VALUE CHAIN ANALYSIS OF WAREHOUSE BUSINESS ACTIVITIES ASSOCIATED WITH GLOBAL AND NATIONAL APPROACHES: A CASE STUDY IN OMAN

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ABSTRACT

The warehouse industry has become a more critical factor in supporting Oman logistics and supply chain management. The global initiative (Industry 4.0) and national vision (Sultanate of Oman Logistics (SOLS) 2040) have put the industry sectors under pressure. This study explores Oman's warehouse companies' awareness of the SOLS 2040 and their readiness to adopt Industry 4.0 technologies. Empirical research was conducted on a sample of thirty respondents from different warehouse companies in Oman by utilizing both qualitative and quantitative data incorporated with Porter's value chain analysis. The outcome found that the level of awareness among warehouses in Oman towards Industry 4.0 is between 40-80% while about 30-60% of companies have adopted Industry 4.0 technologies into their warehouse operation. Furthermore, in achieving SOLS 2040, the level of awareness reported averaged out at just over a half. Remarkably, primary activities on Porter's value chain analysis concluded that the most valuable area is at the receiving point, and the costliest area is within the warehouse operation process. This industry requires good planning and effective technologies to reduce cost consumption and improve warehouse qualities to remain competitive regionally and globally.

Keywords: Logistics Business, Warehouse Operations, Industry 4.0, SOLS 2040, Porter's Value Chain, Business Study

INTRODUCTION

Globalization and internationalization initiatives have had a profound influence on modern logistics businesses. The problems of logistics and supply chain management are essential in the ever-changing context of economic globalization. Global economic integration and corporate globalization have been stimulating both the global logistics systems and supply chains in the international market. Additionally, the modern technologies of Industry 4.0 have changed traditional industries and processes, which affects the global nature, economies, and people (Schwab, 2016).

Although some firms are somewhat less confident due to the difficulty of redefining outer industry limits, lead nations in the global manufacturing sectors such as the United States, Germany, and Japan look at Industry 4.0 as an opportunity, not a danger (Müller et al., 2018). Singapore Economic Development Board established the Smart Industry Preparedness Index to enable firms (including warehousing in logistics) to make their first step towards the adoption of Industry 4.0 by evaluating their present readiness (Economic Development Board Singapore, 2019). Meanwhile, Krishnan & Wahab, (2019) concluded that the readiness of smart warehouses in Malaysia is motivated through top management and cost. However, the adoption of smart warehousing is encouraged through external pressure, the backing of authorities, and geographic location. Nhamo, et al., (2020) highlighted that a substantial amount of work is

necessary for all nations to prepare for Industry 4.0 through ICT readiness and achieve ICT-related SDGs objectives by 2030.

The warehouse industry is a vital logistics industry and an essential player in the supply chain. According to Country-wise Logistics Market Share, which was reported in 2015, that Oman's logistics industry earned $8.81 billion in market revenue and contributed 4.9 percent to the GDP, of which the logistics market share in Oman accounted for 12% in comparison to the Gulf Cooperation Council (GCC) region (Benayoune, 2018). Moreover, this industry is catching up with the Industry 4.0 to reach the mission of the Sultanate of Oman Logistics Strategy (SOLS) 2040. SOLS 2040 is based on Oman vision 2040 to deliver the Oman economy to compete for significant countries' economies that focuses on human capital, technology, market intelligence, and trade facilitation. Additionally, the evolving of technologies towards Industry 4.0 is the key to SOLS 2040, transforming the logistics industry by increasing productivity and efficiency.

Oman logistics is looking forward to being ranked among the top ten in the World Bank's Logistics Performance Index (LPI) in 2040 and use the SOLS 2040 to map the logistics industry's competitiveness regionally and globally. According to the National Center for Statistics and Information (2019), the warehousing sector that refers to the size of the business in Oman was recorded at 53% in 2019, and it is envisaged to increase every year. This research focuses on the technology element and the implementation of technologies in the warehouse industry specifically. The principal goal of technological development is to utilize transport and logistics technology in Oman's economic supply chain.

Thus, the primary goal of this paper is to explore the warehouse industry in Oman concerning their awareness in achieving the SOLS 2040, which aims to implement the latest technologies of Industry 4.0.

LITERATURE REVIEW

Warehouse Sector in Industry 4.0

A former senior manager of the SAP code corporation in Germany named Henning Kagermann was the first person who introduced Industry 4.0 in 2011 (Paprocki, 2016). Hofmann & Rüsch, (2017) illustrated Industry 4.0 as the "industrial internet, "smart manufacturing," or "integrated industry" that is now usually known as the "Fourth Industrial Revolution". The 4th industrial revolution denotes an abrupt change in the world. Historically, the modernization of technology that happens because of the industrial revolutions creates a convenient insight into the industries and process movements worldwide. In the second half of the 18th century, manual handling was transitioned into mechanical power, where production increased and expanded human production (Schwab, 2016). The primary Industrial Revolution covered the period from approximately 1760 to 1840. It started with the structure of railroads and the creation of the steam engine. Now the 4th Industrial Revolution is taking place, which is affecting countries, economies, industries, and people (Liao et al., 2018). As such, Industry 4.0 pertains to automated processes and the integration of these processes that provide information from large devices, monitors, and tools to enable customization, agility, and speed in production and service operations (Deloitte, 2014).

Moreover, globalization increases the complexity of the supply chain, creating obstacles to the logistics flow. To become more digital, automated, and flexible in their operations, supply chains (SCs) are making significant progress. In many stages of SCs, including new product development, production, procurement, planning, logistics, and marketing, today's digital SCs networks use a variety of technologies to construct efficient, transparent, adaptable, and robust systems. Industry 4.0's effects may be experienced at many levels of SCs, as well as in warehousing. Likewise, Maslaric, et al., (2016) regard logistics 4.0 as a solution to Industry 4.0, with the digitalization of logistics operations leading to "logistics transformation" or the

establishment of "smart logistics" solutions. These obstacles are increasing the competitiveness of international traders where the trader is improving the product quality and satisfying the customers with lower costs, surging the fluctuations of supply and demand in the market, and the restriction of product life cycles (Douaioui et al., 2018).

