Smart Warehouse vs. Traditional Warehouse - Review

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***Abstract*---**The purpose of this paper is to review and compare between an automated warehouse and traditional warehouse based on processes or activities, problems, performance, and efficiency. The paper aims to review how new technologies could add value to processes and operations of warehousing and achieve economies of scale by transferring to an automated warehouse, or a traditional could add value without considering the new technologies and innovations in the current SCM. Furthermore, the paper aims to review the pros and cons for both methods taking two examples; one in Bahrain and another in China as the latter is considered one of fasting country in developing and adopting new technologies in the world. The current state of warehousing operations will be analyzed by the author in both types, using a literature overview and current status of typical functions and operations in warehousing and review how technologies in practice lead to promising new research directions.

***Keywords*---**Supply Chain, Materials Management, Smart Technologies, Traditional Warehouse, Smart Warehouse.

I. Introduction

WAREHOUSING is considered the key part in supply chain management through its determination and ability to establish smooth and efficient logistic operations in organizations, and such operations play a vital role in determining a company's competitiveness, as logistic costs are considered an important part of the overall production costs. To control the warehousing costs, many organizations are considering the ways to run the warehouse through an efficient and effective methods, especially after emerging new technologies in the field of supply chain and logistics. The warehouse management is a key part within the supply chain that was paid more attention, according to the popular and scientific literature [5]. Furthermore, the operations, performance, and design of the warehouse were highly focused on according to the literature, since the warehouse is a place to accommodate buffer the material flow along the supply chain, along with other key functions that cause to increase operating costs in both parts (variable & fixed) [11]. Therefore, the warehouse is taken into account as an essential component in the supply chain that must be enhanced in order to control the significant costs of today's businesses [9]. To this end, this paper aims to conduct insight investigations to find out the roles of new technologies to enhance the warehouse operations and performance through a comparative analysis between an automated warehouse and traditional or manual warehouse, since there are many organizations believe that a traditional warehouse still can add value to their businesses.

Basically, businesses think of warehouse in advance, and allocate the necessary budget, which is normally high, to ensure achievement the optimization process and performance improvements [26]. However, the argument starts about the warehouse design as it is a highly complex task and many trade-offs have to be considered since it takes a high part of budget, and different scenarios, hence discussed by management among often-conflicting objectives and priorities [21]. In the past and before emerging new technologies, organisations used to consider the basic elements of warehousing before allocating the budget, such as the space management portion, storage layout, types of materials handling equipment, headcounts, and the buy or rent. After new technologies have occurred, many organsations have changed their strategy and thought deeply about utilizing new technologies to control the budget more efficiently and at the same time make warehouse activities faster for people to perform and generate efficiencies to reduce costs and labour-intensiveness. Also, the warehouse managements have now a wide array of technologies to consider to strive to reduce costs, improve efficiency and streamline operations, and an automated warehouse is an ideal choice to achieve such objectives. To this end, this paper aims to conduct an analysis to distinguish an automated warehouse from a traditional warehouse by reviewing the literature to assess with evidence whether new technologies are better choice to implement in warehousing rather than the traditional methods to meet the new strategy in organisations. In this paper, we analyze the key warehousing operations and elements based on the existing literature on warehouse design, operations, and control for both types.

II. Related Work

Warehousing is an extremely crucial function of supply chain collaboration as it forms high expectations from strategic's perspective. As reported by speakers in Summit 2018 with regard to warehousing and inventory optimization in India [19], the logistics industries in India are spending 13% of the GDP on the development of the logistics framework, and that includes the increase of costs to USD 2 Billions for space requirements which is expected to expand from 621 mn sq ft in 2016 to 839 mn sq ft by 2020. Furthermore, [7] stated in his report based on his experiences in warehousing and its efficiency that warehouse planning is essential to a smooth daily workflow through the supply chain,

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and she used to have a solid plan in writing before any warehouse is set as the layout of the warehouse could play either a positive or negative way in terms of meeting the organisation's end goal. Moreover, Rob O'Byrne as a professional in supply chain emphasized that the warehouse facility and operations boil down to increasing company's competitive advantage, and it extracts maximum value from its facilities and removing obstacles that inflate supply chain costs and ultimately erode profitability [18]. To this end, it reveals how the importance of the warehouse and its objective which is directly aligned with the overall business strategy of the company. Thus, the decision to set up warehousing is determined by the overall objectives that must be met, and that decision could be taken either to have a traditional warehouse or consider a smart warehouse based on the company's strategy.

