



FINAL PROJECT – TI141501

**BENEFIT-COST ANALYSIS OF SEMI-AUTOMATED TECHNOLOGY  
IMPLEMENTATION FOR OUTBOUND LOGISTICS PROCESS:  
A CASE STUDY**

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# APPROVAL SHEET

## BENEFIT-COST ANALYSIS OF SEMI-AUTOMATED TECHNOLOGY IMPLEMENTATION FOR OUTBOUND LOGISTICS PROCESS: A CASE STUDY

### FINAL PROJECT

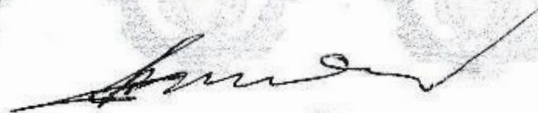
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Institut Teknologi Sepuluh Nopember  
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PROCESS: A CASE STUDY**

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**ABSTRACT**

The need of automated warehouse system arises from the fact that manual process could cause human error which may affect warehouse productivity. Automated warehouse could help the company to reduce its operation time, response time, increase accuracy, and increase warehouse productivity. Kamadjaja Logistics, one of Indonesia logistics company, still implement manual process in all of its process. Kamadjaja Logistic wants to automate its outbound logistics process in order to obtain faster delivery time, decreasing labor cost, and increasing labor efficiency. There are two alternative technologies suggested, Actiw LoadMatic and ATLS Skate Loader. Both alternative will be analyzed trough benefit cost analysis in order to know whether it is financially feasible to be run. The result obtain from LoadMatic is 1.1912 while Skate System value is 1.2600. Based on the benefit cost value, the suggested technology to be implement is Skate System. Besides benefit cost, the existing condition will be analyzed through work sampling analysis. Based on work sampling analysis, all of the labor in outbound logistics are having a higher nonworking activity rather than working activity. Sensitivity analysis will also be done in order to obtain which variable is the most sensitive one that affecting the result of benefit cost value. The most sensitive variable according to sensitivity analysis is investment cost.

**Keywords - Benefit Cost Analysis, Sensitivity Analysis, Tornado Diagram, Value Chain, Value Stream Mapping, Work Sampling.**

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# CHAPTER I

## INTRODUCTION

This chapter contains the background of the research, problem formulation, research objectives, research benefits, and research scope. Besides that, this chapter also contain the outline of the report to give a big picture of the report mechanism.

### 1.1 Research Background

The term “Value Chain” introduced by Michael Porter in 1985. Value Chain describes organization activities which could be the competitive strength or competitive advantages of the organization. Porter distinguished the activities into two categories, primary activities and support activities. Primary activities of value chain consist of inbound activities, operation, outbound activities, marketing and sales, and service. While support activities consist of firm infrastructure, human resource` management, technology development, and procurement. Porter Value Chain will be presented in Figure 1.1.

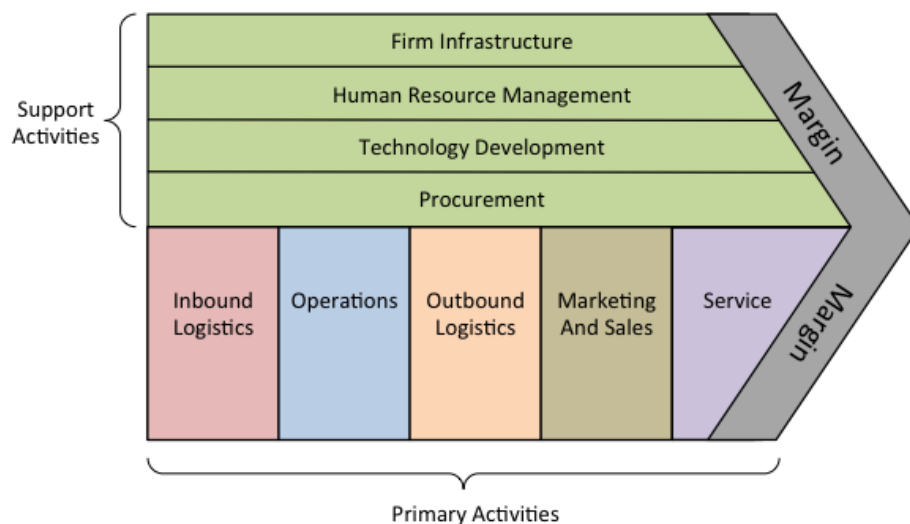


Figure 1. 1 Porter Value Chain

Technology development is one of support activities in value chain. In today business environment, companies compete each other in order to gain more profit more than the competitors. In this rapid technology development era, there are a lot

of innovative automated technology to support the company to achieve its goals. Technology could become a critical aspect for logistics industry. With the existence of automated technology, company could provide less effort, more efficient, and more reliable result compare to manual process. Automated warehouse could help the company to reduce its operation time, response time, increase accuracy, and increase warehouse productivity. Automated warehouse could be implemented in several areas, such as loading/unloading, allocation, and tapping. The need of automated warehouse system arise s from the fact that manual process could cause human error which may affect warehouse productivity.

Even though there are a lot of benefits regarding the implementation of automated technology for logistics industry, there are still a lot of company which use manual process on its processes. Kamadjaja Logistics is one of the biggest logistics industry in Indonesia is a service company which offers warehousing service. Kamadjaja Logistics offers warehouse management system, inventory management, distribution management, and order management. One of Kamadjaja Logistics warehouse is located in Surabaya. Surabaya Warehouse organized fast moving consumer goods, such as personal wash products and oral care products. Surabaya Warehouse held its inbound logistics and outbound logistics daily. The existing condition in Surabaya Warehouse is it still use manual process from unloading process until its loading process. Loading process or also known as outbound logistics process is one of the primary activity based on Porter Value Chain, which makes it as a critical process in logistics industry. With the average of 50,000 cases or boxes distributed per week and five workers per shift, Surabaya Warehouse surely has a busy schedule of its outbound logistics. The existing condition of Surabaya Warehouse outbound logistics can be seen on figure 1.2 and figure 1.3.



Figure 1. 2 Outbound Logistics Process



Figure 1. 3 Outbound Logistics Process (cont'd)

Based on the historical data obtain form one year behind, Surabaya Warehouse already perform a well-managed outbound logistics, as it can be seen on figure 1.3.

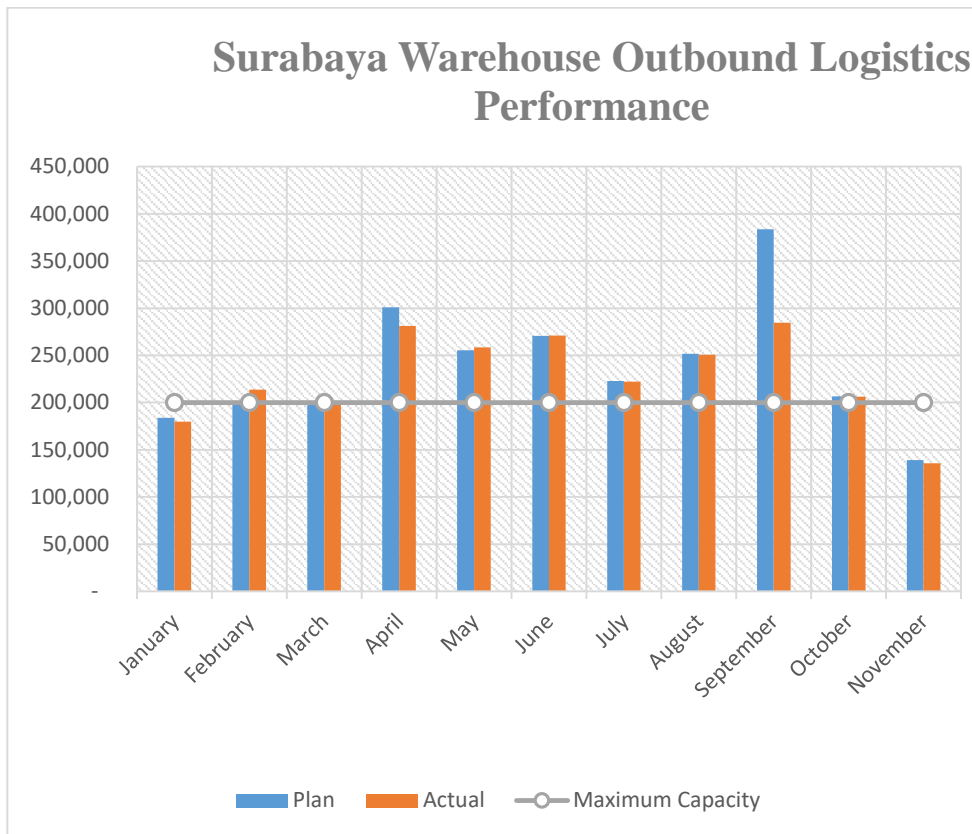


Figure 1. 4 Surabaya Warehouse Outbound Logistics Performance

Source: Kamadjaja Logistics Management

However, Kamadjaja Logistics Management board expect Surabaya Warehouse business process could be improved by automated technology with the output of faster delivery time, decreasing labor cost, and increasing labor efficiency. In Surabaya Warehouse existing condition, number of labor required are five labors, with two labors as forklift operator, one labor as checker, and two labors as product arrangement. Product arrangement required longer time since the labor has to arrange each box inside the truck, therefore, with the implementation of new technology, the expectation is to eliminate the need of product arrangement.

### 1.2 Problem Formulation

Based on the observation held in Surabaya Warehouse, it already has a well-designed business process. However, it still using manual processes in operation and data entry. Kamadjaja Logistics Management expect a faster and more accurate business process in Surabaya Warehouse. Therefore, aligned with background on

previous section, to solve the problem in Surabaya Warehouse is to implement automated technology in its outbound logistics. To be able to determine which technology is appropriate to be implemented in Surabaya Warehouse, alternatives technology will be evaluated.

### **1.3 Research Objectives**

Based on research background and problem formulation two previous section, the objectives of this final project are:

- To obtain the technology alternatives which can be used to automate outbound logistic process in Surabaya Warehouse.
- To analyze the benefit-cost analysis of technology implementation.

### **1.4 Research Benefits**

According to the research objectives, the benefits that will be obtained by company are:

- Company could define which technology is appropriate to be implemented in the warehouse.
- Company could improve its warehouse outbound logistics process performance and data accuracy through the implementation of automated technology.

### **1.5 Research Scope**

There are some limitations and assumption used in this report, such as:

#### **1.5.1 Limitations**

Limitations of this research are listed as follow:

- Observation held on October 2016 until January 2017.
- Historical data used are data from Januari 2016 until November 2016.
- The benefits analyzed includes of labor cost, forklift fuel cost, forklift maintenance cost and technology maintenance cost,

#### **1.5.2 Assumptions**

Assumptions used in this research is listed as follow:

- Rate used for Euro (€) is 14,118

- Technology implementation is not recommended to be implemented if the result of Benefit-Cost Analysis is infeasible.

## **1.6 Report Outline**

To give the big picture of this research, following are the outline of the research report.

- **CHAPTER I – Introduction**  
This chapter contains the background of the research, problem formulation, research objectives, research benefits, and research scope. Besides that, this chapter also contains the outline of the report to give a big picture of the report mechanism.
- **CHAPTER II – Literature Review**  
This chapter elaborates the concept used to conduct this research. The concepts used are Supply Chain Management (SCM), Warehouse Management System (WMS), Fast Moving Consumer Goods (FMCG), automated outbound logistics technology, work sampling, cost-benefit analysis, and sensitivity analysis.
- **CHAPTER III – Research Methodology**  
This chapter elaborates the methodology and its explanation which is used in this research. There are two phases in this research, preliminary and preparation phase, and data collection and data processing phase.
- **CHAPTER IV – Data Collection and Processing**  
This chapter elaborates the data collection and its processing which is related to the problem solving and analysis. There are two data processing methods in this research, such as benefit-cost analysis and work sampling.
- **CHAPTER V – Implementation**  
In this chapter, it elaborates the implementation effect of investing new technology in Surabaya Warehouse. The effect will be affecting the business process in the outbound logistics process.

- **CHAPTER VI – Analysis and Interpretation**

This chapter explained the analysis and interpretation which aligned to the data processing. This chapter also elaborate the analysis of each data processing which related to the problem solving and decision making.

- **CHAPTER VII – Conclusion and Suggestion**

This chapter consist of the conclusion of the research and the suggestion offered to the company to solve the problem identified in Surabaya Warehouse

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## CHAPTER II

### LITERATURE REVIEW

This chapter elaborates the concept used to conduct this research. The concept used are Supply Chain Management (SCM), Warehouse Management system (WMS), Fast Moving Consumer Goods (FMCG), automated outbound logistics technology, work sampling, cost-benefit analysis, and sensitivity analysis.

#### 2.1 Supply Chain Management

Supply chain is network between stakeholders or companies which cooperate to create and deliver product to end-user. Those companies are supplier, plant, distributor, retail store, and other supporting company such as logistic company. There are three kinds of flow in supply chain such as product flow, cash flow, and information flow. All of the flows flow from upstream to downstream as can be seen on Figure 2.1

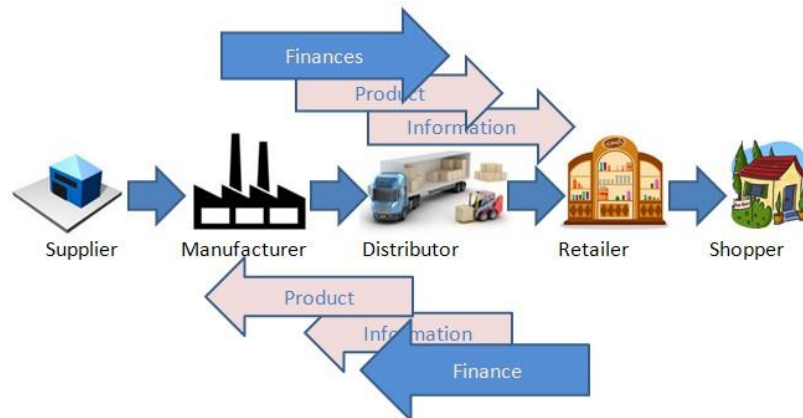


Figure 2. 1 Supply Chain Flow

Source: [www.biz-development.com](http://www.biz-development.com)

According to Oliver & Weber (1982), Supply Chain Management (SCM) is a method, tools, or the approach of supply chain. While the Council of Logistics Management define SCM as “The systematic, strategic coordination of the traditional business functions within a particular company and across business within the supply chain for the purpose of improving the long-term performance of

the individual company and the supply chain as a whole”. The critical aspect of SCM is coordination because all of the stakeholders related have the same goal which is to satisfy the same customer. There are several activities embroiled in SCM, such as product development, procurement, purchasing, planning and control, production, distribution, and return.

## **2.2 Warehouse Management System**

Warehouse management is the coordination of incoming goods, storage, tracing goods, and the distribution of goods. In nowadays business environment, the primary goal of many organization is to improve customer satisfaction to increase profit. To achieve these goal, companies tend to embark its process improvement to be able to produce high quality product. In logistic company case, to satisfy customer is to minimize response time. Response time affected by how warehouse manage its warehouse processes. To be able to achieve the goal, logistics companies implement Warehouse Management System (WMS) in their warehouse. The primary goal of WMS is to automate warehouse process related to moving and storing inventory and materials. An automated WMS will help warehouse to reduce effort, provide more efficient work, and gives reliable result compare to warehouse with manual processes (Atieh et.al, 2015). WMS used by company to manage warehouse processes and activities effectively. With the existence of WMS, company could reduce transaction errors, maximize warehouse space utilization, minimize material handling travel time, and optimizing warehouse processes. The need of automated WMS arises to minimize human errors which could lead to warehouse utilization. WMS includes monitoring and management of: Stock Keeping Units (SKUs), warehouse storage locations, dock doors, workforce management, inbound receiving and put away (outbound), enterprise inventory management, and material handling.

## **2.3 Warehouse Activities**

Warehouse activities define as activities involved in handling items inside the warehouse. Following are the activities in Surabaya Warehouse:

### 2.3.1 Receiving (Inbound Logistics)

Receiving process or inbound logistics is process of receiving goods or products from plant to warehouse. With the help of WMS, warehouse could verify Purchase Order (PO) immediately. Besides that, WMS will help warehouse to do receiving inspection requirements to products.

### 2.3.2 Put away (Outbound Logistics)

Put away or outbound logistics is the reverse activities with inbound logistics. Outbound logistics is the process of delivering products to distributor, retail store, or customer.

### 2.3.3 Incoming Inspection

Incoming inspection is an inspection process regarding to products or goods which just delivered from plant. Incoming inspection held right after inbound logistics and before storage. The output of this process is warehouse will know which product should be send back to plant because it has defect or weakness.

### 2.3.4 Storage

After incoming inspection, the following process is storage. In this process, warehouse usually use forklift as material handling to allocate pallet. Several warehouse already use automated storage system using conveyor to allocate pallet.

### 2.3.5 Product Picking

Product picking is the process when worker allocate product or pallet which will be distribute to customer. Same like storage process, warehouse usually use forklift as its material handling or conveyor for the fully-automated warehouse.

### 2.3.6 Tapping

Tapping is an additional process in the form of manual re-packaging process. Manual re-packaging happen when there is the need of product bundling from supplier or because of there is defect in product packaging.

## **2.4 Fast Moving Consumer Goods**

Fast moving consumer goods is product which sold quickly with low cost. This type of product categorized as functional product, because it is a daily consumption product. Functional product is easily substituted by competitor

product, therefore, company should have safety stock regarding to functional product. Fast Moving Consumer Goods will result daily inbound and outbound in warehouse. Lead time since Purchase Order (PO) become the main parameter to measure warehouse performance.

## 2.5 Automated Outbound Logistics Technology

As it already been mentioned in previous chapter, technology has a critical role in supply chain. Automated technology could help logistic company to increase productivity, automatic information gathering, and analyze the information in order to do future planning and improve its performance. Automated technology which will be elaborate in this subsection are Actiw LoadMatic and Automatic Truck Loading System (ATLS).

### 2.6.1 Actiw LoadMatic

LoadMatic is one of product produced by Actiw. Actiw is a Finland based manufacturer and turnkey integrator, specialized in intelligent and sustainable automated warehouse and loading solutions. Actiw's automated material handling projects have been executed since the mid-1980's. Actiw LoadMatic is an automatic trailer loading and container loading solution for palletized or palletless goods. The appearance of LoadMatic can be seen on figure 2.2.

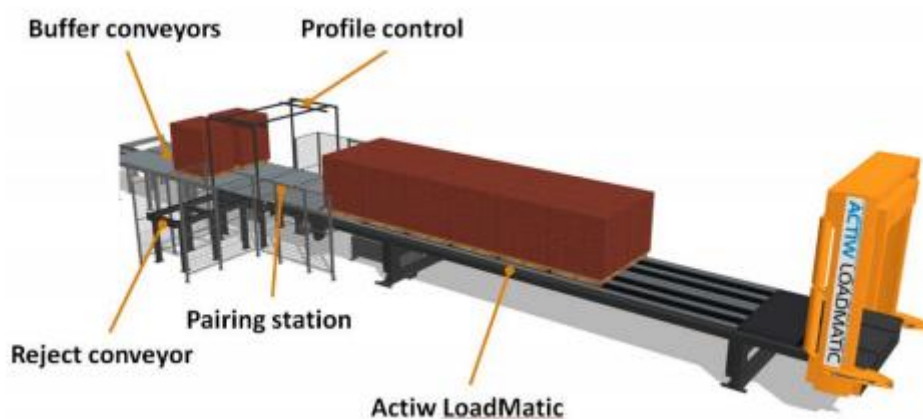


Figure 2. 2 Actiw LoadMatic

LoadMatic makes truck and container loading as easy as it should be. Advantages of implementing LoadMatic are:

- Fully automated truck loading, seamlessly integrated to any complementary systems
- One shot loading, reducing docking time to a matter of minutes
- Less manual work and equipment needed
- No product damage due to gentle loading, both for cargo and cargo space
- No alterations needed to trailers and containers
- No special equipment required at the receiving end

LoadMatic is a semi-automated technology, which means it still requires operator to operate the machine. LoadMatic could accommodate until 30,000 kg products. With vehicle turn around time of 17 minutes, it could load up to 60 pallets per hour. Table 2.1 shows the cost required in investing LoadMatic.

Table 2. 1 LoadMatic Investment Cost

<i>LoadMatic</i>	<i>Cost</i>
	€ 400,000.00

### 2.6.2 Automatic Truck Loading System (ATLS)

Automatic Truck Loading System (ATLS) is the first fully automated system to load or unload pallets, slip-sheets, racks, or other types of unit loads. ATLS is developed by Ancra. Ancra is a company which specialized in automatic truck for loading and unloading systems. Ancra is located in Boxtel, the Netherlands, and it supplied its products worldwide. ATLS have been applied in many industries, such as air cargo industry, Fast Moving Consumer Goods (FMCG) industry, paper industry, consumer durables industry, post & parcel industry, food and beverage industry, etc. Advantages of implement ATLS are:

- Reduce labor cost

Since ATLS is an automated technology, it will reduce the need of labor which will lead to reduction in labor cost.





