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A Critical Evaluation of The Impact of Information Technology on The Warehouse Operations

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Abstract

Currently, information technology plays a major role in the lives of individuals and in the way that individuals conduct business, so there are indications that technology progress and the use of IT will continue to the future. Also, when companies use IT in their business, this enables them to provide innovative products and services of high quality, the ability to reach a large number of customers, communicate with business partners and suppliers around the world, ease of data flow and decision-making process, etc. Therefore, this is represented in the impact of information technology on business in general, which results in the shift from the industrial society and economy to the information society and economy. This study focuses on the critical evaluation of the impact of information technology on warehouse operations and the role of smart IT in improving operations and increasing their efficiency. So, the researcher will use quantitative and qualitative approaches, where the researcher will conduct the interview, the survey questionnaire, and comprehensive literature review to collect information for this study.

Keywords: Information Technology, Warehouse Operations, Businesses, KPIs.

1. Introduction

The Sultanate of Oman is one of the countries that enjoys a strategic location that helps it in the implementation of many logistical projects easily, which works to grow the country and improve its economy. Where the logistics sector is one of the important sectors in Oman Vision 2040, which means improving the free zone, infrastructure, sea, airports and roads, which attracts many companies to carry out a lot of logistical activities in Oman. On the other side, the global economy is affected by the logistical sectors and by other factors, for

example, the spread of epidemics, as is the case at the present time, with the spread of Corona virus, which negatively affected the global economy in closing economic activities in most countries of the world, including the Sultanate of Oman and this affect warehouse and other logistics activities of the supply chain. So, this study focuses on a critical evaluation of the impact of information technology on warehouse operations. As it is known, Information technology is developing over the years, and companies cannot plan a business or project without using IT. So, information technology is the physical devices that are used to exchange, store, process and secure electronic data, for example, computers, applications, communication networks, modern and smart devices that are used in business and others. Where IT facilitates the lives of individuals and at the same time works to reduce costs and time in business in general and warehouse operations in particular. So, warehouse operations are various activities that occur in warehouses and start from the receive the product and end with the shipment of the product to the customer.

2. Problem Statement

Information technology is an important part of every company's business strategies, as IT has a good or bad effect on the company's business. Therefore, this study presents a specific problem which is that IT does not work well in the warehouses due to some problems that make IT work at a lower level, for example, delay in updating data, old programs, human errors, and weak IT infrastructure, delay in downloading, lack of necessary skills and competencies. So, these problems will affect the company's business and affect costs, efficiency, customer service, quality, and profit. As is known, no company wants to live with any operational challenges affecting profit, survival and sustainability. So, this study will discuss some warehouse challenges and their impact on warehouse operations and suggest appropriate solutions to these problems.

3. Objectives of The Study

This study aims to critically evaluate the impact of IT on warehouse operations. There are also other objectives of this study, as follows:

- Find out the impact of information technology on business in general
- Determine warehouse operations and the role of each one
- Identify the KPIs of information technology on warehouse operations
- Analyze the requirements of the IT infrastructure and the company's skills versus the reality on the ground.
- Conduct a comprehensive literature review on issues related to IT in warehouses and the impact of those issues and best practices.

4. Significance of The Study

This study has significance for researcher, educational institution, companies, and country. Where the researcher can gain experience and skills and increase scientific knowledge in the logistics sector. While the educational institution can exploit and implement student ideas mentioned in the research. Also, the company can look at the proposals and solutions mentioned in the research which can contribute to its development. And the country can look at the student's experience and ideas in this research and using them to benefit the country and its economy. This means that this research is of great importance because it is in the logistical sector and therefore this is considered a step to Oman Vision 2040 and boosting the GDP of the country.

5. Literature review

Literature review helps the researcher and the reader to understand the topic of the research in a broad way. So, it is a comprehensive overview of previous research of scholars in a specific topic, which means it shows what is known and unknown about a specific topic [1].

➢ IT systems best practices for warehouse management

The warehouse management system needs some best practices to improve efficiency. So, these practices are represented in the use of wireless devices such as e-mail and direct communication to improve the communication process and improve productivity, also blockchain integration for data security and transaction security, thus storing transaction data

and sharing it in a secure way by integrating the blockchain with the WMS [2]. In addition, the use of a barcode reader (RFID) to avoid errors resulting from manual inputs and increase the efficiency of WMS and maintaining records are other best practice for warehouse management, also the use of smart technologies such as robots that help in the storage, sorting and movement of products in the warehouse, as well as, reduce time and cost [3]. Other writers mentioned best practices for warehouse management in using a cloud system to store warehouse data and make a backup copy of the data that can be referred to in the case of data loss, and integration of artificial intelligence solutions that are used in decision-making and recreating business and predict future trends[4].

