The Digitalization' Economic Effects in Warehouses Management

Comparison Study before and after Implementing Digital Solution in

Egyptian Petrochemical Industry

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الآثار الاقتصادية للرقمنة في إدارة المستودعات

دراسة مقارنة قبل وبعد تطبيق الرقمنة على صناعة البتروكيماويات في مصر

الملخص:

إن الضرورة الاستراتيجية لأي منظمة هي التجديد والاستجابة للتحديات والفرص التي تواجهها، لا سيما في عالم اليوم، والذي يشهد تقدم السريع في تطبيقات الرقمنة، لما لها من آثار اقتصادية واسعة النطاق في القطاعات الصناعية.

لقد اهتمت المؤسسات بتطبيقات الرقمنة في إدارة المستودعات في السنوات الأخيرة لما كان لعمليات التخزين من تأثير كبير على الشركات بل وكان عاملا هام في نجاح أو فشل الأعمال

يوضح هذا البحث كيف تؤثر الرقمنة على إدارة المستودعات، ويقدم منظورًا للآثار الاقتصادية لتطبيقات الرقمنة، لذا يهدف هذا البحث الى تحديد التأثير الاقتصادي للرقمنة على أداء إدارة المستودعات بالتطبيق على شركة IVL Dhunseri Polyester SAE ، لتمثيل عينة لشركات الصناعات البتروكيماوية في مصر.

بُني هذا البحث على منهج بحثي دراسة نوعية واستخدمت الاختبارات الإحصائية لفحص الفروق قبل وبعد تطبيق الرقمنة في إدارة المستودعات. أظهرت نتائج الدراسة أنه لوحظت اختلافات جوهرية في متوسط التغيرات في الأداء التشغيلي لمراحل الاستلام والتخزين والإرسال قبل وبعد نشر الحلول الرقمية في إدارة المستودعات وكان لها من فوائد اقتصادية في تعزيز فعالية إدارة المستودعات وأوصى البحث بأهمية تطبيق الرقمنة في إدارة المستودعات في صناعة البتروكيماويات

الكلمات الدالة:

عمليات المستودعات، الآثار الاقتصادية، الأجهزة المحمولة، التقنيات الرقمية

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Abstract:

The strategic imperative for any organization is to renovate and respond to the challenges and opportunities it faces, particularly in today's world, which is defined by the rapid advancement of the digital world. Digitalization is a new phenomenon that is causing economic widespread effects in industrial sectors. The organization has recognized the potential of digitalization in warehouses management. In recent years, warehousing has great effect on businesses and has been an important factor in the success or failure of businesses.

This research shows how digitization affects warehouse management does exist and offers a perspective on the economic impacts of digitalization, so the aim of the research is to determine the economic impact of digitalization on warehouse management performance by using the I.V.L Dhunseri Polyester Company SAE, to represent the sample as a Petrochem Industries company,

This research is constructed based on a qualitative study research approach and used statistic tests to examine the differences before and after digitalization was implemented in warehouse management. The findings of the study showed that substantial variations were observed in average changes in the operational performance of the receiving, storing, and dispatching phases before and after the deployment of digital solutions in warehouse management because of their economic benefits in enhancing the effectiveness of warehouse management and operations, so, the research recommended that the importance of applying digitalization in warehouses management in petrochemical Indust

Introduction:

The world today is witnessing major developments and acceleration in all political, economic, social, cultural, and scientific fields. Businesses always need to develop new competitive advantages to keep up with the speed of change in technology and consumer demands. Businesses may benefit more from innovation strategies and technologies since they help strengthen their competitive power by improving their performance and efficiency.

In recent years, warehousing has great effect on businesses and has been an important factor in the success or failure of businesses. Businesses are forced by global competition to maintain more inventory and get their products to market faster (just in Time).

The rapid advancement of technology has changed the way firms run, consumers purchase, and the velocity at which these activities occur. These innovations continue to have a significant impact on corporate processes across the board. The warehouses allow businesses to respond faster to both market and internal company changes, and new automated methods may help organizations to increase their productivity and efficiency, so, the ways of managing complex warehouses have become a difficult challenge.

