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Role of Warehouse Attributes in Supply Chain Warehouse Efficiency in Indonesia

Kittisak Jermsittiparsert[a,b], Jutamat Sutduean[c], Thanaporn Sriyakul[d], [a]Department for Management of Science and Technology Development, Ton Duc Thang University, Ho Chi Minh City, Vietnam, [b]Faculty of Social Sciences and Humanities, Ton Duc Thang University, Ho Chi Minh City, Vietnam, E-mail: kittisak.jermsittiparsert@tdtu.edu.vn, [c]College of Innovative Business and Accountancy, Dhurakij Pundit University, Thailand, [d]Faculty of Business Administration, Mahanakorn University of Technology, Thailand,

Warehouse efficiency has now turned into a centre of competency or a strategic weapon among organizations. An efficient warehouse has the ability to fulfil customer needs quickly and increases a firm's performance. Thus, the objective of this study is to examine the role of warehouse attributes with regard to supply chain warehouse efficiency. Two warehouse attributes, namely; layout and operations are taken into consideration in this study. In addition, management information system (MIS) is investigated as a meditating variable between warehouse attributes and supply chain warehouse efficiency. Indonesian supply chain companies are the focus and data is gathered by collecting the opinion of supply chain company staff through questionnaire surveys. Data was examined by using the latest statistical techniques, namely; PLS-SEM. Findings of the study highlight that warehouse attributes have a positive influence on supply chain warehouse efficiency. Proper warehouse design and effective operations increase the warehouse efficiency among Indonesian supply chain companies. In addition, it is found that MIS is one of the mediating variables between warehouse attributes and supply chain warehouse efficiency.

Key words: *supply chain, warehouse attributes, warehouse layout and operations, efficiency.*

Introduction

Supply chain warehousing is an important element of the supply chain process (Banabakova, Latyshev, Georgiev, & Stoyanov, 2018; Jaehrling, 2018). Typically, problems in supply chain warehouse efficiency and supply chain management are not expansively considered after business globalisation development takes place (Ali, Jaafar, & Mohamad, 2008; Osman & Hariri, 2009; Olowa, 2018). These problems keep developing with the growth of logistics in a company that becomes more complicated, which was aggressive practice after the 1990s (Gundlach, Bolumole, Eltantawy, & Frankel, 2006). This has particularly became more serious in the last two decades among supply chain, where the warehouse has become a vital part of the main logistics service companies (Coyle, Bardi, & Langley, 2003; De Koster, Le-Duc, & Roodbergen, 2007).

Tompkins (1998) portrayed that warehouse efficiency has now turned into a centre of competency or a strategic weapon that numerous organizations use to improve their situations in the market. In the meantime, warehouse efficiency is experiencing unconceivable difficulties that influence progress toward excellence. Earlier, warehousing was seen as a steady industry to other functional areas, however it is presently viewed as a strategic industry in itself (Gundlach et al., 2006; Sum, Teo, & Ng, 2001).

