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Assessment of Readiness for Industrial Organization to Digitize Production Processes

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Abstract

Industrial organizations need help defining the roadmap for digital transformation and choosing between readiness models offered by academic bodies or provided by manufacturing companies. This study aims to test a model that represents both parties' viewpoints, to provide a better understanding of Industry 4.0 readiness. A case study of an industrial company was used to make the research plan, conduct interviews with specialists, clarify the dimensions and criteria of the chosen model, and discuss areas for improvement by identifying current gaps. A literature review on the significance of measuring readiness and preparedness for industrial organizations that want to assess their current situation, identify their future goals, and improve their production processes through digitization techniques serves as the study's main source of inspiration. The study focuses on the scope of an industrial company, assessing its condition, and identifying the gap. The ideas of Industry 4.0 design, its significance, and the means of measuring and implementing it in industrial organizations are all subject to further research, which deals with the concept of the Fourth Industrial Revolution and its dimensions, which are represented in three types of integrations. It sheds light on the readiness assessment and distinguishes between it and maturity measures. A common point of view and the study motivate industrial organizations to adopt a clear road map to achieve their goals.

Keywords: *Industry 4.0, Readiness assessment, Dimensions of Industry 4.0, Self-assessment, WMG Model*

Introduction

Digital technologies have been used in operations management to better understand and manage resources, improve safety, and make production processes more efficient. The area of industrial automation has been leading to the third industrial revolution for almost 50 years.

The Fourth Industrial Revolution (Industry 4.0) is the future coming so fast that it has been thought of as a far-fetched phenomenon ever since the term "Industry 4.0" was coined by the German government in 2011. However, it has gained popularity in recent years, and its application has been increasing in manufacturing companies as well (Hizam-Hanafiah & Soomro, 2021). This is due to the fact that the highest levels of implementation of Industry 4.0 appear in the German industry, such as in General Electric and Siemens companies, which are multinational technology companies and already own a wide range of automation and production solutions (Rodic, 2017). The term "Industry 4.0" refers to recent developments in production processes that integrate advanced technologies through the Internet of Things and lead to the integration of physical objects (machines, systems, manufacturing lines, processes, and human actors) across organizational stages, building new business models and kinds of new technical data and high-speed value chains (Shu, Lee, Aziati & Ahmad, 2020; Haeri et al., 2022)

If a manufacturing company wants to adopt Industry 4.0, it must first conduct an assessment of its

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operations (i.e., determine whether or not it is ready and willing to implement the requirements of Industry 4.0) before it can begin to identify its strengths, priorities, opportunities, and challenges, as well as develop the comprehensive transition plans that will be required to overcome the many obstacles blocking the company's way. According to the readiness theory, “readiness” is a precursor to the successful implementation of complex changes. Specifically, organizational readiness for change refers to the organization’s members’ commitment to change and its effectiveness. It is a state of psychological and behavioral readiness to take action (i.e., desire and ability), that organizations produce innovation, or adopt it, internalize it, and exploit if (1) changes are necessary, and (2) the organization has the capabilities to change (Lokuge, et al., 2018:7).

The rest of this paper is organized as follows: Section 2 gives an overview of I4.0 and its dimensions and displays I4.0 readiness models. Section 3 presents the case study and research methodology used in this paper, and Section 4 describes the analysis and discussion of this study.

1.1 Fourth Industry Revel ion

People want their lives to get better and better over time. To keep up with these kinds of needs, the business has been getting better. It has already gone through three major changes, or three economic revolutions. People's living standards can continue to go up if the industry keeps giving people customized, high-quality goods and gives workers a better place to work (Wang, 2016; Aşkın, 2022)

The new industrial revolution (Industry 4.0) revolves around the Cyber-Physical System (CPS), an algorithm-based computing mechanism integrated into the Internet and its users. According to Merriam-Webster and Oxford dictionaries, the term cyber is commonly used as a term to describe a computer, network, and related things to broadly describe the internet and its virtual environment.