As mentioned, warehousing is defined as an assumption of responsibility for the storage of finished goods, raw materials, work in process, and spare parts. Warehousing as a concept is the act of organizing and controlling everything within the warehouse and ensuring all runs in the most optimal way possible. Furthermore, the main activities and responsibilities of having the warehouse is to maintain the appropriate items, manage new stock coming into the facility, packing and shipping orders, tracking and improving overall the storage, and arranging for dispatching finished goods to end customers. Therefore, warehousing plays the key role to ensure the requested goods are until being delivered to customers, which is the ultimate goal for an organisation. According to [25] that MetaPack's 2015 in a report mentioned in the E-commerce Delivery Report, 66% prefer a retailer with an efficient delivery process and goods to be more appealing, and 96% said that they would continue to buy from the same retailer . Furthermore, the warehouse is the key player among other departments in providing high-quality products at relatively less cost, as the inventory carrying costs typically range from 20% to 40% of inventory value according to [3]. The warehouse has an important role in the supply chain as it affects the process of the material flow from the suppliers and to end consumers for finished goods, and to Production for raw materials, and thus the operations of the warehouse have been given high attention as organisations expect more outcomes as the requirements on its ability are changing, therefore, the traditional warehousing is viewed as a non-value process [24]. The operations of warehousing include various activities such as transportations, storage, inbound delivery, outbound delivery, quality inspection, physical stock counting, and packaging, and all the mentioned activities are considered to be automated to achieve high efficiency in terms of eliminating redundant operations and reducing the execution time of necessary activities in warehouse operations [4]. For example, as stated by [2], using new technologies in warehousing the operations costs could be reduced to 30% in the next few years and lose in inventories could be reduced up to 75%, in addition to enhancing the operations through more agility and efficiency, and (Amazon.com) is a good example in this respect. Equally important, the materials handling equipment (MHE) being used in operations is also changing and new machines are mostly operated more efficiently through new technologies [22]. Furthermore, with an automated warehouse the MHEs have become more efficient in terms of safety procedures, and it enables to reduce accident & incidents in the warehouse as stated by [12]. The main reasons let organizations think of the changes in warehousing as recited by [20] that warehouses were referred to as cost centers and rarely adding value, but with the increase need for transfer of products across cities, countries and continents resulting from movement of production to the Far East, the growth in technologies and increasing demand of end users have seen a change about the perception of warehousing. Moreover, the changes in operations and processes of warehouses should cover every activity in warehousing as stated by [4] such as:

- Receiving: the process of unloading incoming truck, identifying, registering and sometimes repacking.
- Put away: moving the goods from unloading dock to the storage area.
- Storage - in bulk or pick activities at the warehouse affect goods in storage. For instance, the amount of stocks has to be counted to verify inventory quantities.
- Replenish If inventory levels of the pick storage drop to certain amounts, it is replenished with stocks from the bulk storage.
- Pick upon order for need of an item in storage, either full pallets are picked from the bulk area of storage, or smaller quantities are picked from the pick area of storage.
- Ship The picked items are packed, consolidated and staged for shipping.
- Cross-dock Some goods do not make their way into storage. Such goods, upon receipt are transferred to the shipping dock for shipment to the point of need.
- Value Added Logistics: such as adding value to logistics activities through the reverse logistics process, or establishing a distribution network for fast delivery with less costs.