Several scholars have conducted significant case studies and research on warehouses in Industry 4.0, including Loan, et al., (2020), who found that AGV can enhance the bottom line of warehouse operations by reducing labour costs, solving labour problems, and increasing productivity in one of the Fast-Moving Consumer Goods (FMCGs) factories in Vietnam. Meanwhile, Zhang, et al., (2021) conducted a case study on Alibaba's Smart Warehouse, developing AI capabilities by coordinating AI and other relevant resources, resulting in automating the products storage process. This automation increases efficiency in terms of space usage, human work, the danger of accidents and injuries, and the optimization of storage facilities. Anitah (2019) found that between Unilever and L'oreal companies in East Africa showed slightly different outcomes in which L'oreal has implemented Industry 4.0 technologies. In contrast, Unilever witnessed limited awareness of Industry 4.0 technologies. In addition, the study on the Kiva robot's installation has had a considerable influence on the contemporary warehouse centre, which can now contain 50% more inventory than the old warehouse (Bougue, 2016). The Amazon Kiva System is a revolutionary multi-robot system that will replace Automatization Tri-dimensional Storehouse (ATS), Long Distance Belt, Conveyor, and Carousel. As a result, Yudiansyah, et al., (2020) concluded that Amazon could be optimized by utilizing many robots with multi-robot systems results in more effective and efficient work, as the impact provided by robots may save time and expedite the fulfilment of client orders on e-commerce.

Mourtzis, et al., (2019) validated a real-life case study, the Augmented Reality Application in the papermaking industry, making warehouse administration easier by facilitating effective navigation and product retrieval. The use of QR codes is placed in warehouse divisions and on each pallet or product to digitalize the process of recording product intake and output. When a request is made to the warehouse, the operators can utilize the created application to navigate and respond more effectively. The three functions of the app are to view available stock, locate a product in the warehouse and report a new entry. Therefore, Industry 4.0 introduces Logistics 4.0, smart warehouse, modern warehouse, smart factory, smart industry, factory of the future, an industry of the future, digital factory, and others. This revolution in industry improves the new processes for operations of production, products, and services. Industry 4.0 in logistics and warehousing in supply chain management includes four elements which are Cyber-physical system (CPS), Internet of Things (IoT), Internet of Services (IoS), and intelligent factories (Sarvari et al., 2018; Ghobakhloo & Fathi, 2019).

Cyber-Physical System (CPS)

A Cyber-physical system allows information to flow automatically using sensors, software, and communication components to deliver on-time data. CPSs comprise two parts which are a physical network and a cybernetic network. A physical network connected *via* the infrastructure and a cybernetic network automated with links without cables. The interface of these two networks is connected through sensors, actuators, processing and control units, and communication devices (Hermen et al., 2015; Douaioui et al., 2018). The CPS is effective in smart warehouses where thousands of devices can be employed. For example, radio frequency identification (RFID) readers and tags, Bluetooth low energy beacons, other various sensors, and wireless networking technology (Wi-Fi) apps ensure robust communication scheduling is efficient. The other benefits of CPS are accurate and robust localization on the warehouse operation side, mainly used for fetching and tracking inventory (Liu et al., 2018).

Internet of Things (IOT)

Internet of Things (IoT) is a system that links physical entities, systems, information sources, and intelligent services capable of impacting the physical world. The Internet of Things (IoT), also known as the Industrial Internet of Things (IIoT), is a crucial component of the fourth industrial revolution (Haddud et al., 2017; Ghobakhloo & Fathi, 2019). The usage of IoT technologies has increased over the years due to the technical innovations in industry. The advantage of IoT is connecting previous inefficient physical components to the network to manage storage facilities, facilitating operations, and positioning sensors link to the network sensors, providing real-time inventory information to their management system (Buntak et al., 2019).

Many technologies, such as radio frequency identification (RFID), Wi-Fi, Bluetooth, sensors, and cloud computing, are used in IoT infrastructure. IoT may help improve the operation of the whole supply chain and turn it into a smart one by, for example, monitoring, tracking items, developing an intelligent transportation system, and anticipating demand. IoT in warehousing can significantly impact since it can monitor various operations in real-time and remove manual intervention. It can link everything, allowing for the analysis of the massive amounts of data collected due to these connections and converting those views into insights to aid decision-making and enhance overall performance.

Internet of Services (IOS)

The IOS means accessing the world services through web technologies where services can be reached faster and smoother. Business operators and private industries have had more accessible data access and innovated new types of services (Douaioui et al., 2018). IOS is created from two concepts, the second generation of the World Wide Web (Web 2.0) and Service-Oriented Architecture (SOA), that allows interconnection between the web browser and social data network to another partner. Another feature is tagging, where they add a tag such as keywords to a product to be quickly identified. Web services allow software offered by web applications to exchange data (Reis & Gonçalves, 2018) smoothly.

Smart Factory

The intelligent factory combines the IoT, CPS, and IOS, aiming to the decentralized production system to connect humans with machines and resources as a social network. Smart factories are about finding the conditions of the product on productions and product locations in the factory in an uncomplicated way and at the lowest cost possible (Jung et al., 2021). The smart factory is about a self-performance optimizer that can flexibly modify to suit warehouse conditions in real-time to run the production processes. This technology can operate within the four walls of the warehouse, connected with a global network of another warehouse through the digital supply network. The top five features of a smart factory in the warehouse are connection, optimization, agility, proactivity, and transparency. The connection allows real-time decisions assets fixed with smart sensors where data is continually pulled. Another feature is optimization, which reduces manual involvement and high reliability, improves tracking, and reduces costs, waste, and energy consumption. The agile feature of the smart factory in the warehouse helps to improve up-time and yield by reducing switches to scheduling or cargo changes and qualify flexible scheduling. The Proactive feature allows acting before the risk occur, replenishing inventory, accurately addressing quality, and monitor safety and maintenance. The final factor is transparency; this feature enables higher visibility to ensure accurate decisions (Burke et al., 2017).

