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Research Article

The Role of Digital Manufacturing in Achieving Operational Excellence/an Exploratory Study of the Opinions of Al-Kindi Factory Managers

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ABSTRACT

The current study aimed to crystallize the cognitive and field premises of the study according to a philosophical perspective that simulates the contents of contemporary trends, within the framework of what is known as digital manufacturing as a contemporary technology that can contribute to achieving operational excellence, which represents a goal that contemporary companies seek, and on the basis of that, local companies now need to Adopting technical and administrative approaches that go beyond traditional frameworks in employing contemporary manufacturing techniques and providing a qualified human resource in a way that enables it to benefit from its resources efficiently and effectively.

We adopted the questionnaire form as a tool for collecting data and information, which was distributed to the individuals surveyed at the Al-Kindi factory, by (220) and (205) valid questionnaires were obtained. The data and information were analyzed using statistical programs (AMOS V.25), and the results showed support for its hypotheses and the positivity of its goals. The field verification was consistent with the theoretical objectives, and there was a correlation and influence relationship between the investigated variables, their techniques, and their dimensions. The study reached a set of conclusions, according to which we presented a number of proposals and a mechanism for implementing them.

Keywords: Digital Manufacturing, Operational Excellence, Fourth Industry, Al-Kindi Factory.

I. Study methodology

A. The problem of the study and its questions

Industrial companies in general and Iraqi companies in particular face great challenges and difficulties due to the dynamic environment with rapid technical development and the resulting negative phenomena, in addition to the challenges of competition, which represent one of the most important factors that stand as an obstacle to many departments to continue successfully, which has made it imperative for them to Striving seriously to strengthen its competitive position in the market by innovating and applying new methods that contribute to strengthening its position and meeting customer needs, continuity and growth. This study is supported by examining two important variables in the study. And analysis.

Despite the great interest that researchers pay to the topic of digital manufacturing, these efforts did not highlight the relationship between digital manufacturing techniques as a tool through which operational excellence can be achieved, which was indicated through a review of previous studies and cognitive efforts that produced many philosophical concepts. However, there are Many cognitive contents still need further research and investigation, which seeks to bridge the philosophical gap and address the cognitive problem, which can be formulated as follows:

1. What are the philosophical foundations and conceptual frameworks for the study variables (digital manufacturing and operational excellence)?

2. What are the scientific opinions regarding the adoption of the two variables of the study, with its various techniques and dimensions?

B. The importance of the study

Our current study seeks to address both digital manufacturing and operational excellence as modern methods and methods that enhance the status of the researched factory in a way that achieves its uniqueness and achieves its goals in accordance with scientific foundations. Based on the above, the importance of the current study lies in the following:

1. This study derives its importance from the importance of its variables, as well as the advantages and benefits it achieves from applying them together.

2. We seek to contribute to enriching the Arab library in general and the Iraqi library in particular with a modern study on contemporary topics, including digital manufacturing and operational excellence in the Canadian factory.

3. Its serious endeavor to adopt current developments in the field of production and operations management in particular to keep pace with the rapid changes taking place in the industrial environment.

In addition to the above, the study gains its field importance from the importance of the field studied, which is represented by the Al-Kindi factory, which seeks to provide distinguished products to society.

C. Study objectives

The current study aims to achieve a number of objectives, the most important of which are as follows:

1. Diagnosing the dimensions of operational excellence that can be used and determining the benefits achieved in the researched factory.

2. Contributing to improving the performance of the investigated factory and motivating it to adopt and apply modern manufacturing systems.

3. Employing the cognitive framework of the study as a tool to achieve operational excellence in the researched factory through digital manufacturing.

4. This study seeks to present a set of conclusions and a number of proposals that can be benefited from based on the findings of the study.Data Privacy and Security in Health Systems

D. Hypothetical study plan

The current study adopted a hypothetical scheme that expresses the assumed relationship between digital manufacturing and operational excellence as follows:

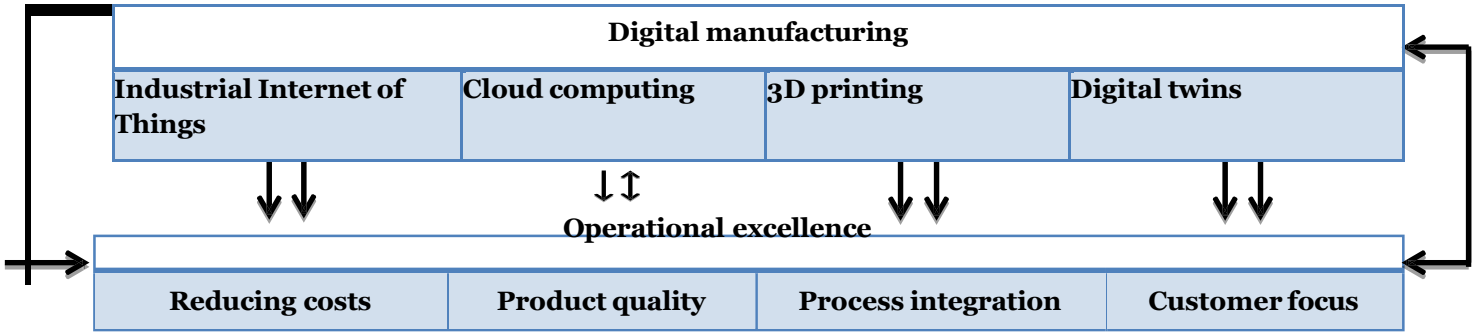


Figure (1) Hypothetical study plan

A relationship of influence → A relationship of Correlation ↔

Source: Prepared by the researcher

E. Study hypotheses

The most important hypotheses of the study were as follows:

1. The first main hypothesis: There is no significant correlation between digital manufacturing and operational excellence in general and individually in the investigated factory.

2. The second main hypothesis: There is no significant effect of digital manufacturing on operational excellence overall and individually in the investigated factory.

F. Description of the study population and sample

The current study was conducted in Al-Kindi factory, which aims to provide the local market with industrial products to meet its needs with appropriate technical specifications and quality.

As for the study sample, its population included the individuals surveyed from the directors of departments, divisions, and units, their assistants, and those with experience and specialization at various administrative levels (senior management, middle management, executive management), and the characteristics of the description of the individuals surveyed are reflected through the general information in the first part of the questionnaire.

II. LITERATURE REVIEW

Companies face many challenges during digital transformation as they must overcome several obstacles to ensure the successful implementation of Industry 4. Among these obstacles are the lack of digital skills in the workforce, high investment requirements, uncertainty about the economic benefits associated with investing in technology, and concerns related to information security. and increased security risks associated with data sharing, in addition to the low level of technology maturity, lack of standards and regulations, and weak digital infrastructure. Moreover, companies suffer from a lack of internal digital capabilities and appropriate culture, as well as resistance to change (Raj et al., 2019, 15).

Digital transformation also includes integrating digital technology into the operations of manufacturing companies through a comprehensive approach that includes monitoring, testing, control, and predictive analysis, by analyzing data and information at every stage, with the aim of integrating the entire life cycle of the manufacturing industry within the framework of digitalization. This approach seeks to Achieving comprehensive and environmentally smart production, which enhances core competitiveness (Yao et al., 2023, 2).

It is clear from the above that the digital transformation of manufacturing means converting factory operations into electronic operations through the use of modern technologies, which leads to reducing time, effort and costs and facilitating the performance of operations further.

A. Digital manufacturing concept

Many writers and researchers have addressed the concept of digital manufacturing, each according to his point of view, and in this context (Brugo, 2016, 50) refers to digital manufacturing as an integrated approach centered around the computer system due to the use of more automated tools in factories, as it has become necessary to model, simulate and analyze all Machines, tools and materials are input in order to improve the manufacturing process. (Szalavetz, 2019, 145) explains that digital manufacturing is the impact of digital transformation in manufacturing driven by technology enabling factors such as (the Internet of Things, cloud computing, artificial intelligence, big data analysis, simulation, and augmented reality).

Based on the opinion of (Putro & Wirasmoyo, 2020, 1), it is a technology-driven design-oriented model that represents a leap in the field of technological innovation in the design industry, allowing designers to develop their own design approach.

(Benjamin et al., 2021, 4) believe that digital manufacturing is the application of digital information from multiple sources and forms to enhance manufacturing processes, value chains, goods, and services.

It is clear from the above that digital manufacturing is a manufacturing system that uses a set of computer-supported tools and modern technologies that transform three-dimensional designs into digital information that contains commands and coordinates that machines understand, such as (3D printers, control machines, and laser cutting).

B. The importance of digital manufacturing

Digital manufacturing is a vital element within the framework of the fourth industry, as it includes a set of

technologies that are used to manage information, which contributes to making and making decisions at all stages of the digital manufacturing life cycle. This manufacturing depends on integrated computer systems, simulation, information sharing models, and collaboration tools. Which is used in designing and analyzing products and manufacturing processes, and in this context (Jayanth et al., 2021, 4) shows the importance of digital manufacturing through the following:

1. Reducing time and development procedures.

2. Integrating information from various processes and departments, which contributes to increasing efficiency and effectiveness and improving performance.

3. Dispersed production of an increasing variety of parts and products in a number of different locations.

4. Manufacturing companies focus on their core competencies and collaborate effectively with other companies and suppliers using effective ICT-based collaborative engineering.

(Matthew et al., 2021, 2-3) embodies the importance of digital manufacturing through the following:

1. Digital communication contributes to avoiding interruptions to the production process.

2. Companies seek to adopt digital manufacturing to reduce costs and improve production efficiency, saving time, money and effort.

3. Digital technologies contribute to enhancing the efficiency and effectiveness of manufacturing processes and making better use of workers' time.