As a result, warehouse management is taking advantage of digitalization's benefits, which include increased efficiency and productivity as well as better transparency and accuracy in the movement of goods. The efficiency of the administration has become linked to the extent to which it has digital communication equipment and means, as well as their quality, given the services they provide to administrators and employees in general, as it facilitates their work and ensures coordination and communication among them, as well as supporting the effectiveness of their activity. Therefore, this research is concerned with identifying the economic impact of digitalization on warehouse management.

The Research aims: the research aims to determine the economic impact of digitalization on warehouse management performance and dealing with the following sub-aims:

- Identifying changes in the operational performance of the receiving and storage phase before and after the implementation of digital solutions in warehouse management

- Recognizing changes in the operational performance of the preload and fill phases before and after the implementation of digital solutions in warehouse management.

Research importance: The research studies the significant influence of digitalization on the development and improvements of warehouse management which have economic benefits on the firms' performance such as increasing efficiency and enhancing productivity, cutting expenses, simplifying operations transparency, accuracy in the movement of goods, saving money, increasing customer satisfaction and the competitiveness of products.

Research Questions: What are the economic effects of digitizing applications in the warehouse's management?

Research methodology: The rapid advancement of technology has changed the way firms run, consumers buy, and the velocity at which these activities occur. As a result, warehouse management can take advantage of digitalization's benefits, which include increased efficiency and productivity as well as better transparency and accuracy in the movement of goods. Current research has been done on suggesting implementing digital solutions in warehouse management by using two approaches "Quantitative and qualitative" to establish a better understanding for the research problem, this research was limited to one case research (IVL Dhunseri Polyester Company SAE) based on the historical data of it and trying to identifying changes in the operational performance before and after the implementation of digital solutions in warehouse management

Literature review:

Karina Naumova (2016), entitled "Digitalization and Warehouse Management", and the research was conducted in Russia and aimed to review the digitalization phenomenon and its implications for warehouse management, identify digital solutions in warehouse management, analyze best practices of digital solutions in warehouse management, and develop an algorithm for digital

solutions in warehouse management for Russian companies.

Igor Pihir, (2011). ""Improvement of warehouse operations through the use of mobile barcode systems aimed at speeding up the sales process by utilizing mobile technology to adopt new barcode systems". Despite the fact that barcoding has a wide range of applications in retail and consumer goods stores, many business systems still have room for improvement in business processes. It can make a difference in business operations if deployed in big production systems as support to ERP systems, notably in terms of enhancing sales processes through improved warehouse processes.

Nicholas J. Cross's research " The Impact of Executing a Warehouse Management System Change: A Case Study" was published in (2019). This study s to efficiently develop and install a warehouse management system (WMS) in a central warehouse. Observing and evaluating day-to-day departmental procedures will provide insight into the primary issues that each department faces, as well as the consequences that these issues have on the project's overall success. The reactions to the WMS adjustments will be utilized to identify pre-and post-implementation areas of attention that will help the WMS implementation process succeed.

Ilyas Masudin, (2020). entitled " Effect of Information Technology on Warehousing and Inventory Management for Competitive Advantage: A Theoretical Framework", this article looked at how the use of technology in inventory control affects organizational performance. According to the findings of this study, the use of technology such as RFID in inventory management improves organizational performance in terms of both financial and customer responses. In terms of business performance, RFID has the potential to increase organizational performance by minimizing inventory carrying costs in warehouses, such as lowering the expiration cost of stocked products, increasing warehouse space, avoiding excess inventory, and lowering labor expenses. Furthermore, from the standpoint of customer service, RFID implementation could improve customer responsiveness by minimizing stock-out risk, improving product delivery accuracy, and increasing customer connection with the company. Furthermore, from the standpoint of customer service, RFID

implementation could improve customer responsiveness by minimizing stock out risk, improving product delivery accuracy, and increasing customer connection with the company

Walaa hamdy, (2020). entitled " An Intelligent Warehouse Management System Using the Internet of Things", This research paper is on how a warehouse may be a competitive factor in a supply chain because it connects all of the partners. As a result, it's become critical to effectively allocate and manage the company's resources. A good warehouse management system can help the saving money and increase customer satisfaction.

The previous researches agreed on the same objective: to investigate the implications of applying digital to warehouse management by identifying digital solutions and analyzing best practices for digital efforts, as well as the most recent developments in evaluating and improving the efficiency of warehouse operational processes, and how warehouses have become a competitive factor in the supply chain., in addition to all of that, the current research linking the research problem with contemporary changes in the warehouse management by using two approaches "quantitative and qualitative" to deal with the case study and understanding for research problem to compare between before and after Implementing Digital Solution in Egyptian' petrochemical industry.

