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Optimize Feeder Supply Operation and Efficiency Ratio through MHDS (Material Handling Design Simulator) Analysis

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Abstract:- On-time supply by ensuring the material description is correct and the correct quantity becomes the main KPI. To optimize the performance of the feeder, we must do a more detailed analysis so that the operational and efficiency ratio of their performance increases. In this study, an analysis using the MHDS (Material Handling Design Simulator) system was used, namely modeling all aspects of support including Layout analysis, scale supply analysis, modeling depots, WIP modeling, MHE (Material Handling Equipment) modeling and route modeling. from the results of the improvements made, the increase in Operational ratio 80.06% to 86.23% and the efficiency ratio of 75.82% to 84.63% .

Keyword:- *Supply Chain Management, Feeder Supply, Operational Ratio, Efficiency Ratio, MHDS.*

I. INRODUCTION

The industrial revolution is growing rapidly and has spread throughout the world (Ashworth, 2014). which was marked by increasing connectivity, interaction and boundaries between humans, machines and other increasingly complex resources through information and communication technology (Minister of Industry Airlangga Hartarto at the Industry 4.0 Implementation Roadmap Socialization event in Jakarta, Tuesday (20/3/2018) (http://www.kemenperin.go.id/artikel/18963/Sosialisasi-Roadmap-Implementasi-Industry-4.0).

The first industrial revolution used water and steam as a driver of production machinery (Mouhot, 2011). The second industrial revolution uses electricity to produce mass production (Chu and Majumdar, 2012). The third industrial revolution uses the advancement of electronics and IT in computing and networking, with artificial intelligence to automate production (Ahmed, 2015). Throughout the world, not only has it entered but there have been many implementations of the third industrial revolution, we are now entering the Fourth Industrial Revolution. The fourth industrial revolution is now the development of the third industrial revolution, namely the digital revolution that has occurred since the middle of the last century. This is characterized by convergence, and a combination of technologies that we usually call virtual environment (Gabriel and Pessl, 2016). This has an impact on the whole system both, the country, the company and society as a whole. Compared to the previous industrial revolution, the fourth was developed on exponents, not linear. Certainly making new problems for every industry in the world, and the breadth and depth of these changes are related to the transformation of the entire system of production, management and governance. This causes increasingly fierce competition to seize the position of market leader. Increasingly fierce competition in the global market, product innovation that has an increasingly short life cycle, as well as higher customer expectations forces all companies to invest and focus on their supply chain (Hilman et al, 2012). Production optimization is one the basic thing in order to achieve optimal production results (Prasmoro& Hasibuan, 2018)

PT. ABCDE company is one of the companies with global marketing, to meet market needs, the timely supply of goods to customers is the key to the main performance index. In the supply chain there are several main players who are companies that have the same interests, namely: 1. Supplies, 2. Manufactures, 3. Distribution, 4. Retail Outlets and 5. Customers (Anwar, 2013). In carrying out a work process activity a method is needed that can increase productivity, namely by replacing existing work methods by considering the factors that influence the work activity. Another way to do this is to further optimize labor and material movement (Habibi, et al, 2015).

From the beginning to the end, the process of material flow will be classified into three stages, namely: a. Movement of movement of all elements (material/part) starting from the original source to the factory that will manage it, b. Movement of displacement of material/parts in or around the plant during the production process takes place, c. Movement of movement which includes distribution activities from the finished product produced to the location of the buyer or consumer (Habibi, et al, 2015). Specifically in this case we will learn about the movement of the material/parts in or around the plant during the production process, the supply chain of goods in the company line is still needed improve how to supply raw material from the depot to the production line so it is not too late. the indicators used to calculate the success of the improvements made can be seen from the increase in Operational ratios and feeder supply material efficiency.

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II. LITERATURE REVIEW

A. *Supply Chain Management*

Understanding Supply Chain Management in general can be explained as the integration of activities that start from the procurement of goods and services, convert raw materials into goods in process and finished goods, and deliver these goods to their customers in an efficient manner. Some basic definitions of Supply Chain Management is as follows:

- Simchi and Zhao (2003): "Is set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouse and stores, so that merchandise is produced and distributed to the right quantities right locations and at the right time, in order to minimize system wide cost while satisfying service level requirement. "
- Hanfield and Nichols (2002): "Is the integration and management of supply chains organization and activities through cooperative organization relationship, effective business process, and high levels of information sharing to create high-performing value sistems that provide members organizations a sustainable competitive advantage ".

