected within the framework of a close collaboration between the economic forum world and the International Finances Corporation. The selection was made by 10 experts, and allowed the most promising selection of 110 startups (the selection criteria were not made public) on 17 countries of the Middle East and North Africa.

Table n°2: Breakdown of startups by country

Country	Number of startups
Algeria	01
Bahrain	02
Egypt	14
Iraq	01
Jordan	20
Kuwait	03
Lebanon	09
Libya	01
Morocco	03
Oman	01
Palestine	07
Qatar	02
Saudi Arabia	07
Syria	03
Tunisia	05
UAE	28
Yemen	03
Total	**110**

Source: By the author based on data from the World Economic Forum

Figure n°2: Startups regional distribution



Source: By the author based on data from the World Economic Forum

These start-ups were selected in collaboration between World Economic Forum and International Finance Corporation, with industry leaders in the region, such as Wamba, Fla6Labs and Leap Ventures. Together, these promising companies will have a clear footprint in the preparation of the fourth industrial transition in the region.
The experience of the selection committee members has made it possible to select startups by country according to the dynamics and the intensity of startups activity in each country; we see that countries are represented by single startups. This is due to the lack of innovation; and the embryonic phase in the digital domain, and the absence of a modern industrialization that can rely on the evolution of information and ICT. The countries in question are Algeria as well as Oman, Iraq and, Libya. While other countries represent the largest part of the study population, such as the UAE as well as Jordan, Egypt, and Lebanon.

IV - Results and discussion:

Table n°3: Spheres of activities by country

Country	Number of Startups by spheres of activities	Activities' spheres
UAE	11 Online Retail, Consumer Goods, Lifestyle / 03Online Banking / 03Information Technology / 02 Media, Entertainment & Information / 02 Supply Chain & Transportation / 01 Online Networking & Platform / 01 Agriculture, Food & Beverage / 01Global Health & Healthcare / 01 Language & Culture / 01 Education Technologies / 01 Energy Technologies / 01 Virtual & Augmented Reality	12
Jordan	04 Language & Culture /03 Online Networking & Platform /03 Media, Entertainment & Information /03 Online Banking /02 Education Technologies /02 Online Retail, Consumer Goods, Lifestyle / 01 Telecommunications /02 Global Health & Healthcare	08
Egypt	03 Online Banking /03 Education Technologies /02 Global Health & Healthcare /01 Online Retail, Consumer Goods, Lifestyle /01 Telecommunications 01 Online Networking & Platform /01 Energy Technologies /01 Manufacturing Tech /01 Artificial Intelligence / Cloud-Based /01 Agriculture, Food & Beverage	10
Lebanon	02 Online Networking & Platform /02 Telecommunications /01 Artificial Intelligence & Cloud-Based / 01 Energy Technologies / 01 Information Technology /01 Language & Culture /01 Media, Entertainment & Information	07
Palestine	02 Information Technology 02 Media, Entertainment & Information 01 Online Networking & Platform 01 Online Retail, Consumer Goods, Lifestyle 01 Virtual / Augmented Reality 02 Media, Entertainment & Information 01 Telecommunications 01 Energy Technologies	05

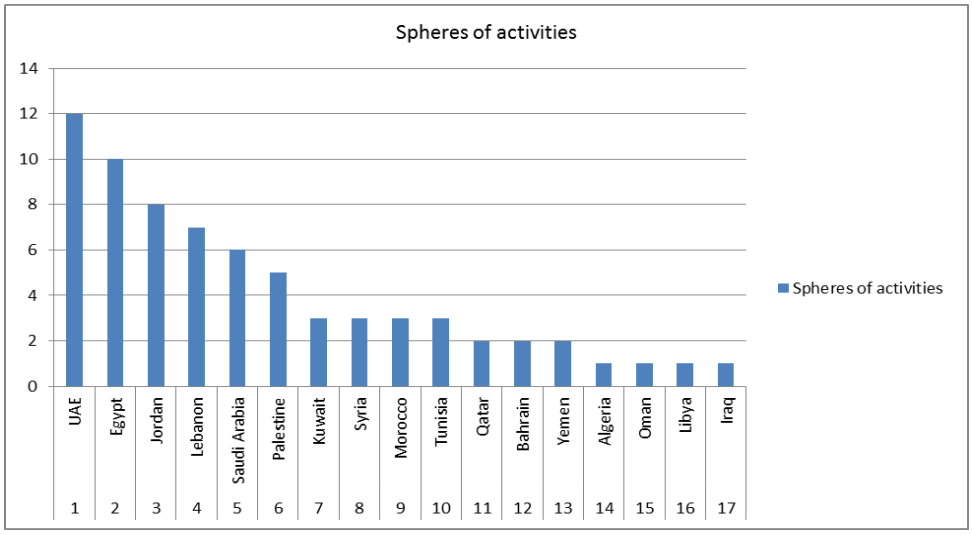
Saudi	01 Language & Culture	06
Arabia	01 Information Technology	
	01 Online Networking & Platform	
Tunisia	02 Artificial Intelligence / Cloud-Based	
	01 Education Technologies	03
	01 Agriculture, Food & Beverage	
Kuwait	01 Media, Entertainment & Information	
	01 Information Technology	03
	01 Health Tech & Healthcare	
	02 Online Retail, Consumer Goods, Lifestyle	
Yemen	01 Online Networking & Platform	02
Syria	01 Education Technologies	
	01 Information Technology	03
	01 Media, Entertainment & Information	
Morocco	01 Education Technologies	
	01 Energy Technologies	03
	01 Supply Chain & Transportation	
	01 Education Technologies	
Qatar	01 Media, Entertainment & Information	02
Bahrain	01 Online Banking	
	01 Artificial Intelligence / Cloud-Based	02
Oman	01 Media, Entertainment & Information	01
Libya	01 Online Banking	01
Algeria	01 Online Networking & Platform	01
Iraq	01 Online Networking & Platform	01