Industry 4.0 is the new globalization that transforms the industry to cost efficiency and high-performance quality, changing from the conventional warehouse into the smart warehouse

concept with modern technologies and the latest innovation in the industry. It is predictable that substantial risk of goods damage in a conventional warehouse when handling the cargo in warehouse operations, leading to time consumption and high cost. Smart warehouses eliminate the drawbacks of conventional warehouses and are designed to be operated in full automation, unmanned, paperless warehouses, which will reduce the risk of damaged goods when performing the operations (Karunarathna et al., 2019). However, it will be difficult to properly transition to a smart environment unless a fair degree of awareness and fundamental understanding of Industry 4.0 related ideas, elements, and essential parts is achieved, particularly among developing countries like Oman. Table 1 summarizes variables to measure the level of awareness of Industry 4.0 in Oman warehouses.

Table 1
VARIABLES TO MEASURE THE LEVEL OF INDUSTRY 4.0 AWARENESS

Variable	Description	Authors
Employee	The possibilities for human-centric logistics posed by the transition to Industry 4.0	Cimini et al. (2019)
Technology	The fourth industrial revolution or Industry 4.0 refers to entirely automated and revolutionary digital technologies in the twenty-first century. While there is no one categorization, the Internet of Things, cloud computing, big data analytics, and robots are seen to be the essential parts of Industry 4.0.	Ali et al. (2021); Wamba et al. (2017)
Reshaping	The fourth industrial revolution reshapes the industry's traditional methods and business processes by introducing the Industrial Internet of Things (IIOT) and Cyber-Physical Production System (CPPS). The digital transformation to Industry 4.0 makes the system more organized, flexible, transparent, and interconnected, with internal production, pre-assembly sales and external service providers.	Schrauf & Berttram (2016)
Profitability	Industry 4.0 smart network will help automate, automate, and optimize operations, increase flexibility, safety, and productivity, reduce costs and increase profitability. It is significant for customer service and maintenance, and this part brings more profits to the company.	Mohamed & Al-Jaroodi (2019); Hagreve et al., (2017)

Sultanate of Oman Logistics Strategy (SOLS) 2040

The Sultanate of Oman Logistics Strategy 2040 is based on Oman vision 2040 to deliver the Oman economy to compete for significant countries' economies. The current Oman vision to reach the 2040 strategy goals is to adopt and facilitate innovation and technologies in four key areas. Through intelligence tools and technologies, transparency in governance, governance through business intelligence in the logistics industry streamlines records to evaluate performance (SOLS 2040, 2015). The main aims of SOLS 2040 are maximizing logistics contributions to the Gross Domestic Product (GDP) up to 12%, increasing the number of job opportunities in the logistics field up to 300,000 workers, and ranking among the top 5-10 logistics hub globally (SOLS 2040, 2015).

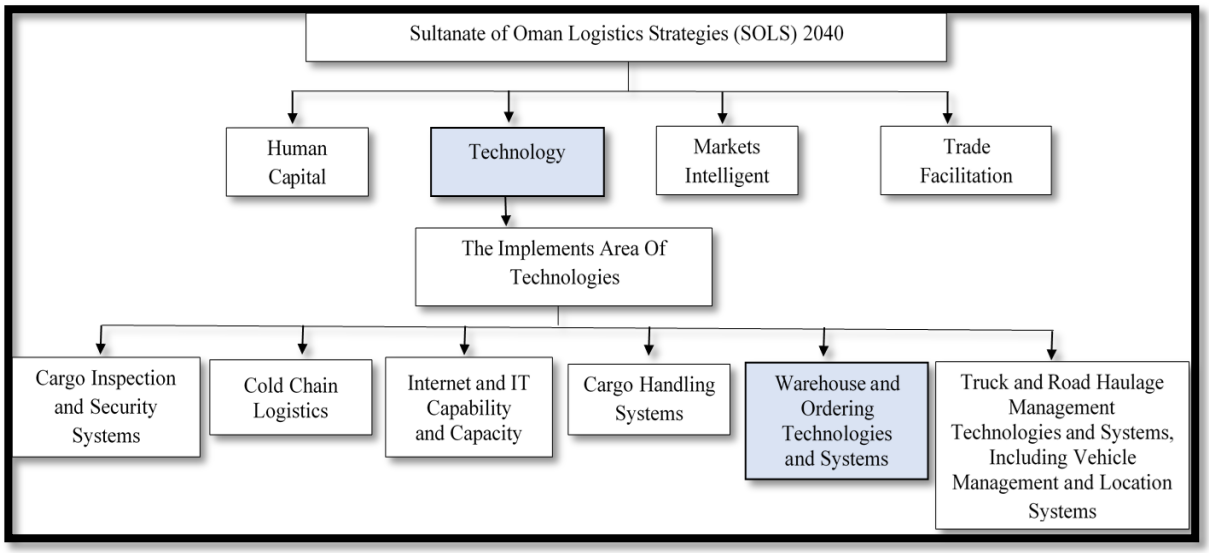

FIGURE 1
SCOPE OF STUDY BASED ON SOLS 2040

Figure 1 shows the scope of study based on the four elements of SOLS 2040. The principal goal of technological development is to utilize transport and logistics technology in the Oman economy's supply chain. The functions of technologies are technology and Information Technology (IT) and infrastructure. Fulfilling the five essential goals of adopting the technologies in SOLS 2040 (SOLS 2040, 2015):

1. To improve the speed and rate of handling cargo in Oman.
2. To adopt technology as a competitive tool for Oman logistics to become a preferred logistics location.
3. To improve the transportation infrastructure to become fully optimized and aligned with demand.
4. To establish programs to adopt appropriate technology on the supply chain in Oman.
5. To set and monitor technical standards and create research. Develop programs for implementing technology combined with academic players and industry.

The principal areas considered in adopting technologies in the supply chain are supply chain process automation, improved transparency, visibility, data collection and analytics, accountability, and ensuring systems. For example, a single window is correctly corresponding and integrated throughout the supply chain to meet the customer requirement through an Oman trade portal (SOLS 2040, 2015).