In Swaminathan et al. (1998), Henkoff (1994) mentions that supply chain management is a process where the company moves material, components and product to customer. In the operational definition the previous supply chain definition is contained three aspects that need to be considered are as follows.

- Supply Chain Management is an approach used to achieve efficient integration of suppliers, manufacturers, distributors, retailers, and customers. This means goods produced in the right amount, at the right time, and at the right place with the aim of achieving costs from the system minimum overall and also reach the level of service desired.
- Supply Chain Management has an impact on control cost.
- Supply Chain Management has an important role in improve the quality of company services to customers.

Supply Chain Management involves many parties in it, both directly or indirectly in an effort to fulfill consumer demand. Here the supply chain does not only involve manufacturing and suppliers, but also involves many parties, such as consumers, retailers, wholesalers, producers and product transporters.

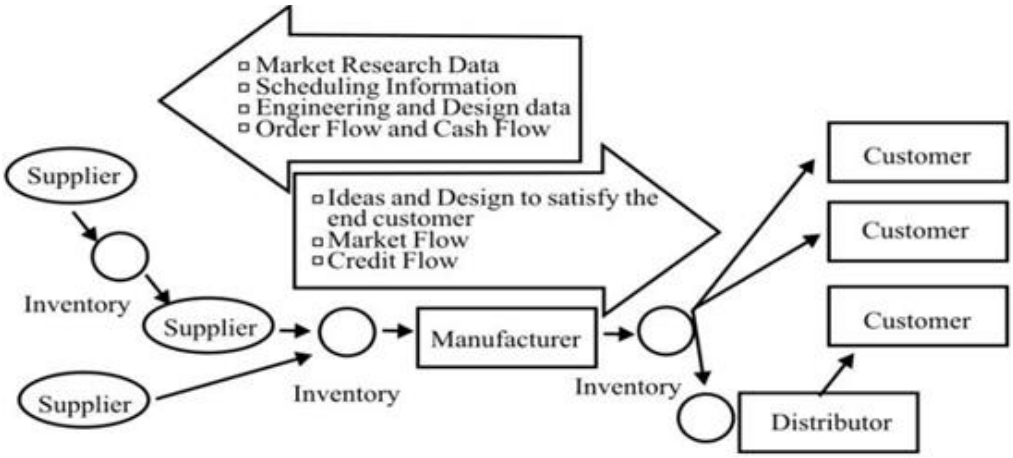

Fig 1:-. Material Flow Process (Henkoff, 1994).

Supply Chain Management comes from various scientific disciplines, and there are various definitions (Li et al., 2006). The concept of Supply Chain Management comes from the management of purchasing and supply, and transportation and logistical management (Li et al., 2006; Tan et al., 1998). According to Wisner & Tan (2000) and Reck & Long (1988), Supply Chain Management is a basic strategy of business processes, compared to certain support functions. From the perspective of transportation and logistics management is the overall integration of the logistics system, and focuses on reducing inventory in both organizations and between organizations in the supply chain (Fiseher, 1997; Lamb, 1995). In this case, Supply Chain Management is integrated logistics into business strategy decisions (Carter & Ferrin, 1995). The combination of the two perspectives eventually becomes integrated Supply Chain Management together in the overall supply chain activity (Li et al., 2006; Tan et al., 1998).

The supply chain shows the existence of a long chain that starts from suppliers to customers, where there is an entity involvement or called players in this context in a very supply chain network the complex. The following are the main players involved supply chain (Indrajit and Djokopranoto, 2002):

- *Chain 1: Supplier*

The network starts here, which is source that provides the first ingredient, where new distribution chain will start. First ingredient this can be in the form of raw materials, raw materials, auxiliary materials, merchandise, spare parts and etc.

- *Chain 1-2-3: Suppliers - Distribution*

Items that have been produced by manufactures have started to be distributed to customer. Although there are many ways available to distribute goods to customers, which general is through distributors and this is usually taken by most supply chains.

➢ *Chain 1-2-3-4: Suppliers - Distribution-Retail-Outlet*

Wholesalers usually have facilities own warehouse or can also rent from the party other. This warehouse is used for storing goods before being distributed again to the retailer. Here is an opportunity to obtain savings in the form of inventory amounts and warehouse costs by doing design return the pattern of sending good goods from the warehouse manufacture and to retail stores.