➢ Key performance indicators of the IT system in warehouse operations

KPI is an important component of the warehouse management system. It is a measure of business performance for improvements to better market competition. Therefore, it is very important to use some KPIs to illustrate warehouse performance as shown in the following figure:

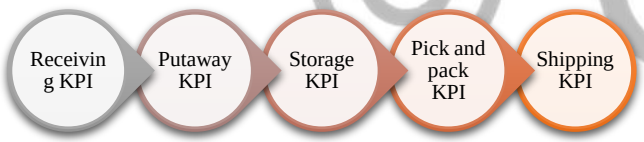


Figure 1: KPI of IT in warehouse management

It is also known that warehouse operations are varied and are represented in receiving the products supplied in the warehouse, putting those products away in the storage location in the warehouse, storing products in different types of warehouses according to their type, picking products from the warehouse upon receiving the order and packing the products based on the order, and ship the products to the customer. As the KPIs of IT in warehouse operations differ according to the operation, which means that the KPIs of IT in the receiving operation and put-away are cost, productivity, utilization, quality and cycle time[5]. While the KPIs of IT in the storage operation are the storage cost per product, productivity, and utilization[6]. As for the KPIs of IT in the picking and packaging operation, theyare the cost of picking, the use of IT in the picking process, productivity, quality and cycle time[7]. Finally, the KPIs of IT in the shipping operation are the cost of shipping, productivity, use of shipping ports, quality in accurate shipping, and the shipping cycle time.

➢ Factors affecting warehouse performance

The previous writers analyze the various factors that influence supply chain and warehouse performance. One of these factors is the spread of epidemics such as Coronavirus, which is what is happening now in the world, where the supply chain is disrupted due to the spread of the Coronavirus that led to the closure of companies and thus revenues decreased throughout the world including Oman. Also, the borders were closed, and thus trade became limited, and this leads to the suffering of the supply chain and a big loss in the economy.

As for the other factors that affect the performance of warehouses, they are represented in the demand structure, the area and the method of work [8]. Another study by Alshubiri [9]concluded that the design factor plays an important role in warehouse performance. Three decisions must be followed in the warehouse design, which are the structure and size of the warehouse, the selection of effective equipment, operational technology, and design for each department in the warehouse. Also,Razik, Radi, Okar[10] stated that warehouse design is a critical factor in improving warehouse performance, and investment cost, storage capacity, response time, demand quality, best and efficient use of manpower, automation, and investment are some other factors that affect warehouse performance. According to a study conducted by Lu et al. [11],four criteria affecting warehouse performance are ease of access to storage location, storage capacity, complexity of the internal structure, and level of the information system. Another factor is the use of smart IT systems in warehouse management such as RFID[12]. In addition, the use of artificial intelligence and big data analytics has become an important factor in improving efficiency of the warehouse[13].Whereas, warehouse performance includes flexibility, quality, productivity and an effective business plan. Therefore, all these factors affect the performance and productivity of warehouses and at the same time improve the efficiency of warehouses.

- **IT system in the warehouse management and smart systems**

The integration of smart IT systems into warehouse management, resulting in a smart warehouse management system. The warehouse management system can be accessed remotely and can be useful for predicting future trends using IT. There are a lot of technologies that are used in warehouses to improve warehouse productivity and efficiency, and one of these technologies is RFID, which is a barcode reader that is used to scan products and can be used to reduce errors. Also, study conducted by Mao et al. [13] concluded that an automated guided vehicle is another automated system and is an important part of warehouse management. Tracks can be included in vehicles so that they can drive to the destination automatically. With this smart invention, warehouse performance and accuracy can be improved. According to Žunićet al. [14], COBOTs are another smart system that can be included in warehouse management and are collaborative robots that work with humans instead of replacing them and this improves warehouse productivity.In addition, Automated retrieval and storage are used as intelligent systems to make management more efficient and to increase productivity and automatic inventory control [15].Moreover, automatic control reports of IT can be created in the WMS and through which all records can be entered or maintained easily.

- **Impact of IT on warehouse operations**

Information technology plays an important role in managing warehouse systems. From the above literature it is clear how IT is involved in every warehouse system process, so IT is used in various warehouse operations. The impact of IT on inventory is through information exchange, cost reduction, time efficiency, and much more. The speed and quality of service is also improved by integrating IT into warehouse operations. As mentioned above, the use of all of these technologies, for example, COBOT, automated guided vehicles, AI, RFID will improve warehouse performance [16].IT has many positive impacts on the warehouse, such as if the warehouse is integrated with IT, requests will be better handled, picking, packaging and data entry will be effective, and the efficiency of warehouses that directly affect the supply chain will be improved.