4. Collaboratively design products and store them in a central place, making them easy to share with others at any time.

5. Machine learning is used in digital manufacturing to analyze large amounts of data and information related to production, equipment, and products, which helps improve manufacturing processes and develop best practices.

6. Digitization enhances customer and worker satisfaction by improving quality management and control, which contributes to customer happiness and increases workers' enjoyment of their tasks.

7. Investing in digital manufacturing technologies helps attract and retain workers who seek to use this technology to improve efficiency and effectiveness.

8. Eliminating paper-based or manual processes can significantly increase productivity by reducing the need for rework.

9. Rapid adaptation to increasing customer expectations and shortened product development cycles, enabling them to achieve benefits such as increased sales and market share in light of global competition.

10. Improving safety conditions for workers and increasing productivity, as smartphones can be used to collect safety incident reports quickly and accurately.

It is clear from the above that digital manufacturing contributes to experimenting with policies in a virtual environment, as alternative solutions are evaluated and three-dimensional models are designed with the aim of improving productivity, which leads to reducing the time required for production and reducing costs, as well as enhancing communication and cooperation between the various levels of the company and ensuring the achievement of quality and consistency in All stages of production.

C. Digital manufacturing techniques

1. **Industrial Internet of Things (IIoT):** IIoT was initially adopted by manufacturing industries as a way to improve operational efficiency. In the current environment, it can improve the overall efficiency of industries in terms of productivity, quality, cost, delivery, safety, and morale. It has significantly changed the work of industries. Significant, both in terms of detecting errors through predictive maintenance of any machine or machine and monitoring any process in real time, as IIoT devices have helped industries safely implement many activities that have been identified as being prone to accidents, IIoT technology applies not only to manufacturing, mining, oil and gas, agriculture and public utilities but also to hospitals, warehouses, transportation and logistics, ports and the

banking sector. (Singh et al., 2018, 1)

(Corrales et al., 2020, 6469) argue that continuous access to real-time production information is expected to have positive effects on production productivity because it allows tracking and identifying defects and deficiencies in production processes.

It is clear from the above that Industrial Internet of Things technology includes many devices equipped with sensors, which allows companies to collect large amounts of data and information in real time. This technology helps in tracking processes, identifying defects, and discovering deficiencies in production, which leads to increased productivity and reduced... Operational costs through improved monitoring and control of assets and production processes.

2. **Cloud Computing:** Cloud Computing (C**C)** is a model that enables users to access resources easily without the need to manage the underlying infrastructure. Cloud computing providers usually offer different service models through which infrastructure services and virtual computing resources such as servers, storage, and networks are rented from the provider. In platform services, the provider provides a platform for users to develop, test, and install their own applications, and in software services, the provider delivers application software to users over the Internet (Chandramohan & Ramasamy, 2023, 201). Users can extend the reach of computers. This makes it easier, more efficient and cost-effective for businesses to respond to changing demands and opportunities (Ram et al., 2023,125). In the same direction, cloud computing provides the possibility of backing up data and information to avoid disasters. Service providers often offer multiple options for backup, as data and information are stored in various locations, which reduces the risk of losing records in the event of a disaster or service interruption. It is possible to restore Data and information can quickly be retrieved from backups, reducing downtime and ensuring business continuity. However, there are some potential drawbacks associated with cloud computing, such as security issues as

information stored in the cloud is vulnerable to cyber attacks or breaches. (Fatemi, 2022, 125)

It is clear from the above that cloud computing technology provides access to data, information, and systems, and also provides the necessary infrastructure and resources to host programs. This facilitates cooperation and work with different parties. In addition, it provides high levels of security and reliability by providing multiple options for backing up data and information, which makes Reduces the risk of losing information in disaster situations.

3. **Digital Twin (DT):** The emergence of the digital twin has created new platforms and paths to enable the implementation of functions and services in the easiest ways and has been identified as one of the latest promising digital platforms that create digital twins of physical assets (Martinez et al., 2018, 55).

In this field (Rasheed et al., 2020,219) the digital twin is defined as a virtual representation of the physical asset that is enabled through information and simulation devices to visualize and predict system states. While (Madni et al., 2019, 3) identified many features of the digital twin, which include the following:

- The digital twin reflects the specific version of the physical structure, including its performance, maintenance, repair history, health status and other characteristics, and tracks the life cycle stages of physical assets through the connection provided by digital threads.
- The virtual model is used to monitor and understand the performance of physical assets, as well as predict future performance and maintenance patterns.
- Allows facility developers to monitor system performance and make necessary adjustments to meet expected requirements.
- Predicts future system performance after improving assumptions using predictive analytics data derived from the physical structure.
- Improves services and operations by integrating information from the Internet of Things with data from physical assets.

It is clear from the above that the digital twin is a virtual representation of processes, people, places, systems, or devices, and it is supported by information and simulation devices, which allows system states to be visualized, predicted, monitored, and improved, leading to improved decision-making.