➢ *Chain 1-2-3-4-5: Suppliers – Customer - Distribution-Retail- Outlet.*

Retailers or retailers offer goods directly to customers or buyers or direct goods users.

According to Jebarus (2001), Supply Chain Management is a further development of product distribution management to meet consumer demand. This concept emphasizes an integrated pattern that involves the process of product flow from suppliers, manufacturers, retailers to consumers.

➢ *Upstream Supply Chain*

Covers the activities of a manufacturing company with its suppliers and their connections to their suppliers. The main activity is procurement.

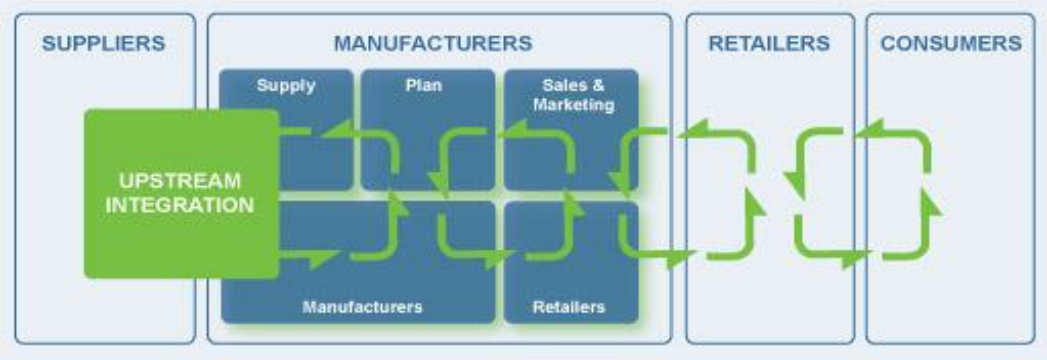

Fig 2:-. Upstream Supply Chain (Jebarus, 2001).

➢ *Internal Supply Chain*

Includes all in-house processes used in transforming input from suppliers into the organization's output. The main activities are management of production, fabrication and inventory control.

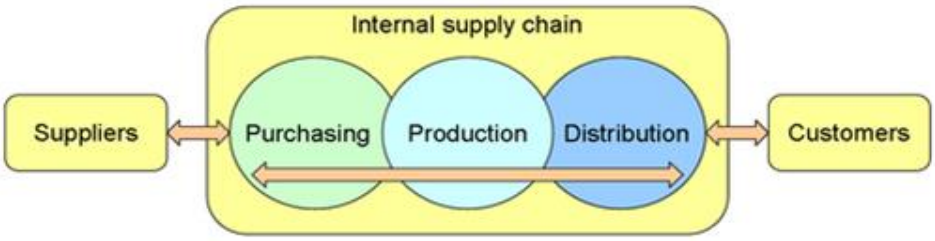

Fig 3:- Internal Supply Chain (Jebarus, 2001)

➢ *Downstream Supply Chain*

Includes all activities involving the delivery of products to end customers. Activities are directed at distribution, warehousing and after-sale service.

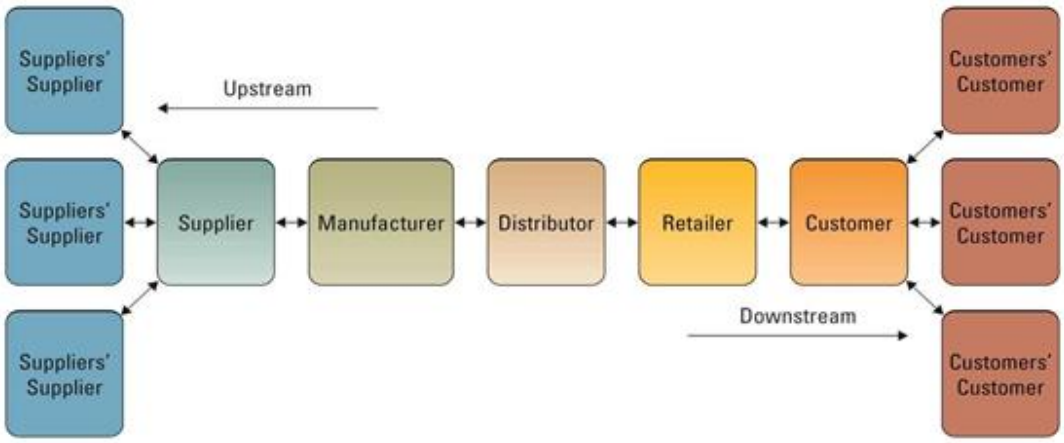

Fig 4:-. Downstream Supply Chain (Jebarus, 2001)

