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Warehousing Productivity Assessment on Logistics Service Sector

Karim Nur Hazwani[1*], Abdul Rahman Noorul Shaiful Fitri[2]
[1,2,]School of Maritime Business and Management, Universiti Malaysia Terengganu, Malaysia
*Corresponding author: hazwanikarim26@yahoo.com

ABSTRACT

Warehousing industry is a very crucial determinant of Malaysia and acts as an enabler and economic multiplier of the nation's trade-dependent. Warehousing has become less attention compared to other logistics service providers. This study intends to study the current development of the warehousing industry in Malaysia. Under the focus area of "Unleashing growth of logistics and enhancing the facilitation" in Eleventh Malaysia Plan 2016-2020, Malaysia desires to become the most preferred gateway to Asia. However, Malaysia was ranked 32nd out of 160 countries under the World Bank Logistic Performance Index (LPI) 2016 compared to their best ranked of the nation at 25th in year 2014. There are reasons for the decrement in the ranking have been well identified which was due to the warehousing productivity issue and warehousing infrastructure matters. A decision-making method of Analytic Hierarchy Process (AHP) will be in this research study. In addition, the objective of this paper is to rank the importance factors of warehousing productivity on logistics service sector in Malaysia have been determined by considering ten parameters. As a finding, this study also intends to propose a set of indicators to measure the warehousing productivity in this concept paper. This study contributes to the enhancement of warehousing productivity in order to achieve the Eleventh Malaysia Plan (2016-2020) as well as any other on-going policy related in the warehousing industry together to improve the supply chain.

Keywords: Logistics Service Sector, Warehousing, Warehousing Productivity Performance, AHP Method, Malaysia

Introduction

Warehousing subject has been chosen for this research study due to the fact that logistics acquire more and more attention. The warehouse is one of the important components in the logistics service sector due to its roles and functions in order to ensure the movement of goods/products can be completed in the efficient and effective way. Supply chain management consist logistics management system component as the warehousing and warehouse management is part of it.

World Bank Logistic Performance Index (LPI) announced that Malaysia was ranked 32^{nd} out of 160 countries in year 2016 compared to their best rank of the nation on 25^{th} in year 2014. Supported by the Ministry of Transport (2017). stated that low LPI is due to high logistics costs and unreliable supply chain which reduce a nation's competitiveness. Presently, to be the most preferred gateway in Asia and to be among the top ten in Logistic Performance Index (LPI) by World Bank in the year 2020 is highly hopes by the nation under the Eleventh Malaysia Plans, 2016-2020. However, Malaysia Productivity Corporation (MPC) (2017) has declared that the warehouse industry is less willing to innovate and make improvement to expand especially in efficiency and productivity of the warehouse. Hence, Malaysia Economic Planning Unit (EPU) (2015) mentioned that unleashing growth of logistics and enhancing trade facilitation are among the key initiatives in strengthening infrastructure to support economic expansion. By having these (MPC, 2017 and EPU, 2015) evidences, the problem for this research paper is due to the insufficiency of productivity performance in warehouse operation effect as a barrier in achieving Malaysia's high aspiration by year 2020. According to Bakar (2016) findings in order to understands the issues and challenges of logistics performance in Malaysia where there is poor awareness among leaders about logistics performance, especially on the components, measurements and World Bank reports of Logistics Performance Index (LPI) and to focus on the infrastructure and border management for growing development, demand of outbound and inbound activities.

Therefore, the objectives of this paper to study the current development of the warehousing industry in Malaysia and to rank the important factors of warehousing productivity in logistics service sector in Malaysia by considering ten parameters. As a finding, this study also intends to propose a set of indicators to measure the warehousing productivity in this concept paper.