With the physical interconnection of physical and digital systems and new enabling technologies, the way work gets done will change. Therefore, the way it is managed can change the tradeoff between alternatives to traditional processes to determine competing priorities of cost, flexibility, speed, and quality (Tava & Brian, 2019). Industry 4.0 relies heavily on the incorporation of Internet technology into the manufacturing process. The majority of the technological components are already on the market, but see more widespread use in other sectors like the consumer goods market (Drath and Horch, 2014), and it will have a significant impact on the industry's overall transformation because it demonstrates development in three areas (Roblek et al, 2016; Mainaly, 2023)

1. Production digitization is the use of information technology for management and production planning.
2. Automation refers to systems for collecting data from production lines and utilizing machinery.
3. Automatic Data Interchange - linking production sites in a comprehensive supply chain, as well as using electronics and information technology (IT) in production and services in a special environment.

Rojko (2017) stated that Industry 4.0, since its basic concept was introduced, has received great attention and has become a central focus of discussions among researchers, academics, as well as industrialists. The main idea in their discussions was to make the best use of the potential of new technologies and concepts, such as:

- Internet access and use, as well as the Internet of Things (IoT).
- Organizational integration of technical and business operations.
- Digital mapping and virtual simulation of the real world.
- A “smart factory” with “smart” industrial production methods and “smart” goods.

Sukhodolov (2019) referred to the key characteristics of Industry 4.0, as:

- Being able to move from manual labor to robotic electronics, ensuring the automation of all manufacturing processes.
- Modernization of transportation and logistics networks as a result of the widespread use of unmanned aerial vehicles.
- Manufacture of new products due to the improvement of production techniques and increasing the complexity and accuracy of the technical products manufactured.
- Development of machine-to-machine communication and self-management of physical systems, which is carried out through the assistance of the Internet of Things (IoT).
- Applying self-education programs to provide continuous development of production systems.

Achieving and implementing Industry 4.0 depends on many key technologies. The literature on Industry 4.0 makes reference to nine enabling technologies that international consulting bodies have published to implement the necessary requirements. The Boston Consulting Group (BCG) in 2015 identified nine foundations for technological advancement that meet the requirements of Industry 4.0 (Mubarok, 2019). They are the Industrial Internet of Things, Big Data, Cyber-Physical Systems, Simulation, Computing, Augmented Reality, Autonomous Robots, Additive Manufacturing, and Cyber Security.

These technologies will lead to a qualitative change in the production process. Stock & Seliger, (2016); Liao, (2017); Pereira & Romero, (2017); Beata and Magdalena, (2017); Yubao, (2017) they indicated that the industry 4.0 paradigm is mainly defined by three dimensions or main elements of its performance within production systems, each with different challenges, as follows:

1. Horizontal integration across value networks

Horizontal integration occurs in many manufacturing plants and also throughout the supply chain at the manufacturing level. A horizontally integrated organization focuses on business types that are closely related to its competencies and builds partnerships that support the entire value chain. Horizontal integration facilitates the flow of information. Production data should flow between production sites with minimal delay.

2. End-to-end digital integration of engineering across the entire value chain

End-to-end engineering along the product life cycle describes intelligent networking and digitization in all phases of the product life cycle, from the procurement of raw materials, through the production system to the use of the product, and at the end of its life cycle.

3. Vertical Integration and Network Manufacturing Systems

It describes vertical integration and networked production systems, intelligent connections, and digitization at different levels of aggregation and hierarchy of the value creation unit, from production plants to production cells, production lines, and plants, to the integration of related value creation activities such as marketing and sales or technology development.

Manufacturers who have the expertise and workforce to create and implement underlying technology trends, as well as sufficient support from stakeholders to invest heavily in new technologies, may find the benefits of transitioning to Industry 4.0 outweigh the costs. While the benefits of the industry 4.0 are undeniable, there are also numerous obstacles to overcome. Some of these include a lack of resources, concerns over data security, the need to safeguard the integrity of the production process, immature information technology, and a lack of expertise in relevant fields (Ghobakhloo, 2018; Dugar

& Fox, 2022)

