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# Simulation of Strategic Planning for Compound Storing and Shipment

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**Abstract**
In 2015, AFTA made amendment for rubber commodity's import duties, especially import duties imposed on natural rubber to China. This amendment gives negative impact on companies that use natural rubber as its main raw material since they have to pay additional import duties for imported natural rubber. One of the ways to cope with the increase of the financial burden is by changing the raw material supply into work in process goods that have higher levels of natural rubber, as is done by the XYZ Company in China. In exchange of natural rubber, the XYZ Company is importing work in process goods, called compound, which is supplied by its group company in Indonesia. The production process of compound is effecting regular operational in Indonesia XYZ Company, which will be highlighted in this paper. The focus of this research is the area of the storage and delivery of compound and problem analysis will be performed by cause and effect diagram. The purpose of this research is to find more efficient alternative processes, compare to current process, thus the data collection is done by observation and interviews to produce alternatives that can be applied in real practice. Researcher uses ARENA software and manual calculations to measure the utilization of the storage area, the effectiveness of the delivery area and mileage required forklift for 30 days of work as method to determine the best alternative
**Keywords:** Startegic Planning, Warehouse, ARENA simulation, Cause and Effect Diagram

## 1. Introduction

### *1.1 Background*

Free trade agreement amongst the ASEAN-China Countries which was enacted since 2010, or publicly known as the *ASEAN-China Free Trade Agreement* (ACFTA), an agreement which aims is to agree on the elimination of 90% of commodity tariffs, which will impact on the opening of a more potential and profitable market if the cooperation in various sectors is established. Overtime, the Government realizes the negative impact that arise (from this agreement), namely the amount of imported products, especially from China that comes into the local market thus hampering the competitiveness of domestic industries. Based on the study results, several Countries involved, such as Indonesia and China are both benefited from the ACFTA. Howeverm in the context of trade relations, China is more optimal in their efforts to take adventages from the agreement so that the benefit that they gain are far greater compares to the benefit gained by Indonesia (Setiawan, 2012).

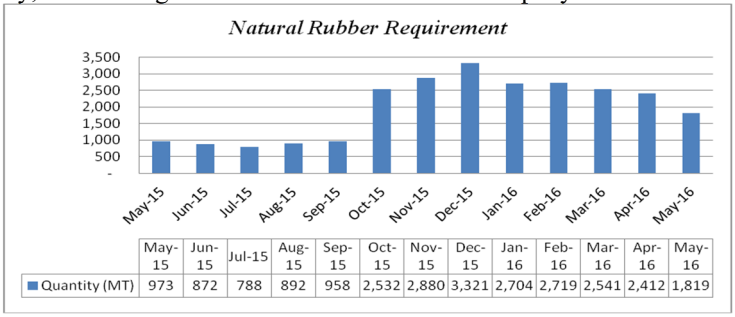
From those reasons, one of the commodity which will be subjected to import duties which will be charged to the importing country is Rubber (*Natural Rubber*). This import duty will only be enforced to rubber commodity in the form of natural rubber, whereas for other forms of rubber or processed rubber will be exempted and subjected to tariff-free policy. One of the products example is supply of product in the form of *compound* or mill-mixed rubber which consists of natural rubber, carbon and chemical pigment.

Indonesia as one of the suppliers of rubber and member of *Association of Natural Rubber Producing Countries* feel those impacts. This is due to the needs for local industries which absorbs 18% from the total of national production of natural rubber (Gobel, 2015). This policy is considered profitable to the local industry as one of the industries that will be increasing is intermediate goods or producer goods industry with rubber as its raw materials. If we see according to the BPS 2015 survey results, rubber exports in 2010 until 2014 are considerably stabil, whereas the impact of this policy will be depicted in 2015. Natural rubber exports will be decreasing but the needs of rubber in national level will be increasing, one of the parameters can be seen in Figure 2., the increase of rubber usages in one of multinational company that owns factories in Indonesia.With the new policy in China, the increase in Custom Duty for $245 per ton, which will be started from July 2015 will have significant impact to the industries that use natural rubber as their raw material. One of the companies that will feel this impact is the company engaging in the tire manufacturing industry. It is said to be highly significant because one of the main materials that they use is natural rubber, in addition to other supporting materials such as synthetic rubber, carbon or wire, which does not have as much contribution to the industry as natural rubber. This policy will be even more pronounced for the multinational companies, especially for ASEAN.