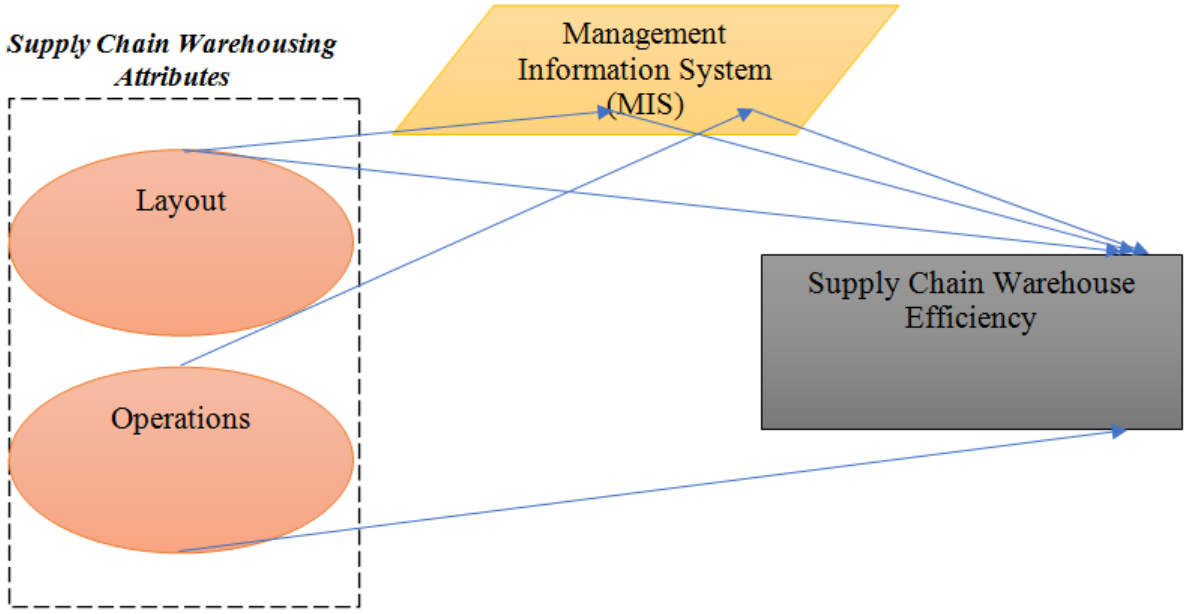
In the present worldwide environment, supply chain ideas and competitiveness have extraordinarily changed warehouse efficiency perspective regarding the ability to enhance a firm's operational activity (Harmon, 1993). Hamel and Prahalad (1994) explained that this improvement happened because business exercises became more complex in a contemporary climate where competition is an opportunity for sharing practice rather than market sharing. The massive difficulties faced in warehouse efficiency require considerably more expert methodologies than the recently embraced activities in arranging and enhancing today's warehouse tasks (Hompel & Schmidt, 2006; Smith, 1998).

Today most of the supply chain companies are facing warehouse issues (Manzini, 2012). These issues adversely effect supply chain activities which ultimately effect performance. As a certain level of performance is important to survive in the market (Nadeem, Alvi, & Iqbal, 2018), therefore logistic companies must resolve warehousing issues to increases performance. Indonesian supply chain companies are also facing these challenges (Herliana

& Parsons, 2011; Okon, 2016). Increased issues play a negative role in supply chain performance. However, these issues can be handled by focusing on warehouse attributes.

Various researchers have investigated supply chain warehousing (Baker, 2007; Mason, Ribera, Farris, & Kirk, 2003; Haseeb et al., 2019), however, the literature is not well represented with regard to warehousing attributes. It is necessary to study warehousing attributes to overcome different challenges related to supply chain warehousing. Thus, the objective of this study is to examine the role of warehouse attributes on supply chain warehouse efficiency. Additionally, management information system (MIS) is taken as a meditating variable between warehouse attributes and supply chain warehouse efficiency as MIS has significant a relationship with warehousing (Nee, 2009). Two warehouse attributes, namely; layout and operations are the focus in this study. The relationship between warehouse attributes and supply chain warehouse efficiency is shown in Figure 1 below.

Figure 1. Theoretical framework of the study showing the relationship between warehouse attributes and supply chain warehouse efficiency



Literature Review

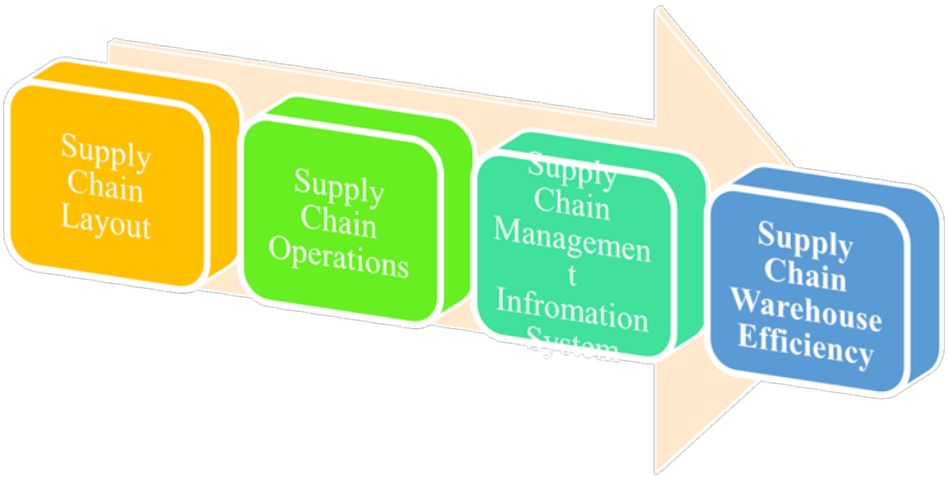
The warehouse connection with efficiency assumes an essential role particularly in the assembling businesses (Bartlett & Ghoshal, 1995; Hout & Carter, 1995). Lambert, Cooper, and Pagh (1998) portrayed that warehouse exercises are increasingly cantered around the capabilities of the operations. This could fulfil client desire in the shorter period of time and