- Reduce products and pallet damage  
Since the products or pallets are unloaded and loaded automatically without human interface, there will be no human error which could cause products or pallets damage.
- Reduce ergonomics issues related to forklift operation  
Since the system is fully automated, the need of forklift operation is decreasing. The high forklift operation need means that worker or labor will work in a long time which could make the worker or labor feels injured caused by the lack of ergonomics in forklift design.
- Increase loading and unloading speed  
It believed that with the implementation of ATLS, loading and unloading time will reduce approximately to 80% each.
- Improves process reliability  
Process reliability is related to products or pallets damage. With the decreasing of potential products or pallets damage, reliability of the process is increasing.

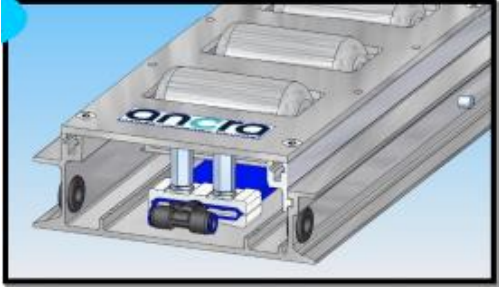
ATLS has several capabilities, such as:

- Be able to load a 53-foot container in 10 to 12 minutes
- Be able to perform any load pattern
- Be able to handle any type of pallet, rack, or slip sheet.
- Be able to load to 6,000 lbs
- Be able to load over 110 pallets per hour

ATLS has three type of automated loading/unloading technology, such as conveyer system, load runner, and skate loader. Each type will be explained on table 2.2 as follow.

Table 2. 2 Automatic Truck Loading System Types

<i>System</i>	<i>Picture</i>	<i>Usage Description</i>
Chain Conveyor System		<p>For standardized pallets, with the chains running under the supporting blocks of the pallets. Depending on the quality of the pallets and the weight of the goods, 2 or 3 track systems per pallet can be used.</p>
Slat Conveyor System		<p>For a mix of pallets, non-palletized cargo or slip-sheets. The slats create a full surface. Depending on the type and weight of the goods a 3 or 4 lane system can be used.</p>
Belt Conveyor System		<p>For loose loaded parcels and nonpalletized goods. The belt creates a full surface.                      For loose loaded parcels and nonpalletized goods. The belt creates a full surface.                      For loose loaded parcels and nonpalletized goods. The belt creates a full surface.</p>
Skate System		<p>Euro pallets, short side leading, or when using a subfloor, double deck pallets can be used as well. No system in the trailer is needed, only limited modifications to the trailer floor.</p>

<i>System</i>	<i>Picture</i>	<i>Usage Description</i>
Roller Track System		For air cargo pallets. There are different types for different weights depending on the pitch and width of the rollers and the number of tracks used.



In order to understand more about ALTS types, Table 2.3 shows the comparison between each type of ALTS.

Table 2. 3 ALTS Types Comparison Table

<i>ALTS Type</i>	<i>Type of Application</i>	<i>Type of Product</i>	<i>Trailer Modification Required</i>	<i>Trailer Investment Cost (€)</i>	<i>Dock Investment Cost (€)</i>	<i>Truck Turn Around Time (min)</i>
Chain System	Short Shuttle	Standard Pallet	Yes	30,000.00	65,000.00	< 2.5
Slat System	Short Shuttle	Non-Palletized	Yes	35,000.00	75,000.00	<2.5
Roller System	Short Shuttle	ULD's	Yes	8,000.00	100,000.00	5
Skate Loader	Long Haul	Standard Pallet	No	-	250,000.00	8

## 2.6 Value Stream Mapping

Value Stream Mapping (VSM) is a tool used to improve a process by identifying added value and eliminate waste. VSM let the company to identify the production flow from raw material until it become finished good on customer hand, it shows a big picture from concept to product launch. By taking VSM perspective means that to improve the whole processes, not only individual process. Following figure shows the VSM of Surabaya Warehouse.

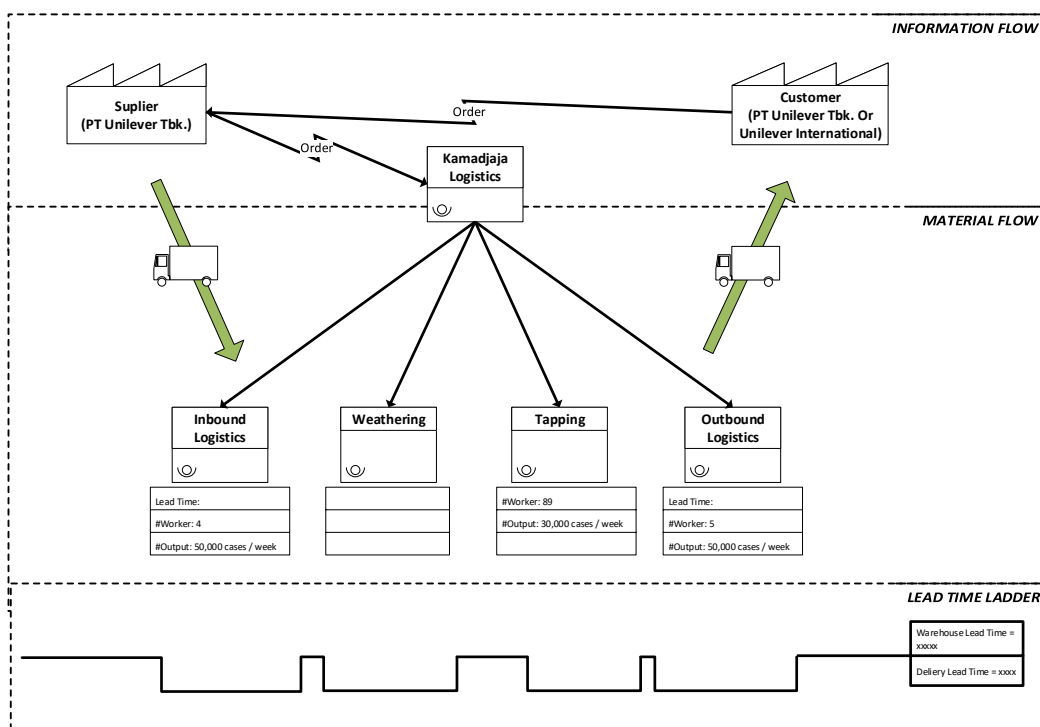


Figure 2.3 Kamadaja Logistics Surabaya Warehouse Value Stream Mapping

## 2.7 Work Sampling

Work sampling is a tool used to finding a fact of a process. Work sampling used for several uses:

- Activity and Delay Sampling

Work sampling used to identifies the working activities and delay or idle of workers or machines.

- Performance Sampling

Work sampling used to measure working and nonworking time of workers in order to establish performance index or performance level for the worker during his working time.

- Work Measurement

Work sampling used to establish operation time standard

To be able to do work sampling, procedure that have to be run are:

- Determine confidence level and accuracy level
- Determining the process or activities that want to be observed
- Prepare the schedule of random observation
- Take a preliminary sample to obtain an estimation
- Compute the sample size required based on the preliminary sample
- Observe and record the activities
- Determine data adequacy by adequacy test
- Analyze the workers based on the observation record.

## 2.8 Benefit-Cost Analysis

Benefit-Cost Analysis (BCA) is a process of identifying, measuring, and comparing the benefits and cost of an investment of a project (Campbell and Brown, 2003). Benefit-Cost Analysis is a common analysis used to evaluate project based on its cost and benefit (Pujawan, 2012). To analyze the benefit-cost of a project, the benefit of the project has to convert in qualitative form. To calculate the benefit-cost of a project, the following formula used:

$$B/C = \frac{\textit{Benefit Value}}{\textit{Investment Cost}} \quad (\text{Eq. 2.1})$$

Both value above are in present worth value. When the value of B/C is greater than 1, then the project is said to be feasible to run.

## 2.9 Sensitivity Analysis

Sensitivity analysis is the investigation of potential changes and errors and its impact on conclusion to be drawn from the model (Baird, 1989). Sensitivity analysis used for several purposes, such as:

- Decision making tool  
Sensitivity analysis as decision making tool helps the decision maker to test the robustness of an optimal solution, identify the critical value of a system, identify the sensitive variable of a system, comparing values of decisions, and assessing the riskiness of each strategy.
- Communication tool  
Sensitivity analysis help the decision makers to communicate with each other in the making of more credible recommendation.
- Increasing the understanding of the system  
Sensitivity analysis helps in the understanding the relationship between variables and the developing of hypothesis testing.
- Model development toll  
By doing sensitivity analysis, model could be simplified by eliminating the errors. Besides that, validity and accuracy could also be tested.

## **CHAPTER III**

### **RESEARCH METHODOLOGY**

This chapter elaborates the methodology and its explanation which used in this research. There are two phase in this research, preliminary and preparation phase, and data collection and data processing phase.

#### **3.1 Preliminary and Preparation Phase**

In this phase, problem identification is done based on the observation of existing condition in Surabaya Warehouse. Literature review which become the theory of problem solving also done in this phase.

##### **3.1.1 Observation and Problem Identification**

In this phase, problem identification done according to the first observation held in Surabaya Warehouse. Observation includes direct observation of inbound logistics. Besides direct observation, interview with the warehouse worker also become the input of problem identification. Based on the observation, the problem identified in Surabaya Warehouse is the lack of automated technology implementation in outbound logistics process which could lead to longer outbound lead time.

##### **3.1.2 Literature Review**

In this phase, literature review related to warehouse management and automated warehouse technology is done. Literature review become the theory of Surabaya Warehouse problem solving literature used as book, journal, article, and technology vendor website.

#### **3.2 Data Collection Phase**

In this phase, data collection done in order to be the input for data processing to solve the problem occur in Surabaya Warehouse. Data required is the data related to outbound logistics process and technology data.

##### **3.2.1 Outbound Logistics Data**

Outbound logistics data obtain from observation held in Surabaya Warehouse and secondary data obtain from Kamadjaja Logistics. Data collected are

number of labor required in outbound logistics process, labor cost, and material handling cost. Number of labor required will be obtain from direct observation which will be held in Surabaya Warehouse. Labor cost and material handling cost will be obtain from secondary data. Besides that, direct observation will also held in order to become the input of work sampling analysis to obtain worker efficiency.

Those data then will be compared with technology data in order to know whether the implementation of technology is giving the company the desired benefit and achievement.

### 3.2.2 Technology Data

Technology data obtain from developer website. Data obtain are similar to outbound logistics data, such as number of labor required and output rate. Beside those data, the other data required is investment cost. Output rate will be obtained from developer website, while investment cost will be obtained from developer website or developer quotation.

Those data then will be compared with outbound logistics data in order to know whether the implementation of technology is giving the company the desired benefit and achievement.

## 3.3 Data Processing Phase

After the data required are complete, the next phase is data processing. Steps to do this phase are listed as follows.

### 3.2.1 Value Stream Mapping

Businiss Process data will be presented by Value Stream Mapping (VSM). VSM will be made according to the existing condition of Surabaya Warehouse based on direct observation. Based on VSM, process that should be improved will be identified. Literature review which has been done before then become the theory to solve and solve the problem. Literature review will then identify which technology should be the alternative.

### 3.2.2 Technology Need Analysis

Technology need analysis is a review that provides framework to assist key stakeholders to make decision related to technology implementation. Before

defining alternatives for Surabaya Warehouse, the first thing to do is to make technology need analysis. Analysis used to analyze the technology need in Surabaya Warehouse is gap analysis.

### 3.2.3 Work Sampling

To do work sampling method following are the steps to be run:

- Determine confidence level and accuracy level  
Confidence level and accuracy level define the limit error that want to be achieved.
- Determining the process or activities that want to be observed  
Since the focus on this final project is outbound logistics process, the activities that will be observed is the outbound activities in Surabaya Warehouse.
- Prepare the schedule of random observation  
The next step is to determine the observation schedule.
- Take a preliminary sample to obtain an estimation  
Usually, preliminary sample required 100 samples in order to estimate the observation sample size required for the next observation.
- Compute the sample size required based on the preliminary sample  
This step is done in order to know whether the sample that have been obtain is enough. If the test shows that the sample size is not enough, the next observation sample size has to be according to the result of test. This step will be repeated until the result shows that sample size is enough. The formula of sample size required is as follow.

$$N' = \frac{z^2 \cdot p \cdot q}{(s \cdot p)^2} \quad (\text{Eq. 3.1})$$

Where:

N' = Amount of observation that should be done

Z = Level of confidence index

s = Expected error

p = probability of nonworking element

q = probability on working element (1 - p)

- Observe and record the activities

In the observation, determine the working activities element and nonworking activities element.

- Determine data adequacy by adequacy test

In this step, adequacy test held in order to know whether each observation data is enough to be analyzed or not. Observation data considered to be adequate when its value of N is greater than the value of N'(adequacy test). The formula of adequacy test is as follows.

$$N' = \frac{z^2 \cdot p \cdot q}{(s)^2} \quad (\text{Eq. 3.2})$$

Where:

N' = Amount of observation that should be done

Z = Level of confidence index

s = Expected error

p = probability of nonworking element

q = probability on working element (1 - p)

- Analyze the workers based on the observation record.

Based on the data recorded in the previous step, analyze the percentage of worker working activities and nonworking activities.

### 3.2.4 Benefit Cost Analysis

After the alternative technology has already defined, the next step is to analyze it by benefit-cost analysis. Benefit-Cost Analysis will show whether the alternative technology is giving the benefit if it is implemented in the warehouse or not. The calculation of benefit-cost analysis will refer to Chapter II.

Steps to do benefit cost analysis are as follows:

- Define the value of Weighted Average Cost of Capital (WACC)

Weighted Average Cost of Capital is the average after-tax cost of a company's various capital sources. A company has two primary financing sources, such as debt and equity. WACC is calculated by



multiplying the cost of each financial source. Following are the formula used to calculate WACC:

$$WACC = \frac{E}{V} \times Re + \frac{D}{V} \times Rd (1 - T_c) \quad (\text{Eq. 3.3})$$

Where,

*Re* = cost of equity

*Rd* = cost of debt

*E* = market value of the firm's equity

*D* = market value of the firm's debt

*V* = *D* + *E*

*Tc* = corporate tax rate

- Define cost that relate to the implementation of the technology  
Cost that will be related are investment cost, labor cost, and material handling cost. Investment cost is cost spent by the company to buy or leasing the technology required in the process. Labor cost is related to number of labor, the higher the number of labor required in the process, the higher the labor cost. Besides that, labor cost also includes labor training cost. Since the implementation of technology is a new thing in Surabaya Warehouse, therefore, training is required in order to make the labor keep up with the technology. Material handling cost also related because of some company use leasing system to material handling which sometime the payment is based on either the km used or the number of hour used. The higher the utilization of the material handling, the higher the material handling cost.
- Define the benefit of the implementation  
Benefit of the implementation obtained by calculating the incremental of operational cost in existing condition and if the technology is implemented. Operational cost related to benefit are labor cost, forklift cost, forklift fuel cost, and pallet cost.

- Calculate the Present Value (PV)

Present Value (PV) or also called as Present Worth (PW) or Net Present Value (NPV) is an equivalent amount at present time which explain the net cash flow of investment expenses in a certain interest rate. To calculate PV, following is the formula used:

$$PV(i) = \sum_t^n F_t(1 + i)^{-t}, 0 \leq i \leq \infty \quad (\text{Eq. 3.4})$$

Where,

$i$  = *interest rate value*

$F_t$  = *Future value*

$t$  = *Period of time*

PV will be calculated both for existing condition and if the technology is implemented.

- Define the value of B/C

To analyze the benefit-cost of a project, the benefit of the project has to convert in qualitative form. To calculate the benefit-cost of a project, the following formula used:

$$B/C = \frac{\text{Benefit Value}}{\text{Investment Cost}}$$

Both value above are in present worth value. When the value of B/C is greater than 1, then the project is said to be feasible to run.

### 3.2.5 Sensitivity Analysis

Sensitivity analysis done in this final project is one way sensitivity analysis and the analysis used is by tornado diagram.

#### 3.2.5.1 One Way Sensitivity Analysis

One way sensitivity analysis is done by changing the value of a variable which then it will automatically change the outcome of a model. To be able to do one way sensitivity analysis, the first thing to do is to define variables which affecting the change of the outcome. After defining the variables, the next thing to

do is to define the minimum and maximum line of each variable. This step done in order to know how affecting the variable is to the outcome. When the minimum line and maximum line are already defined, the next step is to record the result of the outcome of each line. The gap between the outcome of maximum line and minimum line will define which variable is more sensitive compare to the other. The higher the gap means the more sensitive the variable is.

#### *3.2.5.2 Tornado Diagram*

When the result of the outcome of each line and its sensitivity sequence has been defined, the next step is to analyze it. To visually represent the result of the sensitivity analysis and to ease the analysis, tornado diagram is used. Tornado diagram shows the variables from the lowest to the highest or from the least sensitive to the most sensitive.

### **3.4 Interpretation and Analysis**

In this phase, the result which obtain in data processing phase will be analyzed in order to know whether the implementation of the alternative technology should be done. Analysis used is the incremental of the cost related and the benefit between the manual process and the automation process.

Following flowchart shows the methodology of this final project.

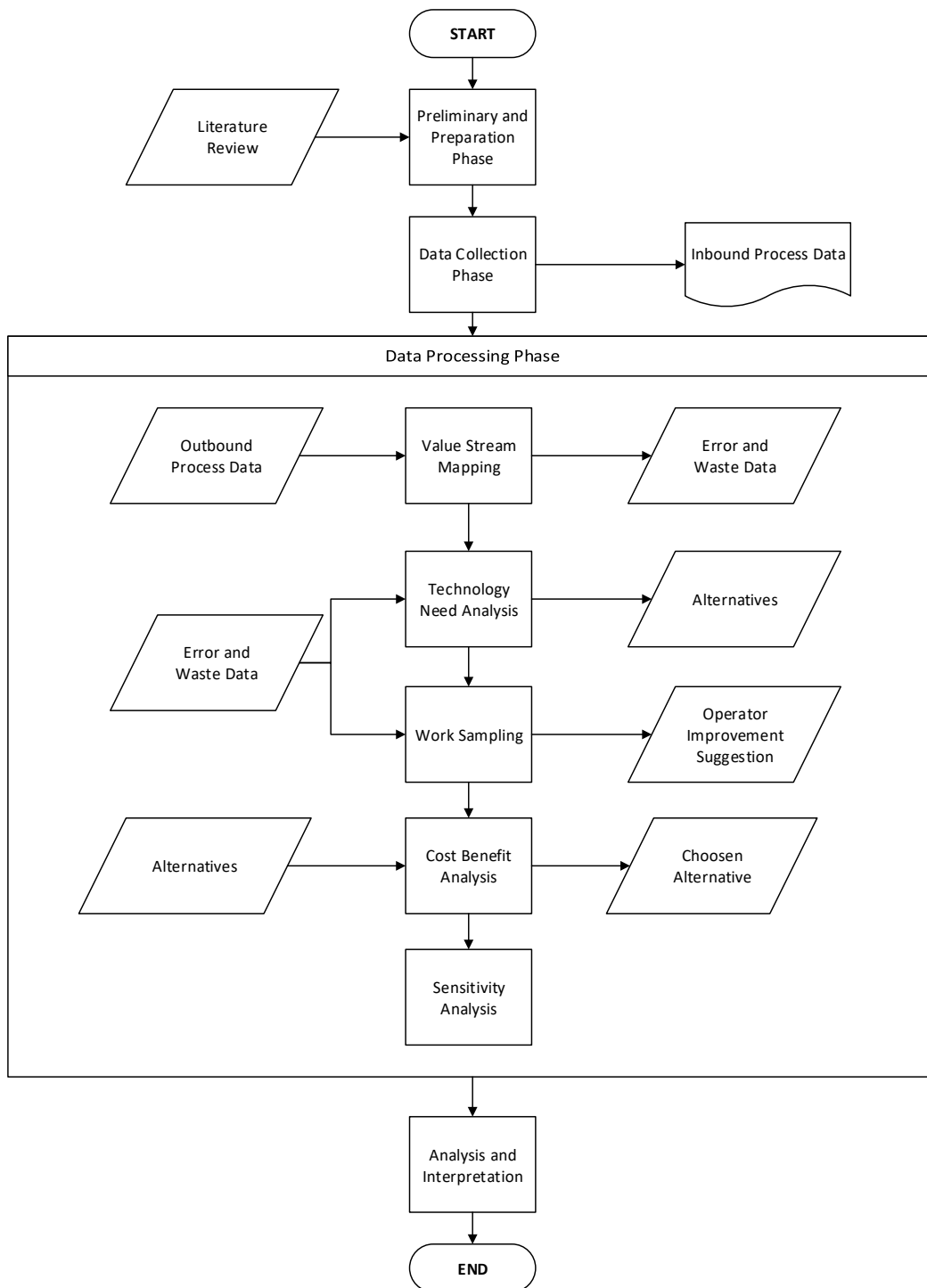


Figure 3. 1 Research Methodology Flowchart

## **CHAPTER IV**

### **DATA COLLECTION AND PROCESSING**

This chapter elaborates the data collection and its processing which related to the problem solving and analysis. There are two data processing method in this research, such as benefit-cost analysis and work sampling.