Smart innovation and digitization are the characteristics of an automated warehouse, which are taken into account as a means to change the whole processes, using new technologies in the markets. As stated by [1], SCIS is a must to grow business through efficient logistics operations, and 53 % of supply chain practitioners and executive believe that the supply chain is a way to grow the business and hence new technologies are the key factor to achieve such the goal. He added, SCIS can be used more efficiently with newly emerged technologies such as cloud computing, Internet of Things (IoT), robotic systems, big data, RFID, ERP, and sensing system are the main technologies that able to promote a process of smart business operations, including logistics operations. Furthermore, for distribution, the one network is believed the new new concept can help and ensure fast delivery through a very collaborative system between suppliers and customers. As stated in a report issued by [17] who cited from Tony Vercillo, Ph.D., who operates IFM.,

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Inc., a Yorba Linda, California based supply chain consulting "The trick to warehousing is eliminating human touches", he added, “Every time a human touches a pallet or a case, an expense occurs. Technology should thus should be used to reduce the number of touches, and steps within the warehouse process." In the same report, the author cited the same thought from Karen Mathews, senior program manager of warehouse automation at The Coca-Cola that Automation has provided an easier method of getting our products to our customers. To this end, it is clear that technologies could change the trend in warehousing, and for that reason many organizations are seriously thinking that a traditional warehouse is no longer useful to achieve the goals as the costs are higher than revenues.

III. Research Methodology

The research problem is the key issue that should be the center of the research being conducted, and the results must identify an effective way to deal with issues and objectives by firms as in this paper. To this end, this study is designed towards comparing between automated warehousing and traditional warehousing from two ways: efficiency and costs. The research design and the methods used to gather the facts to support the study and answer the research question "Is a smart warehouse better option with new technologies compared to a traditional warehouse?". The topic focuses on the factors affecting the successful implementation of warehousing, whether through utilizing smart technologies or running a warehouse based on a traditional method. Two different warehousing systems were selected to demonstrate the gap between smart warehousing and traditional warehousing through a brief review of pros and cons for each one, which could answer the research question based on the multiple case methodology as conducted in this paper.

IV. Traditional Warehousing vs. Smart Warehousing

A. Traditional Warehousing (Company in Bahrain):

1 - The characteristics of the Traditional Warehouse:

The warehouse is installed in a way to work with a space in which certain factors limit the surface area available, and to cover all requirements for day to day activities in the warehouse. The layout is built to cover the following needs of the most important areas in the warehouse:

– Loading and unloading areas
– Reception area for new receipts
– Storage area for storing items
– Picking area for assembly
– Dispatch area for delivery

The company has built the warehouse to achieve the maximum efficiency and space utilization:

- Making the most of the available space
- Reducing the handling of goods to a minimum
- Providing easy access to the stored product
- Having the highest rotation ratio possible
- Offering maximum flexibility in the positioning of products
- Controlling the amounts stored

The layout is built in a way to smooth inbound and outbound of materials, such as Docks, Picking storage and racking systems for storing items. Furthermore, there is the capacity in the building for pallets which are normally put on the racking system inside the warehouse, considering the size of the same. The warehouse has three docks for loading and unloading goods and open areas for storing. As illustrated in Fig. 1, the trucks that deliver/pick up goods and RMs arrive at one of the loading/unloading docks and the operators collect or deliver the required goods from/to their storage area. The inspector's role is to check inbound and outbound items in terms of quality, quantity, packaging, and invoice. On the other hand, the Inventory encoder's role is to update inventories into the system in both cases; in and out. Furthermore, the forklift operators are aware how to manage the handling process and where to store the goods, which are normally closer to the docks.

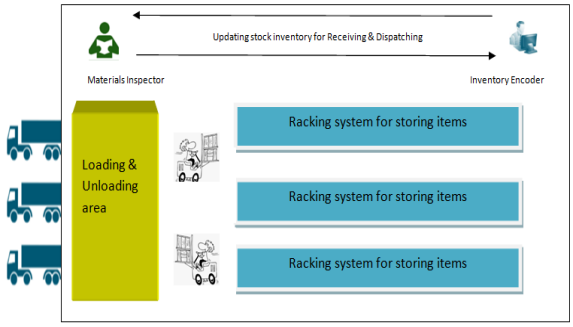

Fig.1 The Layout of a Traditional Warehouse

The warehouse is designed to make the movements of materials and humans convenient to avoid wasting time as maximum as possible. Moreover, approaching and accessing to each of the pallets within the warehouse is made easy as the space in the warehouse is properly organized to obtain any items easily and without delay.