Main Hypothesis			Sub-hypotheses
H1	There exist no significant differences between average changes in the operational performance of the receiving and storing stages before and after the implementation of digital solutions in the warehouse management.	H1.1	There exist no significant differences between average changes in the operational performance of manpower for the receiving and storing stage before and after the implementation of digital solutions in the warehouses.
		H1.2	There exist no significant differences between average changes in the operational performance of the number of jumbo bags for the receiving and storing stage before and after the implementation of digital solutions in the warehouse management.
		H1.3	There exist no significant differences between average changes in the operational performance of jumbo bags weight for the receiving and storing stage before and after the implementation of digital solutions in the warehouse management.
H2	There exist no significant differences between average changes in the operational performance of the preloading and stuffing stages before and after the implementation of digital solutions in the warehouse management	H2.1	There exist no significant differences between average changes in the operational performance of manpower for the receiving and storing stage before and after the implementation of digital solutions in the warehouses.
		H2.2	There exist no significant differences between the average changes in the operational performance of Jumbo Bags Weight for the preloading and stuffing stages before and after the implementation of digital solutions in the warehouse management.
		H2.3	There exist no significant differences between the average changes in the operational performance of stuffing duration for the storing stage before and after the implementation of digital solutions in warehouse management.

Research hypothesis:

2-Definition of Digitization and Digital Transformation

As businesses in all sectors increasingly need to adapt to the changeable environment, it is critical to recognize the differences between concepts that have a significant effect on the future of all businesses: digitization, and digital transformation.

2-1 Definition of Digitization

It is widely acknowledged that digitalization has ushered in a new wave of innovation that will have far-reaching ramifications for mankind, altering citizen- government- business interactions and altering the structure of communities and economies. The degree of integration with the digital economy will increasingly influence growth, productivity, and human development. Digitalization and frontier technologies open up new business opportunities, (UNCTAD, 2019).

Digitization is a high-end reproduction technique that involves transforming a document, regardless of its format or content, into a digital chain. (Saleh Lbaear, 2020)

Digitization, or digital conversion, is done by a computer. In the field of information systems, digitization is the process of transforming printed text or images into binary signals. This enables the output of that effort to be displayed on a computer screen. (Autio and Yoo,2021)

A digital business consultancy offers a definition of digitalization "In business, digitalization most often refers to the use of digital technologies as well as the broader meaning and use of digitized data translated into information and actionable knowledge, to allow, improve, and/or transform business operations, business functions, business models, and/or activities. (I-SCOOP, 2021).

Digitalization is a fundamental transformation of company operations and business models based on newly developed information obtained through value-added digitization programs. (A. Schallmo and A. Williams, 2018)

Digitalization, which is known as the adoption and use of digital and mobile technology, entails not only the purchase of certain technologies but also their training and use. (Seethamraju and Diatha, 2019).

The basic definition of digitalization is the use of digital technology that can improve or transform a company's operations. This involves shifting business models, interactions, and processes to a hybrid form between digital and physical means, as well as reducing manual operations to increase productivity. The need to digitize information is part of a company's digitalization. The concept of digitalization, on the other hand, is based on the use of digitized records and data to improve the effectiveness and intelligence of business processes. (CSHARK, 2020).

Digitalization is a technique that, once applied, alters the core of the entire business model as well as the progression of work processes. (AROBS, 2021).

2-2 Definition of digital transformation

We need to understand digital transformation as consistent networking of all sectors of the economy and adjustment of the players to the new realities of the digital economy. Data interchange and analysis, calculation and evaluation of choices, as well as the commencement of actions and introduction of consequences, are all part of the decision-making process in networked systems (Schaible, 2015). Digital transformation is defined as a reinvention of how a corporation leverages technology, people, and processes in pursuit of new business models and revenue streams as a result of changes in customer expectations for products and services.

Digital transformation describes as it includes IT automation (ex, cloud computing), digital optimization, and the development of new digital business models. Small initiatives like putting facilities online or modernizing legacy processes are generally referred to as "digital transformation" in the public sector. As a result, the terms "digital business transformation" and "digitization" have become interchangeable (Gartner, 2021).