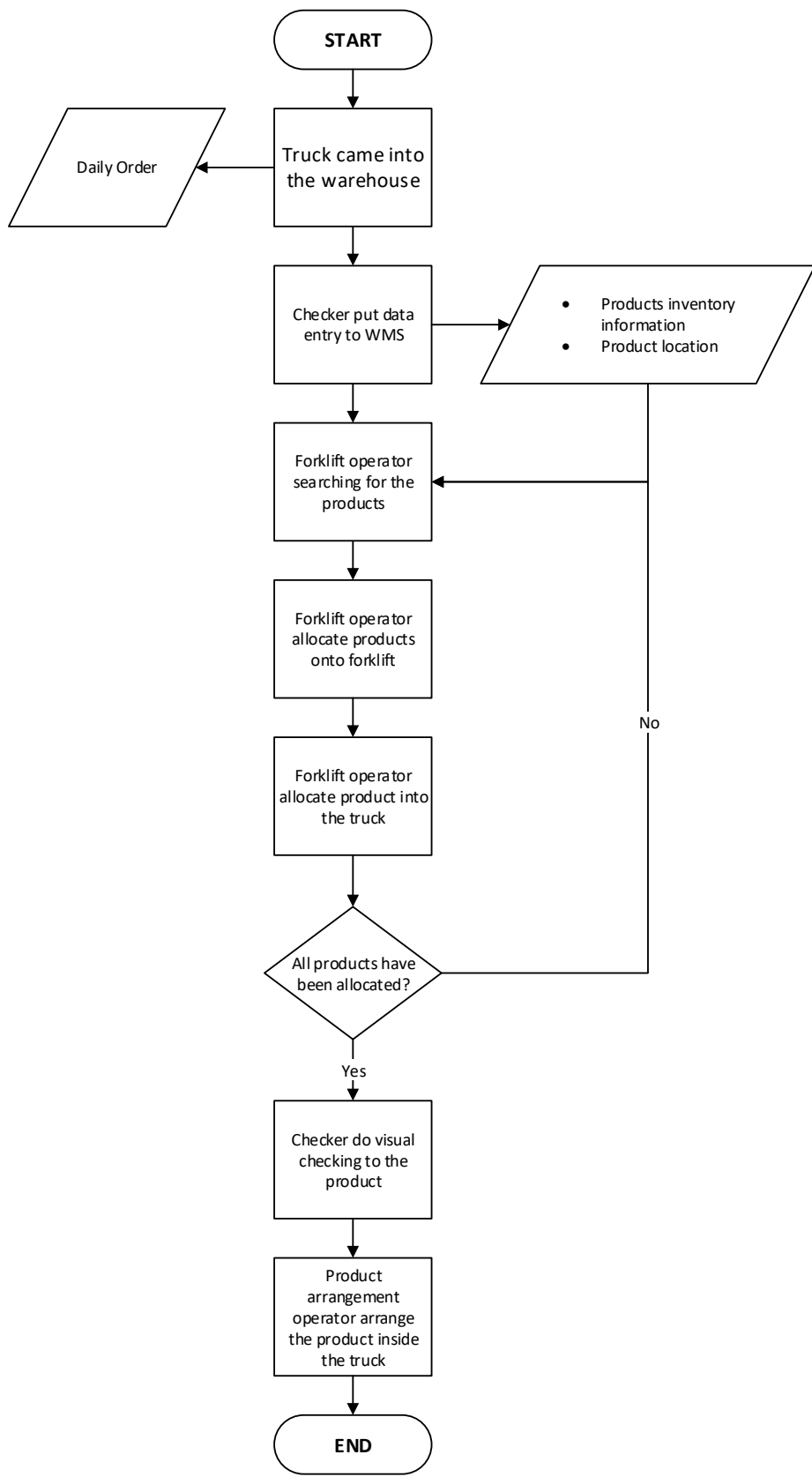
#### **4.1 Data Collection**

This subchapter consist of data which required as the input to do benefit cost analysis in order to know whether the investment is financially feasible or infeasible.

##### **4.1.1 Existing Condition Business Process**

Business process of outbound logistics process are first, truck came into the warehouse with daily order from PT Unilever Tbk. Order have been issued since the day before the truck came. Next, checker will do data entry to WMS regarding the number of products that will be distributed. Checker will also tell the forklift operator regarding the number of products and product location. Forklift operator will then searching for the product and allocate it to the truck according to the number of order. When the all of the products have been allocated to the truck, product arrangement operator will arrange the products inside the truck while checker will do final visual check to the products.

Following chart shows the business process of Surabaya Warehouse outbound logistics existing condition.



#### 4.1.2 Outbound Logistics Data

Based on the final project scope, this project focused on outbound logistics process. Outbound logistics data required are number of labor, number of forklift, and forklift cost related. Table 4.1 shows the data collected.

Table 4. 1 Outbound Logistics Existing Condition Data

<b><i>Existing Condition</i></b>			
<b><i>Working Time</i></b>			
Working Hour		8	hours per day
Working Day		6	days per week
		51	weeks per year
<b><i>Num of Labor</i></b>			
Forklift Labor		2	per shift
Product Arrangement		2	per shift
Checker		1	per shift
<b><i>Labor Cost</i></b>			
Forklift Labor	IDR	4,000,000.00	per labor
Product Arrangement	IDR	3,349,500.00	per labor
Checker	IDR	3,349,500.00	per labor
<b><i>Forklift</i></b>			
Number of Forklift		2	for outbound logistics
Fuel Cost	IDR	170,000.00	per LPG
Forklift Cost	IDR	204,680,000.00	per forklift per year
Maintenance Cost	IDR	2,600,000.25	per forklift per month

Based on the data above, shown that Surabaya Warehouse has eight working hours per day with six working days per week and 51 weeks per year with two shifts per day. For outbound logistics process, five labors are required, two people as forklift operators, one person as checker, and two people as product arrangement operators. Number of forklift allocated for outbound logistics are two forklifts. The operational cost related to forklift are fuel cost with cost of IDR 170,000 per LPG and forklift investment cost IDR 204,680,000 per forklift.

#### 4.2 Data Processing

This subchapter elaborates the data processing based on data that have been obtained in previous subchapter. Data processed will then be the input to analyze whether the investment is financially feasible or infeasible.

#### 4.2.1 Technology Need Analysis

Based on the existing condition business process, the longest time required in outbound logistics process is the arrangement process. Since the process is in manual process, operator has to arrange each box inside the truck, which usually consists of 18 pallets or hundreds of boxes.

Technology required in implementing automated or semi-automated for Surabaya Warehouse outbound logistics are technology which provide faster operation time, required less labor, and produced less damage to the products. By implementing those kind of technology, Kamadjaja Logistics Management Board expect better performance in outbound logistics.

Alternatives offered for Surabaya Warehouse outbound logistics warehouse are Actiw LoadMatic and ATLS. Actiw LoadMatic provides characteristics that Management Board Expect. While for ATLS, ATLS has several types of technology with different characteristics. Based on the characteristics Surabaya Warehouse has, the suitable ATLS type to be implemented in the warehouse is ATLS Skate Loader.

#### 4.2.3 Technology Data

There are two alternatives offered to solve the problem occur in Surabaya Warehouse, such as Automatic Truck Loading System and Actiw LoadMatic. This subchapter will elaborates both alternatives in specification aspects.

##### *4.2.3.1 Automatic Truck Loading System (ATLS)*

There are several kinds of ATLS technology, however, after the characteristics of each technology have been fitted to warehouse condition, the appropriate ATLS type for Surabaya Warehouse is Skate Loader.

Skate Loader could only be used for loading or outbound logistics process for palletized products. It used aluminum skates with integrated chains powered by a pusher plate. Since it only used for loading process, it does not required truck modification. Vehicle cycle time by implementing this technology is 8 minutes.

##### *4.2.3.2 Actiw LoadMatic*

LoadMatic data are obtained from the quotation given by the company Business Unit Department. LoadMatic could accommodate until 30,000 kg of



products for 40ft container. The system is designed to load 18 pallets for 40ft container, or 8 pallets for 20ft container. LoadMatic capable to transfer pallets with specified size (2,200 mm x 2,300 mm x 11,900 mm)

The purchasing of LoadMatic will includes:

1. Actiw LoadMatic, 1 pc

LoadMatic unit 40ft for maximum load of 30,000 kg, according to the attached specification and follow principles of provision EC directive 2006/42/EY. Loading plate equipped with free rotating rollers (roller tracks according to the pallet types):

- Angling of the equipment (turn) to secure proper docking with container/trailer (rear leg has side movement about +/- 250 mm).
- Height adjustment (400 mm), container loading height 1200mm – 1600mm.
- Clamps for container docking o Sensors to check containers/trailers alignment (in the front of LoadMatic unit).
- Side guide

LoadMatic operations are semi-automatic and requires actions by operator

2. Load forming device, 1 unit per LoadMatic unit

LoadMatic's drive end is equipped with conveyor and a pusher beam to pack the sets of pallets when they are fed from the buffer conveyor to LoadMatic

3. Conveyor system (standard roller and chain conveyors)

4pcs (2 x 2) roller conveyors with forklift barriers to buffer loads for pallet inbound. 1 pc conveyor system to pack 2 pallets next to each other, check profile (outer dimensions of the pallet set), and a reject lane:

- 1 pc reject conveyor with forklift impact protection.
- 1 pc right angle transfer station (“pairing station”)
- Controls integrated to LoadMatic

4. Safety equipment, 1 set
  - ✓ 2 pcs safety light beams o one between inbound conveyor and pairing station.
  - ✓ Mechanical fencing where applicable
5. Documentation, 1 set
  - Supplier's standard documentation in English (Maintenance, Safety and Operation documentation).
  - 2 pcs hard copies (printed one) and 1 CD or USB
6. Site operations, 1 set
  - Site language English.
  - Site operations or Installation (mechanical and electrical), start-up and training, max 6 work weeks (6\*5 = 30 working days max á 10 hours) including 4 days for traveling

Total purchasing cost or investment cost of Actiw LoadMatic is € 400,000. Buffer conveyor does not includes in one purchase, it requires additional cost. For 6 pallets buffer it cost € 16,000 while for 18 pallets buffer it cost € 112,000.

#### 4.2.4 Work Sampling

Work sampling done thrice for forklift and checker, while product arrangement worker required twice observation. Following are the data observed for work sampling.

##### 4.2.4.1 Forklift Worker

Forklift worker required thrice observation according to sample size calculation. The first observation is the preliminary observation, while the second and the third are the work sampling observation. Following are the activities observed for forklift worker.

Table 4. 2 Forklift Worker Activities

	<i>Working</i>	<i>Nonworking</i>
I	Forklift go to the product location	No outbound activities
II	Forklift allocate products onto the forklift	Waiting for other worker
III	Forklift allocate products into the truck	Personal Time (Break time)
IV		Unavailable

Based on the observation, following are the data of forklift worker.

Table 4. 3 Forklift Operator Prewrite Sampling

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator</i>							
		<i>Working</i>			<i>Nonworking</i>				
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	
<i>13:00:53</i>	<i>1</i>				1				
<i>13:04:09</i>	<i>2</i>				1				
<i>13:04:33</i>	<i>3</i>				1				
<i>13:05:31</i>	<i>4</i>				1				
<i>13:05:36</i>	<i>5</i>				1				
<i>.</i>	<i>.</i>								
<i>.</i>	<i>.</i>								
<i>.</i>	<i>.</i>								
<i>14:48:15</i>	<i>95</i>				1				
<i>14:48:20</i>	<i>96</i>				1				
<i>14:48:57</i>	<i>97</i>				1				
<i>14:49:18</i>	<i>98</i>				1				
<i>14:53:23</i>	<i>99</i>				1				
<i>14:54:10</i>	<i>100</i>				1				
<b><i>Total Element</i></b>		4	1	3	92	0	0	0	
<b><i>Probability</i></b>		8%			92%				

<b><i>Confidence Level</i></b>	95.00%
<b><i>Accuracy Level</i></b>	5.00%
<b><i>Zvalue</i></b>	1.65
<b><i>N' (sample size)</i></b>	95

Table 4. 4 Forklift Work Sampling I

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator</i>							
		<i>Working</i>			<i>Nonworking</i>				
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	
<i>10:00:18</i>	<i>1</i>				1				
<i>10:02:09</i>	<i>2</i>				1				

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator</i>						
		<i>Working</i>			<i>Nonworking</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:02:38</i>	<i>3</i>				1			
<i>10:02:48</i>	<i>4</i>				1			
<i>10:03:47</i>	<i>5</i>				1			
<i>.</i>	<i>.</i>							
<i>.</i>	<i>.</i>							
<i>.</i>	<i>.</i>							
<i>13:58:03</i>	<i>90</i>				1			
<i>14:08:30</i>	<i>91</i>				1			
<i>14:09:50</i>	<i>92</i>					1		
<i>14:10:29</i>	<i>93</i>					1		
<i>14:20:16</i>	<i>94</i>	1						
<i>14:20:31</i>	<i>95</i>	1						
<b><i>Total Element</i></b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>60</b>	<b>7</b>	<b>0</b>	<b>26</b>
<b><i>Probability</i></b>		<b>2%</b>			<b>98%</b>			

<b><i>Confidence Level</i></b>	95.00%
<b><i>Accuracy Level</i></b>	5.00%
<b><i>Zvalue</i></b>	1.65
<b><i>N' (sample size)</i></b>	24

Table 4. 5 Forklift Operator Work Sampling II

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:09:46 AM</i>	<i>1</i>				1			
<i>10:14:00 AM</i>	<i>2</i>				1			
<i>10:14:22 AM</i>	<i>3</i>				1			
<i>10:25:12 AM</i>	<i>4</i>				1			
<i>10:30:06 AM</i>	<i>5</i>				1			

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:30:34 AM</i>	<i>6</i>				1			
<i>10:34:42 AM</i>	<i>7</i>				1			
<i>10:36:34 AM</i>	<i>8</i>				1			
<i>10:36:52 AM</i>	<i>9</i>				1			
<i>10:38:05 AM</i>	<i>10</i>				1			
<i>10:39:06 AM</i>	<i>11</i>				1			
<i>10:41:41 AM</i>	<i>12</i>				1			
<i>10:42:36 AM</i>	<i>13</i>				1			
<i>10:43:25 AM</i>	<i>14</i>				1			
<i>10:44:18 AM</i>	<i>15</i>				1			
<i>10:49:11 AM</i>	<i>16</i>				1			
<i>10:50:55 AM</i>	<i>17</i>				1			
<i>10:52:14 AM</i>	<i>18</i>				1			
<i>10:53:49 AM</i>	<i>19</i>				1			
<i>10:54:20 AM</i>	<i>20</i>				1			
<i>10:55:08 AM</i>	<i>21</i>				1			
<i>10:59:32 AM</i>	<i>22</i>				1			
<i>11:00:59 AM</i>	<i>23</i>				1			
<i>11:10:27 AM</i>	<i>24</i>				1			
<b><i>Total Element</i></b>		0	0	0	24	0	0	0
<b><i>Probability</i></b>		<b><i>0%</i></b>			<b><i>100%</i></b>			

<b><i>Confidence Level</i></b>	95.00%
<b><i>Accuracy Level</i></b>	5.00%
<b><i>Zvalue</i></b>	1.65
<b><i>N' (sample size)</i></b>	0

Table 4. 6 Forklift Operator Work Sampling Summary

<i>Worker</i>	<i>Forklift Operator</i>				
<i>Observation</i>	<i>Time</i>	<i>Sample Size (N)</i>	<i>Probability</i>		<i>N'</i>
			<i>Working</i>	<i>Nonworking</i>	
Preliminary	Dec 19 <sup>th</sup> 2016	100	8%	92%	48
Work Sampling I	Dec 27 <sup>th</sup> 2016	48	2%	98%	24
Work Sampling II	Jan 3 <sup>rd</sup> 2017	24	0%	100%	0

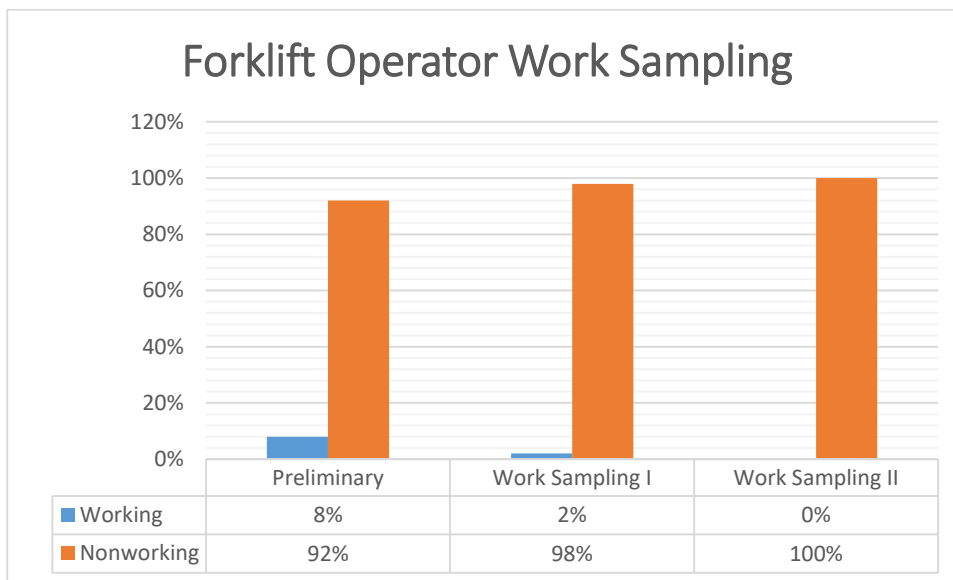


Figure 4. 1 Forklift Operator Work Sampling

#### 4.2.4.2 Checker

Checker required thrice observation according to sample size calculation. The first observation is the preliminary observation, while the second and the third are the work sampling observation. Following are the activities observed for checker.

Table 4. 7 Checker Activities

	<i>Working</i>	<i>Nonworking</i>
I	Checker do visual checking of products	No outbound activities
II	Checker entry products information into WMS	Waiting for other worker
III		Personal Time (Break time)
IV		Unavailable

Based on the observation, following are the data of checker.

Table 4. 8 Checker Prewrite Sampling

<i>Time</i>	<i>Observation</i>	<i>Checker</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>13:00:53</i>	<i>1</i>			1			
<i>13:04:09</i>	<i>2</i>			1			
<i>13:04:33</i>	<i>3</i>			1			
<i>13:05:31</i>	<i>4</i>			1			
<i>13:05:36</i>	<i>5</i>			1			
.	.						
.	.						
.	.						
<i>14:48:15</i>	<i>95</i>			1			
<i>14:48:20</i>	<i>96</i>			1			
<i>14:48:57</i>	<i>97</i>			1			
<i>14:49:18</i>	<i>98</i>			1			
<i>14:53:23</i>	<i>99</i>			1			
<i>14:54:10</i>	<i>100</i>			1			
<i>Total Element</i>		9	4	79	7	0	0
<i>Probability</i>		<i>9%</i>		<i>86%</i>			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	114

Table 4. 9 Checker Work Sampling I

<i>Time</i>	<i>Observation</i>	<i>Checker</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:00:18</i>	<i>1</i>			1			
<i>10:02:09</i>	<i>2</i>			1			
<i>10:02:38</i>	<i>3</i>			1			
<i>10:02:48</i>	<i>4</i>			1			
<i>10:03:47</i>	<i>5</i>			1			
<i>.</i>	<i>.</i>						
<i>.</i>	<i>.</i>						
<i>.</i>	<i>.</i>						
<i>15:13:05</i>	<i>110</i>	1					
<i>15:17:14</i>	<i>111</i>	1					
<i>15:21:22</i>	<i>112</i>	1					
<i>15:25:30</i>	<i>113</i>	1					
<i>15:29:39</i>	<i>114</i>	1					
<b><i>Total Element</i></b>		<b>5</b>	<b>2</b>	<b>86</b>	<b>21</b>	<b>0</b>	<b>0</b>
<b><i>Probability</i></b>		<b>7%</b>		<b>94%</b>			

<b><i>Confidence Level</i></b>	95.00%
<b><i>Accuracy Level</i></b>	5.00%
<b><i>Zvalue</i></b>	1.65
<b><i>N' (sample size)</i></b>	82

Table 4. 10 Checker Work Sampling II

<i>Time</i>	<i>Observation</i>	<i>Checker</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:09:46 AM</i>	<i>1</i>			1			
<i>10:14:00 AM</i>	<i>2</i>			1			
<i>10:14:22 AM</i>	<i>3</i>			1			



<i>Time</i>	<i>Observation</i>	<i>Checker</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:25:12 AM</i>	<i>4</i>			1			
<i>10:30:06 AM</i>	<i>5</i>			1			
.	.						
.	.						
.	.						
<i>1:10:03 PM</i>	<i>68</i>			1			
<i>1:10:49 PM</i>	<i>69</i>			1			
<i>1:11:43 PM</i>	<i>70</i>			1			
<i>1:12:24 PM</i>	<i>71</i>			1			
<i>1:14:32 PM</i>	<i>72</i>			1			
<i>Total Element</i>		0	0	45	0	0	27
<i>Probability</i>		0%		100%			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	0

Table 4. 11 Forklift Operator Work Sampling Summary

<i>Worker</i>	<i>Checker</i>				
<i>Observation</i>	<i>Time</i>	<i>Sample Size (N)</i>	<i>Probability</i>		<i>N'</i>
			<i>Working</i>	<i>Nonworking</i>	
Preliminary	Dec 19 <sup>th</sup> 2016	100	9%	86%	114
Work Sampling I	Dec 27 <sup>th</sup> 2016	114	7%	94%	72
Work Sampling II	Jan 3 <sup>rd</sup> 2017	72	0%	100%	0

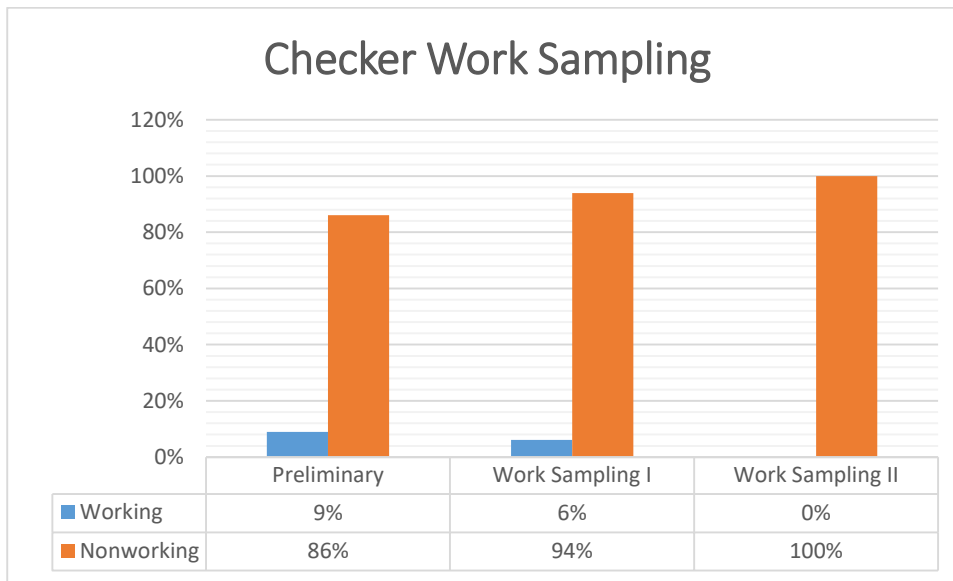


Figure 4. 2 Checker Work Sampling

#### 4.2.4.3 Product Arrangement Operator

Product arrangement worker required twice observation according to sample size calculation. The first observation is the preliminary observation, while the second is the work sampling observation. Following are the activities observed for checker.