The space allocated for the activities inside the warehouse is regularly calculated and compared to the remaining space for better good placement of the equipment and raw material, as the company uses the warehouse mainly for these two types of items.

The company uses the SAP as the inventory system, and the throughput is running smoothly as the speed at which products flow in the system is evaluated, and regular checks are conducted to assess an impact on the speed of the system.

The company has recruited 45 staff to handle the day to day activities in the warehouse. The manpowers are divided into different sections as shown below:

- 5 staff in receiving
- 2 staff in Picking
- 3 staff in Assembly
- 10 staff in dispatching

- 5 Forklift operators
- 10 labours
- 5 Drivers
- 4 supervisors
- 1 manager

2 - Disadvantages of the current layout:

The current warehouse layout has some disadvantages in terms of allocating the storage space available to finished goods and raw materials in such a way that the material handling costs and headcounts are very high. In other words, the company is suffering from constant adding up costs on a daily basis, which caused to reduce the revenues in the last 5 years. The main areas where the company is probably losing money are**:**

➢ Over-Handling Material

Each time that materials are moved, sorted, counted, stocked, or prepared for storage or shipment are taking employee time and money, because the handling of items is no more than the minimum necessary.

➢ Inefficient Operations and Workflow Bottlenecks

As we observed, there are some weaknesses with a poor material handling system. After the peak time, most machines sit idle and hence operators have nothing to do, which is of course impacting productivity, and for that reason the company is leaking money which has affected the revenues about 20% in the last 5 years. In other words, it is a waste of time and resources.

➢ Negligence and Damaged Materials

Many accidents and rough handling have been reported in recent years, which led to breakage of finished goods and some raw materials. As reported, the damaged materials have been costly over time through Incorrect techniques, outdated materials, and inadequate equipment received.

➢ Inefficient Space Management

Not every inch of storage space is efficiently utilized in the warehouse. There are plenty of cubic spaces (30%) are not utilized and the company is not able to invest them properly. Moreover, the storage costs are huge which caused to reduce the revenues in the last 5 years.

➢ Inefficient Materials Handling Equipment

There are bulky and expensive forklift trucks unused in the warehouse. Furthermore, the company has to maintain each MHEs on a regular basis, which cost lots of money to maintain. The point that the management is not able to plan properly for efficiency and economy as well as functionality. According to the movements and activities in the warehouse, there are many MHEs are not necessary needed for the job, and hence some MHEs can be reduced to save money. Additionally, some costs of MHEs are due to inappropriate storage of materials, especially RMs as forklifts need more time to fetch and move them to Production.

B. Smart Warehousing (Company in Chian):

In recent years, many companies have been on the forefront of smart warehouses, and run their businesses through developing automated warehouse robots. The internet-connected robots have replaced human labor to move around the warehouse and pick customer-ordered items. As a result, the business has been improved and costs reduced, and a good example in this regard is Amazon [23]. Furthermore, the smart warehousing is using a mix of technologies, including robotics systems, Enterprise Asset Management (EAM), digital twins—exploded 3-D representations of objects and their components such as sensors, Radio Frequency Identification (RFID) tags, smart supply chains, and AI are allowing organizations to gain unprecedented insight into the lifecycle of products, components, and even materials [6]. In this part, we selected a company in China as a case study to review how a smart warehousing could yield advantages to businesses in comparison to a traditional warehousing as briefed in the previous section.

1 - The characteristics of the smart warehouse:

In china, smart warehouses are built based on a structural upgrades to cover all the latest technologies, higher ceilings and stronger air conditioning (robots like it cool), in order to make activities smoothly and more efficiently, saving labor costs, reducing errors, and generating higher productivities. As illustrated in Fig. 2, the structure of smart warehousing is almost similar to traditional warehousing in terms of layout and design, but the key differences between the two options is the type of technologies being used and implemented. However, any upgrades could make the costs of interior work more soaring in the beginning. China now has the world's fastest growing economy and is going through what has been described as a second industrial revolution, and its development has affected in the new the new trends in supply chains, including the technology development impact on warehousing. Smart warehousing in China has been totally become mechanized and automated.