One of multinational companies that will feel the impact (of this policy) is the company engaged in tire manufacturing with headquarter in USA. This type of company is commonly known to have several factories in Asian countries, such as Indonesia, Thailand, Malaysia, Jepang, India and China. From those countries, there are two countries that have an impact, namely Indonesia (XYZ Indonesia) as supplier of natural rubber and China (XYX China) as natural rubber importing company. From that policy XYZ China predicts additional expenditure resulting from import duty, amounting $5 billion per year. This addition will have an impact to the company profit

which portrayed globally, considering that XYZ is a multinational company.




| | May-15 | Jun-15 | Jul-15 | Aug-15 | Sep-15 | Oct-15 | Nov-15 | Dec-15 | Jan-16 | Feb-16 | Mar-16 | Apr-16 | May-16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantity (MT) | 973 | 872 | 788 | 892 | 958 | 2,532 | 2,880 | 3,321 | 2,704 | 2,719 | 2,541 | 2,412 | 1,819 |

Figure 1. Natural Rubber Usages on XYZ Indonesia

*1.2 Formulation of Problems*

Below is the formulation of problems of this study:

1. What is the current problems of the existing compound storing and shipping activities on XYZ Indonesia?
2. How does the availability of facilities within the company that can be used as an alternative area for compound storing and shipping area?
3. How does simulation of existing activities and simulation of new area and new shpping process planning with the utilization of available facilities?
4. How does the comparison between current model simulation with new model simulation by measuring the capacity, mileage travelled by forklift and outcome of simulation results?

*1.3 Purpose of Study*

Below are the purpose of this study:

1. Identify the problems in compound storing and shipping activities by using the *Cause-and-Effect* Diagram.
2. Identify the availability of facilities that can be used as alternative area for storing and shipping process.
3. Do a simulation for the existing area and process and new process in accordance to available facilities by using *ARENA Simulation* Software.
4. Do a comparison of each activities between the existing simulation model and alternative of new process by measuring the utilization of storing area, effectiveness of storing area, mileage travelled by forklift and outcome of simulation data.\

## 2. Research Methodologies

*2.1 Location and Research Period*

This research is conducted at XYZ Indonesia, Bogor which engaged in manufacturing sector. The object of this study is limited to the compound storing and shipping activities. Data collection in the field is conducted for 7 months, starting from March 2016 until September 2016.

*2.2 Method of Data Collection*

This research is using two types of data, which are primary data and secondary data. Primary data obtained by direct observation. To identify the ongoing activities and will be made to be one of the inputs for depiction of new simulation process. Whereas secondary data obtained from the information and data source from wthin the company, which are relevant and correlated with the research.

*2.3 Frameworks of Conceptual and Operational Thinking*

This study consists of several stages in order to determine the alternative of new process by comparing it with the old process. Started by identifying problems on the compound storing and shipping through observations and interviews on the parties involved in the activities being studied. The results obtained from the observations and interviews are expected to be able to identify the problems exists in the process that is being studied using the *Cause and Effect Diagram.*

The next process is to determine the possible alternatives that can be done based on the field observatios, interviews and secondary data collection. The available alternatives are described by using ARENA simulation. From the outcomes, comparison between the emerging alternatives will be made to determine the best model or alternative. In addition, measurement of storing area utilization, the effectiveness of shipping area and the mileage travelled by forklift is also done.

## 3. Result And Discussion

### *3.1 Compound Production Process and Criteria to Determine Alternatives*

*Compound* is an intermediate goods (also known as producer goods) which composition consists of natural rubber, black carbon and several types of pigments. Compound can be referred as the initial component in tire production process, wherein from several ingredients mentioned, the ingredients with the highest percentage is natural rubber. Compound production process is doe in the grinding area using a machine called *Banbury.* The outcomes from said machines then directly packed into a metal box called *Goodpack* (Figure 1), with production outcome data as follows (Table 1).