Table 4. 12 Product Arrangement Operator Activities

	<i>Working</i>	<i>Nonworking</i>
I	Operator arrange the products inside the truck	No outbound activities
II		Waiting for other worker
III		Personal Time (Break time)
IV		Unavailable

Based on the observation, following are the data of product arrangement operator.

Table 4. 13 Product Arrangement Operator Prewrite Sampling

<i>Time</i>	<i>Observation</i>	<i>Product Arrangement Operator</i>				
		<i>Working</i>	<i>Not Working</i>			
		<i>I</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>13:00:53</i>	<i>1</i>		1			
<i>13:04:09</i>	<i>2</i>		1			
<i>13:04:33</i>	<i>3</i>		1			
<i>13:05:31</i>	<i>4</i>		1			
<i>13:05:36</i>	<i>5</i>		1			
<i>.</i>	<i>.</i>					
<i>.</i>	<i>.</i>					
<i>.</i>	<i>.</i>					
<i>14:48:15</i>	<i>95</i>		1			
<i>14:48:20</i>	<i>96</i>		1			
<i>14:48:57</i>	<i>97</i>		1			
<i>14:49:18</i>	<i>98</i>		1			
<i>14:53:23</i>	<i>99</i>		1			
<i>14:54:10</i>	<i>100</i>		1			
<i>Total Element</i>		4	96	0	0	0
<i>Probability</i>		4%	96%			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	46

Table 4. 14 Product Arrangement Operator Work Sampling II

<i>Time</i>	<i>Observation</i>	<i>Product Arrangement Operator</i>				
		<i>Working</i>	<i>Nonworking</i>			
		<i>I</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:00:18</i>	<i>1</i>		1			
<i>10:02:09</i>	<i>2</i>		1			
<i>10:02:38</i>	<i>3</i>		1			
<i>10:02:48</i>	<i>4</i>		1			
<i>10:03:47</i>	<i>5</i>		1			
.	.					
.	.					
.	.					
<i>11:43:36</i>	<i>42</i>		1			
<i>11:49:44</i>	<i>43</i>		1			
<i>11:52:05</i>	<i>44</i>		1			
<i>11:54:56</i>	<i>45</i>		1			
<i>11:55:07</i>	<i>46</i>		1			
<i>Total Element</i>		0	41	5	0	0
<i>Probability</i>		0%	100%			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	0

Table 4. 15 Product Arrangement Operator Work Sampling

<i>Worker</i>	<i>Checker</i>				
<i>Observation</i>	<i>Time</i>	<i>Sample Size (N)</i>	<i>Probability</i>		<i>N'</i>
			<i>Working</i>	<i>Nonworking</i>	
Preliminary	Dec 19th 2016	100	4%	96%	46
Work Sampling I	Dec 27th 2016	46	0%	100%	82

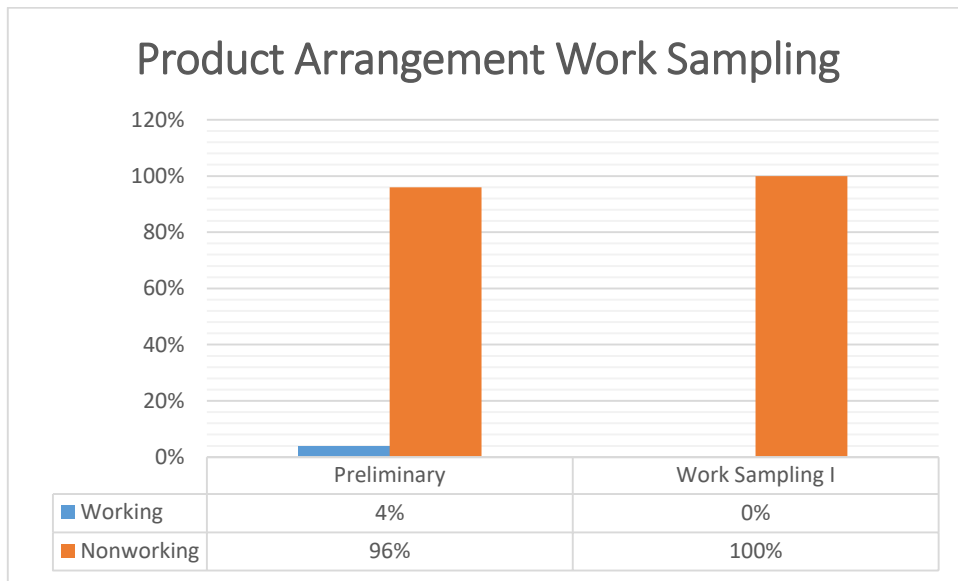


Figure 4. 3 Product Arrangement Work Sampling

Based on the work sampling data above, it shows that idle time of each operator is higher than the working time. Therefore, it is recommend to minimize the number of labor.

#### 4.2.4.4 Adequacy Test

Adequacy test held in order to know whether each observation data is enough to be analyzed or not. Observation data considered to be adequate when its value of N is greater that the value of N'(adequacy test). Formula used to obtain the adequacy of each observation is:

$$N' = \frac{z^2 \cdot p \cdot q}{(s)^2}$$

Where:

N' = Amount of observation that should be done

Z = Level of confidence index

s = Expected error

p = probability of nonworking element

q = probability on working element (1 - p)

Based on the formula above and observation data in previous subchapter, following are the adequacy of each observation.

Table 4. 16 Observation Adequacy Test

<i>Worker</i>	<i>Forklift Operator</i>			
<i>Observation</i>	<i>Time</i>	<i>Sample Size (N)</i>	<i>N' (Adequacy Test)</i>	<i>Note</i>
Preliminary	Dec 19 <sup>th</sup> 2016	100	81	Adequate
Work Sampling I	Dec 27 <sup>th</sup> 2016	48	23	Adequate
Work Sampling II	Jan 3 <sup>rd</sup> 2017	24	0	Adequate
<i>Worker</i>	<i>Checker</i>			
<i>Observation</i>	<i>Time</i>	<i>Sample Size (N)</i>	<i>N' (Adequacy Test)</i>	<i>Note</i>
Preliminary	Dec 19 <sup>th</sup> 2016	100	85	Adequate
Work Sampling I	Dec 27 <sup>th</sup> 2016	114	63	Adequate
Work Sampling II	Jan 3 <sup>rd</sup> 2017	72	0	Adequate
<i>Worker</i>	<i>Product Arrangement Operator</i>			
<i>Observation</i>	<i>Time</i>	<i>Sample Size (N)</i>	<i>N' (Adequacy Test)</i>	<i>Note</i>
Preliminary	Dec 19 <sup>th</sup> 2016	100	42	Adequate
Work Sampling I	Dec 27 <sup>th</sup> 2016	46	0	Adequate

Based on data above, shown that all of the observation are adequate. Which means that the observation data are enough for further analysis.

#### 4.2.5 Forklift Investment and Depreciation

Surabaya Warehouse has two forklifts allocated for outbound logistics process. Forklift used in the warehouse is Toyota Toner HST 2.5 with ten years life expectancy. Based on the data on previous subchapter, the investment cost of one forklift is € 17,056.24. Following are the investment and depreciation of Surabaya Warehouse forklifts.

Table 4. 17 Forklift Investment and Depreciation

<i>Year</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>	<i>2013</i>	<i>2014</i>	<i>2015</i>	<i>2016</i>
<b><i>Forklift</i></b>							
Investment Cost	204,680,000.00						
Number of forklift	2.00						
Life Expectancy	10.00						
<b><i>Asset Account</i></b>							
Initial Accounting Value	-	409,360,000.00	409,360,000.00	409,360,000.00	409,360,000.00	409,360,000.00	409,360,000.00
Investment Cost	409,360,000.00	-	-	-	-	-	-
<b>Total Asset Account</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>
<b><i>Depreciation Account</i></b>							
Initial Value	-	(23,479,999.95)	(46,959,999.90)	(70,439,999.85)	(93,919,999.80)	(117,399,999.75)	(140,879,999.70)
Depreciation	(23,479,999.95)	(23,479,999.95)	(23,479,999.95)	(23,479,999.95)	(23,479,999.95)	(23,479,999.95)	(23,479,999.95)
<b>Total Depreciation</b>	<b>(23,479,999.95)</b>	<b>(46,959,999.90)</b>	<b>(70,439,999.85)</b>	<b>(93,919,999.80)</b>	<b>(117,399,999.75)</b>	<b>(140,879,999.70)</b>	<b>(164,359,999.65)</b>
<b><i>Net Book Value</i></b>	<b>432,839,999.95</b>	<b>456,319,999.90</b>	<b>479,799,999.85</b>	<b>503,279,999.80</b>	<b>526,759,999.75</b>	<b>550,239,999.70</b>	<b>573,719,999.65</b>

Table 4. 18 Forklift Investment and Depreciation (cont'd)

Year	2017	2018	2019	2020	2021	2022	2023
<b><i>Forklift</i></b>							
Investment Cost				204,680,000.00			
Number of forklift				1.00			
Life Expectancy				10.00			
<b><i>Asset Account</i></b>							
Initial Accounting Value	409,360,000.00	409,360,000.00	409,360,000.00	-	204,680,000.00	204,680,000.00	204,680,000.00
Investment Cost	-	-	-	204,680,000.00	-	-	-
<b>Total Asset Account</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>	<b>409,360,000.00</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>
<b><i>Depreciation Account</i></b>							
Initial Value	(164,359,999.65)	(187,839,999.60)	(211,319,999.55)	-	8,468,000.00	16,936,000.00	25,404,000.00
Depreciation	(23,479,999.95)	(23,479,999.95)	(23,479,999.95)	8,468,000.00	8,468,000.00	8,468,000.00	8,468,000.00
<b>Total Depreciation</b>	<b>(187,839,999.60)</b>	<b>(211,319,999.55)</b>	<b>(234,799,999.50)</b>	<b>8,468,000.00</b>	<b>16,936,000.00</b>	<b>25,404,000.00</b>	<b>33,872,000.00</b>
<b><i>Net Book Value</i></b>	<b>597,199,999.60</b>	<b>620,679,999.55</b>	<b>644,159,999.50</b>	<b>196,212,000.00</b>	<b>187,744,000.00</b>	<b>179,276,000.00</b>	<b>170,808,000.00</b>



Table 4. 19 Forklift Investment and Depreciation (cont'd)

<i>Year</i>	<i>2024</i>	<i>2025</i>	<i>2026</i>	<i>2027</i>	<i>2028</i>	<i>2029</i>
<i>Forklift</i>						
Investment Cost						
Number of forklift						
Life Expectancy						
<i>Asset Account</i>						
Initial Accounting Value	204,680,000.00	204,680,000.00	204,680,000.00	204,680,000.00	204,680,000.00	204,680,000.00
Investment Cost	-	-	-	-	-	-
<b>Total Asset Account</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>	<b>204,680,000.00</b>
<i>Depreciation Account</i>						
Initial Value	33,872,000.00	42,340,000.00	50,808,000.00	59,276,000.00	67,744,000.00	76,212,000.00
Depreciation	8,468,000.00	8,468,000.00	8,468,000.00	8,468,000.00	8,468,000.00	8,468,000.00
<b>Total Depreciation</b>	<b>42,340,000.00</b>	<b>50,808,000.00</b>	<b>59,276,000.00</b>	<b>67,744,000.00</b>	<b>76,212,000.00</b>	<b>84,680,000.00</b>
<b>Net Book Value</b>	<b>162,340,000.00</b>	<b>153,872,000.00</b>	<b>145,404,000.00</b>	<b>136,936,000.00</b>	<b>128,468,000.00</b>	<b>120,000,000.00</b>

Based on the tables above, shown the depreciation of forklift with salvage value of IDR 120,000. In 2010, forklifts invested were two forklifts, however in 2020, the forklift invested is one forklift due to the need of forklift for outbound logistics is only one since in work sampling subchapter, it already mentioned about the higher idle time of outbound logistics worker.

#### 4.2.6 Benefit Cost Analysis

Benefit Cost Analysis is a method used to help decision maker in decision making regarding investment. In this final project, Benefit Cost Analysis used to define whether Surabaya Warehouse investment is financially feasible or infeasible to be run. Elements required in this method are Weighted Average Cost of Capital (WACC) which will be used as interest rate, operational cost, and implementation cost. Those elements which then will be the input to identify the benefit of the implementation and benefit cost value of the project.

##### *4.2.6.1 Weighted Average Cost of Capital*

Weighted Average Cost of Capital (WACC) is calculated by cost of debt and cost of equity. Since the data of Surabaya Warehouse cannot be published the value of WACC obtained for the common WACC value of Indonesian Industrial Goods and Services based on waccexpert.com. Based on the website the common value of Indonesian Industrial Goods and Services Company is 15.26%.

##### *4.2.6.2 Existing Condition Operational Cost*

Based on the data given in subchapter 4.1.2, following is the existing condition operational cost from 2017 until 2028.

Table 4. 20 Existing Condition Cost

<i>Year</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
<b><i>Inflation</i></b>	4.63%	4.61%	4.59%	4.57%	4.56%	4.56%
<b><i>Existing</i></b>						
<i>Year</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
<b><i>Investment</i></b>						
Forklift				204,680,000.00		
<b><i>Operational and Maintenance Cost</i></b>						
Labor Cost	11,045,682,000.00	11,554,887,940.20	12,085,257,296.66	12,637,553,555.11	13,213,825,997.23	13,816,376,462.70
Fuel Cost	231,200,000.00	241,858,320.00	252,959,616.89	264,519,871.38	276,581,977.51	289,194,115.69
Maintenance Cost	64,000,008.00	66,950,408.37	70,023,432.11	33,462,404.18	34,988,289.81	36,583,755.83
<b>Total</b>	<b>11,340,882,008.00</b>	<b>11,863,696,668.57</b>	<b>12,408,240,345.66</b>	<b>12,935,535,830.67</b>	<b>13,525,396,264.55</b>	<b>14,142,154,334.22</b>
<b>TOTAL COST</b>	<b>11,340,882,008.00</b>	<b>11,863,696,668.57</b>	<b>12,408,240,345.66</b>	<b>13,140,215,830.67</b>	<b>13,525,396,264.55</b>	<b>14,142,154,334.22</b>
	0	1	2	3	4	5
<b>Present Value</b>	11,340,882,008.00	10,260,938,132.30	9,282,057,769.05	8,501,657,473.70	7,568,645,037.24	6,844,642,147.50

Table 4. 21 Existing Condition (cont'd)

<i>Year</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>	<i>2026</i>	<i>2027</i>
<b><i>Inflation</i></b>	4.55%	4.55%	4.55%	4.55%	4.54%

***Existing***

<i>Year</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>	<i>2026</i>	<i>2027</i>
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***Investment***

Forklift

***Operational and Maintenance Cost***

Labor Cost	14,445,021,591.75	15,102,270,074.18	15,789,423,362.55	16,507,842,125.55	17,257,298,158.05
Fuel Cost	302,352,447.95	316,109,484.34	330,492,465.87	345,529,873.07	361,216,929.31
Maintenance Cost	38,248,316.72	39,988,615.13	41,808,097.12	43,710,365.54	45,694,816.13
<b>Total</b>	<b>14,785,622,356.42</b>	<b>15,458,368,173.64</b>	<b>16,161,723,925.54</b>	<b>16,897,082,364.15</b>	<b>17,664,209,903.49</b>

<b>TOTAL COST</b>	<b>14,785,622,356.42</b>	<b>15,458,368,173.64</b>	<b>16,161,723,925.54</b>	<b>16,897,082,364.15</b>	<b>17,664,209,903.49</b>
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	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>
<b><i>Present Value</i></b>	6,189,304,069.55	5,596,711,126.72	5,060,855,806.08	4,576,305,782.09	4,137,753,039.78

The formula used to obtain Present value of each year is as for the example;

$$PV(i) = \sum_t^n F_t(1+i)^t, 0 \leq i \leq \infty$$

Where,

$$i = WACC = 15.62\%$$

$$F_t = 13,140,215,830.67$$

$$t = 3$$

$$PV(3) = 13,140,215,830.67 (1 + 15.62\%)^3$$

$$PV(3) = 8,501,657,473.70$$

Based on each year Present Value, following is the Net Present Value (NPV) of existing condition;

Table 4. 22 Net Present Value of Existing Condition

<i>Year</i>	<i>Present Value</i>
2017	11,340,882,008.00
2018	10,260,938,132.30
2019	9,282,057,769.05
2020	8,501,657,473.70
2021	7,568,645,037.24
2022	6,844,642,147.50
2023	6,189,304,069.55
2024	5,596,711,126.72
2025	5,060,855,806.08
2026	4,576,305,782.09
2027	4,137,753,039.78
<b><i>Net Present Value</i></b>	<b><i>79,359,752,392.02</i></b>

Based on the calculation above, the NPV of existing condition is IDR 79,359,752,392.02 .

#### *4.2.6.3 Implementation Cost*

Implementation cost is investment cost and operational cost by implementing new technology. The implementation cost of both technologies are as follow. The data used are based on data in subchapter 4.1.2. However, there are several data which are different, such as number of labor and number of forklift. Based on subchapter 4.2.4, it shows that idle time is higher than working time, therefore, in implementation, it is recommend to minimize number of labor into three worker per shift and only one forklift allocated for outbound logistics.

##### *4.2.6.3.1 Actiw LoadMatic*

Following is the implementation cost regarding Actiw LoadMatic investment.

