



# An Exploratory Study and Impact of Fourth Industrial Revolution (4IR) on SMEs in the Middle East

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**Abstract:** The evolution of industrial creation over a period of time can be seen through its first version in 1784 until today 4<sup>th</sup> Industrial revolution, where cyber-physical system components will communicate with each other using IoT concept. The driving forces of industries are dynamic leadership and emerging technologies. Small and medium enterprises are constantly emerging and facing the challenges of market leaders. Thus there is a need to spot and react immediately seeing the new competitions on the horizon. It is been observed that structure of today will not suit the companies of tomorrow and thus change in the industries and leadership is evolved as 4.0. In this research we have looked at the concept of 4<sup>th</sup> Industrial Revolution and its impact on SMEs through the leaders of tomorrow. Research also proposed the changes required as robust & strategic planning, acquiring a culture of engaging people, the readiness of SMEs and enhanced communication plans.

**Keywords:** Industrial revolution, SMEs, cyber-physical, IoT

## 1. Introduction

Small and Medium Enterprises (SMEs) with innovative high-tech developments are always crucial to the economy of any country. They play the role as economic pillar of growth and brings prosperity to the people. With the advancement in technology and now the new concept of 4th Industrial Revolution, it creates new infrastructure and work place, motivating people to come up with new enhanced ideas as well solutions. This is also true that SMEs are facing various challenges with respect to political and environmental changes as well as technological advancements and security measures. Fourth Industrial Revolution (4IR) concept is considered to be the game changing factor and was initially discussed in 2011 where the German government initiated plans to safeguard competitiveness environment for industry [1]. Thus, we can argue that strong relationship exists between 4IR and knowledge-based economy that mainly depends on innovation, creation and adopting new technologies by having strong IT infrastructure. Additionally, recent research about 4IR pay attention to the implementation of new and advanced technologies raised in the knowledge era and how different organizations can adapt and manipulate these technologies. In fact, research investigations related to 4IR pay its major part to the effect of that revolution on the different types of organization like public and private profitable organizations (large, medium and small organization (SMEs)) [2].

SMEs are considered to be the main driver of the economy due to many reasons, like job creation, production enhancement and poverty reduction. In fact, SMEs are playing vital role in enhancing socio-economic development as they are considered as the best actor for pursuing innovation and sustainable development related practices. [3] mentioned that SMEs have a great role in innovation which is summarized as “Upgrading aggregate productivity, exploiting knowledge, and making breakthrough innovations”. Likewise, it was agreed that SMEs are mostly depending on their capacity to fulfil customer needs and requirements in order to survive in the current high competitive business environment. Literature showed that Omani SMEs got boost as after the decree issued by H.M Sultan Qaboos bin Said at Al-Shamekhat Seminar to establish the Public Authority of Small-Medium Enterprise

Development [4]. The entrepreneurs specially related to the SME sector in the sultanate can enhance the economic growth by investments and at the same time create job for the locals. The main role of the public authority in this case would be facilitation of such entrepreneurs and administrators. Local banks and financial institutions can play their important role with the required financial fund along with the necessary consultancies. In any country, SMEs improve innovation and innovation in turn increase knowledge. To provide well-qualified individuals who can compete in global and international economic changes and at potential risks such as economic crisis and recession.

Industry 4.0 is assuring into a new era of industrial production. Which is mining its way into all new industries of any nation's economy. Science, business, and politics are all working together to make Industry 4.0 a reality. It encompasses a complete restructuring of production processes, transforming and synthesizing workflows into digital and decentralized processes. Comprehensive digitalization for decrease production cost and more resource efficient and customer oriented. At the same time new business model, innovative products and integrated new services shall be created. Internet driven, self-controlling and sensor added production systems will shape the future of the machines. As a result of global research, organizations are developing such applications that are analyzing digital industrial data, thus in the future, production will involve machines and objects equipped with sensors. The industrial internet also called industry 4.0 is network of machines, people and data that will enable us to proof the efficiency of productions throughout its entire life cycle. In the future production processes men, machines and products would be communicating to each other, allowing to the self-organize production process. Knowing how to deal with such changes that might happen due to the emergence of 4IR and its applications is critical for the organization, the economy and the country as a whole. In this regards, it could be also mentioned that the publications about 4IR in the management discipline is still at infancy level and that it could be considered as an emerging topic. According to the available literature, few papers were published in the field of SMEs and 4IR, which constitutes 9% of the overall publications. The future research concerning 4IR should focus on all of the aspects and models of the management within any organization like open innovation and value co-creation [5]. Thus, understanding the interaction of SMEs with 4IR is very important as this would help decision makers as well as planning drawer to align their strategies to be in-line with the concept of 4IR.