increase reliability as well as accurcy. There is an essential link between the end client and the producer that have experienced the warehouse exercises. Warehouse operations effect the supply chain warehouse efficiency.
Likewise, Stock (2001) supported that the organizations need to concentrate on the enhancement of warehousing efficiency in stock turnovers and spending orders from assembling to ultimate delivery. Thus the most critical job in a firm is identification of the warehousing capacities for material development, stockpiling, and data exchange (Adam, 2012). These elements such as material development, stockpiling, and data exchange play important role in supply chain warehouse efficiency. Smoothness in these factors increases the warehouse efficiency (Talamo and Sabatino, 2018).

The connection between the warehouse and its efficiency is considered critical amongst the most basic practices in supply chain coordination among companies and businessmen as it has the potential to reduce cost (Lambert et al., 1998). Lambert et al. further described that these are the exercises with huge potential that effect consumer loyalty and are a successful marketing weapon that could be utilized to gain competitive advantage. Therefore, warehouse efficiency is important to gain competitive advantage.

Warehouse efficiency is generally based on warehouse attributes. In the current study two main attributes are referenced from the literature, an examination of which found that layout and operations are the key attributes in which MIS has a significant role as shown in Figure 2 below. According to Adam (2012), layout and operations has a positive effect on warehouse efficiency. Additionally, he revealed that MIS is another important factor which effects the relationship between warehouse attributes and supply chain warehouse efficiency. A good MIS system provides ease to the employees which increases the satisfaction level and improves performance (Laudon & Laudon, 2016; Shah, Ali, Dahri, Ahmed, & Brohi, 2018).

Figure 2. Supply chain warehousing



Warehousing Layout Relationships with Efficiency

Frazelle and Frazelle (2002) referenced that the procedure of laying out a warehouse is like putting a puzzle together and the puzzle-building procedure is characterized by profiling, benchmarking, streamlining, computerisation, and automation warehouse operations. A proficient warehouse layout adds to the decrease in production cycles, work-in-advance, idle times, number of bottlenecks, or potentially material taking care times (Bartholdi III & Hackman, 2008; Johnston, 1995; J. Tompkins, 1996). This consideration of layout would at least increase the yield with positive consequences on profitability. The area of the assembling hardware, warehouse, and parking zones for work forms are a portion of the central point to be considered in the meaning of the material management system. The plan for the management of warehousing layout undoubtedly influences the efficiency of the whole system, as the management of warehousing layout plays a critical job in the business achievement of the organization (Bartholdi & Hackman, 2008; Gelders et al., 1992).

Bartholdi and Hackman (2008) posed that choosing the best warehousing layout productively is definitely not a trivial issue because many factors influence warehousing activity achievement including for example, dock area, rack types, rack access, and others. However, Faber, de Koster, and van de VELDE (2002) state that the warehousing layout should be standardized to defeat administration limitations on expenditure. Other related issues, for example, security, labour, offices, framework, correspondence, stock and control need consideration. There should be flexibility to provide goods for any requests or demands by clients or providers for their inventories. Therefore, warehouse layout has central importance in supply chain warehouse efficiency.