Operational technology is the technology adopted to improve overall operations in the supply chain. Examples are (1) cold chain logistics, (2) truck, road carrying management technologies and systems, (3) warehouse and ordering technologies and systems, (4) cargo handling systems, (5) cargo inspection and security systems, and (6) internet, and information technology (IT) capability (SOLS 2040, 2015). The automation of processes involves the movement of goods within Oman and across the borders, transfer of goods from one mode of transport to another, and between one port or between ports, free zones, shippers, consignees, moving physical goods transparent visibly throughout the country. Moreover, providing analytical tools to make things evident and more efficient while performing the processes in real-time, which creates responsibility and accountability for those managing (SOLS 2040, 2015). Parallel to the Industry 4.0, technologies will be a tool to guide the technologies adoption in SOLS 2040.

METHODOLOGY

In this paper, to investigate the level of awareness and readiness among the warehouse companies in Oman about the SOLS 2040 and Industry 4.0, two different approaches are

employed. Figure 2 illustrates the theoretical framework in this study, which is divided into policymakers' approach and warehouse industry approach, respectively. This paper first collected data, information, and figures from secondary data on Industry 4.0 from global perspectives and the national blueprint on SOLS 2040. Then, the primary sources are collected from interviews and questionnaires distributed among the selected sample of this study, leading to a study on the level of awareness and readiness of warehouse companies in Oman on Industry 4.0 and SOLS 2040. Finally, this paper also develops the Porter's Value Chain of warehouse activities in Oman as a guide for the policymakers and industrial players to plan the warehouse operation management towards achieving the country's goal by 2040. In addition, the theoretical framework supports to determine the relationship between independent variables (such as employee, technology, reshaping and profitability) for Industry 4.0 and SOLS 2040 and dependent variables of awareness and readiness of the warehouse industry associated to both global and national approaches.

Sampling Technique

The nature of this case study involves the technology being implemented in the warehouses in Oman towards an intelligent warehousing approach. The quality of the data gathered depends on information obtained from the distributed online survey and interviews. The sampling size for this research was based on 30 warehouse companies as the focus groups. The study targets specific industry logistics explicitly, Oman warehousing and the Industry 4.0 technologies in warehousing companies. The survey and interview were conducted online due to the pandemic situation.

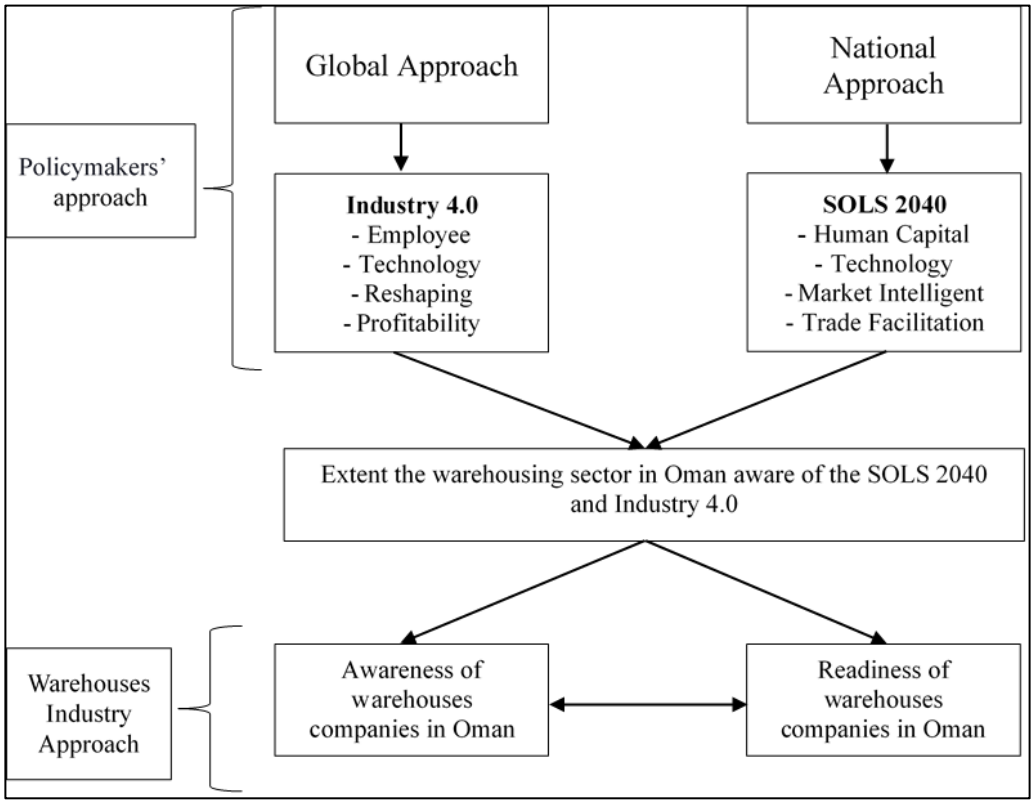

FIGURE 2
THEORETICAL FRAMEWORK

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In general, more than 100 warehouse companies' information has been gathered from ASYAD Group, the Ministry of Transport Oman, and the Oman Logistic Centre. However, only 30 samples of respondents representing 30 warehouse companies were available and cooperative in providing survey feedback because most warehouse companies had ceased operations during the time of this study, making them unavailable to communicate.

Table 2 depicts respondents' summary according to their position at work, years of experience, type of the warehouse and market classification. As for the position at the workplace, only 13% of the respondents are in top-level management. There was a difference of 3% between middle-level management (29%) and lower-level management (26%), whereas almost a third (32%) of the respondents are categorized as others, representing employees in the operation and marketing department. Meanwhile, over half of the respondents have less than five years of experience, which amounted to 58.1% collectively. Respondents with 5-7 years of experience and 7-10 years of experience constituted 6.5% and 25.8%, respectively, and the remaining about one in ten (9.7%) have more than ten years of experience in warehousing. Furthermore, Bonded warehouses represented the highest amount of respondent's types of warehouses at 35%, followed by refrigerated warehouses and others, generating at 29% and 16%, respectively. In addition, bonded warehouses refer to storage where the goods are stored until the customs duty is paid and can own either government-owned or privately owned. Private and public warehouses share the same amount accounted for 20%, collectively. Finally, most of the respondents' warehouse market clarifications are for the local market and global business trading, accounting for 36% and 32%, respectively. Others can be categorized as business markets in some parts of states or entire states generated at 26%, which was over fourfold that of regional market (6%).