4. **3D Printing:** 3D printing technology has the potential to bring about a radical transformation in various industries, leading to a change in production lines. Adopting this technology contributes to increasing production speed and reducing costs, while consumer demand has a greater impact on the production process and consumers will have the opportunity to... Greater impact on the final product, as they can order any product to be manufactured according to their own specifications. 3D printing facilities will be established closer to consumers, allowing for more flexible and responsive manufacturing, in addition to improving quality control. Finally, adopting this technology could contribute to changing logistics services. For companies by improving process management and providing comprehensive services starting from the manufacturing stage and ending with delivery (Rajan et al., 2016, 6).

Embracing 3D printing helps manufacturing companies provide highly customized products in small quantities and allows production on demand, which leads to cost reduction. It also supports the design of environmentally friendly products, which leads to the elimination of waste and energy savings. 3D printing provides opportunities to enhance competitive advantage and reduce distances. Transportation and available inventory, and adopting integrated manufacturing helps manufacturing companies improve their performance in many areas, including: (Huang, et al., 2013, 1191) (Strange et al., 2017,90)(Tang, et al., 2019, 129)

- Develop faster, cheaper and better quality prototypes and customized products to meet customer needs.
- Enhance the value created by simplifying the production of complex products, increasing parts, and enhancing their flexibility.
- Increase production efficiency and production flexibility by improving lead times, reducing cost, enhancing material efficiency, and reducing produced waste.
- Achieving a competitive opportunity through the diversity of products and the use of computer-aided design software outputs allows remote production through 3D models compatible with printers and enhances the cost.

It is clear from the above that 3D printing works to create three-dimensional physical structures from a geometric representation through the successive addition of materials, which allows for more flexible and responsive manufacturing, in addition to providing customized products and allowing production on demand, which contributes to reducing costs. Finally, adopting This technology is changing corporate logistics services by improving operations management and providing comprehensive services starting from the manufacturing stage and ending with delivery.

D. The concept of operational excellence

The word “excellence” refers to goals that must be achieved and sustained in order for these goals to remain distinct (Mitchell, 2015, 43), while the word “operational” refers to assembling all products, distributing them, and completing tasks (Wojtkowiak & Cyplik, 2020, 12). Operational excellence is directly linked to improving performance. And efficiency and effectiveness across all aspects of the process (Zhu et al., 2018, 84) and is also linked to both performance Operational excellence, such as measures of cost, quality, flexibility, and delivery, and sustainable performance, such as dealing with people and resources efficiently and effectively to support business expansion. Operational excellence is concerned with manufacturing operations while reducing waste. Proper management of operational excellence increases operating profits and generates interactions between workers and customers to ensure its stability in the production system. (Chakraborty et al.,2020,152)

(Yeo, 2019, 142) indicates that operational excellence represents a philosophy that contributes to continuous improvement of operations within companies, which leads to achieving better performance based on previous experiences and new ideas, and this excellence depends on operational enabling factors and distinct performance standards such as quality, flexibility, delivery and cost. Profitability, efficiency, effectiveness, reliability and safety, and is achieved through a comprehensive system of operations aimed at making a positive impact on the core business.

While (Li et al., 2020, 3) explains the concept of operational excellence as a management system that aims to achieve value for customers through innovation and technology development, and this concept focuses on continuous improvement of the operational process and precisely increasing the efficiency and effectiveness of the

industrial system.

It is clear from the above that operational excellence is a process that helps companies continuously improve their operations with high efficiency and effectiveness by adopting methodologies that enable them to outperform their competitors by improving quality, reducing costs, increasing flexibility and speed of delivery to obtain a larger market share in light of the intense competitive environment.

E. The importance of operational excellence

Many studies, such as (Elouarat et al., 2011, 27), (Miller, 2014, 125), and (Susanti et al., 2015, 354) have addressed the importance of operational excellence in the industrial sector, by focusing on improving operational performance and... Sustainable, which includes dealing with people and resources efficiently and effectively to support business growth and enhance customer value. It does not only focus on the production process and reducing waste, but is also concerned with creating value through the interactive performance of employees, customers and the supply chain. (John, 2015, 52) explains that the importance of operational excellence lies in the following:

1. Improving the performance of production operations by reducing costs, work accidents, and failures, which leads to an enhanced competitive position.

2. Achieving operational excellence in any company requires achieving a balance between five elements: (risk, reliability, cost, continuous improvement, and sustainable improvement), and each of these elements plays a crucial role in maintaining efficiency, effectiveness, and high performance.

3. Identify and eliminate defects that require significant expenditure, and operational and organizational deficiencies are identified in order to avoid bad results.

4. Operational excellence is a way to achieve reliability and reduce costs by implementing tasks correctly the first time. This method is the only way to ensure availability and achieve effective business programs in terms of cost and quality, especially in highly competitive industries.

5. Operational excellence contributes to achieving effective proactive improvements in activities in addition to monitoring operational processes to ensure accuracy and high quality in all functions.