The digital transformation uses current information to fundamentally alter the culture, management strategy, technical mix, and operational setup of a business. It prioritizes the customer in all of its decisions and actions. Adding mobile apps, artificial intelligence (Al), cloud computing, analytics, catboats, and other digital services to an existing business, simply enhances it, not replaces it. This is more of an optimization of digital business than a transformation of digital business

(CSHARK, 2020).

Organizations are undergoing digital transformation because they adopt new and innovative business models based on technological advancements. It is the process of radically transforming something utilizing digital technologies, and it refers to the use of technology and, potentially, cultural shifts to improve or replace what used to be previously available. Digital transformation is not a buyable product or service, yet it has an impact on everything IT touches in every business. (RedHat, 2021).

3- **Warehouse Management:**

A warehouse is one of the most important aspects of any business; it is crucial in facilitating worldwide trade. Customers' needs can be readily met if a company has a functional warehouse management system. It also ensures that things are widely available and delivered quickly and at a reasonable cost to a global client base. However, if it is not properly structured and managed, it might prevent a company from competing effectively on a worldwide scale. Warehouse management was discovered to be underappreciated by top management as a key facilitator of manufacturing competitiveness. (Magoro and Macdonald, 2019). The warehouse is now more crucial than it has ever been in terms of a company's success or failure (Frazelle, 2002).

Warehouses are a crucial link in the supply chain, influencing both cost and service levels. In recent decades, many companies have established centralized manufacturing and storage facilities to streamline supply chain activities and manage them more effectively (N. Faber et al, 2013). As a result, larger warehouses are now responsible for delivering to a broader range of more demanding customers throughout a larger territory, as well as more complex internal logistic processes.

3-1 The importance of digitalization in Warehousing

The importance of digitization lies in various business activities, including business models, by enabling new forms of collaboration between organizations and leading to new product and service offerings, as well as a new customer and employee interactions. Simultaneously, digitalization has put pressure on businesses to rethink their existing strategy and investigate new business

opportunities in a methodical and early manner (Rachinger, 2018).

Digital collections are also characterized by ease of access by the beneficiaries and the possibility of sharing them among several beneficiaries at the same time, and thus can accommodate the growing increase in the number of beneficiaries compared with traditional collections. This is done by publishing and making text collections available online via the global network or the intranet of the library or information institution. (Warner and Wager, 2019). The most recent importance of digitalization in warehouse technology management is assisting WMS implementations where the WMS application relates to these digital technologies. This is due to the fact that customers have high expectations. As these digital technologies become more visible, they are clearly evolving. This is coupled with the following primary values that are added to their business (Andiyappillai, 2020), (Abi-Saabm, 2015) which improving quality, reinventing profitable ways, and fostering consistency, creative digital solutions which give businesses a positive economic revenue and achieve their competitive advantage such as:

- Improvements in warehouse process efficiency;
- Cost-cutting;
- Minimizing human error;
- Data storage in the cloud is more secure, which lowers operational costs.
- Electronic communications that are seamless;
- Dashboards;
- Inventory and business data in real-time;
- Consistency, and quality globally;
- Improving reaction time and customer;
- Service anywhere in the world;
- Consistency, and quality globally;
- Increasing workforce flexibility;
- Analyzing and integrating a traditional;
- Digitized record system;

- The ability to use analytics;
- Improving access to information and making it easier to share it around the world;
- Business continuity improvement plan;
- Decreasing the Charge of refilling returned merchandise;
- Reverse logistics recovers inventories after they are dropped off at a warehouse.

*3-2 -*Warehousing tech trends

As the fourth industrial revolution occurs in the twenty-first century, digitalization has a major effect on all business activities and revolutionizes industries. In today's digital age, in order to remain competitive and profitable, an increasing number of businesses are implementing digital technologies in their activities, including warehouse management (Pfohl et al., 2015). Warehouse managers may now select from a variety of technology to help them cut expenses, enhance productivity, and simplify operations. Warehouse executives rank equipping staff with new technology, as well as increasing the use of barcode scanning, tablets, and the Internet of Things, as their top initiatives and lead investments for an optimized supply chain as they prepare to increase the volume of items shipped in the coming years. (Rosencrance, 2020).