Generally, performance refers to the way in which work is done either can be good performance or poor performance. Performance assessments in warehousing are needed to identify the options in operations and design that confer the greatest

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benefits. Productivity is a subject that has been discussed for many years, and nowadays it is being an awakening interest in productivity during performance measurement. Stainer (1997) then described the term productivity is often ill-defined but, basically, its measurement is that of a prescribed output to the resources consumed. National Council of Physical Distribution Management (1997) claimed that in observing the productivity is strictly focus on output/input measures as many relate more to the efficiency and utilization which are not covering all the indicators that are commonly used in logistics. It also recommends in today's complex environment; the measure should be more comparable and complete where to covering the use of all resources in which to be more sustainable.

Through the literature survey, Staudt et. al (2015) found that warehouse productivity consists of ten indicators as described in Table 1.

Table 1. Warehousing Productivity Indicators

Indicator	Definitions	Citation
Labour Productivity	The ratio of the total number of items managed to the amount of item-handling working hours	DeMarco and Giulio (2011) Attar et. al (2012)
Throughput	Items/hour leaving the warehouse	Mentzer and Konrad (1991) Kiefer and Novack (1999)
	Three components which are (i) waiting time for batching, (ii) waiting time for picking and (iii) time for picking	Schlyer and Gue (2012)
Shipping Productivity	Total number of products shipped per time period	Mentzer and Konrad (1991) Kiefer and Novack (1999) Cagliano et. al (2014)
Transport Productivity	Vehicle fill rate	O'Neill et. al (2008) Matopoulos and Bourlakis (2010)
Warehouse Utilization	The average amount of warehouse capacity used over a specific amount of time	Rimiene (2008) Johnson and McGinnis (2011) Wang and Yong (2010)
Inventory Space Utilization	The rate of space occupied by the storage	Ramaa et. al (2012) Rizzi and Zamboni (1996)
Outbound Space Utilization	Utilization of the area inside the warehouse used for retrieving, order picking, packing, and shipping	Johnson et. al (2010)
Picking Productivity	Total number of products picked per labour hours in picking activity	Kiefer and Novack (1999) Manikas and Terry (2010) Petersen et. al (2004)

Receiving Productivity	Number of vehicles unloaded per labour hour	Mentzer and Konrad (1991) Wang and Yong (2010) Faber et. al (2002)
Turnover	The ration between the cost of goods sold and the average inventory	Johnson and McGinnis (201) Yang and Chen (2012) Ballou (2000)

Methodology

Analytic Hierarchy Process

Prof. Thomas L. (1980) developed a method of Analytic Hierarchy Process (AHP) as it is one of Multiple Criteria Decision Making (MCDM) tool that is widely used in various studies. AHP is a method for ranking decision alternatives and selecting the best one when the decision maker has multiple criteria (Abdul Rahman, 2017). In other words, AHP is an effective tool for dealing with complex decision making that may help the decision maker to set priorities and make the best decision. This method has been prevalent used in various logistics and maritime fields for ranking decision in order to achieve their research goals as shown in Table 2:

Table 2. List of the previous study by sector applying AHP method

No.	Sector	Citation
1.	Maritime	i. Abdul Rahman (2012) ii. Malvindran et. al (2017) **iii.** Gaudenzi and Borghesi (2006)
2.	Logistics	i. Büyüközkan et. al (2018) ii. Abdul Rahman (2017) **iii.** Kahramanet et. al (2003)

How the AHP works

Step 1: Decision Maker compares the criteria or alternatives via linguistic terms shown in Table 3.

Table 3. Comparison Scale

Numerical Assessment	Linguistic meaning
1	Equally important
3	Weakly important
5	Fairly important
7	Strongly important
9	Absolutely important
2, 4, 6, 8	The intermittent values between two adjacent scales

Source: Saaty (1980)

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A set of evaluation criteria to be measure which the best decision is to be made. Then, the AHP generates a weight for each evaluation criterion according to the decision maker's pairwise comparisons of the criteria. The higher the weight, the more important the corresponding criterion.