Table 2
DETAILS OF RESPONDENTS ACCORDING TO POSITION, YEARS OF EXPERIENCE, TYPE OF WAREHOUSES AND MARKET CLASSIFICATION

Respondent's Position		**Years of Experience**	
Top Level Management	13%	Less than 3 years	41.9%
Middle Level Management	29%	Between 3-5 years	16.2%
Lower-Level Management	26%	Between 5-7 years	6.5%
Others	32%	Between 7-10 years	25.8%
		More than 10 years	9.7%
Type of Warehouses		**Market Classification**	
Bonded Warehouse	35%	Local Market	36%
Private Warehouse	10%	Regional Market	6%
Public Warehouse	10%	Global Business Trading	32%
Refrigerated Warehouse	29%	Others	26%
Others	16%		

Data Collection

Social Science Statistics Package (SPSS)

This study uses quantitative survey methods. Questionnaires were distributed to warehouse operators in Oman. The data was collected and used in descriptive statistics, frequency, mean, standard deviation, reliability testing and analysis of results using the Social Science Statistics Package (SPSS). Individuals referred to as experts in exposure and handling warehouse operations response were identified as the analysis unit for this study. SPSS is a statistical software package designed by IBM and widely used by researchers or academicians

worldwide. The statistical software package is very user-friendly and can be used to perform various statistical tests. The statistical software performs the comparison and related statistical tests in univariate, bivariate and multivariate analysis of parametric and nonparametric statistical techniques.

The questionnaire contained four variables (employee, technology, reshaping and probability), each of variable had some questions, for a total of 27 questions in the survey. There is a specific scale in each question for each answer, which varied in Likert's scales, including agreement, dichotomous-yes/no and percentage rating scales. Then, the data is analyzed quantitatively. The observed correlation is then translated into description "very high", "high", "moderate", "low" and "negligible" as depicted in Table 3 (Mukaka, 2012).

Table 3
GENERAL INTERPRETATION OF CORRELATION COEFFICIENT

Range	Interpretation
.90 to 1.00 (-.90 to -1.00)	Very high positive (negative) correlation
.70 to .90 (-.70 to -.90)	High positive (negative) correlation
.50 to .70 (-.50 to -.70)	Moderate positive (negative) correlation
.30 to .50 (-.30 to -.50)	Low positive (negative) correlation
.00 to .30 (-.00 to -.30)	Negligible Correlation

Porter's Value Chain Analysis

The value chain describes the activities command by an organization to form value on their merchandise or services. Porter' value chain analysis could be a methodology that helps an organization to outline its activities and determine the most effective value in main activities (Stabell & Fjeldstad, 1998). Porter (1985) planned the value chain concept that understanding an organization's company structure to acknowledge the essence of providing a product or service to rivals at a competitive price or higher quality is essential for evaluating a company's competitive advantage in the market. It is one of the most used analysis methods for managers to diagnose and improve its competitive state to analyze activity levels (Sheehan and Stabell, 2010). This method distinguishes business transactions by breaking them down into smaller, more manageable parts then analyzing each action's cost and value impact to improve the value chain (Hedman et al., 2008).

Systemise is one style of value chain technique that will be used. The value chain refers to the primary and support activities that occur within the company to provide valuable products or services to the market. Further explanation of primary and support activities are as follows:

The primary activities are based on three elements which are direct activities, indirect activities, quality assurance. These three elements force warehouse operators to take the most value from the operations; each one of these activities is linked with others and are significant for the warehouse to gain the best practices. The accuracy of indirect activities is reflected in the efficiency of direct actions and the sufficient flexibility of quality assurance. For example, placing the correct purchase order information affects quality assurance. As soon as the purchase order is received, the inventory is ready to receive the product. Its value lies in the accurate and faster processing of documents through indirect activities to increase the value of direct actions and quality assurance.

While, the supportive activities are firm infrastructure, human resources management, technology and research development, and procurement (Koc & Bozdag, 2017). The firm infrastructure is based on the management of the process within the warehouse; the efficiency of leadership within the warehouse has reflected on primary activities flow and movements of products stored and effecting the final destination of the customer services. Human resources knowledge and ability have affected the operation quality, directly impacting the primary

activities, such as quality assurance, where the rate depends on the labour expert to deal with the work environments (Boudreau et al., 2003; Santos, 2000).

Furthermore, this analysis enables investigating the link between activities and recognizing the organization's source of activities' value. The warehouse activities operate like a chain, and it is linked together to reach the final destinations of the product. The product flow starts from receiving the product at the inbound side, storing it in the warehouse and shipping it to customers when in demand (Li, 2014; Hazwani et al., 2018; Hazwani et al., 2020). The valuable elements of support activities are pushing and attracting vendors to invest in the warehouse or attracting customers to buy the product. In addition, these products are stored temporarily, which means procurement is essential to increase the optimization of warehousing. Warehouse operation should have enforced implementation and adoption of technology, also known as procurement 4.0 (Nicoletti, 2018).

FINDINGS

The study measures the awareness of warehouse players in Oman about the Industry 4.0 that will help them understand the technologies and implement the latest innovation and technologies on the warehouse to meet the SOLS 2040.

Awareness and Readiness of Warehouse Industry in Oman

H1: The correlation between awareness level of warehouse employees and the usage of Industry 4.0 technologies in the warehouse industry

Table 4 represents the warehouse's awareness of Industry 4.0 technologies in percentage. The highest percentage between bracket is (40%-60%), and (60% -80%) categories accounting for 33% and 30% of the respondents, respectively. The lowest percentages for more than 80%, and less than 40%. categories accounting for 16.7%, and 20.0%, respectively. A deep and effective analysis was carried out to understand the correlation more effectively. Therefore, the focus was on the relationship between warehouse employees' awareness level and the usage of technologies in the warehouse and the adoption of technologies. The analysis focused on the role of the Industry 4.0 in reshaping the warehouse industry business in Oman. The final elements were the ability of warehouse operators to adopt technologies and the impact on the profitability of the warehouse.