Moreover, Mohsen and Hassan (2002) referenced that structuring the layout of a warehousing framework is a complex process due to a number of reasons. These include structure choices which are substantial and significantly which involve a combination of issues that are hard to resolve. Numerous operations (picking, double direction, cross docking, and value addition services) and elements (request, physical attributes of things and unit loads, serving worldwide markets, material taking care, and Just-in-Time (JIT), travel time, material taking care expense, and throughput in a warehouse) are included in this further consideration. Such operations and components should be represented in an extensive structure of warehousing layout, so they could bolster every single operational change without turning to visit alterations which would improve the plan. These operations should be considered and represented in the layout structure productively (Mohsen & Hassan, 2002). Thus, warehouse layout design is a most crucial art of supply chain warehousing and is an important element to increase warehouse efficiency in supply chain companies.

H1: Layout has positive effect on supply chain warehouse efficiency.

Warehousing Operations Relationships with Efficiency

The second attribute of warehousing, namely; operations has a further important role in supply chain warehousing efficiency as it is commonly found that effective operations increase system efficiency (Potočan, 2006). As per Frazelle and Frazelle (2002), organizations that need to execute lean operations start with a time study and investigation of the request satisfaction procedure to enhance efficiency in warehousing. They have to deal with the normal process duration to process orders from start to finish, recognize value-added and non-value-added components, and decide the time consumed by each. This is to compute the value-added proportion as a general sign of the potential enhancement and after that evaluate work process for bottleneck, wasted motion and equipment availability (Frazelle & Frazelle, 2002).

Corinna Cagliano, DeMarco, Rafele, and Volpe (2011) explained that warehouse operations and efficiency are fundamental. They state that getting, exchanging, taking care, capacity, pressing, and speeding up operations at the warehouse specifically influence the viability of an organization as a whole and its quality. Also, the increasing need to enhance supply chain performance has compelled warehouse management to concentrate on incorporating their efforts (Corinna Cagliano et al., 2011). Therefore, warehouse operational effectiveness has a positive relationship with supply chain warehouse efficiency.

H2: Operations has positive effect on supply chain warehouse efficiency.

Warehouse Management Information System (MIS)

Lucey (1997) defined MIS as the mixture of various human as well as computer based resources. It is the category of storage, communication, retrieval as well as utilization of specific data for efficient management of different operations including business planning. Haag, Cummings, and Philips (2007) defined MIS as related to management, development and planning and the utilization of IT tools to assist people to perform all tasks associated with information processing and whole system management. Moreover, MIS should be able to streamline quick decision-making process. Therefore, MIS should also be sufficient of in provision as well as distribution of required information to relevant users. Generally, it is designed to report various information which allows the organisation to rapidly collection and edit data, approach results, and correct errors quickly (Handbook, 1995). Therefore, it has the ability to increases the efficiency of supply chain warehouse. MIS highlights the positive effect of warehouse layout and operations on supply chain warehouse efficiency.

On the other hand, McLeod and G. (201) viewed MIS as a computer (PC) based framework that makes data accessible to clients with comparable requirements that occurred previously and will occur in the future. The data is made accessible as reports and results in numeric from. Oz (2009) summarized that the components of MIS in such procedures incorporate equipment, programming, preparing of staff and appropriate technique used in PC operations including the most recent information and most recent broadcast communications organization, for example, email and the Internet. Therefore, MIS facilitates warehouse operations. By using human resources and computer systems, it increases the efficiency of operation within the warehouse which ultimately increases the supply chain warehouse efficiency. It also facilitates the warehouse layout which has positive effect on supply chain warehouse efficiency. Therefore, from above discussion the below hypotheses are proposed;

H3: MIS has positive effect on supply chain warehouse efficiency.
H4: MIS mediates the relationship between layout and supply chain warehouse efficiency.
H5: MIS mediates the relationship between operations and supply chain warehouse efficiency.

Research Methodology

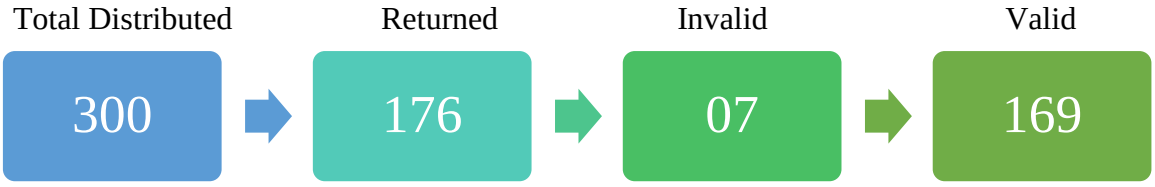
How to choose a most appropriate research method is one of the crucial questions in every research study. It should be consistent with objectives as well as the nature of the research. As this study examined the role of warehouse attributes on supply chain warehouse efficiency, a survey was carried out. The survey was designed to collect the opinion of

supply chain company staff related to the relationship of warehouse attributed and supply chain warehouse efficiency.