Table 4. 23 LoadMatic Investment and Operational Cost

<i>Year</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
<b><i>Investment Cost</i></b>						
LoadMatic	5,647,200,000.00					
Forklift				204,680,000.00		
<b>Total</b>	<b>5,647,200,000.00</b>	<b>-</b>	<b>-</b>	<b>204,680,000.00</b>	<b>-</b>	<b>-</b>
<b><i>Operational and Maintenance Cost</i></b>						
Labor Cost	4,497,894,000.00	4,705,246,913.40	4,921,217,746.73	5,146,117,397.75	5,380,780,351.09	5,626,143,935.10
Fuel Cost	115,600,000.00	120,929,160.00	126,479,808.44	132,259,935.69	138,290,988.76	144,597,057.84
Maintenance Cost						
Forklift	64,000,008.00	66,950,408.37	70,023,432.11	33,462,404.18	34,988,289.81	36,583,755.83
LoadMatic	60,707,400.00	63,506,011.14	66,420,937.05	69,456,373.87	72,623,584.52	75,935,219.98
<b>Total</b>	<b>4,738,201,408.00</b>	<b>4,956,632,492.91</b>	<b>5,184,141,924.33</b>	<b>5,381,296,111.50</b>	<b>5,626,683,214.18</b>	<b>5,883,259,968.75</b>
<b>TOTAL COST</b>	<b>10,385,401,408.00</b>	<b>4,956,632,492.91</b>	<b>5,184,141,924.33</b>	<b>5,585,976,111.50</b>	<b>5,626,683,214.18</b>	<b>5,883,259,968.75</b>
	0	1	2	3	4	5
<b>Present Value</b>	10,385,401,408.00	4,287,002,675.06	3,878,028,107.46	3,614,100,115.87	3,148,622,572.84	2,847,431,034.56

Table 4. 24 LoadMatic Investment and Operational Cost (cont'd)

<i>Year</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>	<i>2026</i>	<i>2027</i>
<b><i>Investment Cost</i></b>					
LoadMatic					
Forklift					
<b>Total</b>	-	-	-	-	-
<b><i>Operational and Maintenance Cost</i></b>					
Labor Cost	5,882,133,484.14	6,149,770,557.67	6,429,585,118.05	6,722,131,240.92	7,027,315,999.26
Fuel Cost	151,176,223.98	158,054,742.17	165,246,232.94	172,764,936.53	180,608,464.65
Maintenance Cost					
Forklift	38,248,316.72	39,988,615.13	41,808,097.12	43,710,365.54	45,694,816.13
LoadMatic	79,390,272.49	83,002,529.88	86,779,144.99	90,727,596.09	94,846,628.95
<b>Total</b>	<b>6,150,948,297.33</b>	<b>6,430,816,444.86</b>	<b>6,723,418,593.10</b>	<b>7,029,334,139.08</b>	<b>7,348,465,909.00</b>
<b>TOTAL COST</b>	<b>6,150,948,297.33</b>	<b>6,430,816,444.86</b>	<b>6,723,418,593.10</b>	<b>7,029,334,139.08</b>	<b>7,348,465,909.00</b>
	6	7	8	9	10
<b>Present Value</b>	2,574,804,658.91	2,328,280,808.59	2,105,360,305.64	1,903,783,255.10	1,721,341,476.29



The formula used to obtain Present value of each year is as for the example;

$$PV(i) = \sum_t^n F_t(1 + i)^t, 0 \leq i \leq \infty$$

Where,

$$i = WACC = 15.62\%$$

$$F_t = 5,585,976,111.50$$

$$t = 3$$

$$PV(3) = 5,585,976,111.50 (1 + 15.62\%)^3$$

$$PV(3) = 3,614,100,115.87$$

Based on each year Present Value, following is the Net Present Value (NPV) of LoadMatic investment;

Table 4. 25 LoadMatic Investment Net Present Value

<i>Year</i>	<i>Present Value</i>
2017	10,385,401,408.00
2018	4,287,002,675.06
2019	3,878,028,107.46
2020	3,614,100,115.87
2021	3,148,622,572.84
2022	2,847,431,034.56
2023	2,574,804,658.91
2024	2,328,280,808.59
2025	2,105,360,305.64
2026	1,903,783,255.10
2027	1,721,341,476.29
<b><i>Net Present Value</i></b>	<b><i>38,794,156,418.33</i></b>

#### 4.2.6.3.2 ATLS Skate System

Following is the implementation cost regarding ATLS Skate System investment.

Table 4. 26 Skate System Investment and Operational Cost

<i>Year</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
<b><i>Investment Cost</i></b>						
Skate System	3,529,500,000.00					
Forklift				204,680,000.00		
<b>Total</b>	<b>3,529,500,000.00</b>	<b>-</b>	<b>-</b>	<b>204,680,000.00</b>	<b>-</b>	<b>-</b>
<b><i>Operational and Maintenance Cost</i></b>						
Labor Cost	4,497,894,000.00	4,705,246,913.40	4,921,217,746.73	5,146,117,397.75	5,380,780,351.09	5,626,143,935.10
Fuel Cost	115,600,000.00	120,929,160.00	126,479,808.44	132,259,935.69	138,290,988.76	144,597,057.84
Maintenance Cost						
Forklift	64,000,008.00	66,950,408.37	70,023,432.11	33,462,404.18	34,988,289.81	36,583,755.83
Skate System	60,707,400.00	63,506,011.14	66,420,937.05	69,456,373.87	72,623,584.52	75,935,219.98
<b>Total</b>	<b>4,738,201,408.00</b>	<b>4,956,632,492.91</b>	<b>5,184,141,924.33</b>	<b>5,381,296,111.50</b>	<b>5,626,683,214.18</b>	<b>5,883,259,968.75</b>
<b>TOTAL COST</b>	<b>8,267,701,408.00</b>	<b>4,956,632,492.91</b>	<b>5,184,141,924.33</b>	<b>5,585,976,111.50</b>	<b>5,626,683,214.18</b>	<b>5,883,259,968.75</b>
	0	1	2	3	4	5
<b>Present Value</b>	8,267,701,408.00	4,287,002,675.06	3,878,028,107.46	3,614,100,115.87	3,148,622,572.84	2,847,431,034.56

Table 4. 27 Skate System Investment and Operational Cost (cont'd)

<i>Year</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>	<i>2026</i>	<i>2027</i>
<b><i>Investment Cost</i></b>					
Skate System					
Forklift					
<b>Total</b>	-	-	-	-	-
<b><i>Operational and Maintenance Cost</i></b>					
Labor Cost	5,882,133,484.14	6,149,770,557.67	6,429,585,118.05	6,722,131,240.92	7,027,315,999.26
Fuel Cost	151,176,223.98	158,054,742.17	165,246,232.94	172,764,936.53	180,608,464.65
Maintenance Cost					
Forklift	38,248,316.72	39,988,615.13	41,808,097.12	43,710,365.54	45,694,816.13
Skate System	79,390,272.49	83,002,529.88	86,779,144.99	90,727,596.09	94,846,628.95
<b>Total</b>	<b>6,150,948,297.33</b>	<b>6,430,816,444.86</b>	<b>6,723,418,593.10</b>	<b>7,029,334,139.08</b>	<b>7,348,465,909.00</b>
<b>TOTAL COST</b>	<b>6,150,948,297.33</b>	<b>6,430,816,444.86</b>	<b>6,723,418,593.10</b>	<b>7,029,334,139.08</b>	<b>7,348,465,909.00</b>
	6	7	8	9	10
<b>Present Value</b>	2,574,804,658.91	2,328,280,808.59	2,105,360,305.64	1,903,783,255.10	1,721,341,476.29

The formula used to obtain Present value of each year is as for the example;

$$PV(i) = \sum_t^n F_t(1 + i)^t, 0 \leq i \leq \infty$$

Where,

$$i = WACC = 15.62\%$$

$$F_t = 5,585,976,111.50$$

$$t = 3$$

$$PV(3) = 5,585,976,111.50 (1 + 15.62\%)^3$$

$$PV(3) = 3,614,100,115.87$$

Based on each year Present Value, following is the Net Present Value (NPV) of Skate Loader investment;

Table 4. 28 Skate System Net Present Value

<i>Year</i>	<i>Present Value</i>
2017	8,267,701,408.00
2018	4,287,002,675.06
2019	3,878,028,107.46
2020	3,614,100,115.87
2021	3,148,622,572.84
2022	2,847,431,034.56
2023	2,574,804,658.91
2024	2,328,280,808.59
2025	2,105,360,305.64
2026	1,903,783,255.10
2027	1,721,341,476.29
<b>Net Present Value</b>	<b>36,676,456,418.33</b>

#### 4.2.6.4 Benefit

Benefit is calculated by obtaining the deviation between existing condition operational cost and new technology implementation operational cost. Following is the financial benefit of implementing Actiw LoadMatic and ATLS Skate System.

##### 4.2.6.4.1 Actiw LoadMatic

Following is the benefit regarding Actiw LoadMatic investment.

Table 4. 29 LoadMatic Benefit

<i>Year</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
<b><i>Benefit</i></b>						
Labor Cost Reduction	6,547,788,000.00	6,849,641,026.80	7,164,039,549.93	7,491,436,157.36	7,833,045,646.14	8,190,232,527.60
Fuel Cost Reduction	115,600,000.00	120,929,160.00	126,479,808.44	132,259,935.69	138,290,988.76	144,597,057.84
Maintenance Cost Reduction	(60,707,400.00)	(63,506,011.14)	(66,420,937.05)	(69,456,373.87)	(72,623,584.52)	(75,935,219.98)
<b><i>TOTAL COST</i></b>	<b><i>6,602,680,600.00</i></b>	<b><i>6,907,064,175.66</i></b>	<b><i>7,224,098,421.32</i></b>	<b><i>7,554,239,719.18</i></b>	<b><i>7,898,713,050.37</i></b>	<b><i>8,258,894,365.47</i></b>
	0	1	2	3	4	5
<b><i>Present Value</i></b>	6,602,680,600.00	5,973,935,457.24	5,404,029,661.59	4,887,557,357.83	4,420,022,464.41	3,997,211,112.94
<i>Year</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>	<i>2026</i>	<i>2027</i>	
<b><i>Benefit</i></b>						
Labor Cost Reduction	8,562,888,107.61	8,952,499,516.50	9,359,838,244.50	9,785,710,884.63	10,229,982,158.79	
Fuel Cost Reduction	151,176,223.98	158,054,742.17	165,246,232.94	172,764,936.53	180,608,464.65	
Maintenance Cost Reduction	(79,390,272.49)	(83,002,529.88)	(86,779,144.99)	(90,727,596.09)	(94,846,628.95)	
<b><i>TOTAL COST</i></b>	<b><i>8,634,674,059.10</i></b>	<b><i>9,027,551,728.79</i></b>	<b><i>9,438,305,332.45</i></b>	<b><i>9,867,748,225.07</i></b>	<b><i>10,315,743,994.49</i></b>	
	6	7	8	9	10	
<b><i>Present Value</i></b>	3,614,499,410.64	3,268,430,318.13	2,955,495,500.44	2,672,522,526.99	2,416,411,563.50	

The formula used to obtain Present value of each year is as for the example;

$$PV(i) = \sum_t^n F_t(1 + i)^t, 0 \leq i \leq \infty$$

Where,

$$i = WACC = 15.62\%$$

$$F_t = 7,554,239,719.18$$

$$t = 3$$

$$PV(3) = 7,554,239,719.18 (1 + 15.62\%)^3$$

$$PV(3) = 4,887,557,357.83$$

Based on each year Present Value, following is the Net Present Value (NPV) of LoadMatic benefit;

Table 4. 30 LoadMatic Benefit Net Present Value

<i>Year</i>	<i>Present Value</i>
2017	6,602,680,600.00
2018	5,973,935,457.24
2019	5,404,029,661.59
2020	4,887,557,357.83
2021	4,420,022,464.41
2022	3,997,211,112.94
2023	3,614,499,410.64
2024	3,268,430,318.13
2025	2,955,495,500.44
2026	2,672,522,526.99
2027	2,416,411,563.50
<b><i>Net Present Value</i></b>	<b><i>46,212,795,973.69</i></b>

#### 4.2.6.4.2 ATLS Skate System

Following is the benefit regarding ATLS Skate System investment.

Table 4. 31 Skate System Benefit

<i>Year</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
<b><i>Benefit</i></b>						
Labor Cost Reduction	6,547,788,000.00	6,849,641,026.80	7,164,039,549.93	7,491,436,157.36	7,833,045,646.14	8,190,232,527.60
Fuel Cost Reduction	115,600,000.00	120,929,160.00	126,479,808.44	132,259,935.69	138,290,988.76	144,597,057.84
Maintenance Cost Reduction	(60,707,400.00)	(63,506,011.14)	(66,420,937.05)	(69,456,373.87)	(72,623,584.52)	(75,935,219.98)
<b><i>TOTAL COST</i></b>	<b><i>6,602,680,600.00</i></b>	<b><i>6,907,064,175.66</i></b>	<b><i>7,224,098,421.32</i></b>	<b><i>7,554,239,719.18</i></b>	<b><i>7,898,713,050.37</i></b>	<b><i>8,258,894,365.47</i></b>
	0	1	2	3	4	5
<b><i>Present Value</i></b>	6,602,680,600.00	5,973,935,457.24	5,404,029,661.59	4,887,557,357.83	4,420,022,464.41	3,997,211,112.94
<i>Year</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>	<i>2026</i>	<i>2027</i>	
<b><i>Benefit</i></b>						
Labor Cost Reduction	8,562,888,107.61	8,952,499,516.50	9,359,838,244.50	9,785,710,884.63	10,229,982,158.79	
Fuel Cost Reduction	151,176,223.98	158,054,742.17	165,246,232.94	172,764,936.53	180,608,464.65	
Maintenance Cost Reduction	(79,390,272.49)	(83,002,529.88)	(86,779,144.99)	(90,727,596.09)	(94,846,628.95)	
<b><i>TOTAL COST</i></b>	<b><i>8,634,674,059.10</i></b>	<b><i>9,027,551,728.79</i></b>	<b><i>9,438,305,332.45</i></b>	<b><i>9,867,748,225.07</i></b>	<b><i>10,315,743,994.49</i></b>	
	6	7	8	9	10	
<b><i>Present Value</i></b>	3,614,499,410.64	3,268,430,318.13	2,955,495,500.44	2,672,522,526.99	2,416,411,563.50	

The formula used to obtain Present value of each year is as for the example;

$$PV(i) = \sum_t^n F_t(1 + i)^t, 0 \leq i \leq \infty$$

Where,

$$i = WACC = 15.62\%$$

$$F_t = 7,554,239,719.18$$

$$t = 3$$

$$PV(3) = 7,554,239,719.18 (1 + 15.62\%)^3$$

$$PV(3) = 4,887,557,357.83$$

Based on each year Present Value, following is the Net Present Value (NPV) of LoadMatic benefit;

Table 4. 32 Skate System Benefit Net Present Value

<i>Year</i>	<i>Present Value</i>
2017	8,267,701,408.00
2018	4,287,002,675.06
2019	3,878,028,107.46
2020	3,614,100,115.87
2021	3,148,622,572.84
2022	2,847,431,034.56
2023	2,574,804,658.91
2024	2,328,280,808.59
2025	2,105,360,305.64
2026	1,903,783,255.10
2027	1,721,341,476.29
<b>Net Present Value</b>	<b>36,676,456,418.33</b>

#### 4.2.6.5 Benefit Cost Value

Benefit cost value obtain by dividing benefit's present value to technology implementation present value. Following are the benefit value of Actiw LoadMatic and ATLS Skate System. Benefit value is calculated by following formula;

$$B/C = \frac{\text{Benefit Value}}{\text{Investment Cost}}$$



Following is the benefit cost value regarding Actiw LoadMatic investment.

Table 4. 33 LoadMatic Benefit Cost Value

<i>LoadMatic Benefit Cost Analysis</i>	
<i>Benefit Value PV</i>	Rp 46,212,795,973.69
<i>Investment Value PV</i>	Rp 38,794,156,418.33
<b><i>Benefit Cost Analysis Value</i></b>	<b><i>1.1912</i></b>

Based on the calculation, the B/C value of LoadMatic investment is 1.2243 which means it is feasible to run, since a project is said to be feasible when the value of B/C is greater or equal to 1. As for ATLS Skate System, following is the benefit cost value regarding ATLS Skate System investment.

Table 4. 34 Skate System Benefit Cost Value

<i>LoadMatic Benefit Cost Analysis</i>	
<i>Benefit Value PV</i>	Rp 46,212,795,973.69
<i>Investment Value PV</i>	Rp 36,676,456,418.33
<b><i>Benefit Cost Analysis Value</i></b>	<b><i>1.2600</i></b>

Based on the calculation, the B/C value of LoadMatic investment is 1.2964 which means it is feasible to run, since a project is said to be feasible when the value of B/C is greater or equal to 1.

According to the existing condition and both technologies benefit cost value, following is the summary of each investment cost, operational cost, benefit value, and cost benefit value.

Table 4. 35 Benefit Cost Value Summary

	<i>Investment and Operational NPV</i>	<i>Benefit NPV</i>	<i>Benefit-Cost Value</i>
Existing Condition	79,359,752,392.02	-	0
Actiw LoadMatic Implementation	38,794,156,418.33	46,212,795,973.69	1.1912
ATLS Skate System Implementation	36,676,456,418.33	46,212,795,973.69	1.2600

#### 4.2.7 Sensitivity Analysis

Sensitivity analysis done in both alternatives in order to identify which variable is more sensitive to affect the value of benefit cost compare to other

variable. There are three variables analyzed, such as inflation, investment cost, and WACC.

*4.2.7.1 Actiw LoadMatic Sensitivity Analysis*

The first variable to be analyzed by sensitivity analysis is inflation. Inflation will affecting the operational cost. Baseline used in inflation changes is based on previous subchapter. While the minimum line used is when the inflation decreased to 50%, and for maximum line used is when the inflation increased to 100%. The second variable to be analyzed is investment cost. Baseline used is according to LoadMatic initial investment cost. While the minimal line used is when the investment cost is IDR 1,000,000,000. As for the maximum line used is when the investment cost is IDR 10,000,000,000. The last variable to be analyzed is the value of WACC. Baseline used is based on the data, which is 21.29%. While the minimum line used is when the value of WACC is 8% and the maximum value of WACC is 25%.

The minimum line and maximum line for investment cost is based on the range of outbound logistics technology cost. As for WACC, the minimum line is set based on Indonesia risk-free rate, and for the minimum line is based on the corporate tax rate. For inflation, the minimum line is based on the historical Indonesian lowest inflation. As for inflation maximum line is based on the highest expected Indonesian inflation.

Following are the value of benefit cost based on each minimum line, baseline, and maximum line. Tornado diagram of each variable also presented on figure 4.4 in order to identify which variable is more sensitive.

Table 4. 36 LoadMatic Inflation Changes

<i>Inflation Change</i>	<i>Benefit Cost Value</i>
-50%	1.1779
Base	1.1912
100%	1.2164

Table 4. 37 LoadMatic Investment Cost Changes

<i>Investment Cost</i>	<i>Benefit Cost Value</i>
IDR 1,000,000,000.00	1.3534
Base	1.1912
IDR 10,000,000,000.00	1.0711

Table 4. 38 LoadMatic WACC Changes

<i>WACC</i>	<i>Benefit Cost Value</i>
8%	1.2384
Base	1.1912
25%	1.1357

Table 4. 39 LoadMatic Sensitivity Analysis

<i>Variable</i>	<i>Benefit Cost Value</i>			<i>Gap</i>
	<i>Min</i>	<i>Base</i>	<i>Max</i>	
Inflation	1.1779	1.1912	1.2164	0.04
Investment Cost	1.3534	1.1912	1.0711	-0.29
WACC	1.2384	1.1912	1.1357	-0.11

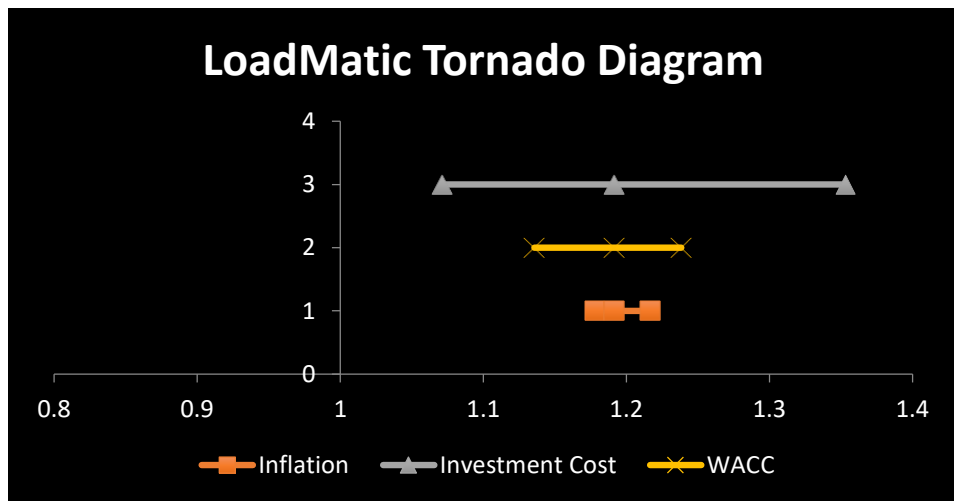


Figure 4. 4 LoadMatic Tornado Diagram

Based on the tables above and the tornado diagram, it can be seen that the most sensitive variable or variable which affecting most to the value of benefit cost is investment cost. The second sensitive variable is WACC and the least sensitive is inflation rate.

4.2.7.2 ATLS Skate System Sensitivity Analysis

The first variable to be analyzed by sensitivity analysis is inflation. Inflation will affecting the operational cost. Baseline used in inflation changes is based on previous subchapter. While the minimum line used is when the inflation decreased to 50%, and for maximum line used is when the inflation increased to 100%. The second variable to be analyzed is investment cost. Baseline used is according to Skate System initial investment cost. While the minimal line used is when the investment cost is IDR 1,000,000,000. As for the maximum line used is when the investment cost is IDR 10,000,000,000. The last variable to be analyzed is the value of WACC. Baseline used is based on the data, which is 21.29%. While the minimum line used is when the value of WACC is 8% and the maximum value of WACC is 25%.

The minimum line and maximum line for investment cost is based on the range of outbound logistics technology cost. As for WACC, the minimum line is set based on Indonesia risk-free rate, and for the minimum line is based on the corporate tax rate. For inflation, the minimum line is based on the historical Indonesian lowest inflation. As for inflation maximum line is based on the highest expected Indonesian inflation.

Following are the value of benefit cost based on each minimum line, baseline, and maximum line. Tornado diagram of each variable also presented on figure 4.5 in order to identify which variable is more sensitive.