Fig. 2 The Smart Warehouse

The main characteristics of warehousing in Chian based on the robotic systems and other features which are described below:

➢ Internet of Things (IoT) [15]

The IoT technology enables to create a smart location management system and Inventory management and warehousing, develop Blockchains, and collecting large amounts of data. The IoT is used for enabling innovative applications used in logistics to connect to the World Wide Web (WWW), and that is performed through a seamless large-scale sensing and analytics using cloud computing. The sensing feature distinguishes the IoT from any traditional systems, which is the method to monitor different assets within a supply chain through different technologies and mediums, and it has an ability for handling vast amounts of data sets and then turning them into insights that drive new solutions. In China, RFID which is used as the main automated system in warehousing to identify, track and transmit information. Moreover, the IoT is implemented in the transportation system as an asset tracking solution to track shipments in a real time by Internet-connected trackers using Wide Area Networks (WANs), and allows for optimized route planning and vehicle maintenance throughout their delivery journeys based on near real-time data.

- Cloud Computing [15]

This new technology is the main character in a smart warehouse in China as it has many advantages as mentioned through many studies. For example, it is the broader network access to deliver computing resources over the network (e.g. Internet) and for that feature it is called as "the cloud", and all computing resources such as storage, processing, memory, network bandwidth or virtual machines can be pooled together geographically in order to provide services to multiple consumers and subsequently achieve economies of scale and specialization. Furthermore, the cloud computing is essential to current warehousing operations to meet customers' demands on time through a strong collaboration between all players, especially between buyer & supplier based on the win-win concept, and that can't be achieved without developing collaborative improvements to ensure delivery on time, shorter life cycle, and inventory reduction. Moreover, the cloud computing enables to connect different components in logistics operations and makes processes autonomous. For example, the system can create replenishment orders based on information received through the system when items are picked from bin locations in the warehouse. Finally, it can be said that the cloud computing has emerged and developed from the SCIS concept and it is processed through inter-organizational system (IIO) that has its roots in cloud computing technology used for intra-organizations, and it meets with the globalization concept that the accessibility of the data and applications from anywhere, at any time, and with any web-allowed device.

- Automatic Identification Technology (AID) [15]

Automatic identification systems have become a common technology in China, and consist of various devices used as tracking systems to provide accurate information about specific data in warehousing. The AID is mainly used to explain the direct entry of data or information in the computer system, programmable logic controllers or any microprocessor-controlled device without operating a keyboard. The AID includes a range of technologies such as Bar Coding, Radio Frequency Identification (RFID) and Voice Recognition. Auto ID can be used for tracking the containers, packages, cartons or a truck carrying the goods on time bound dispatches to the customers. All the mentioned technologies incorporate the rapid and accurate capture of data and its subsequent processing for cognitive recognition and identification.

1 - Bar Coding: This technology is printed horizontal strips of vertical bars used for identifying specific items. Bar coding is used to read through a scanner to identify inventory items during storage, retrieval, pickup, inspection and dispatch. The technology has many advantages such as reducing human error because the symbols that represents the stock information is unique, papering work, and processing time leading and also increases logistics system productivity through speed as it is the easy way of rapid data input, accuracy and reliability.

2 - Radio Frequency Identification (RFID): This technology uses radio waves to automatically identify and track objects. The system enables large amounts of information to be stored on the chips (tags/transponders) that can be read at a distance by readers, without requiring line of sight scanning. This innovative technology is able to make logistics operations faster and more efficient with less human error. Moreover, the system works through the rapid transmission of data, and it is used to avoid any overstocked or understocked in the warehouse. The system has proven its reliability in the automotive industry, the inventory found accurate all the time.

3- Voice Recognition Technology (VRT): Voice Recognition is a system based on an automatic identification (AutoID), and it is used in a modern Warehouse Management System (WMS) through the Radio Frequency (RF) scanning. The technology provides communications between the worker and the device to identify the location of stock via voice. The VRT works similar to the bar coding system but the difference that the former in a pre-programmed vocabulary. Basically, the VAR integrates with other technologies in WMS in order to make communication more efficient. The VAR is best suited for stock picking, put-away, receiving, cycle counting, and truck building.