By utilizing cross-sectional research design, 300 questionnaires were decided for distribution in Indonesia supply chain companies. A simple random sampling technique was utilized to distribute all questionnaires. 300 questionnaires were used to collect data from employees. First of all, the lists of employees were collected from these companies. However, it was not possible to get lists of all companies in Indonesia because the employee data of supply chain companies was confidential. The lists of employees were received just to select the respondents and respondents were selected randomly. After selection of respondents, the questionnaires were distributed by self-visit to supply chain companies. This survey was completed in 3 months, between June 2018 and August 2018.

The survey questionnaire was divided into different sections. The first section of the questionnaire was based on the profile of respondents and the second section was based on the items related to the independent variables. The third section was based on dependent variables. Finally, the fourth section was based on items related to the mediating variables, namely; MIS. From all distributed questionnaires, 169 valid responses were returned and collated to get results. Figure 3 below shows the response rate.

Figure 3. Response Rate



Analysis, Results and Findings

Partial least square (PLS) is used to examine the data. Structural equation modelling was preferred to obtain end results. It is a commonly used tool in social sciences research based on two major steps which were recommended by Henseler, Ringle, and Sinkovics (2009). These steps are:

1. Measurement model assessment
2. Structural model assessment

Measurement model assessment is used to examine reliability as well as validity. Reliability includes, composite reliability, factor loadings and Cronbach alpha. Structural model assessment includes the significance of path coefficients.

Following the suggestions of various prominent studies such as Hair Jr, Hult, Ringle, and Sarstedt (2016) and C. M. Ringle, Wende, and Becker (2015), measurement model was assessed and found that all items have a factor loading higher than 0.5, a minimum threshold level for items retention. The items having a value of less than 0.5 were deleted. Reliability is also found above 0.7 and average variance extracted (AVE) also above 0.5 which validates the convergent validity, see Figure 4 and Tables 1 and 2 below.