1.2 Readiness Models

Industrial organizations seek to improve their operations through a set of related technologies, such as work teams, simultaneous engineering, job completion, and the cooperation of the management and strategy teams in improving the production process (Nagham, Batool & Hind, 2020). Digitization is the central element of Industry 4.0 and has a significant impact on current operations and capabilities. It means the integration, improvement, and flow of both information and goods in the supply chain, which has a significant impact on operations. Considering digitization as a prerequisite for reaching the fourth edition of the revolution and claiming that Industry 4.0 describes the digitization of manufacturing organizations in this sense, the degree of digitization seems to be the appropriate unit of measurement to determine the readiness and maturity of industrial organizations for digital transformation. Therefore, (Rakic & Marjanovic, 2021) indicated that one of the critical steps in the digitization path for manufacturing organizations is to determine their current status in relation to the concepts of Industry 4.0, and thus, to make comprehensive plans for the transition to implement the Industry 4.0 concept, it is recommended to use readiness and/or maturity assessment models to effectively and systematically guide organizations and stakeholders through the transition phase. There are currently two widely used models called "maturity models" and "readiness models", that quantify the degree of adaptation to Industry 4.0 (Parham, Mohammad, & Basil, 2022). Various readiness indicators and maturity models can help organizations make easier and faster decisions about building their Industry 4.0, while at the same time indicating not only the organization's position but also the competition's position (Josef & Petr, 2019).

The Cambridge Dictionary states that readiness is "the state of being ready for something" and that maturity is very important, it is "an advanced or developed form or condition". The Oxford Dictionary also defines readiness as the "state of complete readiness for something" and maturity as the "state of truth or the period of maturity". Also, in many cases, maturity and readiness are sometimes used interchangeably to describe evaluation patterns. According to (Hanafiah, Soomro & Abdullah, 2020) it seems that organizations, in general, are confused about implementing Industry 4.0 initiatives because they mix means with related ends and do not understand cause and effect. This is because most organizational strategies will be changed after adopting the ideas and technologies of Industry 4.0. This means that the organization's vision, purpose, values, goals, and key performance indicators (KPIs) will change. Therefore, it is essential to learn about and evaluate the most crucial aspects of Industry 4.0 readiness.

Lassnig, et al, (2020) indicated that several models of readiness and self-assessment were presented by both academic and industrial parties, but not all of them have been empirically validated. As the main objective of the readiness models is to determine the starting point, as we indicated earlier, these models differ in terms of the diversity of their dimensions, and some of these models are broad and have many dimensions to measure the readiness of Industry 4.0, while others are narrow with a few dimensions of evaluation (Hizam-Hanafiah & Soomro, 2021). The self-assessment tools provided on the Internet, such as the Impuls (Lichtblau, 2015), Industry4WRD (Azhar, 2021), and WMG models (University of Warwick, 2017), are models for measuring the readiness of organizations in dimensions (people, intelligent operations, data-driven services, smart goods, strategy and organization, and smart plants) in following a multi-dimensional approach, each dimension is further broken down into more detailed aspects, using a scheme of scoring, and each aspect is measured and aggregated at the dimension level, as self-assessment tools are presented using questionnaires related to these aspects, and results are presented via charts and indicators (Christian, Jan, Laura, Bernhard, 2017).

The (Impuls) model is one of the most famous models used to measure the readiness of industrial organizations and the most widely used. The model was used, developed, and applied to 232 companies in the field of mechanical engineering and manufacturing (Lichtblau, 2015), and the model was applied to 7 companies in the mining sector in South Africa (Maasz & Darwish, 2018). The application of the model to 250 small and medium-sized companies in the industrial sector in Malaysia (Hamidi, Aziz, Shuhidan & Mokhsin, 2018). Since the tool is available on the Internet and the self-assessment can be conducted directly by the organizations, meaning that it is available to any organization that wishes to measure its readiness for digital transformation. The evaluation website has an action plan to improve readiness related to technology, environment, and organizations, but this model is not used in our research to measure readiness, and the reason is what was indicated by (Ebru et al, 2017) in their study of self-assessment tools, as he explained that the level of readiness of the organization measured using the Impuls model is affected by the level of readiness, and maturity of competing organizations. By identifying the evaluation method for this model, the level of maturity of the competitor is not determined unless any other organization in the same market conducts the survey, otherwise, it will be ignored. Table 1 shows a comparison between the IMPULS model (Lichtblau, 2015) and the model provided by the University of Warwick (WMG) (University of Warwick, 2017), and since our research is the first experiment in measuring the readiness of the Iraqi industry (as far as the researcher knows), there is no Iraqi industrial organization that has conducted a self-assessment of its readiness for Industry 4.0, so the IMPULS model is considered invalid, so the choice was the evaluation tool presented by the University of Warwick (WMG–University of Warwick, 2017). We include observations and justification for choosing the Warwick model:

The model represents the academic and industry views of readiness, which is its main advantage. The model offers a well-rounded way to deal with the complexity of technological changes. They use academic rigor and business experience to make frameworks that are both strong in theory and useful in practice. This gives a full guide to getting ready for Industry 4.0 and other similar changes.

1. The main goal of developing this tool was to provide organizations with a simple and intuitive way to measure their readiness and future aspirations in the digital age. The interesting thing about this tool is that there are particular aspects never met or highlighted in other assessment tools. These dimensions are the supply chain and legal considerations, as there are four sub-dimensions in the supply chain, namely: stock control using real-time data management, supply chain integration, supply chain visibility, supply chain flexibility, and lead times, while in the legal dimension, there are four sub-dimensions, namely: models contract, risk, intellectual property, and data protection unlike IMPULS, every dimension of Warwick is measured by 4 levels of readiness:

Level 1: Beginners are organizations with Industry 4.0 based plans and pilot applications.
Level 2: Intermediate these are the organizations that have already taken the first step.
Level 3: Experienced, as they are organizations that use Industry 4.0 technologies in certain areas but have not yet been expanded to include the entire organization.
Level 4: Experts are leading organizations that are already on their way to Industry 4.0 integration.

2. The model provides a good analysis of the basic capabilities of the organization with regard to preparing it for the transformation of Industry 4.0, indicating the areas that must be worked on to achieve the desired result.
3. The tool is able to measure the organization's readiness for digital transformation through the relevant categories and is accompanied by a practical guide that contains levels of readiness. The tool correctly identifies the categories and levels to enable the organization to know its current status and future steps in Industry 4.0.
4. The difference in this model lies in the fact that the tool for assessment is used to format the table, unlike some models. In addition, the readiness level is calculated for each dimension, which results

in the analysis being more detailed.

Table 1: A Major comparison of the IMPULS and WMG Industry 4.0 readiness assessment models.

Description of items	**University of Warwick Model**	**IMPULS Model**
Publication year	2017	2015
Origin	UK	DE
Institution/source	Academic in cooperation with (Crimson & Co.) and (Pinent Masons) companies	Manufacturing companies
Total levels	1. Beginner 2. Medium 3. Experienced 4. Expert	1. Performer 2. Expert 3. Experienced 4. Medium 5. Beginner 6. Outside evaluation
Dimensions	1. Products and services 2. Manufacturing and operations 3. Strategy and organization 4. Supply chain 5. Business model 6. Legal considerations	1. Strategy and organization 2. Smart products 3. Smart Operations 4. The smart plant 5. Personnel 6. Data-driven services
Description	The purpose of the assessment is to provide a simple and intuitive way for companies to begin assessing their readiness and future ambition to harness the potential of the cyber-physical age. The assessment is also available online, in addition to the submitted report.	It aims to examine the readiness and capabilities of companies in the fields of mechanical and plant engineering to implement the I4.0 concept. The assessment survey contains 24 questions and is available online. A detailed report is provided after the evaluation, and it suggests guidance on how to improve the current level of each dimension.