Table 1. Field observations results data

| Explanation | Quantity | Unit | Per |
|---|---|---|---|
| Average output | 550 | Ton (*compound*) | Week |
| | 525 | Ton (*compound*) | Week |
| Average shipment target | 420 | Unit (*Goodpack*) | Week |
| | 26 | Container | Week |
| Deadline of shipment | 7 | Hour | Shipment time |
| *Cycle Time* shipment loading (Present time) | 3.75 | Minute | *Goodpack* |

With the percentage of the fulfillment of compound shipment target every week, which is 420 *goodpack* or equivalent to approximately 525.000 Kg compound, can be used as the first criteria to choose the new alternatives which will arise based on the results of field observations and interviews. Other criteria are the percentage of utilization of the storage area and the effectiveness of the process in the shipment area by using the cycle time of the compound loading process as parameter. Another criterion used is the manual calculation of the mileage spent by transportation forklift, assuming that the shortest distance has more advantages due to less fuels needed.


Figure 2 Metal Box for Compound Packing (*goodpack*)

### *3.2 Identification of Problems in the Existing Process (Cause-and-Effect Diagram)*

Based on the results of field observations, the existing area used as compound storage is located in the raw materials warehouse, with maximum storage capacity of 92 *goodpack,* which in other words, unable to accommodate compound products that must be stored for one week, which is 420 *goodpack.* As for shipping area is done in the area of raw materials warehouse's loading dock. Based on the calculation and simulation results (Figure 2) with the condition of the existing area the total shipping amount only reach 74 goodpack with sliding scale of 1:3 or equivalent to 222 *goodpack.* Therefore, it can be identified that by using the existing facilities the total amount of shipment every week is under the shipping target.

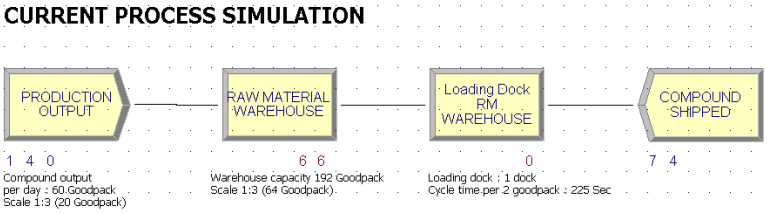



Figure 2. Flows of the existing process and outcomes of the simulation

The existing condition has been ongoing from September 2015. Shipment can be encouraged or forced to hit the target. However, based on the observations and interviews results, there are several emerging problems resulting from the limitation of facilities and available time. It can be concluded there are three problems exist in the current process, and portrated in the form of *Cause and Effect* Diagram. Below is the diagram and its explanation.

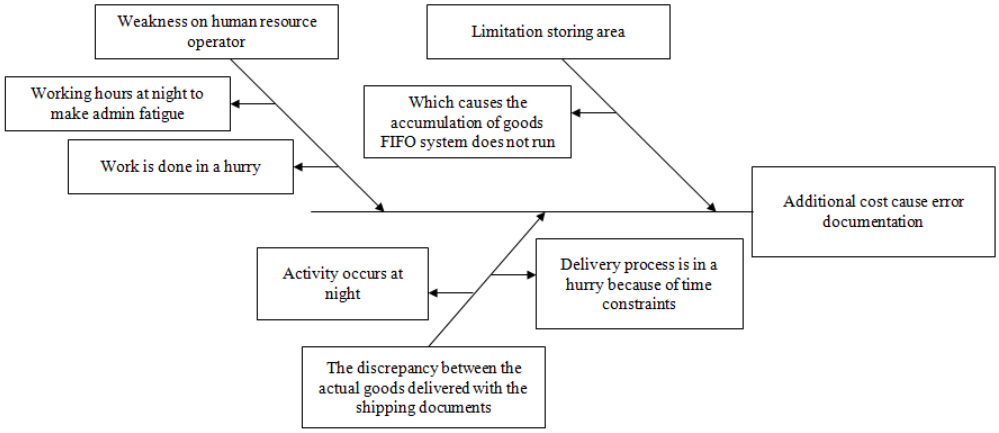



Figure 3 *Cause and Effect* Diagram Problem 1

Figure 3 above is the causal diagram that explains the emergence of problems in the increased of costs due to the documentation error in shipment process, this problem arises due to three main reasons which are the limitation of storage area, weaknesses in human resources and the incompatibility between the actual goods delivered and the shipping documents.

Figure 4 is a causal diagram that explains the emergence of problems in the increased of costs due to shipment cancellation. This problem emerges due to the delays in compound loading process.