The correlation between the awareness level of warehouse employees about Industry 4.0 and the usage of technologies in the Oman warehouse industry is measured. According to Table 4, most respondents scored more than 30%, which means that the type of technologies on Oman warehouse accounted for 83.4%, collectively. However, the level of awareness about Industry 4.0 appears that the upper awareness level is more than 80%, which means that the implementation of technologies in Oman warehouse industry is not correlated with the warehouse industry's awareness level. The correlation of numbers hypothesis test, the findings from the SPSS analysis, the medium positive relationship coefficient described as the increase of awareness level regarding the Industry 4.0 technologies, and usage of technologies in Oman warehouse industries. The p-value shows to refer to 0.004 ($p < 0.8$), which means their low correlation.

Table 4
CORRELATION BETWEEN LEVEL OF AWARENESS AND THE USAGE OF INDUSTRY 4.0 TECHNOLOGIES IN WAREHOUSE

Level of Awareness			Usage Technologies in Oman Warehouse Industry		
Likert Scale	Frequency	Percentage	Likert Scale	Frequency	Percentage
Less than 40%	6	20.0	< 30%	5	16.7

40%-60%	10	33.3	30-60%	14	46.7
60% -80%	9	30.0	> 60%	11	36.7
More than 80%	5	16.7	Total	30	100.0
Total	30	100.0			

Correlation	**Level of Awareness**	**Usage Technologies in Oman Warehouse Industry**
Correlation Coefficient	0.004	0.491
Sig. (1-tailed)	0.000	0.000

H2: The correlation between the adoption of technologies and the role of Industry 4.0 in reshaping the warehouse industry business in Oman

The correlation studied the adoption of the Industry 4.0 technologies by Oman warehouses, and the relation of the Industry 4.0 on reshaping the warehouse industry business in Oman. The warehouse operators in Oman who were ready to adopt Industry 4.0 accounted for 56.7%, and just over a third (33.3%) of respondents were not sure about the adoption of Industry 4.0 technologies. On the other side, the benefit of Industry 4.0 in reshaping the warehouse industry business in Oman showed that the majority agreed with the statements, which constituted 96.6% collectively. Therefore, the warehouse operators in Oman are aware of the benefits of Industry 4.0 in reshaping and developing the warehouse operation. Table 5 displays the Industry 4.0 ratio of adoption of technologies on Oman warehouses and its correlation towards reshaping benefits. The correlation between the two elements is the hypothesis test, and the p-value is 0.407, which is lower than 0.8 refer to the significant relationship at the 0.05 level between the two elements. Therefore, a significant positive correlation between the two suggests that when these two variables increase, such as in the adoption of technologies, this will increase the benefit of the Industry 4.0 in reshaping the warehouse industry business in Oman.

Table 5
CORRELATION BETWEEN THE ADOPTION OF TECHNOLOGIES ON WAREHOUSE AND BENEFITS FOR RESHAPING THE INDUSTRY IN OMAN

Ratio of Adoption of Technologies			**Ratio of Industry 4.0 Benefits for Reshaping**		
Likert Scale	Frequency	Percentage	Likert Scale	Frequency	Percentage
Yes	17	56.7	Strongly agree	10	33.3
No	3	10.0	Agree	19	63.3
Maybe	10	33.3	Strongly disagree	1	3.3
Total	30	100.0	Disagree	0	0
			Total	30	100.0

Correlation	**Benefit of Industry 4.0**	**Adoption of Technologies on Warehouse**
Correlation Coefficient	1	0.407
Sig. (1-tailed)	0.026	0.026

H3: The correlation between the ability of warehouse operators to adopt technologies, and the impact on the profitability of the warehouse

Table 6 shows the results to determine the warehouse technologies level to compete on automation warehouse industries and capability of warehouses for Industry 4.0 technologies. Almost half of the respondents (46.7%) were not sure, followed by respondents who recorded "Yes" and "No" comprised 33.3% and 20%, respectively. The correlation between the warehouse operator's ability to adopt technologies and the impact on the profitability of the

warehouse showed a medium positive relationship due to the correlation is 0.407 between the two variables, consider a positive relationship where the correlation is positive p-value is 0.206.

Table 6
THE PROPER COMPOSITION OF OMAN WAREHOUSE ON BOARD TO NAVIGATE THE INDUSTRY 4.0

Likert Scale	Frequency	Percentage
Yes	10	33.3
No	6	20.0
Maybe	14	46.7
Total	30	100.0
Correlation	**The Ability of Warehouse Operator to Adopt Technologies**	**Impact on the Profitability of Warehouse**
Correlation Coefficient	0.250	0.407
Sig. (1-tailed)	0.000	0.000

H4: The correlation between planning scenarios for SOLS 2040 and held accountable for SOLS 2040 in their warehouse

The SOLS 2040 is highly significant for whole supply chain partners, where the warehouse industry business is one of them. The role of the warehouse's industry and entire supply chain partners is to work on the SOLS 2040 ambition and be aware of goals and strategic involvement. Table 7 depicts to measure the level of awareness of the warehouse industry. The highest score was five, which accounted for a third (33.3%) of the respondents. Meanwhile, between 10-20% of respondents scored between 6 to 10. The lowest frequency category was 1, which achieved a score of 1 and then 3. The correlation between the planning scenarios for SOLS 2040 and those held accountable for SOLS 2040 in their warehouse showed a weak positive relationship scored at 0.113. This can be interpreted that good planning affects the warehouse industries accountability for SOLS 2040. However, the variables are connected directly to each of their effects on the other positively or negatively.