1.3 Iraqi Industry and Readiness

The industry is generally characterized by many advantages compared to other economic sectors, which make it a fundamental and vital role in the development of the economies of both developing countries (Asraa & Thaer, 2020). Companies are attempting to cut costs in order to enhance profits, and these trends have produced many methods and technologies to achieve these goals (Maha & Omar, 2019). The food industry sector contributes to the diversification of the Iraqi economy, as it occupies a pivotal role, especially in securing food security for the population, and is a major catalyst for increasing agricultural production (vegetable and animal) and stimulating the growth of industry, specially manufacturing (Naama & Omaar, 2017). Bahaa, Shihab & Ziad (2020) Indicated that the manufacturing sector in Iraq faced many challenges and problems that prevented its progress in this field. However, there are many signs of hope and encouraging factors for the emergence of advanced and effective manufacturing industries at present. Iraqi industrial organizations often seek to achieve technical efficiency, that is, the ability to use the available inputs to achieve the largest return or quantity of output (Mawlood, Albayatey & Makttoof, 2021). Bushra & Muhammad (2019) recommended the need to follow appropriate mechanisms that contribute to raising the efficiency of Iraqi industrial companies through the use of new technologies in manufacturing, as well as developing the cadres working in them in a way that contributes to enhancing their knowledge and practical experience. Iraqi industrial organizations need to recognize the importance of managing work and finding solutions to problems in order to compete in a highly competitive environment and keep pace with change. The design and implementation must be systematic, based on reading the future and anticipating certain events (Firas & Sahar, 2021).

A comprehensive plan for digitizing Iraq's industries requires a multifaceted approach, considering the country's social and economic situation. It should analyze infrastructure, technological capabilities, and workforce skills, develop a digital vision, and prioritize investments in infrastructure. Skill development programs and job training programs should be implemented while promoting IoT, automation, and data analytics to enhance efficiency. Regular monitoring, evaluation, and changes to the roadmap are crucial for ensuring sustainable digitization and adapting to new technology trends and economic needs. An important step on the way to the digital transformation for Iraqi manufacturing companies is to be able to determine their current, where they are right now, in relation to the concept of Industry 4.0 and then to be able to make thorough transition plans to achieve Industry 4.0. Therefore, (Rakic, Pavlovic & Marjanovic, 2021) recommended using readiness assessment models to effectively and systematically guide organizations and stakeholders through the transition phase.

To answer the research question, we conducted a case study for Etihad Food Industries Company Ltd., which is an Iraqi organization that has a local and regional presence and more than 2000 employees. It has been operating since 2015. It consists of two plants, the first for refining sugar and the second for the production of vegetable oils. Based on 21 interviews conducted in the period from 2021-2022, to reveal the company's readiness for digital transformation and Industry 4.0.

3. Research Methodology

The goal of this study is to find out how ready Etihad Food Industries Company Ltd. is for the food industry with its two plants (for refining sugar and making oil) and how ready it is for digital transformation and working in line with the needs of Industry 4.0. This will be done by answering the questions on the self-assessment form (WMG), which has six basic dimensions: product and services, manufacturing and operations, strategy and organization, supply chain, business model, and legal considerations, with (37) a sub-dimension. The readiness for the basic dimensions is calculated based on the respondent's response to the self-evaluation paragraphs, and to obtain accurate answers, the evaluation form was divided according to the six dimensions to be answered by specialists according to Table 2.

Table 2: Respondents to the self-assessment according to the basic (both plant)

Dimensions	Position
Product and services	Plant manager
Manufacturing and operations	Production Manager
Strategy and organization	Plant manager
Supply chain	Plant manager
Business model	Commercial department manager
Legal considerations	Official of the Legal Affairs Unit

The calculation of the readiness of the main dimensions is done by collecting the degrees of readiness for the sub-dimensions for each main dimension, after using the readiness assessment criteria to determine the current level of readiness for each of the sub-dimensions according to the following equation:

$$\text{Readiness for core dimension} = \frac{\text{Total point scored for all subdimensions}}{\text{Total number of sub-dimensions for core dimension}} \qquad (1)$$

As for the total readiness, it is calculated by adding the readiness scores for the basic dimensions and dividing by their number according to the following equation:

$$\text{Overall Industry 4 readiness} = \frac{\text{Total point scored for all core dimension}}{\text{Total number of core dimensions}} \quad (2)$$

3.1 Company Characterization

Etihad Food Industries Company Ltd. was established in the year 2012 in the Medhatiya region in Babil Governorate, and started with the establishment of the sugar refinery, which started producing refined white sugar in early 2015 and has a current production capacity of 3600 tons of refined white sugar per day, and the company established vegetable oil refinery in 2016, then by sugar mill, which started producing refined vegetable oil in early 2017, with an initial production capacity of 2,000 tons per day of refined vegetable oil, and the production capacity will be doubled to reach 4,000 tons per day. The company employs about 2000 employees. The company owns 200 transport trucks for transporting raw sugar and 100 tanks for transporting crude oil from the port of Umm Qasr in Basra to the company's site. The trucks also transport the company's products to the local market. In this study, the two plants (sugar refining, oil refining) were analyzed in order to assess the readiness level of each plant separately, thereby drawing comparative conclusions about the development status of I4.0. Hence the overall readiness of the company.