Table no (1): Warehousing tech trends

Reference	Warehouse Technology
(Abby Jenkins, 2021)	**Voice picking solutions** are paperless, hands-free technologies that lead order fulfillment workers to particular areas around a warehouse and then inform them which goods to select. One of the most significant advantages of this rapidly gaining popularity warehouse automation technology is that it frees pickers' hands and eyes from other activities like reading or pressing buttons.
(Katie Myers,2021)	**Machine-to-machine (M2M)** technology allows data to be sent between computers and WMS. WMS can use this data interchange to acquire and manage data from warehouse machines. For WMS.
(Myers, 2021)	**Mobile devices include barcode scanners, tablets, Handhelds, laptops, and smartphones. RFID** allows seeing where things are physically located, which dramatically improves warehouse efficiency**.**
(Myers,2021)	**The Internet of Things (IoT)** is a technology that links gadgets to the Internet and allows data to flow between them. IoT facilitates pallet monitoring, data analysis, and forecasting when used with WMS. Sensors, Internet connectivity, and computer processors are the essential components of this technology, with the latter maintaining each device's unique identification
(Lopienski, 2021).	**Real-Time Data Gathering** and Increased Interconnectivity Even when you grow into new sales channels and distribution locations, a digital e-commerce warehousing system should automatically gather and record real-time data and simplify it through a single dashboard.
Mordorintelligence, (2021)	**Autonomous Guided Vehicles (AGVs)** have the potential to transform the way freight is transported both within and outside the warehouse. The global automated guided vehicle market was worth USD 2.41 billion in 2020,

	and is expected to reach USD 14.18 billion by 2026.
(CYZERG, 2021)	**A drone** with sensors, cameras, barcode scanners, or RFID technologies can reach the warehouse's most inaccessible areas. These can-do checks and inventory management can be done in less than a third of the time. drones will grow from 989,000 in 2019 to over 13 million units in 2029.
(Richter, 2019)	**Smart Analytics and Machine Learning** Smart sensors, cloud technologies, and self-learning algorithms can now collect and analyze real-time data to produce fresh insights. ERP systems that utilize machine learning to power smart warehouses can improve productivity by learning and recognizing patterns, regularities, and interdependencies

Source: by authors

4- The Case study:

The Case study: I.V.L Dhunseri Polyester Company SAE

To achieve the goal of the research, the variables of the research hypotheses and the method of measuring the variables that the study will be tested, the research population represents all (15) Egyptian companies in the petrochemical industry in the basic resources sector of the Egyptian Stock Exchange. The research sample is I.V.L Dhunseri Polyester Company SAE, as a Petrochem Industries company, which was incorporated on 2015 under the provisions of the Companies Act, Located in Suez, Egypt. The comparative study is a comparison between before and after the application of the digital solution in warehouses, through the daily reports of the operations in 2014 and the comparison with Daily Operations Reports in 2020 on a daily basis and these variables are represented in the stages (receipt and storage, processing and loading) as shown in table No. (2).

Table (2): Research variables and methods for their measurement

Performance	Stages	Variables	Measurement
Stages of operational processes	Receiving and storing	Manpower	The daily number of workers in the shift
		No. of Jumbo bags	The number of bags received
		Jumbo Bags Weight	Weight in tons
	Preloading and Stuffing	Manpower	The daily number of workers in the shift
		Jumbo Bags Weight	Weight in tons
		Stuffing Duration	Number of hours of Preloading and Stuffing

Source: Daily Operations Reports of I.V.L Dhunseri Polyester Company SAE.

4-1 Normal Distribution Test:

The normal distribution test is used to find out whether the data is parametric or non- parametric.

Two hypotheses were tested:

- The null hypothesis: The stages of the operational processes represented in (receiving and storing, Preloading and Stuffing) follow the normal distribution.

- The alternative hypothesis: The stages of the operational processes represented in (receiving and storing, Preloading and Stuffing) do not follow the normal distribution.

The null hypothesis is accepted if the test significance is greater than the significance level of 5%. The normal distribution of the variables can be illustrated through the following Table No. (3).