Table 7
THE SCORING OF AWARENESS BASED ON WAREHOUSES INDUSTRIES RESPONDENTS

Scoring	Frequency	Percentage
1	1	3.3
2	0	0
3	1	3.3
4	2	6.7
5	**10**	**33.3**
6	6	20.0
7	3	10.0
8	4	13.3
9	3	10.0
10	0	0
Total	30	100.0
	Planning Scenarios for SOLS 2040	**Held Accountable for SOLS 2040**
Correlation Coefficient	0.576	0.113
Sig. (1-tailed)	0.000	0.000

H5: The correlation between adoption the latest technology on the logistics sector and the most essential infrastructure constraints affecting Oman warehouse

The correlation between these two variables is low Kendall's Tau-b correlation is around 0.183 because it is lower than 0.8, which resulted in a low correlation. There is a weak positive

relationship between awareness, and the need for adaptation technologies, and infrastructure constraints affecting Oman warehouse. Using the Simple Linear Regression Test and warehouses operator responses, the hypothesis tested is shown in Table 8. *Hypothesis test*, the correlation coefficient was R=0.201, R-square=0.214, representing the relationship between the two factors. The F-ANOVA ratio determines if the overall regression model is a good match for the data. F-ANOVA=0.567 with P-value=0.00 that indicates that the model is significance since P-value=0.00< α=0.05.

Table 8
LINEAR REGRESSION ADOPTION THE LATEST TECHNOLOGY IN THE LOGISTICS SECTOR AND THE MOST IMPORTANT INFRASTRUCTURE CONSTRAINTS AFFECTING OMAN WAREHOUSE

Model		Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	Awareness	1.785	4.048	0.201	3.982
2	Adoption Technology Infrastructure	1.709	0.502	0.187	3.4
Dependent Variable: Awareness level, R=0.201, R-square=0.214, F=1.05, P-value=0.00					

Porter's Value Chain on Oman Warehouses

Warehouse operations based on Porter's value chain divides into primary and support activities. Primary activities are based on direct, indirect activities and quality assurance, while support activities are defined as firm infrastructure, human resources management, technology development, and procurement. Table 9 represents that the costliest activities on warehouses in Oman were process recorded more than a half of the proportion (55.6%). The correlation coefficient was R=0.066 with R-square=0.004. Hypothesis test, F-ANOVA=0.109 with P-value=0.00 that indicates that the model is significance since P-value=0.00< α=0.05. Furthermore, Beta Coefficient=-0.660 with t=-0.330 and p-value< 0.05, indicating that for each decrease of one unit in negatives.

Table 9
AVERAGE OF COSTLIEST ACTIVITIES ON WAREHOUSE

Type of activities	Percentage
Inbound activities	14.8
Outbound activities	29.6
Process activities	55.6
Total	100

Regression Linear the Valuable Operation and Costliest Operation on Warehouse					
Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	*Std. Error*	*Beta*		
Valuable operation	2.76	0.992	0.291	2.78	0.74
Costliest operation	-0.13	0.394	-0.66	-0.33	0
Dependent Variable: Intention, R=0.066, R-square=0.004, F=0.109, P-value=0.00					

Marketing and Sales

The Marketing and Sales types on warehouse business highly affect Porter's value chain analysis. Table 10 depicts the most approachable Marketing and Sales type within warehouses in Oman recorded just over a quarter (25.9%) of the respondents was through social media marketing, followed by direct marketing and general advertising accounted for 18.5%, respectively.

Table 10 THE PROMOTION TYPES ON WAREHOUSE	
Type of Advertisement	**Percentage**
Personal Selling	7.4
Social Media Marketing	25.9
Direct Marketing	18.5
Digital Promotion	14.8
General Advertising	18.5
Others	14.8
Total	100.0

Technologies area on Warehouse

The focus areas of technology initiatives on warehouses depend on outcomes from findings in six primary areas: operations/processes, marketing or sales, services development, shipping, inbound operation, and outbound operation. The process and operation area scored the highest in technologies used in the warehouse and accounted for 37%, followed by services developments and marketing or sales, which scored 22% and 18.5%, respectively. Shipping and inbound operations accounted for 18.5%, collectively, and only 3.7% were recorded for outbound operations.

Regression Linear between Marketing and Sales, and Focused areas of Technologies

By using the simple linear regression test, a hypothesis on Marketing and Sales, and focused areas of technologies is tested. The Marketing and Sales was taken as a dependent variable and focused on technologies operation as an independent variable. Table 11 represents the correlation coefficient was R=0.206, with R-Square=0.042 representing the relationship. Hypothesis test, F-ANOVA=1.109 with P-value=0.00 that indicates that the model is significance since P-value=0.00 < α=0.05. Furthermore, Beta Coefficient=-0.206 with t=-1.053 and p-value <0.05, indicating that for each decrease means negative relation.

Table 11 REGRESSION LINEAR THE PROMOTION AND FOCUSED AREAS OF TECHNOLOGIES OPERATION ON WAREHOUSE					
Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	*Std. Error*	*Beta*		
Promotion	3.120	0.701	0.000	4.448	0.302
Focused Areas of Technologies	-0.109	0.180	-0.206	-1.053	0.000
Dependent Variable: R=0.206, R-square=0.042, F=1.109, P-value=0.00					

DISCUSSION

The findings show that most warehouses are making a partial investment for shifting from traditional/manual warehouse operation towards an advanced digitalized warehouse operation. However, the transition towards a smart warehouse in Oman highlighted a low correlation with the level of awareness about Industry 4.0 implementation. Furthermore, it was shown that Industry 4.0 adoption highly correlated with the adoption of high technologies and bring about a higher profit to the business. Additionally, most of the warehouse operators are aware of the Sultanate of Oman Logistics Strategy 2040, specifically on their industry roles for enhancement towards more digitalization for improving efficiency and productivity.