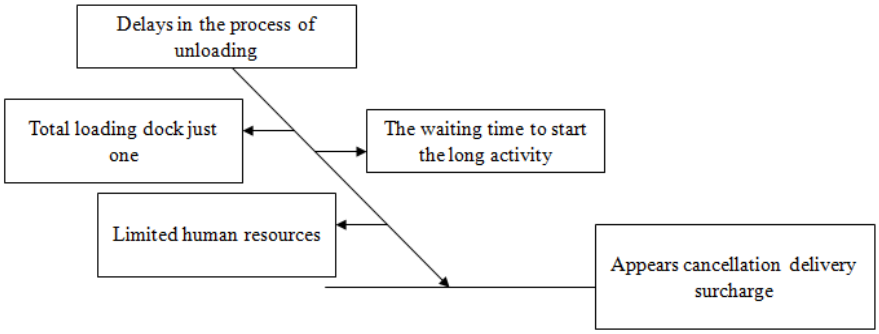



Figure 4 *Cause and Effect* Diagram Problem 2

Figure 5 is a causal diagram that explains the emergence of problems in the increased of costs due to additional working hours or overtime. This problem happens due to the clash between additional working hours and the regular hours, so that this additional process can't be done optimally with the existing facilities.

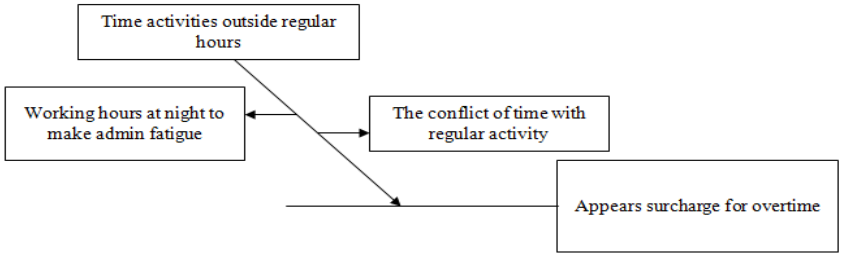



Figure 5 *Cause and Effect Diagram* Problem 3

*3.3 The Availability of Facilities and New Area Alternatives*

Based on the results of interviews conducted with three interviewees, whom are *Head of Logistic and Distribution, Supply Chain Manager* and *Warehouse Manager* and also field observations conducted by researcher there are several new alternatives that can be used as alternative area for storing and shipping activities. Below are new alternatives in accordance with the existing facilities within the company area:

1. Alternative 1 Storage location is done in the finished products warehouse and shipment is done at the loading dock of warehouse.
2. Alternative 2 Storage location is done in the area of finished products warehouse and the shipment is done at the loading dock of the raw materials warehouse.
3. Alternative 3 Storage location is done in the area of sport hall and the shipment process is done in the loading dock of the finished good warehouse.

*3.4 New Alternative Area Simulation*

The simulation was performed with the help of software called *ARENA Simulation* by using a sliding scale of 1:3; number scale is used due to the limitation of total maximum of the entity from the software with maximum entity limit as many as 450 entities. So that shipment target criteria as many as 420 *goodpack* is assumed to be 140 *goodpack*. The information required in the making of this simulation are the capacity of the storage area for each alternative areas, the expected capacity of shipment target, shipment's *cycle time*, and number of available *loading dock* facilities.

***Alternative 1***

In alternative 1, the location of storage and shipment process is conducted in the area of finished products warehouse, it is obtained that the calculation results of the delivered compound is as much as 140 *goodpack* or equivalent to 420 *goodpack* in accordance with the shipment target.

***Alternative 2***

In alternative 2, the location of the storage is carried out in the area of finished products and the shipment process is done at the loading dock of the raw materials warehouse, it is obtained that the results of delivered compound as much as 38 *goodpack* or equivalent to 114 *goodpack*, whereas the other 102 *goodpack* or 306 *goodpack* could not be sent on the same day, however still stored in the area of finished products with the capacity of 650 *goodpack*.

***Alternative 3***

In alternative 3, the location of the storage is done in the area of sports hall and the shipment is carried out at the loading dock of the finished products warehouse, the results obtained shows that the compound delivered is as much as 20 *goodpack* or equivalent to 60 *goodpack*, much lower than the shipment target. This low number is due to longer *cycle time* compared to the other alternatives, which due to the longer distance between the storage area and the shipment area. However, the number of undelivered goods can still be stored in the area of sports hall which has the capacity of 2000 *goodpack*.