## **2. Methodology**

The exploratory research design was applied in order to complete the current research, as the exploratory research is more appropriate and applicable in case of exploring questions based on objectives [6]. Furthermore, focus group is defined as a way to collect primary data in research with the participation of 7 to 12 individual from the related field of the study [7]. People in fact are chosen based on their experience and view regarding the topic and research questions. In this regards, it is worth mentioning that group discussion should be focused on the research area and research topic. [8] claimed that focus group is defined as: Group of individuals, nominated by group of researchers to argue and discuss on specific topic. This discussion is based on personal experience, personal opinion and different views on the topic. According to [9], focus group discussion is nothing but a way that is intensively used in qualitative approach and researches. The main purpose of this method of data collection is to achieve and gain in-depth understanding of the topics that arise with a general overview and knowledge. The data is collected from a purposely chosen individuals who share similar and common characteristics. For the current study, expert top and middle management staff from several different SMEs were chosen as a participants for our focus group discussion.

This study also depends mainly on secondary data (i.e. the previous literature and studies that had been conducted in the field of 4IR in general and its impact on industries in general and its impact on SMEs in particular). It also utilizes descriptive research approach that mainly describes the situation. In fact, secondary data are somehow cheap and easy obtainable when comparing to primary data.

## **3. Data Analysis and Discussion**

### **3.1 The Meaning of Fourth Industrial Revolution (4IR)**

In order to explore the idea of 4IR, it is worth understanding the previous three industrial revolutions that the world had experienced since 1784 till today. To discuss it briefly, First industrial revolution (1784 – 1870) could be characterized by “the substitution of water/coal/steam power” where the beginning of this industrial revolution was in Great Britain [10].

Second industrial revolution (1870-1969), huge advancement in steel, chemical and electricity creation had changed the way of living. This includes “fuel production, including mass-produced consumer goods” [11]. Third industrial revolution (1970-2011) appeared with the emergence of computers, telecommunication and electronics (transistor and microprocessor).

In this revolution, high-level of automation is incorporated in production process through two main inventions: Automaton and robots [12]. The last industrial revolution that the world is experiencing today is what is known as “Fourth Industrial Revolution” (4IR). According to [13], 4IR is the result of exponential technologies such as Artificial Intelligence, Nano-technology etc. integration. Globally agreed that the main aim of 4IR is to assure the existence of sustainable and competitive production as well as enhancing the standards of livings by creating and assuring

advancement in social, economic and environmental aspects [14]. The main concept of 4IR mainly revolves around manufacturing from the perspective of government and private organizations [1], [15], [16]. In fact, 4IR could be considered as unprecedented fusion in all fields of human being life including digital, economic, social and biological field [17].

### 3.2 Main Components of Fourth Industrial Revolution

- **Big Data**  
Big Data analysis is affecting all aspects in our contemporary daily life. Such examples of these aspects are: Physical science, finance and accounting, manufacturing, retail services, mobile services and life sciences.
- **Smart Factory**  
Smart factory refers to the transformation from traditional automation to a totally flexible system. Flexible system simply means a system that depends on stream of data which is obtained from connected operations and production systems that allow it to learn and develop new products based on new demands [18].
- **Cyber Physical System**  
According to [19], Cyber Physical System (CPS) could be defined as integration of computation, networking, and physical processes. In fact, CPS is a collection of multiple systems showing different nature, where the main idea behind the overall system is to maintain and control all physical processes and adapt to new conditions and requirements based on the collected feedback about the previous physical processes.
- **Internet of Things**  
Simple as it is, Internet of Things, shortly known as (IoT) means network of connected items. These items could be either people or things. The main relationships that exist in IoT are: People-to-people, people-to-things and things-to-things [20]. IEEE defined IoT as “A network of items—each embedded with sensors—which are connected to the Internet [21]. By 2020, it is expected that more than 26 billion devices will be connected to each other by applying the concept of IoT [20].
- **Interoperability**  
As mentioned by [22], Interoperability could be defined as: “connection of cyber-physical systems, humans and smart factories communicating with each other through the IoT”. By applying the concepts of interoperability, information and knowledge could be easily and effectively shared without any chance of error occurrence [22]. Also, [16], mentioned that interoperability is a feature of manufacturing where the integrated components could be able to exchange the generated information together. Interoperability is the mean of efficiency along with accuracy and reliability.

