



Warehouse Operation Breakthrough Transformation Towards Industry Revolution 4.0

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ABSTRACT

Warehousing operation is facing huge challenges in meeting tremendous growth of global e-commerce. Conventional ways of handling goods inventory and logistics at warehouse operation are no longer able to cope with phenomenal growth in volume and speed of execution requirement demanded by customers. This research focus on breakthrough transformations of warehouse operation towards Industry Revolution 4.0. The relationship between workforce competency, perceived usefulness and technology innovation factors and warehouse transformations were evaluated. The outcome of this research identified the critical factors and area of improvements which must be considered as the logistic companies embark on transforming warehouse operation towards Industry Revolution 4.0 technologies.

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1. INTRODUCTION

The Industrial Revolution4.0 (IR4.0) is a transformation of the manufacturing process that includes technological, socioeconomic, and cultural aspects [1]. Companies are implementing IR4.0 to keep up with the phenomenal growth of e-commerce and business supply chain complexities. According to Sony, M. and Naik, S. [2] implementing IR 4.0 requires significant changes in organizational structure and it also warrant to have new workforce competencies. Liboni et al [3], Pejic-Bach et al [4], emphasized the importance of IR4.0 and it became extremely critical to gain a thorough understanding of the necessary knowledge and skills for this rapidly changing technology. IR 4.0 has a significant impact on the logistics industry, with users inclined to

use the increasingly sophisticated internet technology. IR4.0, also known as the fourth industrial revolution, was coined in Germany in 2011 which referred to entirely autonomous automation and interrelated 21st-century technologies [5][6]. Countless technological advancements and industrialization have been enabled by the IR4.0 revolutions, leading to today's production and logistics operation systems [7].

Based on the Winkelhaus and Grosse [8], Logistics IR4.0 is defined as "the logistical system that enables the long-term satisfaction of individualized customer demands without increasing costs, and that supports this development in industry and trade through the use of digital technologies". Technologies associated with IR4.0 can assist the logistics sector in both physical operations such as handling of goods, warehouses and transportation as well as management activities such as resource planning [9]. Warehousing operations must be in continuous operation mode and without interruptions in order to ensure that every product ordered and delivery are fulfilled to meet customer demand.

Warehouse operations that are efficient and effective have a significant impact on both expenses related to logistics and service levels [10]. In addition, the technological sophistication provided by IR4.0 improved warehousing operations via implementation of an automatic system that control the integrated warehousing system. IR4.0 is a collection of diverse informational and operational technologies that work together to reach their full potential [11]. According to Kembro et al [12], receiving, put-away, storage, picking, sorting, packing, and shipping are parts of warehouse operations, Besides, increased in online purchase caused challenges in warehouse operation which includes handling of product returns by customers and cross-docking, which occurs when goods move directly from receiving to shipping. The main goal of logistics is to meet the needs of customers in a timely and cost-effective manner [13]. According to Perotti, et al [14], logistics operation, that has direct impact on organization's efficiency, service level, and customer satisfaction, must also be responsive to the requirements of the new IR4.0 manufacturing environment. According to Ali & Phan [5], the activities of planning, realizing, and monitoring the efficient, effective flow and storage of goods, services, and information from the point of origin to the point of consumption to meet customer needs, have been facing increasing challenges in terms of sustainable practices. This was also stated by Reiser [15], automation trend has also spread among retailers and logistics service providers worldwide, owing to increased competition and more mature and diverse technologies. Besides, the study demonstrates that publications frequently concentrate upon changes that emerge at the operation level, while ignoring both the tactical and strategic organizational levels [16]. Conventionally, warehousing operations were mostly manual, however stiff competition and demands on shorter lead times such as demand for same-day delivery, high product availability, and a variety of delivery and return options required improvements in shifting from manual to smart warehousing [17]. Given the importance of logistics as it affects the performance of manufacturing firms, it is critical to examine its evolution holistically, taking into consideration operational, human, and organizational improvement in addition to technological ones, to ensure a smooth transition towards Logistics IR4.0 paradigm [9].

2. METHOD

This research focused on identifying the critical factors that contributed in warehouse operation transformation towards IR4.0. A quantitative study was conducted utilizing structured questionnaires and cross sectional analysis of targeted respondents who are industry experts and involved directly in warehouse logistics operation. A research instrument in the form of self-administered questionnaires were utilized as a method to measure and analyze primary data from respondents related to the research topic and 5-point Likert scale was applied. The statistical analysis determined the relationship between workforce competency, perceived usefulness, technology innovation factors and warehouse transformation.

3. RESULTS AND DISCUSSIONS

Descriptive Analysis, Reliability Test, Normality Test and Correlation Test were conducted to validate and determine the relationship between independent and dependent variables and identify the influential determinant factors. Cronbach Alpha values of Reliability Test indicated that questionnaires instruments for all variables are within acceptable range. Normality Test results showed that the data distribution was non-normal, thus Spearman Correlation Test has been chosen to examine the correlation relationship of the variables.

Table 1. Statistics of Respondent Demographic

	Items	Frequency	Percentage (%)
Gender	Male	35	50.7
	Female	34	49.3
Department	Inventory Management	13	18.8
	Supply Chain Management	13	18.8
	Material Sourcing	6	8.7
	Transportation	7	10.1
	Order Fulfilment	9	13.0
	Warehousing	21	30.4
	Position	Logistic Manager	10
Logistic Officer		23	33.3
Material Analyst		10	14.5
Logistic Specialist		12	17.4
Storekeeper		14	20.3
Work Experience	<2 Years	13	18.8
	2 – 4 Years	27	39.1
	5 – 7 Years	23	33.3
	8 – 12 Years	5	7.2
	>12 Years	1	1.4
Years Of Service In Current Company	0 -1 Years	7	10.1
	1 – 3 Years	28	40.6
	4 – 10 Years	24	34.8
	10 – 20 Years	8	11.6
	>20 Years	2	2.9

Table 2. Results of Spearman Correlation Analysis

	Correlations	Warehouse Transformation
Workforce Competency	Correlation Coefficient	0.364**
	Sig. (2-tailed)	0.002
Perceived Usefulness	Correlation Coefficient	0.467**
	Sig. (2-tailed)	< 0.001
Technology Innovation	Correlation Coefficient	0.456**
	Sig. (2-tailed)	< 0.001

**Correlation is significant at the 0.01 level (2-tailed)

As summarized in Table 2, Perceived Usefulness factor was proven has the strongest positive correlation with Warehouse Transformation with a coefficient of 0.467, followed closely by Technology Innovation factor with a coefficient of 0.456, while Workforce Competency factor has weak positive correlation with a coefficient of 0.364.

4. CONCLUSION

Technological advancements along with the changes in IR4.0, enabled employee in warehouse operation to perform tasks more efficiently. As supported by Azman et al [18] in previous study, when employees are confident that a certain technology would improve their performance, they are more likely to embrace and use it. Furthermore, technological innovation also enhanced employee performance, as well as improving overall organizational performance. It not only transformed the warehouse operation towards automation, but it also includes the addition of data systems, Internet of Things (IOT), Artificial Intelligence (AI), Cloud Computing, Big Data and many more which are related to the latest technology systems, The

research findings add value to the logistics industry by providing key focus areas for the companies as they migrate from conventional logistic operation to the IR4.0 technologies such as automated material handling, fully integrated inventory management system and smart warehousing.

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DECLARATION OF COMPETING INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY

Data will be made available upon request.

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