From here the activity of suppliers to end consumers is in a single unit without a large divider, so that the information mechanism between the various elements takes place transparently (Anoraga, 2009). Supply Chain Management is a concept concerning the product distribution pattern that is able to replace product distribution patterns optimally. This new pattern involves distribution, production and logistics activities. Meanwhile, according to Jay Hezer and Barry Render, supply chain management is the management of activities related to the procurement of materials and services, turning them into semi-finished goods and end products, and delivering them through a distribution system (Widyarto, 2012). The purpose of supply chain management is to coordinate activities in the supply chain to maximize competitive advantage and the benefits of the supply chain for end consumers (Heizer & Render, 2008).

B. Logistic

The purpose of supply chain management is to improve efficiency and minimize costs for the entire system. The system in question is all activities and components from transportation to distribution and from raw goods to finished goods. Supply Chain is integrated from suppliers, manufactures, warehouses and stores. This includes activities at each level in the company, starting from strategy planning to operational implementation. (Simchi-Levi and Kaminsky, 2008).

The Council of Logistics Management defines logistics as: Logistics is part of the supply chain process by planning, implementing, and controlling efficient, effective flow and storage of goods, services, and related information from the origin to point-of-consumption in order to meet customer needs, this definition implies that logistics is part of SCM. Some of the problems that often occur in supply chain management are as follows (Simchi-Levi et al, 2008):

- Supply chain cannot be determined in an isolated environment, because it is directly influenced by other components contained in the company's supply chain.
- The challenge is in the supply chain is when designing and running it so that the total cost of the system can be minimized besides the level of service satisfaction continues to be improved.
- In the supply chain there is uncertainty and inherent in every component in it.

The purpose of the supply chain directly supports its objectives; as always the goal of manufacturing supply chains can increase revenue through eliminating or reducing operating barriers in the system. The supply chain objectives that directly support this goal can be identified as: 1). Increase throughput 2). Reducing cycle time 3). Reducing inventory at various stages (Raw material - work-in-process - finished goods). 4). Reducing overall capital 5). Procrastination Management.

C. Stock

Inventory term is a general term that shows everything or organizational resources that are stored in anticipation of meeting demand. Inventory system is a series of policies and controls that monitor inventory levels and determine the level of inventory that must be maintained, when to be maintained, when inventory must be filled and how much order to do. This system aims to establish and guarantee the availability of appropriate resources, in the right quantity and at the right time. Or in other words, the system and inventory model aims to minimize total costs through determining what, how and when the order is carried out optimally (Anoraga, 2009). While the forms of inventory can be distinguished as follows:

- Raw materials, namely items received (commonly purchased) from outside the organization that are used directly for the production of final products.
- Intermediaries include spare parts, supplies and so on
- Goods in process are all materials or goods that are being processed or waiting to be processed in the production system
- Finished goods are products that have been processed and are ready for sale

D. Operational and Efficiency

Efficient is appropriate or appropriate to work on or produce something by not wasting time, energy, costs, being able to carry out tasks correctly and carefully, efficiently, in a timely manner. Efficiency is a measure of comparing input usage plans with realized use or other words of actual use (Walewangko, 2013)

In simple terms, efficiency can be interpreted as absence waste (Nopirin, 2000). According to Arif Suadi in his book System Management Control states efficiency is comparison between output and goal, relationship between output with goals to be achieved, and abilities to work correctly (Arief, 1999). Mubyarto and Edy Suandi Hamid in his book Increasing National Efficiency means efficiency as a benchmark and is used for various purposes, comparison between input to output. Whatever included in the input, as well as how the comparison figures it is obtained, it will depend on the purpose of using the benchmark that is. Although the elements that determine efficiency exist various kinds, but savings on input values will in accordance with solving the problems we face today (Mubyarto, 1987). Yotopoulos and Nugent in the Managerial Economics book written by Aulia Tasman and M. Hafidz Aima stated that efficiency is related to achieving maximum output from a set of resources, which consists of two types of efficiency, namely price and technical efficiency (Tasman & Aima, 2013).