### 3.3 The Impact of 4IR on Industries

[23] confirms that 4IR has a great impact on business regardless the type of industry. For example, in supply chain industry, it is expected that 4IR related technologies can create completely new ways of “serving existing needs and significantly disrupt existing industry value chains”. Additionally, new technologies can, in fact, affect the concepts of innovation, research and development, sales, marketing, which would, in turn, affect several aspects of business like: Customer engagement and satisfaction, service delivery, production and transparency. [24] try to analyze the world’s leading companies’ business models and clarify the level of readiness to adapt to new technologies that are related to 4IR. In their analysis they found that less than 10% of these organizations have an economic viable business model as the world becomes digitalizes. It is anticipated also that digital platform business models would be able to contribute to 30% of economic activities by 2030. [14] aim in their study to address the impact of 4IR on supply chain management, especially in Engineer-to-Order industry.

### 3.4 The Impact of 4IR on SMEs

SMEs is short term of Small and Medium Enterprises. Internationally, the existing literature shows a lack of unified definition of SMEs [25]. This is due to the fact that the definition of SMEs is highly affected by several factors like: Number of employees, organization size, party or the organization that provides the definition as well as the place of the definition provided. In fact, SMEs could be defined as “a small firm or organization which operates independently, where the owner of the enterprise is the same person in most cases, and have small market share” [26]. However, two main challenges can face SMEs in the context of 4IR and its advanced applications and technologies. These challenges are: Lack of a digital strategy, and lack of standards and poor data security [27].

### 3.5 Key Benefits of 4IR

Most of goods and services were produced and provided to the end customers manually. This means that the work was done by the hand of the worker. In the current age, the way of production had been transformed from hand working to head working, which indicates that workers now are not working by their hand, but by their minds, pursuing creativity, innovation and knowledgeable solutions. Knowledge is considered to be essential part in the production process. That is why, companies now are facing such challenges in motivating employee in order to release their human potential. Conversely, “the main opportunities that comes with the 4IR are to lower barriers in between markets and the inventors, active role AI, integration and improved quality [28].

### 3.6 Key Benefits of 4IR on SMEs

[29] states that SMEs are greatly affected by the emerging of 4IR in terms of competitiveness, attractiveness, enhance productivity, gain more customers, and expansion. It is stated that by adopting 4IR related technologies, SMEs will have a competitive advantages as this will add another components of competitiveness. By adopting and investing in 4IR, SMEs will, definitely, be capable of attracting young and talent employees. By ensuring so, the organization would be able to retain the employee which will lead to reduce the talent turnover rate is SMEs.

### 3.7 4IR in the Context of Oman

Speaking at national level, 4IR could be analyzed in the context of Oman in terms of knowledge-based economy. As stated earlier, there exist strong relationship between 4IR and knowledge-based economy.

[30] points out that Oman's overall knowledge economy index was 6.14 out of 10 ranking 47 around the world. In this sense, it is worth mentioning that knowledge-based economy could be defined as “economy which is directly based on the production, distribution, and use of knowledge and information” [31]. Another definition provided by [32] about knowledge-based economy explains that knowledge-based economy is the type of economy which mainly depends on generating and utilizing knowledge in economic growth and wealth creation. According to [33] Oman is ready to move towards knowledge-based economy provided that all necessary components are available. Additionally, the Omani government is initiating different initiatives that invest in people and enhance knowledge creation and utilization along with supporting different innovative youth. The most recent initiative launched by the Diwan of Royal Court was the national program for the development of youth’s skills. This program mainly focuses on developing the skills of Omani youth based on 4IR in addition to enhance their principles of innovation and creativity. The duration of this program is two years and it aims at increasing the awareness and knowledge of the youth about the principles of 4IR in terms of its ethics, required skills, knowledge, and correlated technologies [34].