Step 2: The judgment of pair criterion $\boldsymbol{A_i}$ and $\boldsymbol{A_j}$ are presented by an $n \times n$ matrix *D*. The $\boldsymbol{a_{ij}}$ entries are defined by entry rules as follows:

• Rule 1: If $\boldsymbol{a_{ij}} = \alpha$, then $\boldsymbol{a_{ji}} = 1/\alpha$, $\alpha \neq 0$.

• Rule 2: If $\boldsymbol{A_i}$ is judged to be of equal relative importance as $\boldsymbol{A_j}$, then $\boldsymbol{a_{ij}} = \boldsymbol{a_{ji}} = 1$.

According to the above rules, the matrix D is shown as follows:

$$\boldsymbol{D} = \begin{pmatrix} \mathbf{1} & \boldsymbol{a_{12}} & \cdots & \boldsymbol{a_{1n}} \\ \mathbf{1}/\boldsymbol{a_{12}} & \mathbf{1} & \cdots & \boldsymbol{a_{2n}} \\ \vdots & \vdots & \cdots & \vdots \\ \mathbf{1}/\boldsymbol{a_{1n}} & \mathbf{1}/\boldsymbol{a_{2n}} & \cdots & \mathbf{1} \end{pmatrix} \quad (1)$$

Where i, j = 1,2,3…, n and each $\boldsymbol{a_{ij}}$ is relatively importance criterion $\boldsymbol{A_i}$ to criterion $\boldsymbol{A_j}$.

Step 3: The weight vector indicates the priority of each element in the pair-wise comparison matrix in terms of its overall contribution to the decision-making process. This weight value can be calculated using Eq. 2 (Salleh, 2015).

$$W_k = \frac{1}{n}\sum_{j=1}^{n}\left(\frac{a_{kj}}{\sum_{j=1}^{n} a_{ij}}\right)(k = 1, 2, 3, \ldots, n) \quad (2)$$

where *aij* stands for the entry of row *i* and column *j* in a comparison matrix of order n.

Step 4: for a fixed criterion, the AHP assigns a score to each option according to the decision maker's pairwise comparisons of the options based on that criterion. The higher the score, the better the performance of the option with respect to the considered criterion.

Step 5: Saaty introduced the consistency index CI and the Consistency Ratio CR for the matrix, that should be calculated by the following Equation below:

$$CI = \frac{(\lambda_{max} - n)}{n-1} \quad (3)$$

$$CR = \frac{CI}{RI} \quad (4)$$

Where CI is the consistency index, RI is the average random index as shown in Table 4, *n* is the number items being compared, and λ_{max} is the minimum weight value of the *n* × *n* comparison matrix *D* (Abdul Rahman, 2017).

Table 4. Value of Averaged Random Index versus Matrix Order

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Source: Nataša Praščević, Živojin Praščević (2016)

According to Ramik (2009), for comparison of Fuzzy AHP with the well-known AHP method, consider the corresponding crisp matrix $\boldsymbol{A^M}$ taking into account the middle values of averaged summary pair-wise matrix comparison.

$$\lambda_{max} = \frac{\sum_{j=1}^{n}\left(\frac{\sum_{k=1}^{n} w_k a_{jk}}{w_j}\right)}{n} \quad (5)$$

Therefore, if $CR \leq 0{,}10$, the estimates of the elements of the vector *w* are acceptable. Otherwise, the consistency of the matrix *F* should be improved by changing values of some of its elements, taking into account that this matrix must

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be reciprocal (Praščević and Praščević, 2016). Saaty's method is based on a calculation of the maximal eigenvalue and corresponding eigenvectors and hence is known as the *eigenvector method.*

Discussion and Result

To rank the warehousing productivity accordingly

As the result, the second objective has been achieved where the warehousing productivity importance weights have been ranked accordingly. According to the weight value, the first highest score is the Receiving Productivity (C9), followed by Warehouse Utilization (C5) and the third highest score is Picking Productivity (C8).