Table (3): Testing normality of research variables

Operational Performance	Stages	Variables	Kolmogorov-Smirnova			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
Before- Digitalization	Receiving and storing	Manpower	0.190	365	0.000	0.894	365	0.000
		No. of Jumbo bags	0.105	365	0.000	0.944	365	0.000
		Jumbo Bags Weight	0.113	365	0.000	0.938	365	0.000
	Preloading and Stuffing	Manpower	0.141	365	0.000	0.933	365	0.000
		Jumbo Bags Weight	0.102	365	0.000	0.937	365	0.000
		Stuffing Duration	0.110	365	0.000	0.928	365	0.000
After- Digitalization	Receiving and storing	Manpower	0.251	365	0.000	0.818	365	0.000
		No. of Jumbo bags	0.115	365	0.000	0.960	365	0.000
		Jumbo Bags Weight	0.141	365	0.000	0.940	365	0.000
	Preloading and Stuffing	Manpower	0.122	365	0.000	0.963	365	0.000
		Jumbo Bags Weight	0.034	365	0.001	0.995	365	0.002
		Stuffing Duration	0.039	365	0.003	0.994	365	0.008

Source: Outputs of data processing

Table No. (3) shows the test of the normal distribution of the variables of the operational stages of operations represented in (receiving and storing, Preloading and Stuffing) before and after the application of the digital solution in warehouses by the method of the Kolmogorov-Smirnov test and Shapiro-Wilk test to know whether the research data follow the normal distribution (parametric) or do not follow the normal distribution (non-parametric).

Based on the result of the Kolmogorov test, as the sample size is greater than 365, this revealed that the variables of the operational stages of operations before and after the application of the digital solution in warehouses do not follow the normal distribution, as the significance of the test is all less than the level of significance 5%. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted that the variables of the operational stages before and after

the application of the digital solution. In repositories, they do not follow the normal distribution, and then the research used nonparametric tests to research statistical differences.

4-2 Descriptive Statistical Analysis:

The research used the descriptive statistics of the data of the daily changes of the operational stages before and after the implementation of the digital solution in the warehouses of I.V.L Dhunseri Polyester Company SAE and those variables represented in stages (receiving and storing, Preloading and Stuffing), in order to calculate the arithmetic mean, standard deviation, the minimum, and Maximum.

Table No. (4) Descriptive statistics of research variables

Stages of operational performance	Variables	Before-Digitalization 1/1/ 2014 to 31/12/2014				After-Digitalization 1/1 /2020 to 31/12/2020			
		Min	Max	Mean	Std. Deviation	Min	Max	Mean	Std. Deviation
Receiving and storing	Manpower	0.00	26.00	12.32	5.61	6.00	16.00	14.04	2.26
	No. of Jumbo bags	0.00	1150.00	473.15	227.05	395.00	1510.00	994.20	220.33
	Jumbo Bags Weight	0.00	1265.00	538.05	253.50	395.00	1628.15	1112.70	241.34
Preloading and Stuffing	Manpower	0.00	16.00	4.42	3.03	0.00	10.00	6.11	1.91
	Jumbo Bags Weight	0.00	2005.00	501.64	394.78	0.00	2154.95	1120.86	391.22
	Stuffing Duration	0.00	21.81	10.15	6.82	0.00	18.19	9.37	3.26

Source: Outputs of data processing.

4-2-1 The Stage of Receiving and Storing:

Manpower: the largest Manpower has reached a value of (26) individuals whereas, after implementing the digital solution in warehouses, the largest Manpower reached a value of (16) individuals

No. of Jumbo bags: the largest number of Jumbo bags has reached its value (1150) whereas, after implementing the digital solution in warehouses, the largest number of Jumbo bags reached (1510)

Jumbo Bags Weight: It was found before implementing the digital solution in warehouses that the largest Jumbo Bags Weight in was (1265) tons Whereas, after implementing the digital solution the largest Jumbo Bags Weight in was (1628.15) tons

4-2-2 The Preloading and Stuffing Stage

Manpower: It was found before the implementing of the digital solution in warehouses the largest Manpower has a value of (16) individuals whereas, after implementing the digital solution in warehouses, the largest Manpower has a value of (10) individuals

Jumbo Bags Weight: It was found before implementing the digital solution in warehouses that the largest Jumbo Bags Weight reaches its value (2005) tons whereas, after implementing the digital solution in warehouses, the largest Jumbo Bags Weight reaches its value (2154.95) tons

Stuffing Duration: It was found before the implementing of the digital solution in warehouses that the largest Stuffing Duration amounts to (21.81) hours whereas, after implementing the digital solution in warehouses, the largest Stuffing Duration reaches a value of (18.19) hours.