#### Focus Group Responses:

##### Said Al Badi- Omani Wools Turbans Factory

In a discussion with Said, he was quite aware of 4th Industrial Revolution, however, he was not having much idea of past industrial revolutions. He expressed the importance of technology and the developments happening in the Industry. Time to time, they are organizing workshops and on the job trainings for their employees. They showed interest to explore the 4IR concept and further to get benefits offered by it. He discussed some of the issues that they were facing in their business because of technological advancements and some of the security threats. About 4IR, he was quite interested to explore further. They apply all possible changes happening within technological domain related to their business. They are ready to adopt changes over the period of time in order to make their organizational performance better. Their organizational structure is supporting the business mission and achieving their goals annually. They make changes as per requirements and advances their operations. Mr. Said attended few workshops related to 4IR, however, he expressed to organize awareness of 4IR for all its employees in near future. He discussed some of the core benefits of the use of technology. Mr. Said attended few workshops related to 4IR organized by Omantel, Ministry of Chambers & Commerce and Public authority of SMEs, however, he expressed to organize awareness of 4IR for all its employees in near future.

##### Zahoorul Islam: Omani Wools Turbans Factory

In a discussion with staff incharge Mr, Zahoorul, he was a bit aware of 4IR concept, however, he expressed his interest to learn about it more. Time to time, they try to organize training sessions for their employees to make sure that they are aware of using technology and at the same time share their experiences with other colleagues. Mr. Zahoorul is the oldest employee working in this business and his experience is making him a valuable asset for the organization. He also showed great interest of exploring the idea of 4IR and to get the maximum possible benefits out of it. Mr. Zahoor showed interest to explore the concept of 4IR. He was not having much idea and the overall benefits of the new paradigm. Currently, they were using advanced technological tools and applications in their business. They prefer not to disclose the names, however, they discussed the workshop material, and they organize every month with their

employees. This is their usual practice to organize workshops monthly. Mr. Zahoor told that they call industry experts for these workshops and sometimes send their employees to other places for getting hands on experience. He also expressed that sometimes resources are constraints but they try to manage within available resources. Mr. Zahoor showed interest to explore the concept of 4IR. As in our discussion, he was not having much idea and the overall benefits of the new paradigm. Currently, they were using technological tools and applications in their business. In conclusion, they expressed their full support and cooperation with their employees in enhancing the production process and overall performance of their organization.

#### **Ahmed Al Zadjani: Engineering Village**

In discussion with Ahmed, he was quite aware of 4th Industrial Revolution and technological advancement in the Industry over the period of time. He expressed the importance of technology and the developments happening in the IT and Electronics Industry. They are supporting individuals in skills development as well as organize training sessions for all levels of IT and Electrical & Electronics Engineering. They do business of Electrical and Electronics hardware items and troubleshooting/ assembling services. He discussed some of the issues that they were facing in their business because of delay in production and delivery. The supplier supply products based on production and market demands. In a limited market, sometimes it is hard to survive and with limited resources. However, they were having good plans to improve in new future. He discussed the benefits of the use of technology and overall production process. The transition could take time, however, the impact of industry 4.0 would be high. It will not only have positive impact on SMEs but also overall business with reduced cost and competitiveness.

#### **Ali Khamis: Engineering Village**

In discussion with staff officer Ali, discussion was fruitful as he was participating in organizing training and workshops to several different organizations. He attended awareness sessions on Industry 4.0 and was aware about the revolutions around the world. Mr. Ali showed interest to inculcate the concept of 4IR. Currently, they are using technological tools and applications in their trainings and workshops. Ali discussed the future digital strategy and some of the issues related to cyber security. Limited resources and technological readiness could be some issues. Mr. Ali also showed interest to look into ways of practicing 4IR. It will have positive strategic and production improvements. In conclusion, they expressed their short and long terms plans of implementing emerging technologies and practicing latest industry standards to improve performance.

#### **Maktoom Bin Rashid- Shape Apple Enterprise**

According to Mr. Maktoom, he agreed that 4IR is the combination between two main sectors: Industrial sector and Information Technology sector. He claimed that 4IR is about producing more customized product by incorporating Artificial Intelligence sector, and Big Data. He also claimed that. He also agreed that there is a relationship between enterprise growth and 4IR related technologies application, however, he claimed that this depends on the market demand. As per the discussion was about the difficulties that the enterprise might face due to the emergence of 4IR, Mr. Maktoom, pointed out that some challenges and difficulties might be raised like the current infrastructure, human resource readiness, market skills and demand, the variety in the paid effort, Inventory costs, Manufacturing costs, Logistical costs, Complexity costs, Quality costs, and Maintenance costs. He also tackled the light on the timeline as he said that our problem is that currently we are focusing on the future while in fact, we should focus on the current situation as well. Mr. Maktoom agreed that as the benefits of the 4IR are discussed that, customer services experience would be enhanced, and that customer requirement could be easily met.