Table 5. Averaged relative weight of criteria

CRITERIA	Weight	Rank
C1	0.1023	4
C2	0.0562	10
C3	0.0788	7
C4	0.0741	9
C5	0.1346	2
C6	0.0797	8
C7	0.0971	5
C8	0.1213	3
C9	0.1591	1
C10	0.0968	6
Total		

By conducting the equation (3), (4), and (5) as follows:

CR= $\frac{0.041}{1.49}$ = 0.03; <0.10. Then, the result is consistent and accepted.

In addition, this paper intends to discuss on the top three most important warehousing productivity.

i. Receiving Productivity (C9)

Most of warehouse inventory errors start in receiving process. In other words, a 10-fold effect on the rest of the warehouse process if a mistake in the receiving area occurred at the first place of the process. Some improvements shall be made during the receiving activity which these days human is still involved directly in the unloading cargo from trucks. The warehouse industry shall implement and adopt some technologies in the receiving areas in order to minimize the time during the unloading process. For instance, when unloading palletized cargo, electric rider pallet truck is used to ensure the truck is properly docked with emergency brakes and can handle the weight of cargo. Meanwhile, when unloading loose cargo, the use of a telescopic boom conveyor will reduce safety hazard and processing time.

ii. Warehouse Utilization (C5)

Warehouse utilization is where the warehouse shall be managed by an effective warehouse management system (WMS) that controls all of the resources in the warehouse into one control. Moreover, during this 21st century by adopting the e-commerce system and tools such as EDI, EFT, WWW integrated inventory system in supply chain and logistics industry (including warehousing) for better service to change in communication interaction and information. Therefore, the poor layout of the warehouse that insufficient for smooth and efficient workflow as well as the unused area shall be rent to other party for fully utilized.

iii. Picking Productivity (C8)

For more that 50 percent of operating cost of a warehouse involve in order picking process where it is the most of labour and time intensive internal used. In other words, the labour resources in outbound process typically involve in picking, packing and shipping as it makes sense to focus on these operations first. An automated picking had been implemented in the warehouse industry, yet still, need

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improvements in order to increase the picking productivity as well as to meet the customer satisfaction.

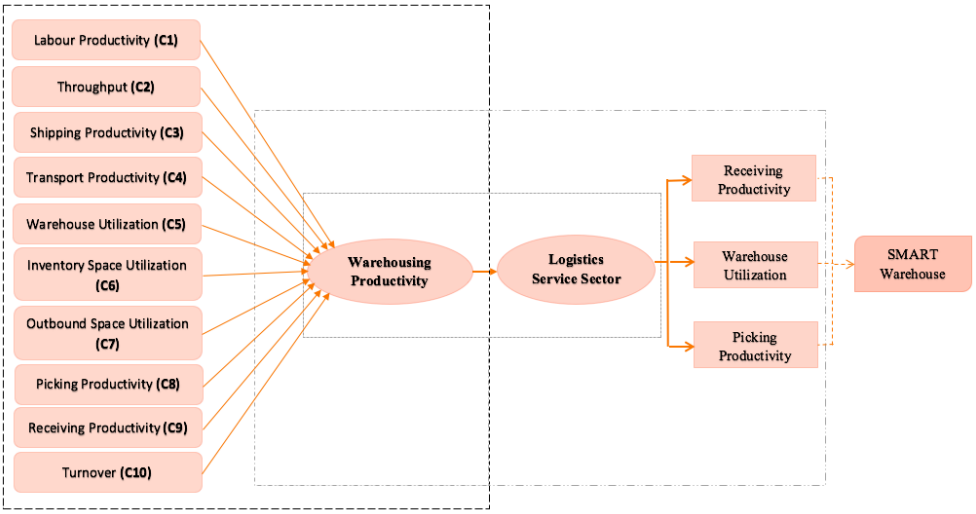

Figure 1. Integrations of the Findings

Consequently, as shown in Figure 1 the warehouse is the central element of logistics system that plays a crucial role for the whole supply chain management. In fact, warehouses are where the transport and storage facilities can be found as they are not just rooms/ space for storage goods. Warehouse operates on the same principles as logistics as it is part of logistics where the system overall need some improvements (Komarova, 2016) in the future in order to achieve the Malaysia's high aspirations.