Table 4. 40 Skate System Inflation Changes

<i>Inflation Change</i>	<i>Benefit Cost Value</i>
-50%	1.2514
Base	1.2600
100%	1.2761

Table 4. 41 Skate System Investment Cost Changes

<i>Investment Cost</i>	<i>Benefit Cost Value</i>
IDR 1,000,000,000.00	1.3534
Base	1.2600
IDR 10,000,000,000.00	1.0711

Table 4. 42 Skate System WACC Changes

WACC	Benefit Cost Value
8%	1.2930
Base	1.2600
25%	1.2202

Table 4. 43 Skate System Sensitivity Analysis

Variable	Benefit Cost Value			Gap
	Min	Base	Max	
Inflation	1.2514	1.2600	1.2761	0.03
Investment Cost	1.3534	1.2600	1.0711	-0.29
WACC	1.2930	1.2600	1.2202	-0.08

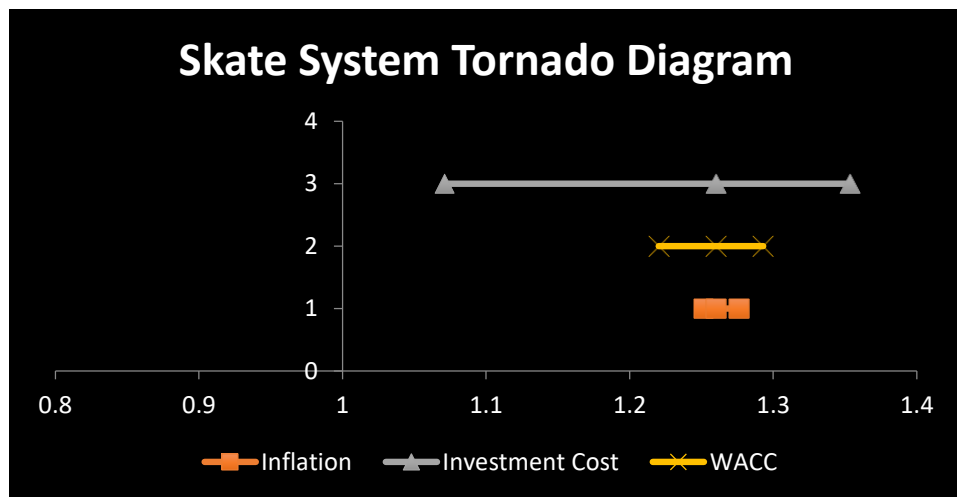


Figure 4. 5 Skate System Tornado Diagram

Based on the tables above and the tornado diagram, it can be seen that the most sensitive variable or variable which affecting most to the value of benefit cost is investment cost. The second sensitive variable is WACC and the least sensitive is inflation rate.

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## **CHAPTER V**

### **IMPLEMENTATION**

In this chapter, elaborates the implementation effect of investing new technology in Surabaya Warehouse. The effect will be affecting business process in outbound logistics process.

#### **5.1 Improvement Business Process**

By implementing new technology for its outbound logistics process, Surabaya Warehouse will has an improved outbound logistics business process. The improved process will be differ in product arrangement process, since the new technology is implemented, Surabaya Warehouse is no longer required product arrangement, since the technology will automatically allocate the product into the truck. Besides that, checker will has a new jobdesc as the technology operator.

The improved outbound logistics business process are: first, truck came into the warehouse with daily order from PT Unilever Tbk. Order have been issued since the day before the truck came. Next, checker will do data entry to WMS regarding the number of products that will be distributed. Checker will also tell the forklift operator regarding the number of products and product location. Forklift operator will then searching for the product and allocate it to the machine or technology. When the all of the products have been allocated onto the technology, it will automatically allocated into the truck. Following chart shows the improved business process of Surabaya Warehouse outbound logistics.

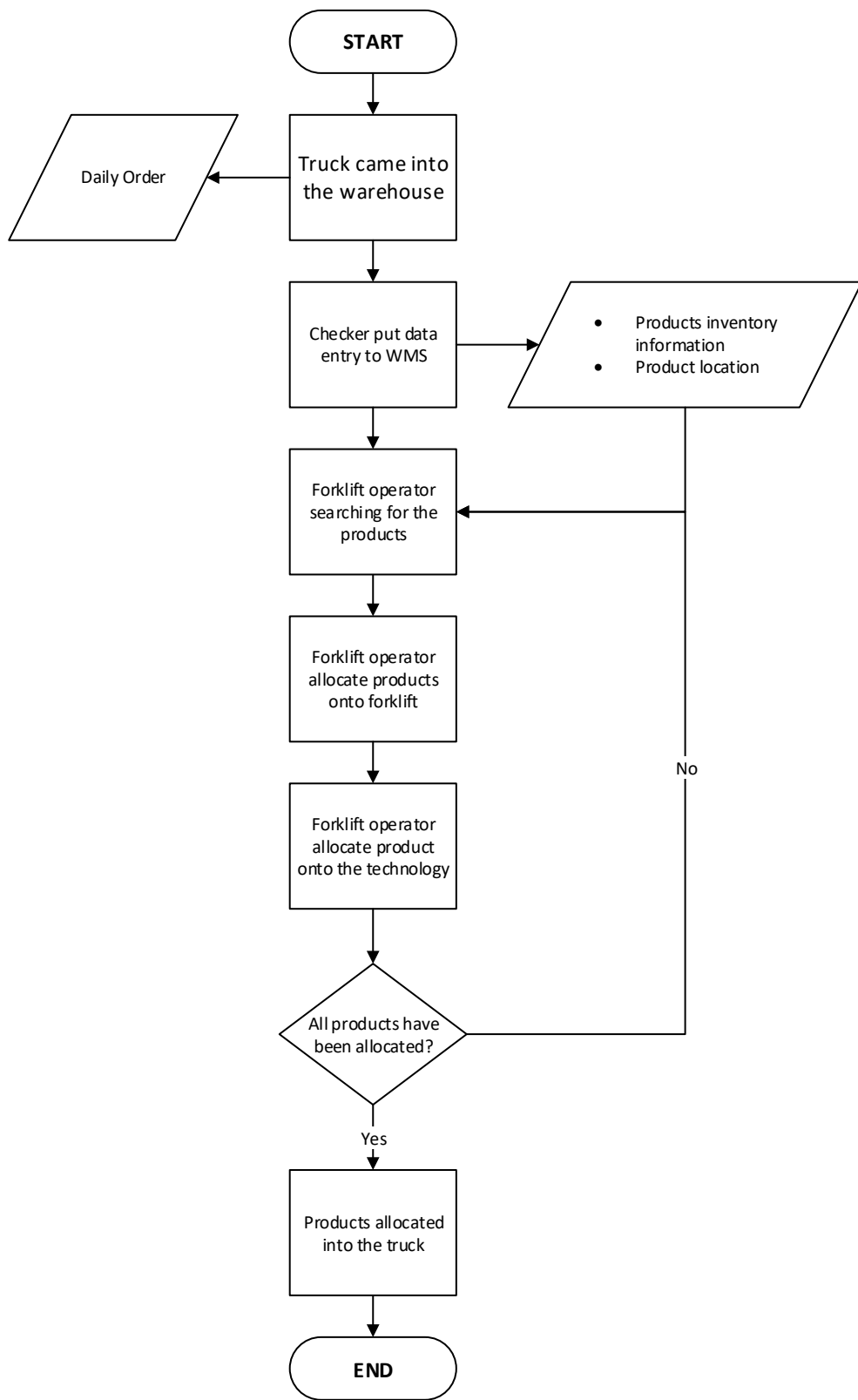


Figure 5. 1 Improved Outbound Logistics Business Process



## **CHAPTER VI**

### **ANALYSIS AND INTERPRETATION**

This chapter explained the analysis and interpretation which aligned to the data processing. This chapter also elaborate the analysis of each data processing which related to the problem solving and decision making.

#### **6.1 Work Sampling Analysis**

In this subchapter, elaborates the analysis of work sampling result based on subchapter 4.2.4. In order to do work sampling, the workers that want to be observed will first identified. The workers which become the observation objects are outbound logistics process workers which includes forklift operator, checker, and product arrangement operator. Before work sampling, prework sampling has to be done. In prework sampling, 100 data are required with random time. Prework sampling held on 19<sup>th</sup> December 2016. The result of prework sampling are the percentage of working and nonworking or idle, and the number of sample size required in the next observation. Based on the prework sampling observation, all of the workers have higher idle time compare to working time. The percentage of idle time for forklift operator is 92%, for checker 86%, and for product arrangement operator is 96%. The next sample size required for forklift operator are 48, for checker are 114, and for product arrangement operator the sample size required are 46.

After prework sampling, the next observation is work sampling 1. Work sampling 1 held on December 27<sup>th</sup> 2016. With 48 sample size, the idle time percentage for forklift operator is 98% and the next sample size required are 24 data. While for checker, with 114 sample size, the percentage of idle time is 94% and the next sample size required are 72 data. As for product arrangement operator, with 46 sample size, the percentage of idle time is 100% and the next sample size required is zero, therefore, there is no need further work sampling for product arrangement operator.

Work sampling 2 is the next observation after work sampling 1. Work sampling 2 held on January 3<sup>rd</sup> 2017. With 24 sample size, forklift operator's

percentage of idle time is 100% and the next sample size required is zero. While for checker, with 114 sample size, its percentage of idle time is 100% and the next sample size required is zero. Therefore, there is no further observation required for both workers.

Based on the data elaborated above, it shows that the idle time is really high for all of the worker. According to the historical data, outbound process is usually held in the evening until night while the observation held in the morning until evening. The reason behind the outbound logistics scheduling is that, customer does not want to have high staple cost. Staple cost is the cost that the customer has to pay when the trucks has already enter the warehouse until it delivered the products to the third party to be distributed.

## **6.2 Technology Implementation Benefit Cost Value Analysis**

In this subchapter, will be elaborates the analysis of benefit cost value for both alternative technologies.

### **6.2.1 Actiw LoadMatic Benefit Cost Analysis**

With the investment cost of IDR 5,647,200,000; investment NPV of IDR 38,784,418.33 and benefit NPV of IDR 46,212,795,937.69; the result of LoadMatic benefit value will be 1.1912 which means it is greater than 1. A project or an investment is said to be feasible to run or recommended to run financially when the result of its benefit cost value is greater or equal to 1.

Therefore, LoadMatic is recommended to be implemented in Surabaya Warehouse.

### **6.2.2 ATLS Skate System Benefit Cost Analysis**

With the investment cost of IDR 3,529,500,000; investment NPV of IDR 36,676,456,418.33 and benefit NPV of IDR 46,212,795,937.69; the result of Skate System benefit value will be 1.2600 which means it is greater than 1. A project or an investment is said to be feasible to run or recommended to run financially when the result of its benefit cost value is greater or equal to 1.

Therefore, since the value of Skate System benefit cost is higher than LoadMatic, Skate System is recommended to be implemented in Surabaya Warehouse.

### **6.3 Sensitivity Analysis**

In this subchapter, elaborates the analysis of the result of sensitivity analysis which has been done in subchapter 4.2.7. There are three variables to be analyzed in sensitivity analysis, such as inflation, investment cost, and WACC.

#### **6.3.1 Inflation Changes Analysis**

The first variable to be analyzed is inflation. The minimum line set for inflation is when inflation decreased to 50%. While the maximum line set for inflation changes is when inflation increased to 100%. For both alternatives, the higher the inflation, the higher the result of benefit cost. This is because, inflation affecting all of the operational cost for existing condition and new technology implementation. The higher the increase of inflation will automatically make the gap or the difference of existing condition operational cost and new technology implementation operational cost higher, the higher the difference means the higher the benefit value. If the benefit value is high, it will resulting higher benefit cost value.

#### **6.3.2 Investment Cost Changes Analysis**

The second variable to be analyzed is investment cost. The minimum line set for investment cost is IDR 1,000,000,000 and for the maximum line set is IDR 10,000,000,000. For both alternatives, the lower the investment cost means the higher the benefit cost value. It is because, the lower the investment cost means the lower the investment NPV. The lower the NPV will resulting the higher division result of investment NPV by benefit NPV.

#### **6.3.3 WACC Changes Analysis**

The last variable to be analyzed is WACC. WACC act as an interest rate in this project. For both alternatives, the higher the value of WACC will resulting the lower benefit cost value. This is because the higher the value of WACC means the expected return of an investment is high. Therefore, the lower the value of WACC will resulting lower benefit cost value.

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## **CHAPTER VII**

### **CONCLUSIONS AND SUGGESTIONS**

This chapter consist of the conclusion of the research and the suggestion offered to the company to solve the problem identified in Surabaya Warehouse.

#### **7.1 Conclusions**

Conclusions of this final project will be answered the project objectives. Following are the conclusions obtained in this final project.

- Aligned with Surabaya Warehouse characteristics, there are two alternatives that can be used to automate the outbound logistic process, such as Actiw LoadMatic and ATLS Skate System. Actiw LoadMatic is an automatic trailer loading and container loading solution for palletized or palletless goods. LoadMatic makes truck and container loading as easy as it should be. LoadMatic is a semi-automated technology, which means it still requires operator to operate the machine. LoadMatic could accommodate until 30,000 kg products. With vehicle turn around time of 17 minutes, it could load up to 60 pallets per hour. While ATLS or Automatic Truck Loading System has several types of technologies. However, the suitable type of ATLS for K15 Warrehouse is Skate System. Skate System used aluminum skates with integrated chains powered by a pusher plate. Skate System could only be used for loading or outbound logistics process for palletized products. Since it only used for loading process, it does not required truck modification. These characteristics is aligned with the condition in Surabaya Warehouse. Surabaya Warehouse does not own the trucks used for outbound logistics. Trucks used for outbound logistics belongs to the customer. Therefore, outbound logistics truck modification is not possible to be implement for Surabaya Warehouse.
- Based on the benefit cost value of both alternatives, both alternatives is considered to be recommended to be implemented in Surabaya Warehouse since both value of benefit cost is greater than 1. In terms

of operational cost, both alternatives have higher operational cost on its existing condition compare to the operational cost using automated technology. Lower operational cost in technology implementation means that the proposed condition is said to be better than the existing condition.

## **7.2 Suggestions**

In this subchapter, suggestions for this final project will be listed. The suggestion are as follow:

- Automated technology for outbound logistics considered to be not urgent to be implemented in Surabaya Warehouse since its existing condition is already good enough. However, if Kamadjaja Logistic Management Board wants to automate Surabaya Warehouse outbound logistics process, the proposed technology is ATLS Skate System since it has lower cost and higher benefit compare to Actiw LoadMatic, but has the same function to it.
- Surabaya Warehouse should minimize the number of labor or worker and number of forklift allocated for outbound logistics if automated technology will be implemented.
- Further research regarding maintenance and intangible benefit are required if new technology will be implemented.

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ATTACHMENT I



29<sup>th</sup> of December, 2016

Kamadjaja Logistics  
Jl Rungkut Industri Raya  
No.15, Surabaya  
Indonesia

Attn: Fairuz Nathania

Dear Mr. Nathania,

We would like to thank you for your Inquiry on Actiw LoadMatic container loading system and value the trust you put in Actiw.

We are pleased to present you our quotation attached to this letter. The scope is designed on very general basis due lack of case specific information.

While we have done our best to provide you with a document that adequately describes the equipment we are quoting, we believe that further clarification will be helpful to fully understand the features we are proposing. Please do not hesitate to contact us for further information.

Of course we are more than happy to have an opportunity to meet you and your team to present our concept in further detail.

Yours sincerely

Juho Kauhanen  
Business Unit Manager – Automated Loading and Load Forming  
Actiw Oy

Enclosure : Quotation  
Drawing

LMQ01-1062a  
LMQ01-1062\_GA.dwg



## Contact Details

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**Contractor:** Kamadjaja Logistics  
Jl Rungkut Industri Raya No.15, Surabaya  
Indonesia

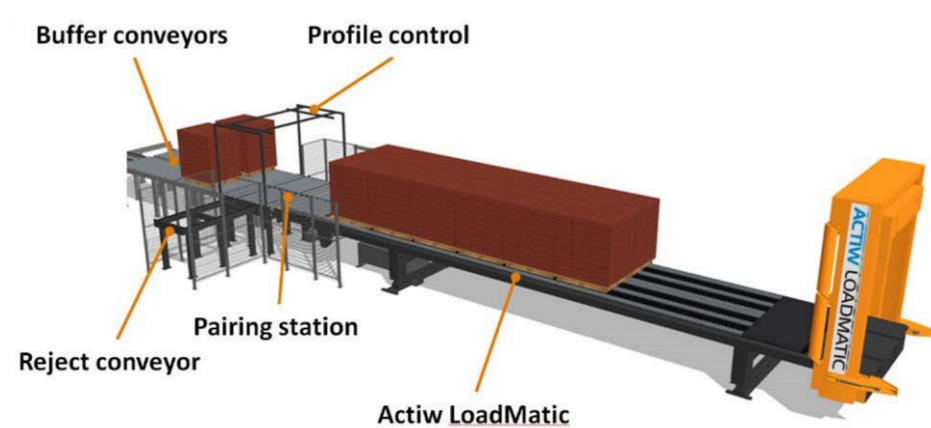
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Jari Vartiainen  
Business Development Executive  
T: +358 207 424 823  
E: [jari.vartiainen@actiw.com](mailto:jari.vartiainen@actiw.com)

**Main Components:**



Note ! Buffer conveyors doesn't belong to this quotation.

**Capacity:**

LoadMatic is designed for loads of up to 30 tons.

LoadMatic's loading capacity in pallets varies according to

- the loading pattern,
- the number of units loaded per container/trailer (cargo space size), and
- buffer conveyor's handling capacity.

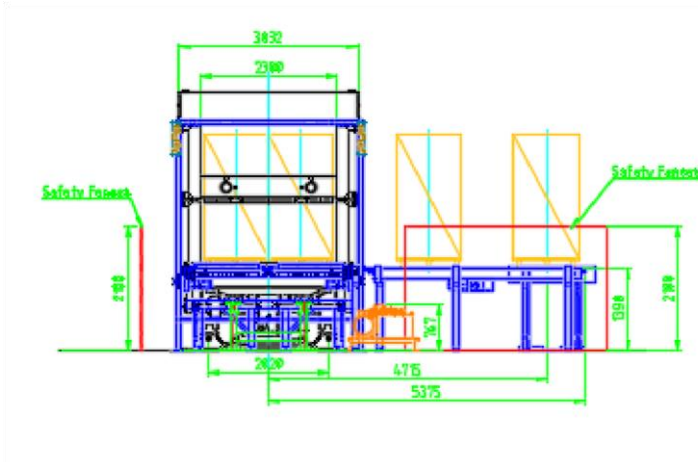
The loading cycle, pushing the loading plate in with the goods, driving the gate down and pulling the loading plate out again, takes totally about 5 minutes.

Based on rough capacity analysis it is required minimum about 10 pallets buffer before Actiw LoadMatic unit (=pallets produced during trailer loading), however a few more pallet places would give additional flexibility for the cases such as trailer is not immediately ready for loading when LoadMatic is full. This request shall be taken into account by the others.



Taking into account time to dock the trailer as well leaving loading position, the loading position turn time from one vehicle to the next one is about 17 minutes, so more than 3 containers (40ft) á 18 pallets can be loaded per hour per LoadMatic unit (about 60 pallets/h). In case of other type of cargo space and number of pallets per it, loading capacity will vary accordingly. 20ft container loading capacity is approximately 50 pallets per hour.





**Type of unit load:**

**Product**

- FMCG (Soap, Shampoo, Tooth paste)
- pallet type: To be defined
- Pallet dimensions: to be defined
- Pallet weight: to be defined

**Load configuration:** ○ The system is designed to load 9 rows of 2 pallets (tot 18 pallets) short side leading to standard 40 ft container, OR 4 rows of 2 pallets short side leading to standard 20ft container.