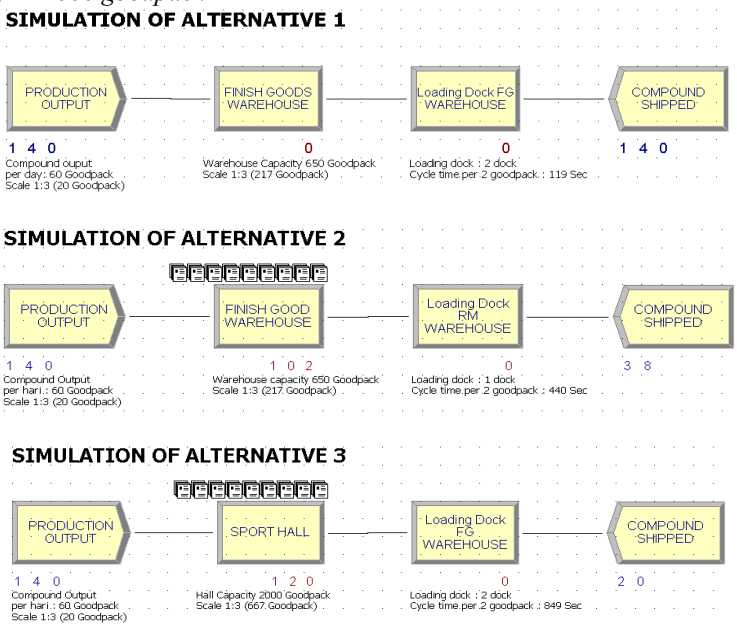



Figure 6 Output of alternatives simulation

*3.5 Calculation of Capacity Measurement of the Facilities and Forklift Distance*

Capacity is the maximum output from a system in certain period of time; in this case, the calculation is done in the period of one month. Other criteria that are calculated in this research is the amount of utilization percentage of the storage area and the effectiveness of the process in the shipment area by using the cycle time of compound loading as the parameter, with another inputted data namely the maximum capacity of each specified alternative area and manual calculation of the mileage travelled by the forklift transportation, assuming that the shortest distance has more advantages because the amount of fuels needed will be less.

*Current storage and shipment area*

From the observations, the *goodpack* maximum storage capacity in the area of the raw materials area is 192 *goodpack* while the shipment target is 420 *goodpack* so that it is discovered that the storage utilization percentage is 46%. Whereas for the effectiveness of shipment process with its *cycle time* as the parameter, the total amount of time needed for shipment activities in the loading dock area of the raw materials warehouse is 13 hours from the available time of 7 hears. This means that shipment process can be carried out for 53% from the target of 100%.

Another calculation is the mileage travelled by forklift from production area to the raw materials warehouse and from said warehouse to the loading dock in the same area with the total amount of shipment target as much as 1680 *goodpack* per month. It is discovered that the forklift's mileage for one month is 537,600 meter.

*Alternative 1*

From the observations, the maximum storage capacity of *goodpack* in the finished products warehouse's area is 650 *goodpack* while shipment target is 420 *goodpack*. Therefore it is discovered that the storage utilization percentage is 155%. Whereas for the effectiveness of shipment with *cycle time* as parameter, the total amount of time needed for shipment activities in the loading dock area of the finished products warehouse is 6.9 hours from the available time of 7 hours. Therefore, the percentage of the shipment is 101%.

Another calculation is the mileage travelled by the forklift from the production area to the finished products warehouse and from said warehouse to the loading dock of the same warehouse with the total amount of shipment target as many as 1680 *goodpack* per month. It is discovered that the forklift's mileage for one month is 818,160 meters.

*Alternative 2*

From the observation, the maximum storage capacity of *goodpack* in the area of finished products warehouse is 650 *goodpack* while the shipment target is 420 *goodpack* so that the storage utilization is known to be as many as 155%. Whereas for the effectiveness of the shipment process, the total amount of time needed for the shipment activities at the loading dock for the raw materials warehouse is 26.7 hours from the available time of 7 hours. Therefore the shipment percentage for this alternative is 27%.

Another calculation done is the mileage travelled by the forklift from the production area to the raw materials warehouse and from said warehouse to the loading dock of the finished products warehouse with total amount of target shipment of 1680 *goodpack* per month. It is discovered that the distance travelled by the forklift for one month is 925.680 meters.