Source: By the author based on data from the World Economic Forum

The classification and categorization of the fields of activity for each country made it possible to bring out the table above; the classification shows the predominance a second time of the UAE, in terms of fields of activities, followed by Egypt, Jordan and Lebanon with an average of eight activity areas per country.

Oman, Libya, Algeria and Iraq are represented by only one startups with only one field of activity; the interpretation of this is that its countries are lagging far behind in the field of innovation and the race to defend the future challenges of industry 4.0.

Figure n°3: Countries ranking in ascending order for the criterion "spheres of activities"



Source: By the author based on data from the World Economic Forum

Table n°4: Ranking spheres of activities

Rank	Spheres of activities (applications)	Repetition frequency
01	Online Retail, Consumer Goods, Lifestyle	17 startups
02	Media, Entertainment & Information	14
03	Online Networking & Platform	12
04	Online Banking	11
05	Information Technology	09
06	Education Technologies	09
07	Language & Culture	07
08	Global Health & Healthcare	06
09	Telecommunications	05
10	Artificial Intelligence / Cloud-Based	05
11	Energy Technologies	05
12	Agriculture, Food & Beverage	04
13	Supply Chain & Transportation	03
14	Virtual / Augmented Reality	02
15	Manufacturing Tech	01

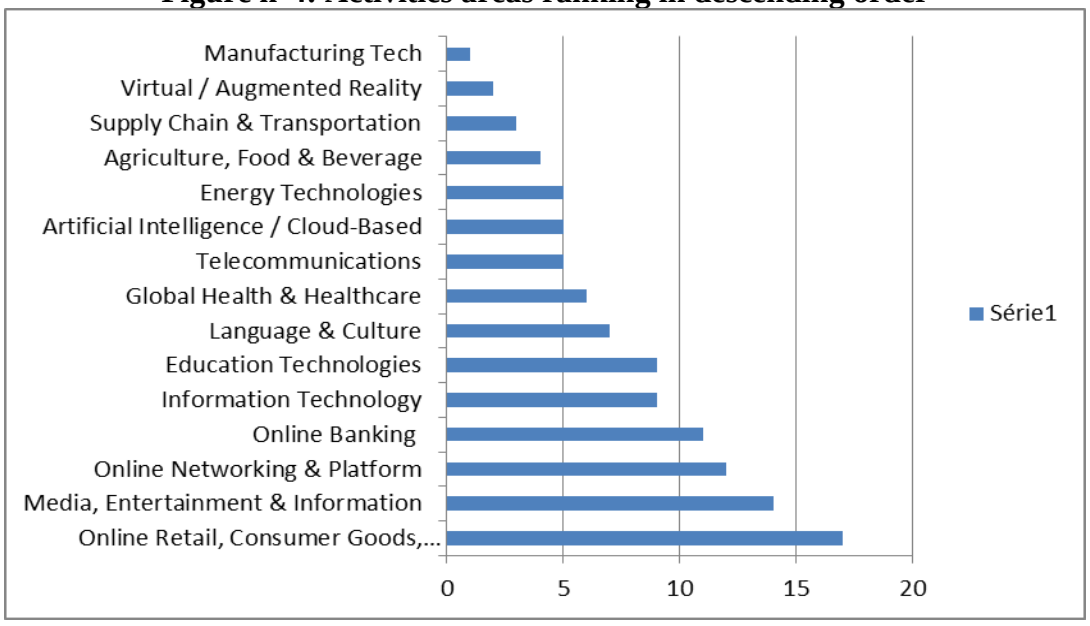
Source: By the author based on data from the World Economic Forum

In terms of spheres of activities, the classification and categorization of business areas for startups in its 17 MENA countries shows a strong focus for the following areas:

- Online Retail, Consumer Goods, Lifestyle
- Media, Entertainment & Information
- Online Networking & Platform
- Online Banking

The four fields of activity are based on the technology of the mobile internet, without really taking advantage of the disruptive technologies that form the basis of the industry 4.0.

Figure n°4: Activities areas ranking in descending order



Source: By the author from the 2017 World Economic Forum data

V- Conclusion:

The outcomes of this study prove that, overall, countries around the Middle East and North Africa the startups are in the early stage of readying to shaping the fourth industrial revolution. It is that the areas of activity and applications of the 4th industrial revolution by startups in the MENA region, we note a lack of practices and a low orientation towards the digital factory and Industry 4.0. This conforms with the ranking of countries according to the number of startups selected by the Davos forum.

The presence of a single startup in the Manufacturing Tech, as well as 02 startups for virtual and augmented reality as artificial intelligence and cloud-based (05 startups), shows that is far from the concept of the digital factory on the whole region.

The orientation of the opportunities of the 4th revolution in the MENA region is more in the form of platforms, than revolution through the exploitation of the potential of the twelve disruptive technologies as described by the McKinsey Global Institute consulting.

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