(Choudhuri et al.,2019, 4) explains that the importance of operational excellence lies in the following:

1. Achieving both organizational efficiency and effectiveness by reducing costs without affecting production or quality, by reducing waste of time, resources and energy used in unnecessary transportation and processing, in addition to improving performance throughout the company.

2. Enhancing customer value by creating value through effective interaction between employees, customers, and the supply chain.

3. Achieving excellence in the internal organizational processes of production and ensuring their delivery to customers on time with a high level of satisfaction.

4. Operational excellence provides a competitive advantage to the company by enhancing customer satisfaction and attracting many new customers.

Based on the above, it is clear that operational excellence is gaining increasing importance in the industrial sector by enhancing production efficiency and effectiveness by improving quality, flexibility and delivery in addition to reducing accidents. All of this contributes to reducing costs and eliminating waste, loss, returns, defective and returned items, and that operational excellence goes beyond traditional standards to include Sustainable performance, which requires effective dealing with individuals and resources to support business growth and enhance customer value. It also highlights the importance of adapting to market dynamics and leads to enhancing the company's competitive position.

F. Dimensions of operational excellence

1. **Reducing costs**: (Gaurav et al., 2013, 2821) defines it as achieving a real and permanent reduction in the cost of manufactured goods or services provided without harming the product’s ability to serve the goal for which it was designed.

Reducing costs is also an effective way to search for unnecessary costs and remove them from operations, which contributes to enhancing benefit without negatively affecting the quality of the product. The continuous search for new methods to reduce costs requires constant promotion at all levels of the company, which reflects the presence of a clear strategic approach towards this goal. Manufacturing companies can adopt strategies such as value analysis, careful budget control, and setting target costs and life cycle costs, with the aim of reducing material, labor, waste, returns, defective, and inventory costs. (Figar & Ivanoic, 2015, 15)

Based on the above, companies must offer their products at low prices compared to competitors. This requires an effective operations strategy that focuses on improving operations efficiently and effectively and reducing costs without affecting quality. This strategy includes reducing waste, training workers to increase productivity, and organizing relationships across the value chain to achieve sustainable competitive advantages.

2. **Product quality:** The concept of quality is one of the modern management concepts that focuses on information, ideas and principles that any company can adopt to achieve better performance. Quality represents a method of leadership and operation that aims to continuously improve performance in the long term by focusing on the requirements and expectations of customers. (Alaa, 2020, 26)

Therefore, business organizations seek to reach the highest levels of quality in order to survive in the competitive market and obtain the largest percentage of that market, because quality means reducing the percentage of defects in the product to the lowest possible extent, or it means producing products that are identical to the design specifications. (Hussein, et,. al,2021, 1267)

It is clear from the above that quality is one of the modern management concepts that focuses on improving performance by meeting customer expectations, and depends on the company's internal policies and major factors that affect them. Managers must identify these factors and understand their impact on the quality of products, identify quality problems and analyze them, and strive to Business organizations to achieve the highest levels of quality to ensure their survival in the market.

3. **Process integration**: It is a process in which the effort associated with the flow of information between activities is reduced. Business process integration describes the practices associated with reducing this effort, or the tighter coupling of organizational activities in the business process, and activities become more coupled to each other through reducing human effort associated with communication. and coordinating its inputs and outputs Since the majority of business processes deal primarily with information-based inputs and outputs, improving the timeliness, accessibility, detail, and transparency of information flow between activities in the process is fundamental to the integration of business processes. (Kock et al., 1997, 70)

Process integration includes reducing the efforts needed to communicate and coordinate between different activities. The time spent in the flow of information between distributed activities is a basic indicator of the level of process integration. The lower the number of steps and information delivery processes, and the less effort expended in each delivery process, the higher the level of process integration. (Kobayashi et al., 2003, 769) (Hassel, 2000, 33).

It is clear from the above that process integration aims to reduce the effort associated with the flow of information between activities, which leads to improving the timeliness, accessibility, and transparency of information flow, and that most business processes depend on information inputs and outputs, and process integration requires information integration, which requires transferring information appropriately and in a timely manner. The right time.

4. **Focus on the customer:** (Pambreni, et al., 2019, 1398) indicates that focusing on the customer is one of the basic elements of comprehensive quality, as it contributes significantly to improving financial and operational performance. This focus is a vital factor for the success of any company, as it constitutes A starting point for any quality initiative. (Abukhadera & Onbaşıoglu, 2021, 522) adds that companies that seek to be customer-oriented need to implement a system that meets customers' requirements and inquiries, allowing them to communicate with the company easily and in an effective manner, and stresses that simply listening to customers is not enough without having mechanisms for analysis and interpretation. Business Results Therefore, customer satisfaction must be a top priority and a driving force for organizational direction and goal achievement.

(Sial, et al., 2021, 14) indicate that the concept of focusing on customers is linked to the marketing process, as it is

an essential part of the marketing mechanism, as it provides market stakeholders and business owners with a measure that helps them improve their products and services.