3.2 Data Collection

We used one case study (Yin, 2017) to reveal the readiness of industrial organizations to take advantage of Industry 4.0, as individual case study, enable the study of a case in its natural context, which allows researchers to understand the phenomena (Chan, Teoh, Yeow & Pan, 2019), which leads us to pay attention to the case of Etihad Food Industries Company Ltd., although we expect this to be prepared for one in a variety of different situations, given the undiscovered nature of the location research area, and to investigate potential patterns, a case study may be appropriate (Yin, 2017).

We have chosen Etihad Food Industries Company Ltd. as a model organization, as it is considered one of the modern and developed companies. As consequence, semi-structured interviews were undertaken, and collected additional data from other sources, including informal communicates, field observations, presentations, and internal papers, as well as material from the public media (Myers, Newman, 2007). Operations were monitored for the sugar refinery plant and the oil refinery plant. At this stage, it is possible to examine how plants receive basic products for production, as well as how to set up production lines to communicate between departments to supply the production chain and to understand more about the production process. Twenty-two informal interviews were conducted with company staff (technicians, operators, and engineers) working in each department assessed. At the sugar refinery, (11) employees were interviewed, and at the refinery (13) employees, and process engineers were interviewed. These interviews not only assess employees' involvement with assistive technologies, but also gather insights into how manufacturing processes work. In the next step, after (28) direct observations for each plant, their managers were questioned, according to a self-evaluation form (WMG), it was possible to perform an individual evaluation of each plant and to determine the dimensions displayed in the evaluation tool (WMG) based on this group.

4.Results And Discussion

According to the self-assessment of readiness (WMG) presented in Table (3), the sugar refinery has the highest readiness for I4.0 and receives a score of 3.05, while the readiness score of the oil refinery plant was 2.90. Figure (1) shows the readiness levels obtained for both plants under analysis for each dimension of the WMG model. The company has not reached full readiness to adopt Industry 4.0 technologies in a relative way and one of the explanations behind this could be the strong market-oriented strategy of the manufacturing sector in Iraq, according to demand, customer requests, and specifications rather than self-initiating in terms of imitation. catch-up technology in the global industry, in other words, rather than pursuing competitiveness through technology, the company only follows a low-cost market strategy, and the reason may be lack of technologies policy tool to provide technological support in the Iraqi manufacturing sector. Identifying barriers to digital adoption requires in-depth research.

Further research should include further examination of the fundamental problems that determine implementation in manufacturing processes, with the aim of developing industry-wide policy recommendations. The research provides a synopsis of the latest findings in the literature in terms of the concept of Industry 4.0 and its readiness. Moreover, it provides a preliminary statistical presentation, and has a significant impact in conducting more complete and in-depth researches covering other non-technological subjects such as the impact of digitization on human resources and the skills required in the digital environment as well as improving concepts at the organizational, and administrative levels and keeping pace with new business models and digital innovation.