**NOTE: The system is capable to transfer pallets of the size specified above, but not capable to load such pallets to containers. The load shall be well within max door opening dimensions and containers internal dimensions. Max size of load (to be verified in engineering phase) is**

- height 2 200 mm
- width 2 300 mm
- length 11 900 mm

**All the oversized pair of pallets are rejected at the pairing station by contour check.**





- Pallets are buffered on buffer conveyors (not in scope) before entering to LoadMatic
- Pallets are received to pairing station one pallet at a time
- At pairing station
  - two pallets will be packed next to each other
  - the contour of pallet pair is checked
  - only the sets within design limits are transferred further to the LoadMatic
    - oversized sets will be forwarded to the reject conveyor
- Immediately LoadMatic is ready to receive a pallet pair, the pair is transferred to the end of LoadMatic by conveyors
- Pusher beam pushes the pallet pair to the loading plate, and simultaneously all the other pallets, which are already loaded onto loading plate, are pushed one step forward
- The pallets are packed to LoadMatic until the entire load is ready for loading
- Simultaneously with load forming operations the truck driver shall park his truck close to the docking position
- Immediately after the load is ready, LoadMatic shall be aligned (height and turn by rear leg side movement) with the cargo space (by the operator)
- After alignment and docking, the container shall be fixed by clamps for loading operations (manual control by operator)
- The pallets are pushed in to the cargo space by using the loading plate (manual control by operator)
- Operator drives down the stopper gate to keep the pallets inside the cargo space when the loading plate is pulled out
- After the loading plate is fully out, the stopper gate is released and moved to its upper position (manual control by operator)
- Clamps can be released and truck with full container can leave the loading position
- After truck has left the loading position LoadMatic is moved back to the nominal position (automatic function)
- LoadMatic is ready to receive pallets for the new load and the next truck can approach and park close to the docking station



**Delivery of one (1) Actiw LoadMatic line includes:**

- A. Actiw LoadMatic, 1 pc
  - LoadMatic unit 40ft for max. load 30 000 kg, according to the attached specification and follow principles of provision EC directive 2006/42/EY.
  - Loading plate equipped with free rotating rollers (roller tracks according to the pallet types) ○ Angling of the equipment (turn) to secure proper docking with container/trailer
    - (rear leg has side movement about +/- 250 mm) ○ Height adjustment (400 mm), container loading height 1200mm – 1600mm
    - Clamps for container docking
      - Sensors to check containers/trailers alignment (in the front of LoadMatic unit) ○ Side guide
  - LoadMatic operations are semi-automatic and requires actions by operator
- B. Load forming device, 1 unit per LoadMatic unit
  - LoadMatic's drive end is equipped with conveyor and a pusher beam to pack the sets of pallets when they are fed from the buffer conveyor to LoadMatic
- C. Conveyor system (standard roller and chain conveyors)
  - 4pcs (2 x 2) roller conveyors with forklift barriers to buffer loads for pallet inbound
  - 1 pc conveyor system to pack 2 pallets next to each other, check profile (outer dimensions of the pallet set), and a reject lane: ○ 1 pc reject conveyor with forklift impact protection ○ 1 pc right angle transfer station (“pairing station”)
    - receive two pallets at a time from the buffer conveyor
    - movement to pack pallets next to each other
    - contour check to check outer dimensions
  - Controls integrated to LoadMatic
- D. Safety equipment, 1 set
  - 2 pcs safety light beams ○ one between inbound conveyor and pairing station ○ one for reject conveyor
  - Mechanical fencing where applicable ○ Light mechanical barriers to prevent pedestrian and FLT etc. access at the sides of LoadMatic



- E. Documentation, 1 set ○ Suppliers standard documentation in English.
  - Maintenance, Safety and Operation documentation ○ 2 pcs hard copies (printed one) and 1 CD or USB
  
- F. Site operations, 1 set ○ Site language English ○ Site operations
  - Installation (mechanical and electrical), start-up and training, max 6 work weeks  
(6\*5 = 30 working days max á 10 hours) including 4 days for traveling

**PRICING (VAT 0%)**

**Main Package:**

**Pricing for Actiw LoadMatic and buffer conveyors:**

One Actiw LoadMatic with Load Forming device and Conveyor System  
400 000 EUR/line Includes Quotation positions: A, B, C, D, E, F

**Options per line (valid only with Main Package order):**

Additional buffer conveyors before pairing station,

Total 6 pallet buffer:	16 000€
Total 18 pallet buffer:	112 000€

**GENERAL TERMS AND CONDITIONS**

**Delivery Terms** Equipment FOB export port, EU (Incoterms 2010)

**Packing details** Main equipment (LoadMatic) as one unit: ○ package size about 3 m wide, 16 m long and 3 m high ○ weight about 17 tons ○ packed into corrosion protected plastic, suitable for RORO shipment only.



Conveyors, safety devices, electric cabinets etc. smaller units: ○  
packed into standard ISO container; containers to be provided by  
Contractor

**Delivery Time** About 6 months from PO and down payment to the readiness for  
shipment of 1<sup>st</sup> unit, the second + 2 weeks

Installation of both units is estimated to be done simultaneously as well  
the commissioning. If separate trips required, additional charges may  
apply.

More detailed delivery schedule will be prepared in the later project  
phases.

**Not included in the above prices (the list may not be exhaustive):**

- Not included in the above prices (the list may not be exhaustive):
- Any civil works buildings, offices, etc.
- Any foundations or flooring
- Doors, drains, sluices and gates
- Lighting, heating, ventilation or air conditioning
- Fire protection systems or sprinkler supports
- Any construction works
- Electricity or air supply
- Fire suppression system and related equipment
- Permits and associated fees
- Any inspections or approvals of local authorities
- Dismantling, removing or modification of existing equipment
- Main power, pressured air and cooling water supplies
- VAT, any taxes, duties or similar costs collected in or to the country of destination
- Service Tax and any other local tax applicable in site works contracts
- Insurance from Port to site during Transportation, De-stuffing, Storage as well as erection and Commissioning of Supply items
- Import duties, customs clearance, customs or any similar costs
- Import licenses and certificates
- Other conveyors and other handling devices than specified above
- Other safety systems than specified above
- 
-



- Customer to allocate a proper safe, clean and rain protected area to keep the goods in their premises with security throughout the period of erection and commission

#### **Customer's duties**

- Installation assistance (fork lift, assistant labor, tools etc.)
- Power supply to the LoadMatic system's cabinets o preliminary 80 A, 3 x 400 V, 60 Hz + neutral + protected earth
- Containers for smaller unit shipments
- Empty containers and trucks available for Commissioning period
- Mobile crane for lifting LoadMatic into installation location
- Ground works
- Customer to allocate a proper, safe, clean and rain protected area to keep the goods in their premises with security throughout the period of erection and commission

#### **Terms of payment**

30 % down payment

30 % when main components for lines procured

30 % when systems are ready for shipment

10 % when systems started up, however not later than 2 months from the readiness for shipment

#### **Additional Field and other possible services and costs**

Invoiced monthly, based on field service days rendered during the elapsed preceding month

#### **Time of payment**

30 days net

The payment instalments to be made within 30 days from the receiving date of email copy of each invoice (the original invoice is sent through the post)

Penalty for late payment is 10 % per annum.

#### **Validity**

The price is valid for 30 days from the quotation date



**Other terms**

Orgalime S2012 with Orgalime S2012S

**Guarantee**

12 months for workmanship, materials and satisfactory mechanical

functioning from the Take-over date, however not more than 18 months from the shipment date. Excluded from guarantee are normal wear and damage caused by injudicious treatment.

**ATTACHMENT II**

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator Prework Sampling</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>13:00:53</i>	<i>1</i>				1			
<i>13:04:09</i>	<i>2</i>				1			
<i>13:04:33</i>	<i>3</i>				1			
<i>13:05:31</i>	<i>4</i>				1			
<i>13:05:36</i>	<i>5</i>				1			
<i>13:06:10</i>	<i>6</i>				1			
<i>13:06:22</i>	<i>7</i>				1			
<i>13:08:22</i>	<i>8</i>				1			
<i>13:11:15</i>	<i>9</i>				1			
<i>13:12:31</i>	<i>10</i>				1			
<i>13:12:58</i>	<i>11</i>				1			
<i>13:14:33</i>	<i>12</i>				1			
<i>13:14:54</i>	<i>13</i>				1			
<i>13:15:43</i>	<i>14</i>				1			
<i>13:15:59</i>	<i>15</i>				1			
<i>13:18:11</i>	<i>16</i>				1			
<i>13:19:35</i>	<i>17</i>				1			
<i>13:22:11</i>	<i>18</i>				1			
<i>13:23:07</i>	<i>19</i>				1			
<i>13:26:20</i>	<i>20</i>				1			
<i>13:26:39</i>	<i>21</i>				1			
<i>13:30:00</i>	<i>22</i>	1						
<i>13:30:16</i>	<i>23</i>		1					
<i>13:30:32</i>	<i>24</i>			1				
<i>13:31:31</i>	<i>25</i>	1						
<i>13:33:37</i>	<i>26</i>			1				
<i>13:34:04</i>	<i>27</i>	1						
<i>13:34:41</i>	<i>28</i>	1						
<i>13:38:41</i>	<i>29</i>			1				
<i>13:39:17</i>	<i>30</i>				1			
<i>13:39:18</i>	<i>31</i>				1			
<i>13:39:22</i>	<i>32</i>				1			
<i>13:39:29</i>	<i>33</i>				1			
<i>13:40:53</i>	<i>34</i>				1			
<i>13:41:55</i>	<i>35</i>				1			
<i>13:41:56</i>	<i>36</i>				1			

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator Prework Sampling</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
13:42:24	37				1			
13:43:13	38				1			
13:45:05	39				1			
13:46:49	40				1			
13:46:57	41				1			
13:48:46	42				1			
13:48:50	43				1			
13:49:00	44				1			
13:49:23	45				1			
13:50:37	46				1			
13:51:05	47				1			
13:51:32	48				1			
13:52:10	49				1			
13:52:30	50				1			
13:59:23	51				1			
14:00:07	52				1			
14:01:07	53				1			
14:01:28	54				1			
14:01:51	55				1			
14:01:53	56				1			
14:01:54	57				1			
14:02:27	58				1			
14:02:46	59				1			
14:03:19	60				1			
14:03:39	61				1			
14:04:54	62				1			
14:05:46	63				1			
14:06:15	64				1			
14:06:21	65				1			
14:06:37	66				1			
14:06:56	67				1			
14:07:53	68				1			
14:11:09	69				1			
14:13:44	70				1			
14:16:15	71				1			
14:16:26	72				1			
14:17:01	73				1			
14:23:08	74				1			
14:24:02	75				1			



<i>Time</i>	<i>Observation</i>	<i>Forklift Operator Prework Sampling</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
14:24:03	76				1			
14:26:53	77				1			
14:28:25	78				1			
14:28:40	79				1			
14:29:35	80				1			
14:30:54	81				1			
14:32:01	82				1			
14:32:05	83				1			
14:32:05	84				1			
14:33:17	85				1			
14:33:33	86				1			
14:41:52	87				1			
14:42:08	88				1			
14:43:01	89				1			
14:44:41	90				1			
14:44:55	91				1			
14:45:58	92				1			
14:46:16	93				1			
14:47:04	94				1			
14:48:15	95				1			
14:48:20	96				1			
14:48:57	97				1			
14:49:18	98				1			
14:53:23	99				1			
14:54:10	100				1			
<b>Total Element</b>		4	1	3	92	0	0	0
<b>Probability</b>		8%			92%			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	95

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### ATTACHMENT III

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator Work Sampling I</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:00:18</i>	<i>1</i>				1			
<i>10:02:09</i>	<i>2</i>				1			
<i>10:02:38</i>	<i>3</i>				1			
<i>10:02:48</i>	<i>4</i>				1			
<i>10:03:47</i>	<i>5</i>				1			
<i>10:04:53</i>	<i>6</i>				1			
<i>10:05:06</i>	<i>7</i>				1			
<i>10:06:55</i>	<i>8</i>				1			
<i>10:13:35</i>	<i>9</i>				1			
<i>10:15:42</i>	<i>10</i>				1			
<i>10:16:38</i>	<i>11</i>				1			
<i>10:16:39</i>	<i>12</i>				1			
<i>10:30:00</i>	<i>13</i>				1			
<i>10:31:15</i>	<i>14</i>				1			
<i>10:32:03</i>	<i>15</i>					1		
<i>10:32:29</i>	<i>16</i>					1		
<i>10:33:56</i>	<i>17</i>					1		
<i>10:34:59</i>	<i>18</i>					1		
<i>10:37:40</i>	<i>19</i>					1		
<i>10:39:43</i>	<i>20</i>				1			
<i>10:41:15</i>	<i>21</i>				1			
<i>10:41:35</i>	<i>22</i>				1			
<i>10:44:58</i>	<i>23</i>				1			
<i>10:45:21</i>	<i>24</i>				1			
<i>10:49:41</i>	<i>25</i>				1			
<i>10:56:33</i>	<i>26</i>				1			
<i>11:05:14</i>	<i>27</i>				1			
<i>11:07:39</i>	<i>28</i>				1			
<i>11:09:22</i>	<i>29</i>				1			
<i>11:13:19</i>	<i>30</i>				1			
<i>11:17:50</i>	<i>31</i>				1			
<i>11:20:47</i>	<i>32</i>				1			
<i>11:20:54</i>	<i>33</i>				1			
<i>11:22:35</i>	<i>34</i>				1			
<i>11:25:32</i>	<i>35</i>				1			
<i>11:30:52</i>	<i>36</i>				1			
<i>11:31:54</i>	<i>37</i>				1			

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator Work Sampling I</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>11:34:04</i>	<i>38</i>				1			
<i>11:35:39</i>	<i>39</i>				1			
<i>11:35:55</i>	<i>40</i>				1			
<i>11:41:56</i>	<i>41</i>				1			
<i>11:43:36</i>	<i>42</i>				1			
<i>11:49:44</i>	<i>43</i>				1			
<i>11:52:05</i>	<i>44</i>				1			
<i>11:54:56</i>	<i>45</i>				1			
<i>11:55:07</i>	<i>46</i>				1			
<i>11:58:33</i>	<i>47</i>				1			
<i>12:01:58</i>	<i>48</i>							1
<i>12:02:14</i>	<i>49</i>							1
<i>12:03:06</i>	<i>50</i>							1
<i>12:04:55</i>	<i>51</i>							1
<i>12:06:35</i>	<i>52</i>							1
<i>12:19:45</i>	<i>53</i>							1
<i>12:24:45</i>	<i>54</i>							1
<i>12:25:06</i>	<i>55</i>							1
<i>12:26:21</i>	<i>56</i>							1
<i>12:31:39</i>	<i>57</i>							1
<i>12:35:39</i>	<i>58</i>							1
<i>12:37:36</i>	<i>59</i>							1
<i>12:44:00</i>	<i>60</i>							1
<i>12:44:22</i>	<i>61</i>							1
<i>12:44:30</i>	<i>62</i>							1
<i>12:44:51</i>	<i>63</i>							1
<i>12:44:52</i>	<i>64</i>							1
<i>12:44:52</i>	<i>65</i>							1
<i>12:47:10</i>	<i>66</i>							1
<i>12:48:06</i>	<i>67</i>							1
<i>12:48:32</i>	<i>68</i>							1
<i>12:48:57</i>	<i>69</i>							1
<i>12:53:20</i>	<i>70</i>							1
<i>12:55:21</i>	<i>71</i>							1
<i>12:58:18</i>	<i>72</i>							1
<i>12:59:42</i>	<i>73</i>							1
<i>13:01:59</i>	<i>74</i>				1			
<i>13:02:10</i>	<i>75</i>				1			
<i>13:06:00</i>	<i>76</i>				1			

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator Work Sampling I</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>13:08:54</i>	<i>77</i>				1			
<i>13:09:03</i>	<i>78</i>				1			
<i>13:09:34</i>	<i>79</i>				1			
<i>13:09:45</i>	<i>80</i>				1			
<i>13:14:12</i>	<i>81</i>				1			
<i>13:16:52</i>	<i>82</i>				1			
<i>13:19:17</i>	<i>83</i>				1			
<i>13:28:00</i>	<i>84</i>				1			
<i>13:34:31</i>	<i>85</i>				1			
<i>13:35:52</i>	<i>86</i>				1			
<i>13:46:18</i>	<i>87</i>				1			
<i>13:49:28</i>	<i>88</i>				1			
<i>13:49:31</i>	<i>89</i>				1			
<i>13:58:03</i>	<i>90</i>				1			
<i>14:08:30</i>	<i>91</i>				1			
<i>14:09:50</i>	<i>92</i>					1		
<i>14:10:29</i>	<i>93</i>					1		
<i>14:20:16</i>	<i>94</i>	1						
<i>14:20:31</i>	<i>95</i>	1						
<b><i>Total Element</i></b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>60</b>	<b>7</b>	<b>0</b>	<b>26</b>
<b><i>Probability</i></b>		<b>2%</b>			<b>98%</b>			

<b><i>Confidence Level</i></b>	95.00%
<b><i>Accuracy Level</i></b>	5.00%
<b><i>Zvalue</i></b>	1.65
<b><i>N' (sample size)</i></b>	24

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**ATTACHMENT IV**

<i>Time</i>	<i>Observation</i>	<i>Forklift Operator Work Sampling II</i>						
		<i>Working</i>			<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
10:09:46 AM	1				1			
10:14:00 AM	2				1			
10:14:22 AM	3				1			
10:25:12 AM	4				1			
10:30:06 AM	5				1			
10:30:34 AM	6				1			
10:34:42 AM	7				1			
10:36:34 AM	8				1			
10:36:52 AM	9				1			
10:38:05 AM	10				1			
10:39:06 AM	11				1			
10:41:41 AM	12				1			
10:42:36 AM	13				1			
10:43:25 AM	14				1			
10:44:18 AM	15				1			
10:49:11 AM	16				1			
10:50:55 AM	17				1			
10:52:14 AM	18				1			
10:53:49 AM	19				1			
10:54:20 AM	20				1			
10:55:08 AM	21				1			
10:59:32 AM	22				1			
11:00:59 AM	23				1			
11:10:27 AM	24				1			
<b>Total Element</b>		0	0	0	24	0	0	0
<b>Probability</b>		0%			100%			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	0

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**ATTACHMENT V**

<i>Time</i>	<i>Observation</i>	<i>Checker Prework Sampling</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>13:00:53</i>	<i>1</i>			1			
<i>13:04:09</i>	<i>2</i>			1			
<i>13:04:33</i>	<i>3</i>			1			
<i>13:05:31</i>	<i>4</i>			1			
<i>13:05:36</i>	<i>5</i>			1			
<i>13:06:10</i>	<i>6</i>			1			
<i>13:06:22</i>	<i>7</i>			1			
<i>13:08:22</i>	<i>8</i>			1			
<i>13:11:15</i>	<i>9</i>			1			
<i>13:12:31</i>	<i>10</i>			1			
<i>13:12:58</i>	<i>11</i>			1			
<i>13:14:33</i>	<i>12</i>			1			
<i>13:14:54</i>	<i>13</i>			1			
<i>13:15:43</i>	<i>14</i>			1			
<i>13:15:59</i>	<i>15</i>			1			
<i>13:18:11</i>	<i>16</i>			1			
<i>13:19:35</i>	<i>17</i>			1			
<i>13:22:11</i>	<i>18</i>		1				
<i>13:23:07</i>	<i>19</i>		1				
<i>13:26:20</i>	<i>20</i>		1				
<i>13:26:39</i>	<i>21</i>		1				
<i>13:30:00</i>	<i>22</i>				1		
<i>13:30:16</i>	<i>23</i>				1		
<i>13:30:32</i>	<i>24</i>				1		
<i>13:31:31</i>	<i>25</i>				1		
<i>13:33:37</i>	<i>26</i>				1		
<i>13:34:04</i>	<i>27</i>				1		
<i>13:34:41</i>	<i>28</i>				1		
<i>13:38:41</i>	<i>29</i>						
<i>13:39:17</i>	<i>30</i>	1					
<i>13:39:18</i>	<i>31</i>	1					
<i>13:39:22</i>	<i>32</i>	1					
<i>13:39:29</i>	<i>33</i>	1					
<i>13:40:53</i>	<i>34</i>	1					
<i>13:41:55</i>	<i>35</i>	1					
<i>13:41:56</i>	<i>36</i>	1					

<i>Time</i>	<i>Observation</i>	<i>Checker Prework Sampling</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
13:42:24	37	1					
13:43:13	38	1					
13:45:05	39			1			
13:46:49	40			1			
13:46:57	41			1			
13:48:46	42			1			
13:48:50	43			1			
13:49:00	44			1			
13:49:23	45			1			
13:50:37	46			1			
13:51:05	47			1			
13:51:32	48			1			
13:52:10	49			1			
13:52:30	50			1			
13:59:23	51			1			
14:00:07	52			1			
14:01:07	53			1			
14:01:28	54			1			
14:01:51	55			1			
14:01:53	56			1			
14:01:54	57			1			
14:02:27	58			1			
14:02:46	59			1			
14:03:19	60			1			
14:03:39	61			1			
14:04:54	62			1			
14:05:46	63			1			
14:06:15	64			1			
14:06:21	65			1			
14:06:37	66			1			
14:06:56	67			1			
14:07:53	68			1			
14:11:09	69			1			
14:13:44	70			1			
14:16:15	71			1			
14:16:26	72			1			
14:17:01	73			1			
14:23:08	74			1			
14:24:02	75			1			

<i>Time</i>	<i>Observation</i>	<i>Checker Prework Sampling</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>14:24:03</i>	<i>76</i>			1			
<i>14:26:53</i>	<i>77</i>			1			
<i>14:28:25</i>	<i>78</i>			1			
<i>14:28:40</i>	<i>79</i>			1			
<i>14:29:35</i>	<i>80</i>			1			
<i>14:30:54</i>	<i>81</i>			1			
<i>14:32:01</i>	<i>82</i>			1			
<i>14:32:05</i>	<i>83</i>			1			
<i>14:32:05</i>	<i>84</i>			1			
<i>14:33:17</i>	<i>85</i>			1			
<i>14:33:33</i>	<i>86</i>			1			
<i>14:41:52</i>	<i>87</i>			1			
<i>14:42:08</i>	<i>88</i>			1			
<i>14:43:01</i>	<i>89</i>			1			
<i>14:44:41</i>	<i>90</i>			1			
<i>14:44:55</i>	<i>91</i>			1			
<i>14:45:58</i>	<i>92</i>			1			
<i>14:46:16</i>	<i>93</i>			1			
<i>14:47:04</i>	<i>94</i>			1			
<i>14:48:15</i>	<i>95</i>			1			
<i>14:48:20</i>	<i>96</i>			1			
<i>14:48:57</i>	<i>97</i>			1			
<i>14:49:18</i>	<i>98</i>			1			
<i>14:53:23</i>	<i>99</i>			1			
<i>14:54:10</i>	<i>100</i>			1			
<b><i>Total Element</i></b>		9	4	79	7	0	0
<b><i>Probability</i></b>		<b>9%</b>		<b>86%</b>			