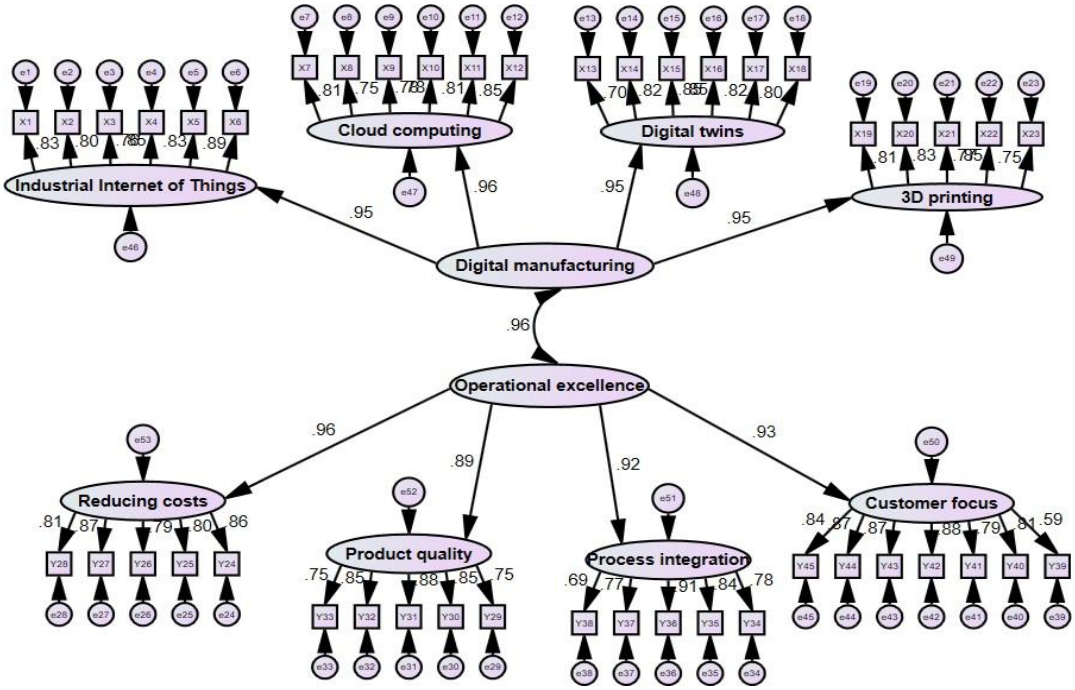
It is clear from the above that companies must understand customer requirements and provide perceived value to them, which leads to their loyalty and increased profitability. Focus on the customer is also an essential part of comprehensive quality, and contributes to improving financial and operational performance. To achieve this, companies must implement effective systems for communicating with customers and listening to their feedback. , with the need to analyze the results to ensure their satisfaction as a top priority.

III. RESULTS

This study presented the testing of hypotheses emerging from the study plan by building a hypotheses model and clarifying the value of the tests for each hypothesis in the Amos program, as follows:

the first main hypothesis: There is no significant correlation between digital manufacturing and operational excellence at the overall level in the researched company.

Figure (2): Model for testing the first main hypothesis



Source: Prepared by the researcher based on the outputs of the AMOS statistical analysis program Table (3) Values of correlation coefficients between the variables of digital manufacturing and operational excellence

Independent variable	Direction of the relationship	Dependent variable	Correlation value	P-value
Digital manufacturing	⟺	Operational excellence	0.958	0 .019

Source: Prepared by the researcher based on the outputs of the AMOS statistical analysis program

Figure (3) and table (2) show the content of the results of the correlation test indicating that there is a direct correlation with a significant significance between digital manufacturing and operational excellence The researched factory, as the value of the correlation coefficient between them reached (0.958) and this value is significant based on the probability value (P-value) which appeared equal to (0.011), which is less than (0.05), so this result indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there is a direct correlation relationship. And moral between digital manufacturing and operational excellence.

The sub-hypothesis emerging from the first main hypothesis: There is no significant correlation between digital manufacturing techniques at the micro level and operational excellence in The researched factory.

Table (4) Values of correlation coefficients between digital manufacturing techniques and operational excellence

Independent variable	Direction of the relationship	Dependent variable	Correlation value	P-value
Industrial Internet of Things	⟷	Operational excellence	0 .913	0.009
Cloud computing	⟷		0.909	0.017
Digital twins	⟷		0.907	0.006
3D printing	⟷		0.945	0.009

Source: Prepared by the researcher based on the outputs of the AMOS statistical analysis program

The table (4) show the content of the results of the correlation test, as follows:

1. There is a direct, statistically significant correlation between Industrial Internet of Things technology and operational excellence in the researched company, as the value of the correlation coefficient between them reached (0.913), and this value is significant based on the probability value (P value), which appeared equal to (0.009), which is less than (0.05), so this result indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there is a direct and significant correlation between Industrial Internet of Things technology and operational excellence.