Table 12
SUMMARY OF RECOMMENDATIONS, MAIN CHALLENGES AND EMPLOYEE READINESS FOR INDUSTRY 4.0 AMONG WAREHOUSE INDUSTRY IN OMAN

Recommendation Strategy for Industry 4.0	
1. Introduce the benefits to the market 2. Artificial intelligence to arrange and transport goods in warehouses 3. Use one system that can link the warehouses to gather 4. Compare the labour cost with the cost of automation 5. They are implementing good software and workflow, and equipment 6. Digitalization, Atomized Loading, and Loading-Ai-based reporting 7. Use new technology 8. Use warehouse management systems and drones	9. They are providing a robust communications network with global technical services 10. Increase the awareness of 4th Industrial Revolution technologies 11. That is more prone to human error. To meet this challenge, many warehouses are looking to technology for solutions 12. Using the satellite to trace the shipments. 13. Cooperating with tech companies 14. Make people aware. 15. Availability of machinery and required specialization 16. Increase facilities and put in place a robust system commensurate with the area
Main Challenges for Industry 4.0	**Employee Readiness for Industry 4.0**
1. Code of Business Conduct and Transparency 2. Lack of employment 3. Monopolies in technological suppliers 4. The legal system should be improved so more 4IR technologies can be used 5. Lack of exposure to the Industrial clients 6. The privacy issue and unemployment for poor skills workers 7. No legal institutions are specializing in this sector 8. Used week password 9. Missing some shipments where cannot be found 10. People Engagement 11. Shortage and misuse job has taken us to legal issues	1. Provide training for teaching employees how to use modern systems and the new ways to follow the 4th industrial revolution 2. Educating the youth on the shift towards industrial revolution 3. Planning and bring expatriates 4. Training and utilization of the proper Enterprise Resource Planning (ERP) 5. Recruit academic people and well educated 6. Training, innovation, and continuous up-gradation of warehouse management systems based on client needs 7. The following skills have helped warehouse managers make better decisions, create better systems, and improve organizational effective 8. Through correct planning and employing people with a broad thought

The types of Industry 4.0 technologies that are commonly used at warehouse companies are: e-tendering and e-contracting systems; barcoding; warehouse management system and transport management system; cloud-based technology; SAP system; radiofrequency; smart warehouse; and robots. Although Industry 4.0 is not something new for this industry; however, this development creates new opportunities, threats, and risks. This including higher investments/capital on recent technologies, market changes, employee readiness, time-consuming redevelopment of innovation, and others. Furthermore, Table 12 summarises the possible strategies to improve Industry 4.0 technologies, main challenges for Industry 4.0 and employee readiness Industry 4.0 in the warehouse sector in Oman.

Therefore, Porter's value chain is developed to assist the warehouse industry in Oman regarding the business strategy to produce a superior performance as a means for a company to gain a competitive advantage. Figure 3 represents the summary of Porter's value chain for warehouse operation in Oman from both primary and support activities. The primary activities include receiving, putting away, picking, packing, and shipping activity, while support activities mainly support warehouse operation delivered efficiently. In addition, the costliest activities fall under warehouse operations.

On the other hand, the overarching aims of a company are defined by support activities that focus on generating value by channelling investment into firms that compete in industries with appealing structures. Quality assurance in warehouse operation involves various strategies, best practices, and technology to make deliberate and well-thought-out steps to reduce the likelihood of errors and enhance overall services. As a result, value chain analysis allows a firm

to evaluate the connections and interrelationships that can bring these two competitive advantages.

FIGURE 3
SUMMARY OF PORTER'S VALUE CHAIN FOR WAREHOUSE OPERATION IN OMAN

IMPLICATIONS

Smart Logistics, which has grown in parallel with the logistics and technology industries, is a new system that integrates technology and robots which significantly influences the logistics sector. Furthermore, it has the potential to lower costs and boost corporate competition. In conclusion, this study contributes to several aspects. The main contribution highlighted in this study is related to the level of awareness of warehouse operators regarding the SOLS 2040 and in making them ready and increasing credentials and credibility towards achieving the nation's lofty mission. This study concluded that the level of awareness towards Industry 4.0 and their readiness towards SOLS by 2040, which will draw warehouse operators, researchers, regulators, government, and all levels of private and public organizations to brainstorm for this industry's success. Moreover, Porter's value chain analysis is the best tool for developing the warehouse operation value chain in Oman. Thus, this value chain enables the warehouse operators to create strategies that align with business strategy, corporate strategy, and other vital functions.

In a practical way, this study as a tool to conduct a workshop for warehouse companies and other partners on the supply chain about the importance of SOLS 2040 and Industry 4.0. Also, raise awareness in the warehousing companies in Oman about their role in the success of SOLS 2040 and propose a number of Industry 4.0 technologies which applicable to Oman case. Furthermore, the limitations of this study are as follows: limitation of published works on warehousing; storage applicable in Oman; and gathering a sample for this study, as only 30 respondents managed to participate in the study. Finally, this study brings new knowledge to the pool of the state-of-the-art literature, specifically in the warehouse industry, distribution centre, logistics and Oman industrial players. As such, numerous features can enhance future research on this topic for more accurate and meaningful to represent the logistics industry. As a result, the recommendation for the future research is to conduct a study focused on the Industry 4.0

technologies implemented in Oman warehouses, with a cost-benefit analysis to motivate the warehousing sector to use technologies.

CONCLUSION

The novel study investigated the level of awareness of the warehousing industry in Oman in relation to both global (Industry 4.0) and national (SOLS 2040) approaches. By having a high level of awareness in all aspects of change, the warehouse companies will be able to enhance their business strategy and operations with the supports of stakeholders and the surrounding business environments. As one of the crucial components in the logistics chain process, this sort of readiness could give significant competitive value to the warehouse business activity. In addition, Porter's value chain approach facilitates the warehouse company in conducting a self-evaluation study, which results in evaluating the strengths and weaknesses of the warehouse itself in terms of both primary and support activities. This self-evaluation study brings more value to the improvement of the warehouse to remain competitive in local, regional, and global markets. This study framework and findings are applicable internationally, subject to changes in each country's national vision/goals. This study contributes to the comprehensive literature, particularly in the study of warehouses from global and Oman perspectives. Furthermore, the study's reliability demonstrates that the finding is transferrable to stakeholders and will bring attention to warehouse operators, researchers, regulators, government, and all levels of private and public organizations to brainstorm for the development of this industry's success. Although the study's practical relevance extends beyond organizational and managerial needs in the warehouse sector, it is particularly useful in responding to the rising unpredictability of external factors in the warehouse business context.

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