Operational is a factor in a company and is one of the main activities to maintain the survival of a company. Operational learning according to Rosenberg which is translated by Haming Murfiding (2007) is as follows: operation is a certain process or action that becomes an element of a number of activities to make a product. Whereas according to Hermawan (2010) the operational

definition includes an explanation as we measure the variable. These measurements can be done by numerical or certain attributes. So that it can be concluded that the operation is an activity carried out to change the form and create or add value to the use of goods or services by using the resources owned and other supporting activities.

III. METHODOLOGY

In analyzing the operational optimization feeder material supply and efficiency ratio, the researchers used the MHDS method. MHDS is translated as Material Handling Design Simulator meaning that we will analyze all aspects of the supporting model. first step we will analyze the layout of the object with a real match, the next step we calculate each distance between the warehouse depot to the production line, the next step we modeling the depot with all the variables in it, then modeling WIP in the production line with all the variants, then we specify the type of handing that is done or the tool used to supply it and our final step is to design a supply route from each feeder. With simulations carried out we will conduct many experiments including rotating supply material, balancing quantity and innovation of supporting factors.We can see the plot in the figure 5.

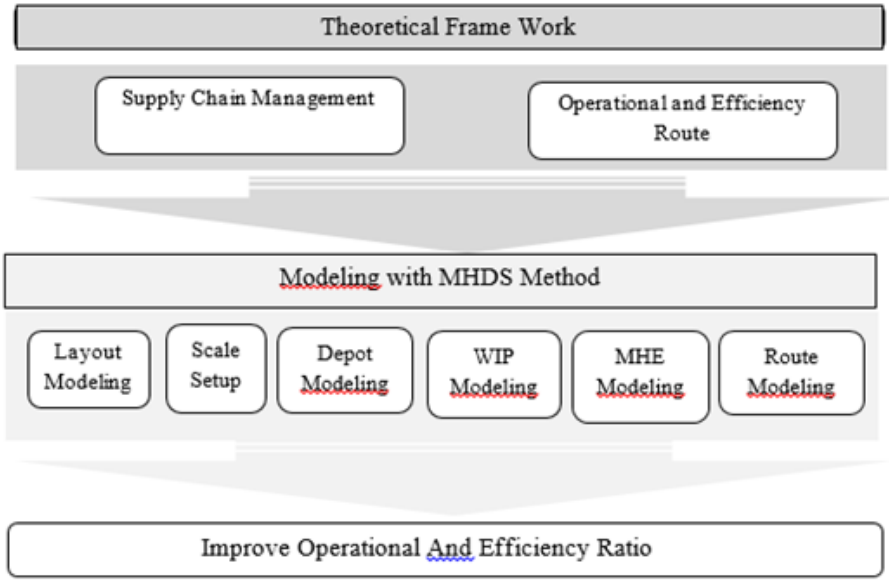

Fig 5:-. Built Up Analysis Tool Box

IV. RESULT AND DISCUSSION

A. *Layout Modeling*

The first step is to describe the layout of the area to be analyzed according to the size as detailed as possible.

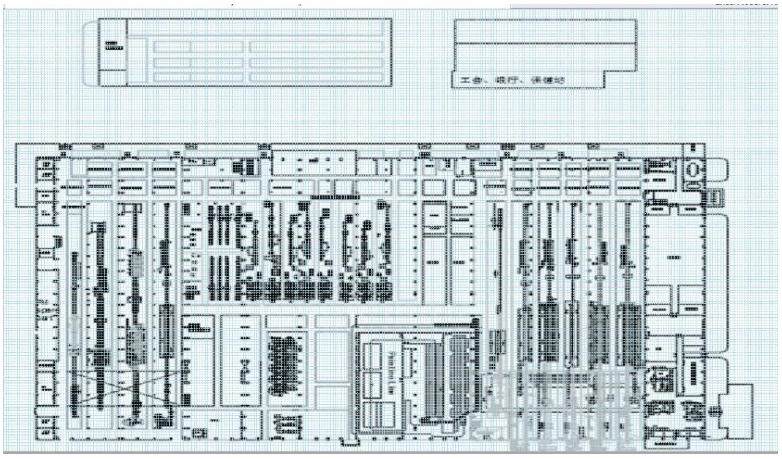

Fig 6:- Layout modeling

B. *Scale Setup*

To make it easier for us to complete the search route, we need to scale the simulation comparison and the real conditions