*Alternative 3*

Alternative 3 has the biggest maximum storage capacity of *goodpack* because the storage is located in the area of sports hall. The maximum capacity is 2000 *goodpack* while the shipment target is 420 *goodpack*. So that it is discovered that the percentage of storage utilization is 476%. This is considered to be a good thing because this means that if the compound demand in the future is increasing in number then the company will already have alternative area available to anticipate the accumulation of goods in the warehouse. Whereas for the effectiveness of shipment process, the total amount of time needed for the shipment process in the loading dock of the finished products warehouse is 49.5 hours from the available time of 7 hours. This means that the percentage of shipment is only reaching 14% from the target.

Another calculation is the mileage travelled by the forklift from the production area to the sports hall and from the hall to the loading dock at the finished products warehouse with total amount of shipment target as many as 1680 *goodpack* per month. Therefore, it is discovered that the total amount of distance travelled by the forklift in one month is 2.113.440 meters.

## 4. Managerial Implication

Below is result comparison table from the calculation results of the research. From the table below, it can be seen that the Alternative 1 is the best alternative because it has the biggest amount of delivered *goodpack* and no *goodpack* undelivered based in the results of the ARENA simulation. In addition, its utilization percentage number and area's effectiveness shows a result of above 100% even though the amount of mileage travelled by the forklift for this alternative is still relatively longer than the existing process.

Table 2 Results Comparison Table

| Explanation | Existing Process | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|---|
| *KPI Number Out (Goodpack)* | 74 | 140 | 38 | 59 |
| *Number Waiting (Goodpack)* | 66 | 0 | 102 | 81 |
| Storage Utilization (per Week) | 46% | 155% | 155% | 476% |
| Shipment Effectiveness (per Week) | 53% | 101% | 27% | 14% |
| Forklift Distance | 537,600 | 818,160 | 925,680 | 2,113,440 |

Based on the results of the above calculation, the possible strategy that can be taken by the company to lower the effect of the three emerging problems due to the limitation of available facilities are:

1. Remove the storage area to the finished products warehouse. Although in practice, some operational issues must be prepared, such as:
   a. Rearrangement for the position of other goods which will be replaced by compound.
   b. Creating new operational standard in accordance to the new storage area.
   c. Retraining for the team that will conduct the activities in the new work area.
2. Remove the shipment area to the area of finished products warehouse. The availability of 2 docks in the new

area will be highly advantageous, proved by the utilization percentage and the output results from the simulation which hit above 100%. However, just as storage area, at the new area the management must do some working standard adjustment in accordance to the working environment in the finished products warehouse.

3. The result for the mileage at the selected area, which is Alternative 1, is not as short as the existing process. This will have an impact to the fuel costs. In this research, cost calculation or financial calculation was not included. However, distance parameter is included into the calculation of shipment effectiveness, therefore, although the mileage is longer, the shipment target is still reaching the number of 101%.

## 5. Conclusions

The conclusions that can be drawn based on the result of this research are:

1. The storage and shipment process conducted at XYZ Indonesia has three problems based on the observations and interviews results, which are: 1) The emergence of additional costs for documentation error; 2) The emergence of additional costs caused by shipment cancellation; and 3) The emergence of additional costs for overtime.
2. From those three problems, and based on the interviews results, there are several company facilities options that can be made into alternative area for storage and shipment purposes, which are:
   a. Alternative 1. Storage location and shipment process conducted in the area of finished products warehouse.
   b. Alternative 2. Storage location conducted in the area of goods warehouse and the shipment process is done in the loading dock at the raw materials warehouse.
   c. Alternative 3. Storage location conducted in the area of sports hall and shipment process is done in the loading dock of finished products warehouse.
3. From the three alternatives proposed, simulation is conducted by using computer software called *ARENA Simulation*. Based on the processing results, alternative 1 has the highest *KPI Number Out* which is 140 *goodpack* and the smallest *Number Waiting* result which are 0 *goodpack*.
4. Other calculation conducted is the utilization of storage area and the effectiveness of shipment area. All alternatives has storage percentage above 100%, shipment percentage above 100% can only be seen in Alternative 1, and the shortest amount of distance can be seen in the existing process.

Based on the calculation conducted, it can be concluded that Alternative 1 is the best alternative compares to the existing process and the other two alternatives, storage location conducted in the area of finished products warehouse and shipping activities is done at the loading dock of said warehouse.

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