To propose a new set of warehousing productivity

In achieving the second objective of this paper, the researcher had conducted an interview session with the experts. Hence, the experts accepted and ratified the ten parameters that had been recognized during the literature survey. On top of that, together with the experts had proposed the new parameters that shall be included in warehousing productivity measures.

i. Facility Productivity

The expert stated that

"Facility is one of the important element to be measured in warehousing productivity such as lighting, water supply, electricity, roof, gates, and refrigerators (for refrigerated cargoes) which are perfectly functioning to store and care of customer's cargoes".

This can be supported by Vogt and Pienaar (2007) addressed the design of the facility to achieve maximum efficiency once the supply chain has been determined. Sivitanidou (1996) described that facilities structures with at least twelve-foot ceilings with docking and loading.

ii. Equipment Productivity

The other expert stated that

"The need to consider equipment productivity such as material handling and machinery are under control and good maintenance to perfectly perform the operation without fail".

Frazelle (2001) mentioned that material handling equipment has a positive contribution to the performance of warehouse operation. Hence, the appropriate use of equipment can achieve a good level of performance.

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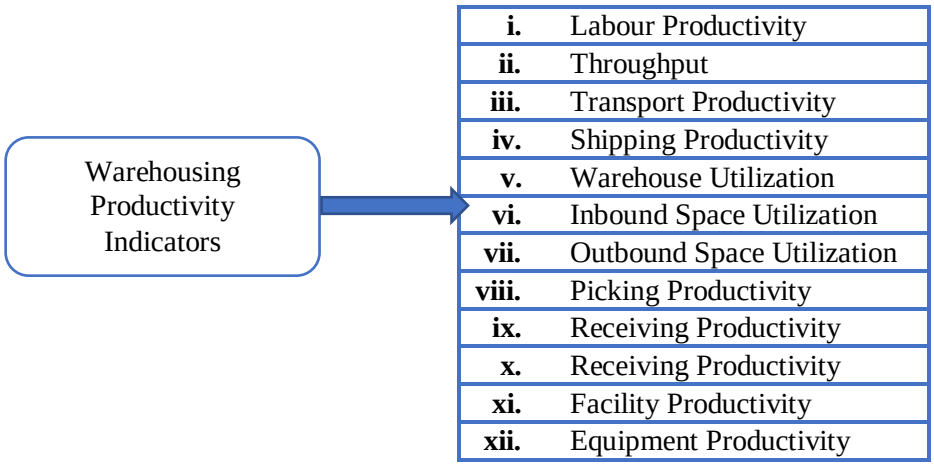

Figure 2. Proposed a set of warehousing productivity indicators.

Conclusion

In conclusion, warehousing industry is another part that need attention to be given by all levels of government, non-profit and private organization in order to sustain the Malaysian Economic Development by now or never. A looking forward in improving in technologies and organization shall be given more attention especially on these top 3 warehousing productivity (C9, C5, and C8) as well as the other indicators in moving together to enhance the warehousing productivity in a whole. Supported by Richards (2017) stated that by improving the information technology, automation of storage processes to increase flexibility, enabling warehouse operators to respond quickly to change and to assess the results of activities in a variety of settings. In fact, the improvements in efficiency and productivity in the warehouse operations will directly increase the logistics industry as the warehouse industry holds the same principle in the logistics service sector. Therefore, the logistics industry in Malaysia shall play the role in making our nation as ASEAN Logistics Hub with all the resources we have in order to sustain the competitiveness with the foreign logistics industry. Above all, all the logistics players especially the local warehouses in helping the nation to boost up Malaysia's rank in LPI by the year 2020.

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