Figure 4. Confirmatory factor analysis

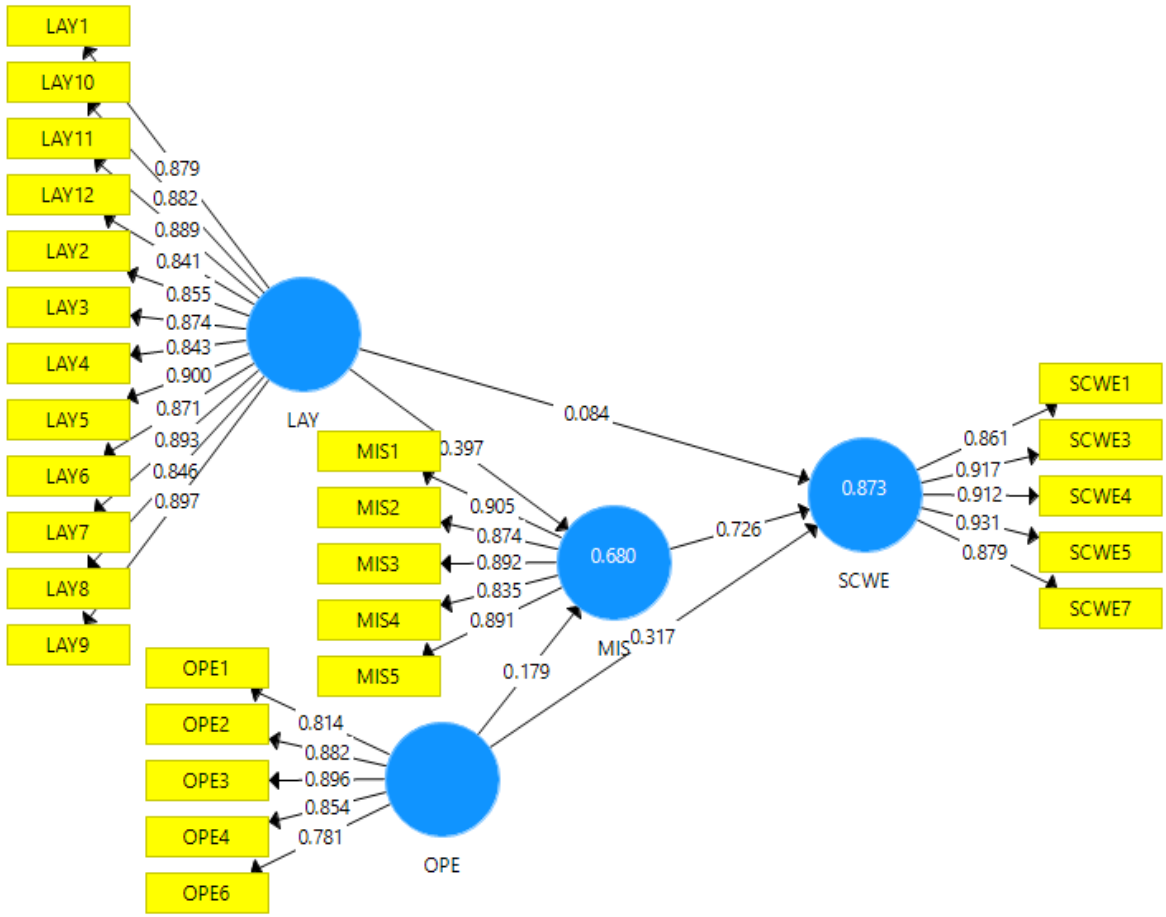


Table 1: Factor Loadings

	LAY	MIS	OPE	SCWE
LAY1	0.879			
LAY10	0.882			
LAY11	0.889			
LAY12	0.841			
LAY2	0.855			
LAY3	0.874			
LAY4	0.843			
LAY5	0.900			
LAY6	0.871			
LAY7	0.893			
LAY8	0.846			
LAY9	0.897			
MIS1		0.905		
MIS2		0.874		
MIS3		0.892		
MIS4		0.835		
MIS5		0.891		
OPE1			0.814	
OPE2			0.882	
OPE3			0.896	
OPE4			0.854	
OPE6			0.781	
SCWE1				0.861
SCWE3				0.917
SCWE4				0.912
SCWE5				0.931
SCWE7				0.879

Table 2: Composite Reliability, Cronbach Alpha and AVE

	α	rho_A	CR	(AVE)
LAY	0.971	0.972	0.975	0.761
MIS	0.927	0.928	0.945	0.774
OPE	0.901	0.91	0.927	0.717

SCWE	0.941	0.943	0.955	0.810

Moreover it is of note that there are various methods to determine discriminant validity, such as cross loadings and the heterotrait-monotrait (htmt) ratio. However, this study utilized Fornell-Larcker criterioa where the square root of AVE is measured. It is evident from Table 3 below that the square root of AVE is higher which confirms the discriminant validity.

Table 3: Square Root of AVE

	LAY	**MIS**	**OPE**	**SCWE**
LAY	***0.873***			
MIS	0.696	***0.880***		
OPE	0.727	0.811	***0.846***	
SCWE	0.715	0.724	0.728	***0.700***

After the analysis of measurement model, structural model assessment was carried out with the help of PLS bootstrapping techniques as recommended by Henseler et al. (2009) and C. Ringle, Wende, and Will (2005). It was noted as a recommended step to test the direct and indirect hypotheses based on previous studies. The results of the study show that layout and supply chain warehouse efficiency is significantly positive with t-value 2.876 and $\beta = 0.084$. Moreover, operations and supply chain warehouse efficiency are significantly positive with t-value 2.489 and $\beta = 0.317$. Similarly, a significant positive relationship is found between MIS and supply chain warehouse efficiency with t-value 11.388 and $\beta = 0.726$. Additionally, the relationship of layout and operations with MIS were found to be significantly positive. These results supported H1, H2 and H3.