- Blockchains [15]

The Blockchain is a new technology used as the perfect place to store value, identities, agreements, property rights, credentials, etc. In other words, every transaction in the network is recorded in a digital ledger and multiple transactions are together forming a block. For example, any data is stored into the Blockchain will stay there forever. The Blockchain is a very powerful database which relies on four main principles: distributed and decentralized database, peer-to-peer transactions, transparency of transactions, and security. The Blockchain is currently used to improve the processes in different ways, such as to improve the logistics through

copying transactions to all nodes of the Blockchain network without transaction party identities, a public key infrastructure that encrypts and decrypts transactions and informs the parties about the existence of executable transactions with single-time keys, and smart contracts. Furthermore, the Blockchain enables partners and stakeholders within the logistics and supply chain to track bottlenecks in the flow of stock, and detect whether the stocks were in one place for a too long period or at a wrong location which is especially important for perishable stocks. There are many advantages by using the technology such as reducing waste and labor costs, presenting the possibilities of tracking and tracing stocks by decreasing events of security attacks, and offering correct and accurate information about potential suppliers and customers' liquidity as well as current financial positions.

2 - Disadvantages of the smart warehousing:

Despite its enormous advantages in terms of cost saving and making works in warehousing more effectively, however, there are some inevitable disadvantages that can't be avoided by many companies in developing countries. Some disadvantages in determine a smart warehouse are listed below:

- High initial costs prevent many companies from implementing automated systems
- Warehouse layouts and processes require some new machinery and systems which are not easy to obtain
- New skills and expertise are required to implement and maintain the systems, and hence existing or potential employees must be retrained to new processes, sometimes to a higher technical aptitude.
- From the economy's point of view, high capital cost often requires several years to achieve a financial payback or minimal ROI.
- Breakdowns can be very costly in terms of repair costs and downtime, and for that reasons companies are forced on a long-term dependency on particular spare parts, hardware and software providers.
- With a highly-automated and sophisticated systems being used in a warehouse , a software glitch could cause the whole operation to stop, and that could cause slow down growing business.

V. Discussion & Recommendations

As per the review in the previous section, it seems that a smart warehouse is rapidly becoming one of the most popular trends in the logistics industry and companies in developed countries, and many companies have already considered it as a replacement to a traditional warehouse. Moreover, many different companies are constantly looking for such new opportunities and methods of design, manufacturing and selling for supply chain based on new technologies. The key factors that push companies to consider a smart warehouse are the margin and service expansion that could be obtained in a new competitive market. As aforementioned, the difference between the smart & traditional warehouse is in the type of technologies being used, not necessarily in the layout of a warehouse, and for that reasons a new business venture thinks of a smart warehouse by implementing smart innovations such as warehouse robots and other technologies as mentioned above to decrease manual intervention and improve the efficiency. Comparing to manual operation in a traditional warehouse, the new smart technologies can achieve 24 hours of ceaseless work, and efficiency could reach 3-4 times than that of manual work [10].

In developing countries,including Bahrain, all companies are still using a traditional warehouse because the warehousing function is still considered as a non-added value to business based on the conclusion achieved by the author in his paper [14]. Beside, to implement a full smart warehouse, companies need to think about many factors such as the costs of labor and resources which are the primary hurdle to the growth of smart warehousing since the marginal gains in switching to a smart warehouse. According to [14], the manpower in the warehouse function receives the lowest pay compared to employees in other functions in organisations in Bahrain. Moreover, recruiting skilled employees is essential prior to switching to a fully smart warehouse, as per the current situation in developing countries most companies employ unskilled or semi-skilled staff to run the operations in the warehouse. One of the important factors that need to be analysed in this regard is the management skills and capabilities in operating the warehouse. In today's competitive environment, management should be aware about factors that could affect the efficiency and effectiveness of the warehouse operations with respect to fast moving consumer goods industry such as simplicity/complexity of the warehouse management systems, product slotting techniques and layout planning of the warehouse [16]. For example, a manager must have the ability to effectively manage the warehouse, reduce costs and fulfillment operations is critical to their success, and should be familiar with new models to tackle any issues could hurdle improvements in managing warehouses. Furthermore, regarding some disadvantages found in a traditional warehouse, such as space management as defined in the previous section, a skilled manager should find out different solutions to tackle that problem. For example, they can consider a theory which was developed by [8]. The theory was developed based on a mathematical model for such problems which needs to be considered. The model proposes how to allocate the storage space available to goods in such a way that the material handling costs are minimized through applying the proper space between the storing point and unloading point.