6. Research Methodology

This research is an exploratory research which means that it depends on the existence of a specific problem and the research is done in studying this problem and finding appropriate solutions to it. So, the researcher used a specific strategy in this study, and this strategy is divided into data collection and data analysis.

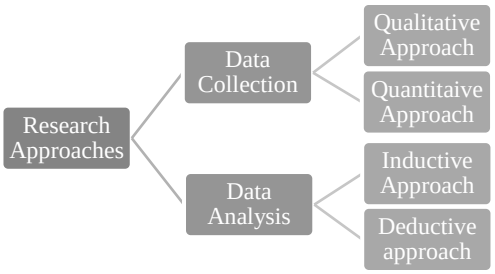


Figure 2: Research Approaches

The quantitative approach and the quantitative approach were used in this study. Where the qualitative approach relies on concepts, interpretations and theories and one of its advantages is to provide a deeper understanding of information and data. This approach is used as open-ended questions in the interview and survey. While the quantitative approach expresses numbers and has an advantage in the speed of searching for standard information. This approach is used as closed-ended questions in the survey [17]. Therefore, the researcher used the quantitative and qualitative approach in order to analyze the objectives of the research initially and obtain correct and reliable results.

The researcher used a mixed method to collect data which is primary and secondary methods, where the primary methods are represented in the semi-structured interview, which is characterized by preparing interview questions before scheduling it and the survey questionnaire. So, the reason for choosing the primary methods is obtaining accurate information from its primary source. While secondary methods are the use of books, articles and other reliable sources on the Internet to conduct a comprehensive literature review related to this research.

As for data analysis, the researcher used the inductive approach that depends on inferring results through the evidence gathered in the research, and the researcher also used

the deductive approach that depends on testing a theory previously identified in the research which means the result of the inductive approach. So, the text of the interview was analyzed using the thematic analysis, while the survey questionnaire was analyzed using the coding analysis, which means converting the collected data into tables and graphs through which to explain the final results easily.

7. Result of the study

The results of the study indicated that 92% of respondents said that warehouses face different types of challenges such as lack of skilled labors, poor use of IT, poor transportation, poor relationship with suppliers, and poor market research. Where the challenge related to the poor use of IT leads to data loss, errors in data entry, and delay in updating data, as this leads to weak IT infrastructure that is represented in smart IT technologies and wireless communication networks, where the IT infrastructure is one of the things that the company needs in warehouses other than the skills that are represented in innovation to provide new ideas, artificial intelligence for machine learning to provide innovative products and services, and the ability of employees to analyze the problems in the warehouse and determine the appropriate solutions, and the ability to adapt with the change that occurs in the business, and this was confirmed through the interview.Whereas, 8% of the respondents said that the warehouses do not face challenges as shown in the following figure:

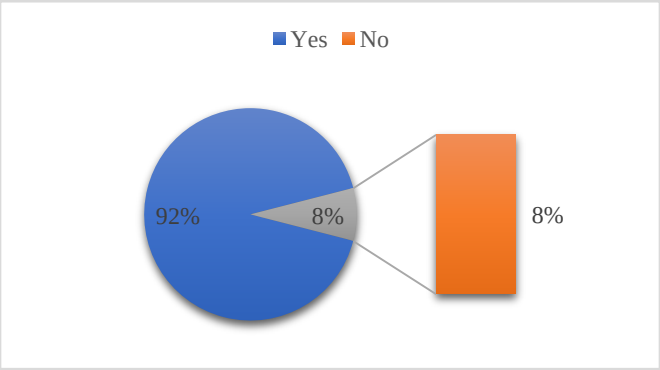
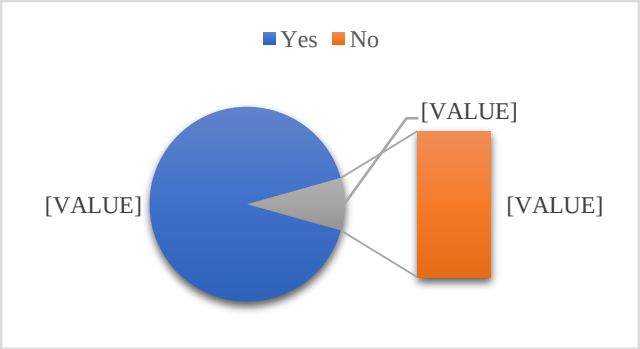


Figure 3: Evaluating respondents in warehouse management challenges

Source: Analysis from MS Excel



On the other hand, 8% of the respondents said that modern technologies cannot solve the warehouses challenges, while 84% of respondents demonstrated that smart and modern technologies for IT have a major role in solving warehouse challenges as shown in the following figure:

Figure 4: Evaluating respondents in using smart IT to solve warehouse challenges

Source: Analysis from MS Excel

As many previous studies explain smart IT technologies that can solve the challenges of warehouses, which is represented in the RFID, which is the scanners that are used in warehouse and reduce the chance of errors, automatic guided vehicles (AGVs) that improve the performance and accuracy of the warehouse and these vehicles have been proven to be safer and at the same time bring the company a faster return on investment than manual work, and COBOTs which mean cooperative robots that work with humans instead of replacing them, this improves the efficiency of the production process and maintains infrastructure design [14]. Also, another technology is automatic retrieval and storage (AS/RS) which is used as smart systems in the warehouse to increase the efficiency. These systems reduce the costs the company spends on labor and these systems are safer than some human procedures that cause accidents. In addition, automated control reports that can be created in WMS that are used to reduce errors in data entry, so that data can be saved and maintained easily.

8. Discussion

According to the results of this study, it indicated that the use of IT in warehouses has become extremely important because It has worked to enhance data security and work efficiency and improve the overall warehouse performance. So, it can be said that IT has a positive and negative impact on businesses in general and on warehouse operations, where the positive impact of IT on warehouse operations has been demonstrated through the following figure:

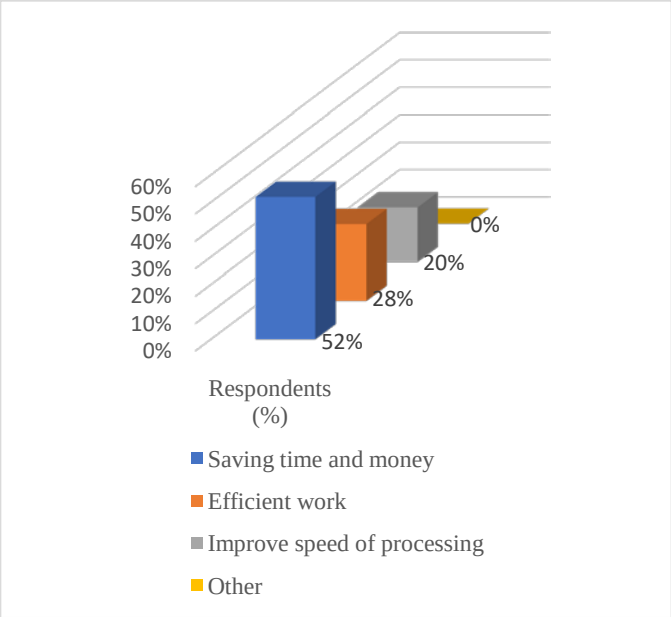


Figure 5: Impact of IT on warehouse management

Source: Analysis from MS Excel

The previous figure shows that 52% of respondents said that the IT system promotes warehouse management by saving time and money, while 28% of respondents said efficient work, and 20% of respondents said improve the speed of processing. This means that IT affects warehouse management positively, and this increases the productivity and increases profits.

Finally, IT has a positive and negative impact on business in general and warehouse operations. Where the positive impact is represented in reducing the time and cost, the efficiency of communication process, protect data from loss, better dealing with orders, the efficiency of picking, packaging, and storing operations, innovation in the production process, the rapid flow of information to improve the decision-making process, predicting future trends, and improving warehouse efficiency that directly affects the supply chain through the use of smart technologies, for example, RFID, AGVs, COBOTs, AS/RS and others [16]. While the negative impact of IT is represented in the increase in unemployment due to the replacement of employees by robots, the loss of individual rights, delay in updating data due to the use of old technologies, the inability to adapt warehouse operations due to the constant change in systems, and the inability to use many IT systems due to the high cost of integrating these systems.

9. Conclusion

This study showed that there are many challenges in warehouse operations, some of them are related to IT, so companies are currently working on the process of renewing and developing the systems they use in their operations to bring modern and smart technologies and keep up with the times in the use of IT. Therefore, implementing smart technologies makes the company's operations more efficient, reduces time and cost, and provides high-quality products and services that satisfy customers and develop the relationship with suppliers and at the same time help companies in developing logistical activities that raise the international economy and sustainability, which is considered one of the themes of Oman Vision 2040.

10. Recommendations

The researcher recommends attracting consultants who work in the field of IT to implement smart technologies that work to solve the challenges of warehouse management and improve warehouse performance, for example, RFID, COBOTs, automatic guided vehicles, automatic retrieval and storage and automatic control reporting technology that works to save data and process it efficiently. Also, using the Internet of Things application that monitors inventory and sends an alert if the inventory is facing some problems to be resolved quickly. In addition, the employee training program should be continued to increase employee's knowledge and experience in the warehouse field. Finally, it is better to deal with specialized organizations in the field of research and development to know developments in the use of smart technologies for IT in warehouses.

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