<b><i>Confidence Level</i></b>	95.00%
<b><i>Accuracy Level</i></b>	5.00%
<b><i>Zvalue</i></b>	1.65
<b><i>N' (sample size)</i></b>	114

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**ATTACHMENT VI**

<i>Time</i>	<i>Observation</i>	<i>Checker Work Sampling I</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:00:18</i>	<i>1</i>			1			
<i>10:02:09</i>	<i>2</i>			1			
<i>10:02:38</i>	<i>3</i>			1			
<i>10:02:48</i>	<i>4</i>			1			
<i>10:03:47</i>	<i>5</i>			1			
<i>10:04:53</i>	<i>6</i>			1			
<i>10:05:06</i>	<i>7</i>			1			
<i>10:06:55</i>	<i>8</i>			1			
<i>10:13:35</i>	<i>9</i>			1			
<i>10:15:42</i>	<i>10</i>			1			
<i>10:16:38</i>	<i>11</i>			1			
<i>10:16:39</i>	<i>12</i>			1			
<i>10:30:00</i>	<i>13</i>			1			
<i>10:31:15</i>	<i>14</i>			1			
<i>10:32:03</i>	<i>15</i>				1		
<i>10:32:29</i>	<i>16</i>				1		
<i>10:33:56</i>	<i>17</i>				1		
<i>10:34:59</i>	<i>18</i>				1		
<i>10:37:40</i>	<i>19</i>				1		
<i>10:39:43</i>	<i>20</i>			1			
<i>10:41:15</i>	<i>21</i>			1			
<i>10:41:35</i>	<i>22</i>			1			
<i>10:44:58</i>	<i>23</i>			1			
<i>10:45:21</i>	<i>24</i>			1			
<i>10:49:41</i>	<i>25</i>			1			
<i>10:56:33</i>	<i>26</i>			1			
<i>11:05:14</i>	<i>27</i>			1			
<i>11:07:39</i>	<i>28</i>			1			
<i>11:09:22</i>	<i>29</i>			1			
<i>11:13:19</i>	<i>30</i>			1			
<i>11:17:50</i>	<i>31</i>			1			
<i>11:20:47</i>	<i>32</i>			1			
<i>11:20:54</i>	<i>33</i>			1			
<i>11:22:35</i>	<i>34</i>			1			
<i>11:25:32</i>	<i>35</i>			1			
<i>11:30:52</i>	<i>36</i>			1			
<i>11:31:54</i>	<i>37</i>			1			

<i>Time</i>	<i>Observation</i>	<i>Checker Work Sampling I</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>11:34:04</i>	<i>38</i>			1			
<i>11:35:39</i>	<i>39</i>			1			
<i>11:35:55</i>	<i>40</i>			1			
<i>11:41:56</i>	<i>41</i>			1			
<i>11:43:36</i>	<i>42</i>			1			
<i>11:49:44</i>	<i>43</i>			1			
<i>11:52:05</i>	<i>44</i>			1			
<i>11:54:56</i>	<i>45</i>			1			
<i>11:55:07</i>	<i>46</i>			1			
<i>11:58:33</i>	<i>47</i>			1			
<i>12:01:58</i>	<i>48</i>			1			
<i>12:02:14</i>	<i>49</i>			1			
<i>12:03:06</i>	<i>50</i>			1			
<i>12:04:55</i>	<i>51</i>			1			
<i>12:06:35</i>	<i>52</i>			1			
<i>12:19:45</i>	<i>53</i>			1			
<i>12:24:45</i>	<i>54</i>			1			
<i>12:25:06</i>	<i>55</i>			1			
<i>12:26:21</i>	<i>56</i>			1			
<i>12:31:39</i>	<i>57</i>			1			
<i>12:35:39</i>	<i>58</i>			1			
<i>12:37:36</i>	<i>59</i>			1			
<i>12:44:00</i>	<i>60</i>			1			
<i>12:44:22</i>	<i>61</i>			1			
<i>12:44:30</i>	<i>62</i>			1			
<i>12:44:51</i>	<i>63</i>			1			
<i>12:44:52</i>	<i>64</i>			1			
<i>12:44:52</i>	<i>65</i>			1			
<i>12:47:10</i>	<i>66</i>			1			
<i>12:48:06</i>	<i>67</i>			1			
<i>12:48:32</i>	<i>68</i>			1			
<i>12:48:57</i>	<i>69</i>			1			
<i>12:53:20</i>	<i>70</i>			1			
<i>12:55:21</i>	<i>71</i>			1			
<i>12:58:18</i>	<i>72</i>			1			
<i>12:59:42</i>	<i>73</i>			1			
<i>13:01:59</i>	<i>74</i>			1			
<i>13:02:10</i>	<i>75</i>			1			
<i>13:06:00</i>	<i>76</i>			1			

<i>Time</i>	<i>Observation</i>	<i>Checker Work Sampling I</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>13:08:54</i>	<i>77</i>			1			
<i>13:09:03</i>	<i>78</i>			1			
<i>13:09:34</i>	<i>79</i>			1			
<i>13:09:45</i>	<i>80</i>			1			
<i>13:14:12</i>	<i>81</i>			1			
<i>13:16:52</i>	<i>82</i>			1			
<i>13:19:17</i>	<i>83</i>			1			
<i>13:28:00</i>	<i>84</i>			1			
<i>13:34:31</i>	<i>85</i>			1			
<i>13:35:52</i>	<i>86</i>			1			
<i>13:46:18</i>	<i>87</i>			1			
<i>13:49:28</i>	<i>88</i>			1			
<i>13:49:31</i>	<i>89</i>			1			
<i>13:58:03</i>	<i>90</i>			1			
<i>14:08:30</i>	<i>91</i>			1			
<i>14:09:50</i>	<i>92</i>		1				
<i>14:10:29</i>	<i>93</i>		1				
<i>14:20:16</i>	<i>94</i>				1		
<i>14:20:31</i>	<i>95</i>				1		
<i>14:20:46</i>	<i>96</i>				1		
<i>14:21:34</i>	<i>97</i>				1		
<i>14:26:04</i>	<i>98</i>				1		
<i>14:27:34</i>	<i>99</i>				1		
<i>14:31:42</i>	<i>100</i>				1		
<i>14:35:50</i>	<i>101</i>				1		
<i>14:39:59</i>	<i>102</i>				1		
<i>14:44:07</i>	<i>103</i>				1		
<i>14:48:15</i>	<i>104</i>				1		
<i>14:52:24</i>	<i>105</i>				1		
<i>14:56:32</i>	<i>106</i>				1		
<i>15:00:40</i>	<i>107</i>				1		
<i>15:04:49</i>	<i>108</i>				1		
<i>15:08:57</i>	<i>109</i>				1		
<i>15:13:05</i>	<i>110</i>	1					
<i>15:17:14</i>	<i>111</i>	1					
<i>15:21:22</i>	<i>112</i>	1					
<i>15:25:30</i>	<i>113</i>	1					
<i>15:29:39</i>	<i>114</i>	1					
<b><i>Total Element</i></b>		5	2	86	21	0	0

<i>Time</i>	<i>Observation</i>	<i>Checker Work Sampling I</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>Probability</i>		<i>6%</i>		<i>94%</i>			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	72



**ATTACHMENT VII**

<i>Time</i>	<i>Observation</i>	<i>Checker Work Sampling II</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:09:46 AM</i>	<i>1</i>			1			
<i>10:14:00 AM</i>	<i>2</i>			1			
<i>10:14:22 AM</i>	<i>3</i>			1			
<i>10:25:12 AM</i>	<i>4</i>			1			
<i>10:30:06 AM</i>	<i>5</i>			1			
<i>10:30:34 AM</i>	<i>6</i>			1			
<i>10:34:42 AM</i>	<i>7</i>			1			
<i>10:36:34 AM</i>	<i>8</i>			1			
<i>10:36:52 AM</i>	<i>9</i>			1			
<i>10:38:05 AM</i>	<i>10</i>			1			
<i>10:39:06 AM</i>	<i>11</i>			1			
<i>10:41:41 AM</i>	<i>12</i>			1			
<i>10:42:36 AM</i>	<i>13</i>			1			
<i>10:43:25 AM</i>	<i>14</i>			1			
<i>10:44:18 AM</i>	<i>15</i>			1			
<i>10:49:11 AM</i>	<i>16</i>			1			
<i>10:50:55 AM</i>	<i>17</i>			1			
<i>10:52:14 AM</i>	<i>18</i>			1			
<i>10:53:49 AM</i>	<i>19</i>			1			
<i>10:54:20 AM</i>	<i>20</i>			1			
<i>10:55:08 AM</i>	<i>21</i>			1			
<i>10:59:32 AM</i>	<i>22</i>			1			
<i>11:00:59 AM</i>	<i>23</i>			1			
<i>11:10:27 AM</i>	<i>24</i>			1			
<i>11:11:51 AM</i>	<i>25</i>			1			
<i>11:13:15 AM</i>	<i>26</i>			1			
<i>11:20:19 AM</i>	<i>27</i>			1			
<i>11:24:30 AM</i>	<i>28</i>			1			
<i>11:26:07 AM</i>	<i>29</i>			1			
<i>11:34:59 AM</i>	<i>30</i>			1			
<i>11:39:00 AM</i>	<i>31</i>			1			
<i>11:39:02 AM</i>	<i>32</i>			1			
<i>11:43:48 AM</i>	<i>33</i>			1			
<i>11:45:58 AM</i>	<i>34</i>			1			
<i>11:46:17 AM</i>	<i>35</i>			1			
<i>11:49:40 AM</i>	<i>36</i>			1			
<i>11:54:45 AM</i>	<i>37</i>			1			

Time	Observation	Checker Work Sampling II					
		Working		Not Working			
		I	II	I	II	III	IV
11:54:56 AM	38			1			
12:04:09 PM	39						1
12:07:55 PM	40						1
12:14:31 PM	41						1
12:15:26 PM	42						1
12:19:29 PM	43						1
12:21:03 PM	44						1
12:25:05 PM	45						1
12:25:41 PM	46						1
12:26:32 PM	47						1
12:31:44 PM	48						1
12:33:43 PM	49						1
12:34:34 PM	50						1
12:38:52 PM	51						1
12:39:23 PM	52						1
12:42:45 PM	53						1
12:43:24 PM	54						1
12:44:58 PM	55						1
12:46:39 PM	56						1
12:49:11 PM	57						1
12:50:51 PM	58						1
12:51:29 PM	59						1
12:52:02 PM	60						1
12:53:00 PM	61						1
12:55:56 PM	62						1
12:57:56 PM	63						1
12:59:01 PM	64						1
12:59:17 PM	65						1
1:05:15 PM	66			1			
1:06:48 PM	67			1			
1:10:03 PM	68			1			
1:10:49 PM	69			1			
1:11:43 PM	70			1			
1:12:24 PM	71			1			
1:14:32 PM	72			1			
<b>Total Element</b>		0	0	45	0	0	27
<b>Probability</b>		<b>0%</b>		<b>100%</b>			

<b>Confidence Level</b>	95.00%
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<i>Time</i>	<i>Observation</i>	<i>Checker Work Sampling II</i>					
		<i>Working</i>		<i>Not Working</i>			
		<i>I</i>	<i>II</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>Accuracy Level</i>		5.00%					
<i>Zvalue</i>		1.65					
<i>N' (sample size)</i>		0					

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**ATTACHMENT VIII**

<i>Time</i>	<i>Observation</i>	<i>Product Arrangement Operator Prework Sampling</i>				
		<i>Working</i>	<i>Not Working</i>			
		<i>I</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>13:00:53</i>	<i>1</i>		1			
<i>13:04:09</i>	<i>2</i>		1			
<i>13:04:33</i>	<i>3</i>		1			
<i>13:05:31</i>	<i>4</i>		1			
<i>13:05:36</i>	<i>5</i>		1			
<i>13:06:10</i>	<i>6</i>		1			
<i>13:06:22</i>	<i>7</i>		1			
<i>13:08:22</i>	<i>8</i>		1			
<i>13:11:15</i>	<i>9</i>		1			
<i>13:12:31</i>	<i>10</i>		1			
<i>13:12:58</i>	<i>11</i>		1			
<i>13:14:33</i>	<i>12</i>		1			
<i>13:14:54</i>	<i>13</i>		1			
<i>13:15:43</i>	<i>14</i>		1			
<i>13:15:59</i>	<i>15</i>		1			
<i>13:18:11</i>	<i>16</i>		1			
<i>13:19:35</i>	<i>17</i>		1			
<i>13:22:11</i>	<i>18</i>		1			
<i>13:23:07</i>	<i>19</i>		1			
<i>13:26:20</i>	<i>20</i>		1			
<i>13:26:39</i>	<i>21</i>		1			
<i>13:30:00</i>	<i>22</i>		1			
<i>13:30:16</i>	<i>23</i>	1				
<i>13:30:32</i>	<i>24</i>	1				
<i>13:31:31</i>	<i>25</i>		1			
<i>13:33:37</i>	<i>26</i>	1				
<i>13:34:04</i>	<i>27</i>		1			
<i>13:34:41</i>	<i>28</i>		1			
<i>13:38:41</i>	<i>29</i>	1				
<i>13:39:17</i>	<i>30</i>		1			
<i>13:39:18</i>	<i>31</i>		1			
<i>13:39:22</i>	<i>32</i>		1			
<i>13:39:29</i>	<i>33</i>		1			
<i>13:40:53</i>	<i>34</i>		1			
<i>13:41:55</i>	<i>35</i>		1			
<i>13:41:56</i>	<i>36</i>		1			

<i>Time</i>	<i>Observation</i>	<i>Product Arrangement Operator Prework Sampling</i>				
		<i>Working</i>	<i>Not Working</i>			
		<i>I</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
13:42:24	37		1			
13:43:13	38		1			
13:45:05	39		1			
13:46:49	40		1			
13:46:57	41		1			
13:48:46	42		1			
13:48:50	43		1			
13:49:00	44		1			
13:49:23	45		1			
13:50:37	46		1			
13:51:05	47		1			
13:51:32	48		1			
13:52:10	49		1			
13:52:30	50		1			
13:59:23	51		1			
14:00:07	52		1			
14:01:07	53		1			
14:01:28	54		1			
14:01:51	55		1			
14:01:53	56		1			
14:01:54	57		1			
14:02:27	58		1			
14:02:46	59		1			
14:03:19	60		1			
14:03:39	61		1			
14:04:54	62		1			
14:05:46	63		1			
14:06:15	64		1			
14:06:21	65		1			
14:06:37	66		1			
14:06:56	67		1			
14:07:53	68		1			
14:11:09	69		1			
14:13:44	70		1			
14:16:15	71		1			
14:16:26	72		1			
14:17:01	73		1			
14:23:08	74		1			
14:24:02	75		1			

<i>Time</i>	<i>Observation</i>	<i>Product Arrangement Operator Prework Sampling</i>				
		<i>Working</i>	<i>Not Working</i>			
		<i>I</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
14:24:03	76		1			
14:26:53	77		1			
14:28:25	78		1			
14:28:40	79		1			
14:29:35	80		1			
14:30:54	81		1			
14:32:01	82		1			
14:32:05	83		1			
14:32:05	84		1			
14:33:17	85		1			
14:33:33	86		1			
14:41:52	87		1			
14:42:08	88		1			
14:43:01	89		1			
14:44:41	90		1			
14:44:55	91		1			
14:45:58	92		1			
14:46:16	93		1			
14:47:04	94		1			
14:48:15	95		1			
14:48:20	96		1			
14:48:57	97		1			
14:49:18	98		1			
14:53:23	99		1			
14:54:10	100		1			
<b>Total Element</b>		4	96	0	0	0
<b>Probability</b>		4%	96%			

<b>Confidence Level</b>	95.00%
<b>Accuracy Level</b>	5.00%
<b>Zvalue</b>	1.65
<b>N' (sample size)</b>	46

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### ATTACHMENT IX

<i>Time</i>	<i>Observation</i>	<i>Product Arrangement Operator</i>				
		<i>Working</i>	<i>Not Working</i>			
		<i>I</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>10:00:18</i>	<i>1</i>		1			
<i>10:02:09</i>	<i>2</i>		1			
<i>10:02:38</i>	<i>3</i>		1			
<i>10:02:48</i>	<i>4</i>		1			
<i>10:03:47</i>	<i>5</i>		1			
<i>10:04:53</i>	<i>6</i>		1			
<i>10:05:06</i>	<i>7</i>		1			
<i>10:06:55</i>	<i>8</i>		1			
<i>10:13:35</i>	<i>9</i>		1			
<i>10:15:42</i>	<i>10</i>		1			
<i>10:16:38</i>	<i>11</i>		1			
<i>10:16:39</i>	<i>12</i>		1			
<i>10:30:00</i>	<i>13</i>		1			
<i>10:31:15</i>	<i>14</i>		1			
<i>10:32:03</i>	<i>15</i>			1		
<i>10:32:29</i>	<i>16</i>			1		
<i>10:33:56</i>	<i>17</i>			1		
<i>10:34:59</i>	<i>18</i>			1		
<i>10:37:40</i>	<i>19</i>			1		
<i>10:39:43</i>	<i>20</i>		1			
<i>10:41:15</i>	<i>21</i>		1			
<i>10:41:35</i>	<i>22</i>		1			
<i>10:44:58</i>	<i>23</i>		1			
<i>10:45:21</i>	<i>24</i>		1			
<i>10:49:41</i>	<i>25</i>		1			
<i>10:56:33</i>	<i>26</i>		1			
<i>11:05:14</i>	<i>27</i>		1			
<i>11:07:39</i>	<i>28</i>		1			
<i>11:09:22</i>	<i>29</i>		1			
<i>11:13:19</i>	<i>30</i>		1			
<i>11:17:50</i>	<i>31</i>		1			
<i>11:20:47</i>	<i>32</i>		1			
<i>11:20:54</i>	<i>33</i>		1			
<i>11:22:35</i>	<i>34</i>		1			
<i>11:25:32</i>	<i>35</i>		1			
<i>11:30:52</i>	<i>36</i>		1			
<i>11:31:54</i>	<i>37</i>		1			

<i>Time</i>	<i>Observation</i>	<i>Product Arrangement Operator</i>				
		<i>Working</i>	<i>Not Working</i>			
		<i>I</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>11:34:04</i>	<i>38</i>		1			
<i>11:35:39</i>	<i>39</i>		1			
<i>11:35:55</i>	<i>40</i>		1			
<i>11:41:56</i>	<i>41</i>		1			
<i>11:43:36</i>	<i>42</i>		1			
<i>11:49:44</i>	<i>43</i>		1			
<i>11:52:05</i>	<i>44</i>		1			
<i>11:54:56</i>	<i>45</i>		1			
<i>11:55:07</i>	<i>46</i>		1			
<i>Total Element</i>		0	41	5	0	0
<i>Probability</i>		0%	100%			

<i>Confidence Level</i>	95.00%
<i>Accuracy Level</i>	5.00%
<i>Zvalue</i>	1.65
<i>N' (sample size)</i>	0

## AUTHOR BIOGRAPHY



Born on January 7<sup>th</sup> 1996, the author is named Fairuz Nathania Putri. Raised in a small city, called Bekasi, the author spent her 17 years in Bekasi, and move to Surabaya to continue her study.

The author was the delegate of her elementary school, SD Bani Saleh 1 Bekasi, for swimming competition. The author continued her study for junior high school in SMP Negeri 1 Bekasi, and for

high school in SMA Negeri 1 Bekasi. The author was not an active student back in junior high and senior high due to personal issue. The author continued her study in Institut Teknologi Sepuluh Nopember majoring Industrial Engineering. The author considered to be an active student, as it can be seen of several events that the author join as the committee, and how the author becoming one of the member in several organizations. In the first year of college, the author join a student management training called as LKMM. Since the second year of college, the author started to active in Industrial Engineering student organization or also known as HMTI ITS. In HMTI ITS, the author was one of the staff in *Pengembangan Sumber Daya Mahasiswa* Department or Student Resource Department. Besides that, the author also a committee of several events. On the third year, the author active in ITS Student Executive Board or BEM ITS as the Assistant General Director in *Pengembangan Sumber Daya Mahasiswa* Ministry or Student Resource Ministry. Besides being active in organization, the author also joined several international events, such as a summer school in Istanbul, Turkey called as Delightful Istanbul, and Asian Youth Leader Travel and Learning Camp (AYLTLC) in Singapore. In Delightful Istanbul, the author took Marketing in Health Care Sector course aligned to one of the author dream of having a hospital. In Singapore, the author manage to be one of the most engaging speaker. The author also once becoming a participant in International Essay Competition arranged by Goi Peace Foundation and UNESCO.

Through all of the experience from the past years, the author be able to have new knowledge and perspective from different point of view and cultures around the world.

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