The indication is that layout and operations have a direct relationship to supply chain warehouse efficiency. Further warehouse layout and warehouse operations affect supply chain warehouse efficiency. Moreover, the moderation effect of MIS was also found to be significant between layout and supply chain warehouse efficiency (t-value 2.884 and $\beta = 0.288$). Similarly, mediation effect between operations and supply chain warehouse efficiency was found to be significant (t-value 5.282 and $\beta = 0.856$). Therefore, MIS mediates the relationship between warehouse attribute and supply chain warehouse efficiency which supports H4 and H5. See Figure 5 and Tables 4, 5 and 6 below which show the quality of the model as the Q^2 value is above zero (Chin, 1998). Furthermore, the r-square value 0.873 which is substantial.

Figure 5. Structural model analysis

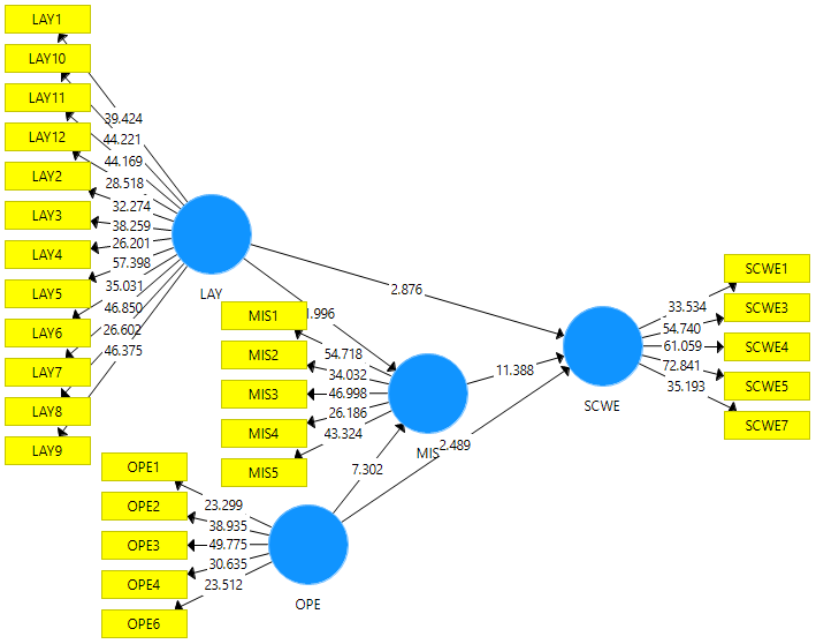


Table 4: Direct hypotheses results

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
LAY -> MIS	0.397	0.371	0.199	1.996	0.047
LAY -> SCWE	0.084	0.076	0.030	2.876	0.009
MIS -> SCWE	0.726	0.715	0.064	11.388	0.000
OPE -> MIS	1.179	1.158	0.161	7.302	0.000
OPE -> SCWE	0.317	0.320	0.127	2.489	0.013

Table 5: Mediation effect

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
LAY -> MIS -> SCWE	0.288	0.272	0.101	2.884	0.060
OPE -> MIS -> SCWE	0.856	0.833	0.162	5.282	0.000

Table 6: Predictive Relevance (Q^2)

	SSO	**SSE**	**Q^2 (=1-SSE/SSO)**
MIS	1,085.00	546.479	0.496
SCWE	1,085.00	357.679	0.67

Conclusion

This study investigated how warehouse attributes effect supply chain warehouse efficiency. This study highlights the fact that supply chain warehouse attributes make a key contribution in supply chain warehouse efficiency by demonstrating the positive effect on efficiency. Further, a well-designed layout of a supply chain company warehouse increases the efficiency by fulfilling customer needs quickly. Together with warehouse layout, warehouse operations have a crucial role to play in enhanced efficiency. Both layout and operations work side by side to increase overall supply chain warehouse efficiency. Without effective warehouse layout design and operations, it is hard to increases warehouse efficiency and company performance. Therefore, it is recommended that Indonesian companies must insure warehouse layout and operation at optimum functionality. Future research is required to introduce open innovation strategies (Hameed, Basheer, Iqbal, Anwar, & Ahmad, 2018) in the current model of this study. Open innovation activities such as external knowledge from customers, partners and suppliers enhance internal ideas as well as innovation which can produce better solution to manage warehouse layout and operations. Hence, open communication between employees can generate new ideas for warehousing.

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