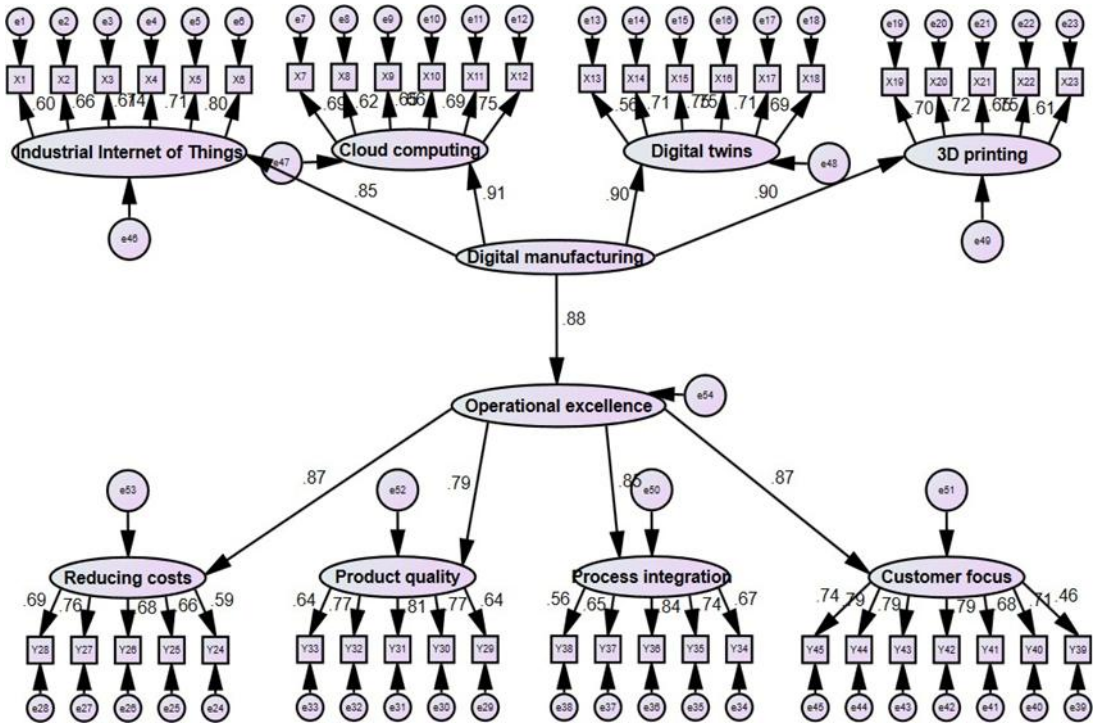
2. There is a direct, statistically significant correlation between cloud computing technology and operational excellence in the researched company, as the value of the correlation coefficient between them reached (0.909), and this value is significant based on the probability value (P value), which appeared equal to (0.017), which is less than (0.05). Therefore, this result indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there is a direct and significant correlation between cloud computing technology and operational excellence.

3. There is a direct, statistically significant correlation between digital twin technology and operational excellence in the researched company, as the value of the correlation coefficient between them reached (0.907), and this value is significant based on the probability value (P value), which appeared equal to (0.006), which is less than (0.05). Therefore, this result indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there is a direct and significant correlation between digital twin technology and operational excellence.

4. There is a direct, statistically significant correlation between 3D printing technology and operational excellence in the researched company, as the value of the correlation coefficient between them reached (0.945), and this value is significant based on the probability value (P value), which appeared equal to (0.009), which is less than (0.05), so this result indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there is a direct and significant correlation between 3D printing technology and operational excellence.

The second main hypothesis: There is no significant effect of the digital manufacturing variable as an independent variable on the operational excellence variable as a dependent variable.

Figure (3): Model for testing the second main hypothesis



Source: Prepared by the researcher based on the outputs of the AMOS statistical analysis program

Table (5) Values of standardized and unstandardized regression coefficients for the effect of digital manufacturing on operational excellence

Independent variable	Direction of the relationship	Dependent variable	Estimate	SRW	Confidence Interval 95%		P-value
					Lower Bound	Upper Bound	
Digital manufacturing		Operational excellence	0.875	0.038	0 .791	0.95	0.015

Source: Prepared by the researcher based on the outputs of the AMOS statistical analysis program

It is clear from the data in Figure (3) and Table (5) that there is a direct and significant effect of the digital manufacturing variable on operational excellence, as indicated by the value of the standard regression coefficient (SRW), whose value appeared to be equal to (0.038), and also the value of the non-standard regression coefficient Estimate is (0.875), and this effect is significant in terms of the probability value (p-value), which appeared equal to (0.015), which is less than (0.05). This result also confirms the similarity of the signs of both the upper and lower limits of the Confidence Interval 95%, which had the same sign. (0.791-0.950), meaning that these limits do not include the value of zero, which indicates the significant effect of the independent variable, digital manufacturing, on the dependent variable, operational superiority over it. The null hypothesis is rejected and the alternative hypothesis is accepted.