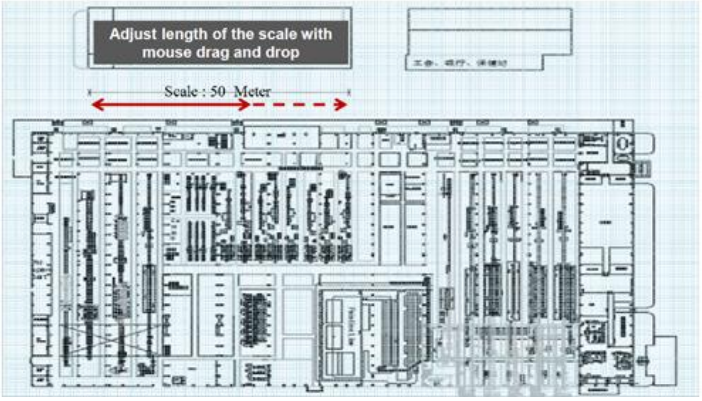

Fig 7:- Scale Adjustment

C. Depot Modeling

In this step we must analyze in detail the variables that exist in all depots, from the type of item, the quantity of each box, the name of the feeder that will supply, the route to be used, and other detailed variables.

Depot Name	Item Name Index(Model+Item+Buffer+Route)	Transport Type (Cart or Box)	Loadage
Depot1	Model1-Item1-1-FeederA-Route1	Cart	200
Depot1	Model1-Item2-2-FeederA-Route1	Cart	200
Depot1	Model1-Item3-3-FeederA-Route1	Cart	100
Depot1	Model1-Item5-5-FeederA-Route1	Box	500
Depot1	Model1-Item8-8-FeederB-Route2	Box	500
Depot1	Model1-Item9-9-FeederA-Route1	Box	500
Depot1	Model1-Item10-10-FeederB-Route2	Cart	100

Fig 8:- Depot Modeling

D. WIP Modeling

In this step we will focus more on the starting point area of the feeder supply material preparing all materials before being sent to the production line

Feeder	Route	Line Buffer No.	Item Name Index(Model+Item+Buffer+Route)	Initial Amount	Consumption per One-Time	Supply Quantity per One-Time	Tact Time*	MIN. Capa.(%)	AVG. Capa.(%)
FeederA	FeederA-Route1	1	Model1-Item1-1-FeederA-Route1	200	1	200	12	30	80
FeederA	FeederA-Route1	2	Model1-Item2-2-FeederA-Route1	200	1	200	12	30	80
FeederA	FeederA-Route1	3	Model1-Item3-3-FeederA-Route1	100	1	100	12	30	80
FeederA	FeederA-Route1	5	Model1-Item5-5-FeederA-Route1	500	2	500	12	30	80
FeederA	FeederA-Route1	9	Model1-Item9-9-FeederA-Route1	500	1	500	12	30	80

Fig 9:- WIP Modeling

E. MHE Modeling

We also have to describe in detail the type of supply carried out, whether using a machine or manually using human power

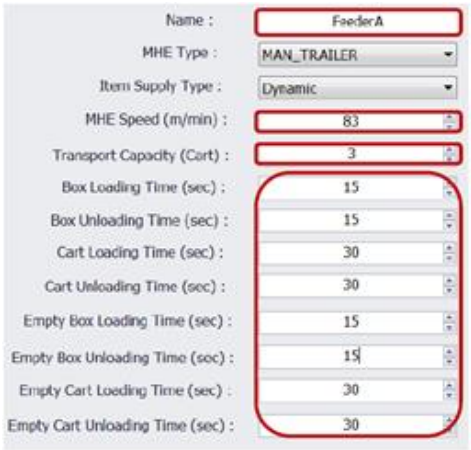

Fig 10:- . MHE Modeling

F. Route Modeling

The next step we will determine the route design that each feeder supply material will pass through