The model works through the following model:

- i= items
- j= Grid square
- Pre assumption that $\sum_{i=1}^{p} F_i = q$; therefore, we know that all the space available should be used.
- c_{ij}–s = the coefficient

- F_i = the total number of grids required to store item *i*.
- r = loading and unloading docks
- w_{ik} is proportional to the number of pallet loads of item *i* moving between dock *k* and the storage area of *i*.

$$x_{ij} = \begin{cases} 1 & \text{if we store item } i \text{ in grid square } j, \\ 0 & \text{if we do not store item } i \text{ in grid square } j, \end{cases} \quad i = 1,\ldots,p;\ j = 1,\ldots,q.$$

The integer programming formulation of this problem is as follows:

$$\min : \sum_{i=1}^{p}\sum_{j=1}^{q} c_{ij}x_{ij}$$

subject to:

$$\sum_{j=1}^{q} x_{ij} = F_i \qquad \text{for } i = 1,\ldots,p, \qquad (1)$$

$$\sum_{i=1}^{p} x_{ij} = 1 \qquad \text{for } j = 1,\ldots,q, \qquad (2)$$

$$x_{ij} \in \{0,1\} \qquad \text{for } i = 1,\ldots,p;\ j = 1,\ldots,q. \qquad (3)$$

Where, $c_{ij} = \frac{1}{F_i}\sum_{k=1}^{r} w_{ik}d_{kj}$ is the average cost of locating item *i* in grid *j*, assuming that each item is equally likely to be loaded or unloaded from each dock. The model aims to minimize the average material handling costs at the warehouse through the set of constraints shows that the space occupied by an item should be equal to the space required for storing the item, and one item can be stored in a particular storage area within the warehouse.

Finally, despite its many advantages in new business challenges, the number one on the list of concerns with implementing a smart warehouse is cost. As stated by [13], smart warehouses cost a lot of money, and according to some studies the interior of a smart warehouse can cost between $150 and $200 per sq. ft, compared with less than $10 for a traditional warehouse. That's the main reason that many companies still prefer a traditional warehouse in developing countries, even though it could decrease their revenues in a long term.

VI. Conclusion

The aim of this paper to show the importance of the warehouse process as the key processes affecting the value-added in supply chain, and based on its role in business companies can make their choice which type should be followed to make it more effective, either to run it based on a traditional method or to consider the new technologies to make it fully automated. The author reviewed both methods to prove pros and cons for each one in order to answer the research question" Is a smart warehouse better option with new technologies compared to a traditional warehouse?". The study has identified some important findings for efficient warehouse management operations from both perspectives based on some evidence to conclude that the effectiveness of overall operations by implementing the smart innovations in the warehouse function as mentioned in some companies in China, or making it run based on a traditional method as explained in the case of Bahrain. The study identified advantages and disadvantages of each one which need to be considered as smooth and appropriate implementation warehousing strategies, as it plays a very significant role in current competitive and challenging business. Also, the study presented they ways should be followed to manage problems of warehouse process efficiency from technical & management aspects, especially in developing countries.

As future recommendations, we suggested that more companies in different countries should be considered and conducted, and further comparisons should be conducted between a smart warehouse and traditional warehouse, taking into consideration the new technologies, profit trends, employee performance, type of materials & businesses. Moreover, further work beyond our study regarding a better choose should be focused on frequency studies and analysis for management performance and their abilities to improve efficiency of warehousing, along with customer relations analysis in order to come out with a clear picture and understanding about justifications should a company implement a smart warehousing to meet its business objectives.

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