The sub-hypothesis emerging from the second main hypothesis: There is no significant effect of digital manufacturing techniques at the micro level on operational excellence in The researched factory.

Table (6) Values of standardized and unstandardized regression coefficients for the effect of digital manufacturing technologies on operational excellence

Independent variable	Direction of the relationship	Dependent variable	Estimate	SRW	Confidence Interval 95%		P-value
					Lower Bound	Upper Bound	
Industrial Internet of Things	-------->	Operational excellence	0.754	0.045	0.660	0.841	0.004
Cloud computing	-------->		0.805	0.041	0.695	0.869	0.017
Digital twins	-------->		0.773	0.043	0.702	0.877	0.003
3D printing	-------->		0.875	0.044	0.777	0.953	0.012

Source: Prepared by the researcher based on the outputs of the AMOS statistical analysis program the table (6), the following impact results can be noted:

1. There is a positive and significant effect of Industrial Internet of Things technology on operational excellence, in terms of the value of the standard regression coefficient (SRW), whose value appeared equal to (0.045), and also the value of the non-standard regression coefficient (Estimate) amounting to (0.754). This is a significant effect in terms of value. The probability reached (0.004), which is less than (0.05). The same result confirms the similarity of the sign of the upper and lower limits of the limits. trust.

2. There is a positive and significant effect of cloud computing technology on operational excellence, in terms of the value of the standard regression coefficient (SRW), whose value appeared equal to (0.041), and also the value of the non-standard regression coefficient (Estimate) amounting to (0.805). This is a significant effect in terms of the probability value. Which amounted to (0.017), which is less than (0.05). The same result confirms the similarity of the sign of the upper and lower limits of the confidence limits.

3. There is a positive and significant effect of digital twins technology on operational excellence, in terms of the value of the standard regression coefficient (SRW), the value of which appeared equal to (0.043), and also the value of the non-standard regression coefficient (Estimate) amounting to (0.773). This is a significant effect in terms of the probability value. Which amounted to (0.003), which is less than (0.05). The same result confirms the similarity of the sign of the upper and lower limits of the confidence limits.

4. There is a positive and significant effect of 3D printing technology on operational excellence, in terms of the value of the standard regression coefficient (SRW), whose value appeared equal to (0.044), and also the value of the non- standard regression coefficient Estimate (0.875). This is a significant effect in terms of value. The probability reached (0.012), which is less than (0.05). The same result confirms the similarity of the sign of the upper and lower limits of the limits. trust.

IV. Conclusions and proposals

This chapter deals with a summary of the conclusions reached by the researcher based on the results of the exploratory study, as these conclusions are the foundation upon which to rely on to present the proposals and implementation mechanisms that the researcher deems necessary for the researched factory, in addition to presenting a number of suggested topics for the researchers who will complete what she left off. The researcher, according to the following:

A. Conclusions

1. The concept of digital manufacturing is one of the modern management concepts, as it combines digital technology with traditional production processes, and can be applied in various industrial sectors regardless of their types.

2. Through operational excellence, many benefits can be achieved that contribute to enhancing performance, increasing efficiency and effectiveness, in addition to improving production processes, reaching high levels of quality, and reducing waste and wasted time. All of this contributes to achieving success and sustainable growth, and enhances the factory's position. In the market.

3. The results of the statistical analysis indicated the existence of a significant correlation between digital manufacturing and operational excellence at the macro and micro levels, which indicates an increasing interest of the management of The researched factory in these technologies, which contributes to achieving operational excellence.

4. The results of the statistical analysis showed a significant effect of digital manufacturing on operational excellence at the macro and micro levels, which expresses the vital role of this variable in enhancing operational excellence in The researched factory.

B. Proposals and the mechanism for implementing them

1. Increasing the interest of the management of the researched factory in the contents of management thought in the field of production and operations management, including digital manufacturing and operational excellence, and its clarification of job cadres to enhance its ability to grow and remain in the business field.

Implementation mechanism:

- Establishing a library specialized in modern administrative research and studies in the surveyed company concerned with production and operations management in addition to modern manufacturing developments, including digital manufacturing and operational excellence, and supplying it with books, magazines, dissertations, dissertations, and instruction manuals, while supplying the company's field work sites with them.

- Publishing posters and wall bulletins in the surveyed company and its various departments and divisions about digital manufacturing techniques and the dimensions of operational excellence to create a culture among employees about them.

2. In order for the researched factory to continue its success and its superiority over its competitors, the researched factory must pay serious attention to digital manufacturing, its technologies, operational excellence and its dimensions.

Implementation mechanism:

- Establishing strategic partnerships with Iraqi technical universities by enhancing digital manufacturing techniques through holding joint conferences and seminars between the two parties, as well as involving factory workers in special courses on both digital manufacturing and the mechanism for maintaining the operational excellence achieved by the factory.

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