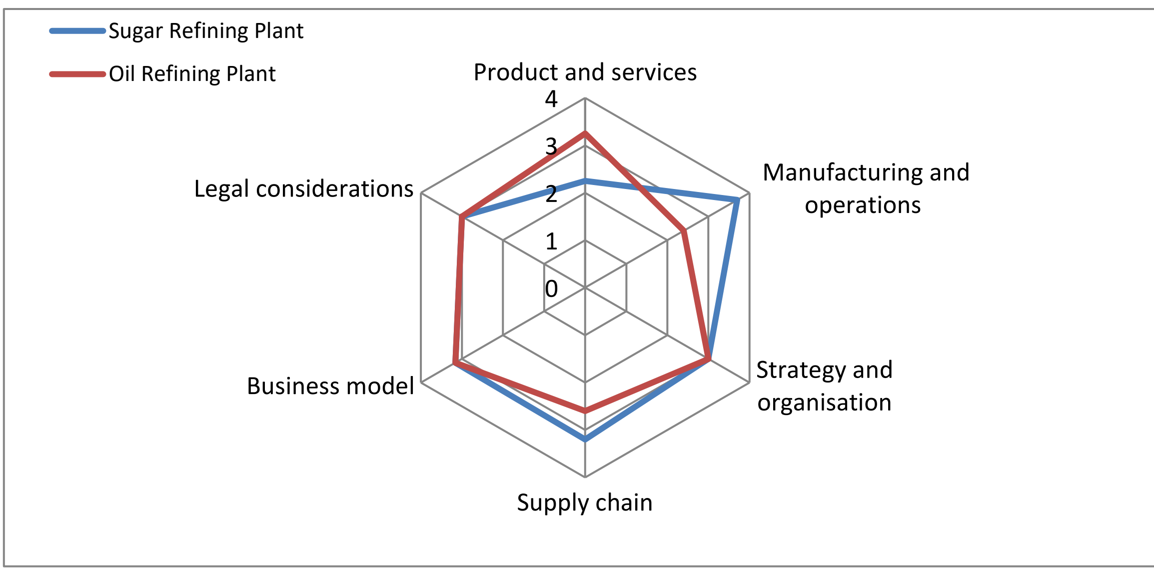

Table 3. Readiness levels for both plants

Dimensions	Sugar Refining Plant	Oil Refining Plant
Product and services	2.25	3.25
Manufacturing and operations	3.7	2.4
Strategy and organization	3	3
Supply chain	3.2	2.6
Business model	3.16	3.16
Legal considerations	3	3
Overall Industry 4 readiness	**3.05**	**2.90**

Figure 1. Comparison of all Levels on Each Plant

Implementing an Industry 4.0 Readiness Assessment by WMG models has strengths in its ability to do structured evaluations, benchmarking, and find gaps, which helps companies make better decisions about adopting new technologies. But the tool has some major flaws that could make it less useful and relevant for guiding Industry 4.0 readiness efforts. These flaws include subjective assessments, limited real-world context consideration, complexity, and possible resource needs. It is important to find a good balance between these strengths and weaknesses to make sure that the tool helps companies on their journey to Industry 4.0.

5. Conclusion

The results indicate that the company has not yet begun a transformation based on cutting-edge digital technology. Although it had begun to absorb some of these digital technologies, it was at an experienced level of Industry 4.0 readiness. This study permits it to be noted that a majority of constraining areas for a more positive assessment of the level of technological evolution of a company are especially linked to a scarcity of a more diverse set of ICT-related occupations and the sharing of information with its business partners. Controlling the current equipment in the sugar refinery through automation and integrating it into the operating system is an opportunity for improvement. By collecting and using data, it may help improve the current production processes. It is important to fully consider the impact of (information technology and data security) from the beginning. In the oil refinery, lack of service delivery depends on data collection as the most impactful area as a chance for improvement. In addition to customer integration, the absence of metrics to track the development status as part of the industry 4.0 strategy and poor adaptability to existing infrastructure functions are other areas of concern and opportunities for improvement for both plants. The main reason for this situation may be due to Iraq's manufacturing industry has a strong market-oriented approach, meeting customer demands and expectations, rather than being autonomous in terms of technology development. In addition, due to a scarcity of political tools to provide technical advancement in the Iraqi manufacturing industry, in order to identify barriers to the adoption of digital innovations, an in-depth study must be conducted with the aim of developing recommendations and plans for the digital transformation of the entire industry.

The study provides a preliminary overview of the latest literature in terms of Industry 4.0 and readiness of the manufacturing companies. It therefore makes a significant contribution to the current study on Industry 4.0 in developing economies. In addition, It provides a preliminary statistics overview, it plays an important broad role in comprehensive, and in-depth studies, including other non-technological areas, that play an important role in the transition, such as human resources and skills as well as improving management and organizational concepts, keeping pace with digital innovations.

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