#### **Zakriya Al-Kindi and Laith Al-Mawali- Swift Beam**

Both claimed that they have an awareness about the concept and the related studies about 4IR. They have some special session about 5G technology. They also claimed that there is a relationship between 4IR and digital transformation. They believe that 4IR increase the level of efficiency of the organization. Both Mr. Zakriya and Mr. Laith shed the light on some difficulties like organizational structure, thinking about the future rather than thinking about the current situation, waste of financial resources, and rules and regulations that facilitate the transitional phase to 4IR. They agreed that all effort could comprehensive so that we can achieve our goals and objectives.

#### **Yhaya Al-Husaini and Asmaa Al-Ghidani – Muscat Statistical Consultation**

Both of them agreed that 4IR leads to the usage of new advanced technologies like big data related technologies. They agreed that awareness level about 4IR is at good level as there are some training program about how to incorporate related technologies. They both also spoke about the difficulties and said that all sectors need to cooperate with each other, enhance the empowerment tools and data access, rules and regulations, cost of training programs, human resource readiness. They pointed out that some benefits could be using new and modern machines in production which can reduce production time, and that everything would be more accurate and that market needs could be met.

### **Saleh Al-Saadi and Meaad Al-Mawali Wasla for Training**

They agreed that awareness about 4IR is gained through different conferences, training and production as well. They believed that 4IR will have an impact on job automation and enterprise efficiency as well. They agreed that transitional phase and preparing for the future are the most difficulties that an enterprise can face due to 4IR related technologies emergence. They agreed that all effort could be comprehensive so that we can achieve our goals and objectives.

### **Salim Mansoor Al Wahaibi Marc Company**

According to Mr. Mansoor Al-Wahibi, 4IR is the digital revolution in the industrial sector and that it would have a great contribution towards job automation in the coming years. As per the difficulties are discussed, it was claimed by Mr. Mansoor, that following are the difficulties and challenges that might face their enterprise due to the emergence of 4IR: Current technology infrastructure that is required to transit to 4IR, organizational structure, availability of skilled workers, management lack of understanding of the strategic importance of 4IR, and lack of employee readiness. He also pointed out that the transition to 4IR should be done to reach the level of competitiveness with other businesses in the same market.

### **Huda Al-Jaradi - Atyabb Al Jouri**

Ms. Huda agreed that 4IR would have a great contribution towards job automation in the coming year. She also claimed that current technology infrastructure to transit to 4IR is not strong and that they are facing the problem of lack of financial resources that are required to move toward 4IR. In addition, they currently face the problem of pressure to work with 4IR (e.g. from customers, suppliers, authorities etc.) As per the benefits of 4IR, Ms. Huda agreed that one benefit of the application of 4IR is to meet customer requirements in addition to many other benefits.

## **Conclusion**

This research aimed at studying the impact of 4IR on industries in general and on SMEs in particular. It also aimed to analyze the case of 4IR in the context of Omani SMEs. The study ended up with important results showing that all organizations should start developing IT strategy that ensure that 4IR concepts and its related technologies are well adopted in order to enhance the performance of the organization in terms of competitive advantages and increasing revenues and profit. Concerning Oman, the study indicated that knowledge-based economy infrastructure allows the individual to start pursuing innovative and creative solutions, so that they would be able to handle more sophisticated jobs and tasks that will arise as a result of 4IR. Additionally, it could be mentioned that awareness level among SMEs owner in Oman is at acceptable level. They have knowledge about it but it could be enhanced more. 4IR does have an impact on business growth according to the results. One of the most important challenge that face SMEs due to the emergence of 4IR, is the current technology infrastructure. 4IR also has some benefits like meeting customer requirement and reduce production time.

Empirical researches could be conducted in the future to measure the level of awareness about 4IR among key individuals as well as SMEs owners. Additionally, challenges and opportunities of 4IR could be examined from the perspective of SMEs owners. Lastly, the role of 4IR in enhancing economic diversification at national level could be examined as it is one priority in Oman vision 2040 that aims at reducing the dependence on Oil and Gas sector and introducing different sources of national income.

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