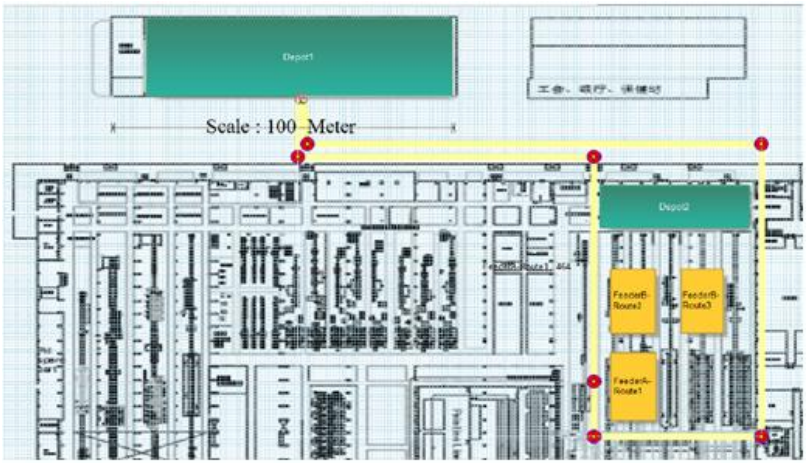

Fig 11:- Route Modeling

G. Result Current Condition

The results of data analysis carried out for the current conditions

➢ *Operational Ratio (80.06 %)*

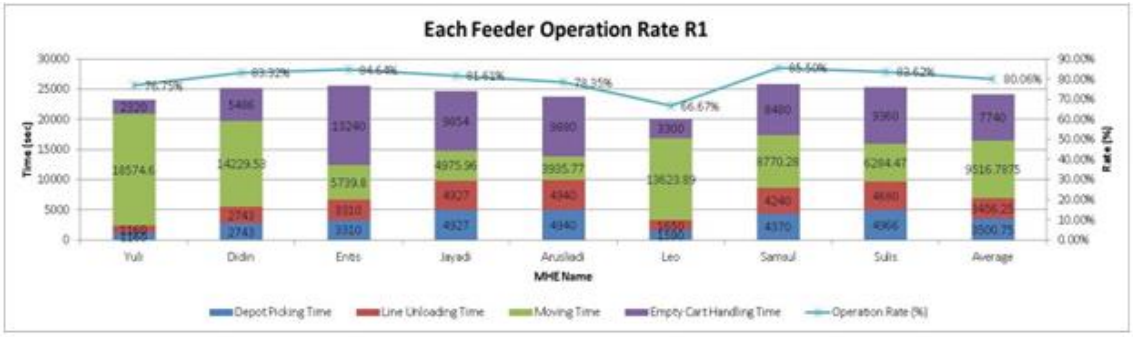

Fig 12:- Current result operational ratio

➢ *Efficiency Ratio (75.82%)*

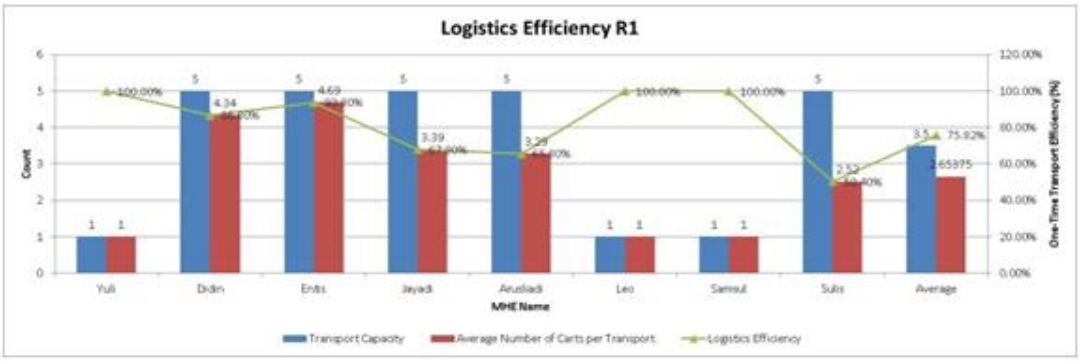

Fig 13:- Current result efficiency ratio

H. Improvement

Improvement ideas carried out, among others, by combining the various supply materials of each feeder; improvement storage process and packaging type. The improvement show in Fig 14 & Fig,15.