5- Tests of research hypotheses:

The research has used the SPSS program to clarify the fundamental differences between the company's operational performance before and after the implementing of digital solutions in warehouses, and according to the results of the normal distribution that the variables of the operational stages of operations before and after the implementation of the digital solution in warehouses do not follow the normal distribution, and then the research used nonparametric tests to research statistical differences. The Wilcoxon Signed-Rank Test (Z test) is also employed to measure the extent of the fundamental differences between the stages of (receiving and storing, Preloading and Stuffing) for the operational processes.

The Wilcoxon Signed-Rank Test is a nonparametric method for determining if two related variables have the same distribution.on. This test provides Z value which is calculated as follows:

$$Z = W / \frac{\sqrt{N(N+1)(2N+1)}}{6}$$

Where:

W = sum of ranks for all observations

N = number of observations for each group.

According to the significance level (associated with Z value), research hypotheses could be accepted or rejected.

5-1 The First Main Hypothesis Test:

There exist no significant differences between average changes in the operational performance of the receiving and Storing stage before and after the implementation of digital solutions. The research used the Wilcoxon Signed-Rank Test to test the sub-hypotheses to find out the extent of the fundamental differences of the first main hypothesis, and the results of the sub-hypotheses were as follows:

Table (5): The Sub-Hypothesis Test of the First Main Hypothesis

Receiving and storing	Period	Mean Rank	Mean	Std. Deviation	Z	Sig. (2tailed)
The first sub-hypothesis test of the first main hypothesis						
Manpower	Before-Digitalization	181.37	12.321	5.608	-5.134	0.00
	After-Digitalization	166.82	14.038	2.259		
The second sub-hypothesis test of the first main hypothesis						
No. of Jumbo bags	Before-Digitalization	14.00	473.151	227.053	-16.515	0.000
	After-Digitalization	185.82	994.200	220.327		
The third sub-hypothesis test of the first main hypothesis						
Jumbo Bags Weight	Before-Digitalization	12.00	538.049	253.501	-16.515	0.000
	After-Digitalization	186.34	1112.700	241.335		

Source: Data processing output using SPSS v.26.

5-2 The second main hypothesis test

There exist no significant differences between average changes in the operational performance of the Preloading and Stuffing stage before and after the implementation of digital solutions. The research used the Wilcoxon Signed-Rank Test to test the sub-hypotheses to find out the extent of the fundamental differences of the first main hypothesis, and the results of the sub-hypotheses.

Table (6): The sub-hypothesis test of the second main hypothesis

Preloading and Stuffing	Period	Mean Rank	Mean	Std. Deviation	Z	Sig. (2-tailed)
The first sub-hypothesis test of the second main hypothesis						
Manpower	Before-Digitalization	135.97	4.422	3.027	-8.788	0.000
	After- Digitalization	179.49	6.107	1.912		
The Second sub-hypothesis test of the second main hypothesis						
Jumbo Bags Weight	Before-Digitalization	77.79	501.636	394.780	-14.898	0.000
	After- Digitalization	197.05	1120.858	391.219		
The third sub-hypothesis test of the Second main hypothesis						
Stuffing Duration	Before-Digitalization	187.29	10.145	6.818	-2.013	0.044
	After- Digitalization	177.80	9.367	3.265		

Source: Data processing output using SPSS v.26.

6-Results:

In this part, the research presents the findings of the study, and based on previous results and statistical analysis related to these results, as shown in the previous tables referred to for hypothesis tests, and based on the conclusions of those tables, the following results were reached: Rejecting the first main general hypothesis and accepting the second alternative hypothesis There exist significant differences between average changes in the operational performance

of the receiving and Storing stage before and after the implementation of digital solutions in I.V.L Dhunseri Polyester Company SAE warehouses" Where the results of the sub-hypotheses were as follows:

Table (7): Results of the first main hypothesis

H1		A rejection of the null hypothesis and acceptance of the alternative hypothesis that there are significant differences between average changes in the operational performance of the receiving and Storing stage before and after the implementation of digital solutions in I.V.L Dhunseri Polyester Company SAE Warehouses, which give businesses a positive economic revenue and achieve more competitive advantage.
H1.1	The results of the first sub-hypothesis test:	Rejecting the null hypothesis and accepting the alternative hypothesis that there are statistically significant fundamental differences between the average changes in the operating performance of the Manpower for the receiving and storage stage before and after implementing digital solutions in I.V.L Dhunseri Polyester Company SAE warehouses. These differences were in favor of the average of the Manpower in the stage of receiving and storing after implementing the digital solution in warehouses, where the average was (14,04), while the average of the Manpower in the stage of receiving and storing before implementing the digital solution was (12,32).
H1.2	The results of the second sub-hypothesis test:	a Rejecting the null hypothesis and accepting the alternative hypothesis that there are statistically significant fundamental differences between the average changes in the operational performance of No. of Jumbo bags for the receiving and storage stage before and after the implementation of digital solutions in I.V.L Dhunseri Polyester Company SAE warehouses. These differences were in favor of the average No. of Jumbo bags in the stage of receiving and storing after implementing the digital solution in warehouses, where the average was (994,20) Tons, while the average No. of Jumbo bags in the stage of receiving and

		storing before implementing the digital solution was (473,15) Tons.
H1.3	The results of the third sub-hypothesis test:	Rejecting the null hypothesis and accepting the alternative hypothesis that there are statistically significant differences between the average changes in the operational performance of the Jumbo Bags Weight for the receiving and storage phase before and after the implementation of digital solutions in I.V.L Dhunseri Polyester Company SAE warehouses. These differences were in favor of the average weight of jumbo in tons in the stage of receiving and storing after the implementation of the digital solution in warehouses, where the average was (1112.70), while the average Jumbo Bags Weight in tons in the stage of receiving and storing before implementing the digital solution was (538.05).

Table (7): Results of the second main hypothesis

H2		A rejection of the null hypothesis and acceptance of the alternative hypothesis that There are significant differences between average changes in the operational performance of the Preloading and Stuffing stage before and after the implementation of digital solutions in I.V.L Dhunseri Polyester Company SAE Warehouses, which give businesses a positive economic revenue and achieve more competitive advantage.
H2.1	The results of the first sub-hypothesis test	Rejecting the null hypothesis and accepting the alternative hypothesis that there are statistically significant fundamental differences between the average changes in the operating performance of the Manpower for the Preloading and Stuffing stage before and after implementing digital solutions in I.V.L Dhunseri Polyester Company SAE warehouses. These differences were in favor of the average workforce in the stage of processing and loading after implementing the digital solution in warehouses, where the average was (6.107), while the average of the Manpower in the stage of Preloading and Stuffing before implementing the digital solution was (4.422),

H2.2	The results of the second sub-hypothesis test:	Rejecting the null hypothesis and accepting the alternative hypothesis that there are statistically significant substantial differences between the average changes in the operational performance of Jumbo Bags Weight for the stage of Preloading and Stuffing before and after implementing the digital solutions in I.V.L Dhunseri Polyester Company SAE warehouses. These differences were in favor of the average weight of the jumbo in tons in the stage of Preloading and Stuffing after the implementation of the digital solution in the warehouses, where the average was (1120, 85), while the average weight of the jumbo in tons in the stage of Preloading and Stuffing before the implementation of the digital solution was (501, 63).
H2.3	The results of the third sub-hypothesis test:	Rejecting the null hypothesis and accepting the alternative hypothesis that there are statistically significant differences between the average changes in the operational performance of the Stuffing Duration of Preloading and Stuffing stage before and after the implementation of digital solutions in I.V.L Dhunseri Polyester Company SAE warehouses. These differences were in favor of the average Stuffing Duration in the stage of Preloading and Stuffing after implementing the digital solution in warehouses, where the average was (10.145), while the Stuffing Duration in the stage of Preloading and Stuffing before implementing the digital solution was (9.367).

The Recommendation

From the previous results, we conclude that after implementing the digital solution in the warehouses the research found the follows:

Manpower decreased, but with the increase in the productivity of the workers in the operational stages represented in the (Receiving and Storing, Preloading and Stuffing).

The number of jumbo bags and jumbo bags' weight increased in the different operational stages. The number of stuffing hours decreased in the preloading and stuffing stages.

This indicates the improvements that digitalization has shown as a result, and therefore, and boosted business economic benefits such as increasing the efficiency and enhancing the productivity as well as better transparency and accuracy in the movement of goods, cutting expenses, simplifying operations transparency, saving money, and increase customer satisfaction and finally, can drive competitive differentiation.

The recommendation of the research is the both theoretical and practical parts as following is "The importance of implementing digital solutions in warehouse management which has Positive economic effects on warehouse operations".

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