Fig 14:- Storage Improvement

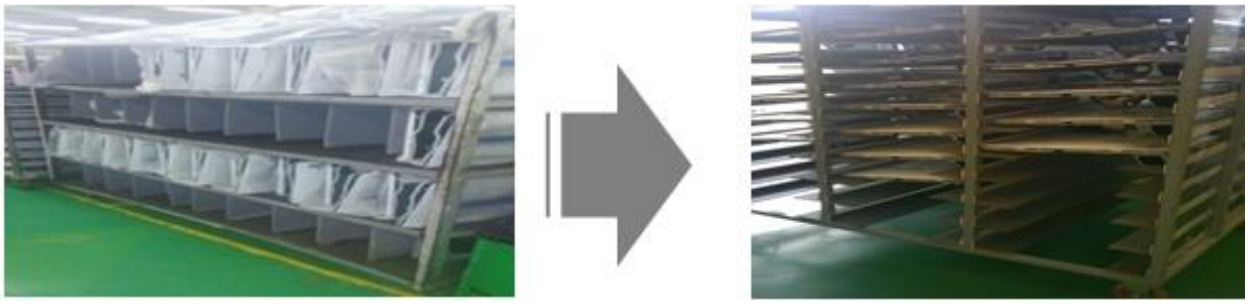

Fig 15:- Packaging Improvement

I. Result after Improvement

The results of data analysis carried out for the current conditions

- *Operational Ratio (86.23 %)*

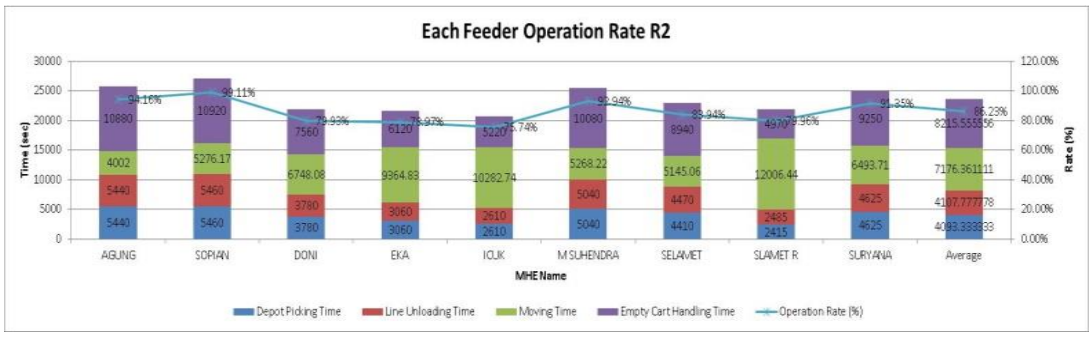

Fig 16:- Current result operational ratio

- *Efficiency Ratio (84.63%)*

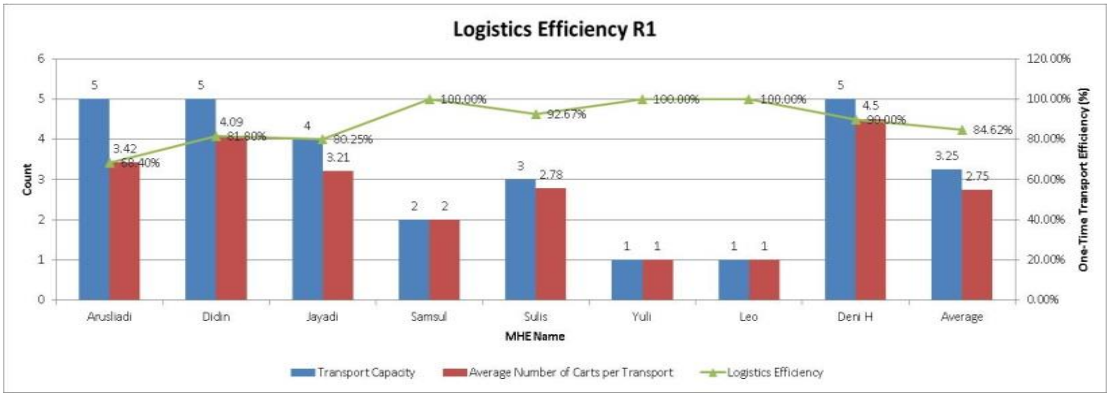

Fig 17:- Current Result Efficiency Ratio

V. CONCLUSION

By employing a MHDS simulation we will be able to know in detail the impact of each improvement made. specifically those related to internal supply in the case we discussed. tie the simulation results it was found that the improvements made had a large impact on the increase in Operational and efficiency ratio where the results showed an increase in Operational ratio 80.06% to 86.23% and the efficiency ratio of 75.82% to 84.63%.

With this simulation, it is expected that there will be research that uses the same method for research on material supply which is wider in scope not only for internal supply.

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