SIMULATION MODEL TO MIMIZE IDLE TIME AT SHIPPING TRANSPORTATION

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I hereby declare that I have checked this project report and in my opinion this report is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Industrial Technology Management with Honours.

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## STUDENT'S DECLARATION

I hereby declare that the work in this report is my own except for the quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurrently submitted for award of other degree.

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# DEDICATION

Dedicated to my parents

## ACKNOWLEGMENT

I am grateful and would like to express my sincere gratitude to my supervisor Dr. Ali Asghar Jomah Adham for his germinal ideas, invaluable guidance, continuous encouragement and constant support in making this research possible. He has always impressed me with his outstanding professional conduct, his strong conviction for technology, and his belief that a degree program is only a start of a life-long learning experience. I appreciate his consistent support from the first day I applied to graduate program to these concluding moments. I am truly grateful for his progressive vision about my training in technology, his tolerance of my naïve mistakes, and his commitment to my future career.

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## ABSTRACT

Simulation modelling is the process of creating and analysing a digital prototype of a physical model to predict its performance in the real world. Simulation modelling is used to help designers and engineers understand whether, under what conditions, and in which ways a part could fail and what loads it can withstand. The simulation is to perform the one flow to reduce idle time with the real shipping procedure. The shipping department can be the area that causes claims for loss, damage, non-delivery or delay, or worse, that results in a law suit filed against your Company.

***Keywords: Simulation model, shipping procedure, idle time***

# ABSTRAK

Pemodelan simulasi adalah proses mencipta dan menganalisis prototaip digital model fizikal untuk meramalkan prestasi dalam dunia sebenar. Pemodelan simulasi digunakan untuk membantu pereka dan jurutera memahami sama ada, dalam keadaan apa, dan di mana cara bahagian yang boleh gagal dan apa yang memuatkan ia boleh menahan. Simulasi ini adalah untuk melaksanakan satu aliran untuk mengurangkan masa terbiar dengan prosedur penghantaran melalui kapal. Jabatan penghantaran boleh menjadi kawasan yang menyebabkan tuntutan bagi kehilangan, kerosakan, yang tidak dihantar atau kelewatan, atau lebih teruk lagi, yang mengakibatkan saman undang-undang yang difailkan terhadap Syarikat anda.

***Kata Kunci: model simulasi, prosedur penghantaran, masa terbiar***

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# CHAPTER 1

# BACKGROUND

## 1.1 INTRODUCTION

Over 40 years ago, the pattern and importance of shipping have changed drastically – probably more so in the past decade than in any era during the past hundred years. This is demonstrated by the fact that throughout this period of 40 years, 1965–2005, world seaborne trade has increased by over 450% from 6,000 to 28,000 billion ton miles. The change has been fast moving and driven by many factors. Today we live in a global environment in which shipping and trade are inextricably linked as never before. The shipper is driving the shipping industry and their spouse is to focus continuously on ship productivity with a strong interface integrated with other transport modes: overland/inland waterways/air. As was explained by Alan E.Branch (2007), shipping has change to be better transportation with their element from the increasing of customer and the time using. Function of shipping is the conveyance of goods from where their utility is low to a place where it is higher. Goods may consist of raw materials conveyed in bulk cargo shipments or purpose-built containers, equipment components/parts for assembly at an industrial plant. The factors influencing the shipper's choice of transport mode has changed dramatically during the past decade. Today it is based on the total product concept embracing all the constituents of distribution logistically driven. These include reliability, frequency, cost, transit time, capital tied up in transport, quality of service, packaging, and import duty, insurance and so on. So for the main shipping problem is about idle time that related with the shipping element like source, destination and weighted edge to make problem like delayed, missed time and weather problem.

Megalift Sdn Bhd is one big company of shipping in Malaysia that not only conduct project Sea freight but also conduct Super Heavy Transport, Lifting & Installation, Barging and RORO, and so on. So, for the shipping part is about the Project Sea freight Megalift is most experienced in arranging any mode of ocean transport to meet your logistics requirement in terms of points of supply, cargo readiness, L/C stipulation, inland routing, customs regulations, precise transit time, cargo specifications, by container ship (FCL or LCL, conference or non-conference) break-bulk vessel, geared heavy lifter, roro carrier or barge and whether from regular seaports or remote loading point, anywhere overseas to any port in Malaysia and the region or vice versa. So from this shipping company element of time, source, destination and weighted edge is to compare with the simulation data that I need to do. In this company there has many type of application that can be choose.

Then is about simulation is a powerful technique for solving a wide variety of problems. The basic idea behind simulation is to simply construct a model for given system by means of some equations and to determine its time given systems by means of equations and to determine its time dependent behavior. For mathematical model of a system, it is sometimes possible to get information about the system by analytical means. However, many systems are highly complex precluding any possibility of an analytical solution. Simulation may define as, numerical exercising of the model for the inputs in questions to see how they affect the output measures of performance. Normally, simulation is used for analytical solution for time consuming and expensive or an exact analytical expression is not available for representing the behavior of the systems. Reproduction is emergence of virtual world; simulation is fundamentally alludes to the impersonation or speaking to of potential arrangement of occasions and situations. Reproduction these days considered as an examination apparatus, particularly for a leader, adding validity and quickness to an investigation. Simulation is characterized as the methodology of making a model existing or proposed framework to recognize and comprehend those elements which control the framework and to foresee the future conduct framework. Reproduction has additionally ended up being profitable apparatus for separation learning assessment framework, where web based test systems may be utilized. Recreation is turning into an imperative help in accomplishing larger amount of productivity and benefit. As explained by Pratiksha Saxena (2011), the simulation is about mathematic that solve the data to be a better data. Simulation also creates one system to make easier program and to solve analytical problem. It is also to recognize the main problem in one system that has been run.

## 1.2 PROBLEM DESCRIPTION

### 1.2.1 Problem Background

The main important of the shipping problem is about applications of quantitative analysis to solving business problems has been in the physical distribution of products, commonly referred to as transportation problems. (J. Reeb and S. Leavengood, 2002). 3However, not all the transportation systems are necessarily successful regarding reducing costs and increasing quality.

So from the main problem of the shipping element, we need to minimize the problem with using the simulation treatment to reduce the main problem of idle time that affect the business problem and run from the exact scheduling. The shipping has many type of item that sometime affect with weather that needs to delay the time of shipping. So from the problem, we need to consider many type of element that relate with the idle time that need to solve and recognize the problem

### 1.2.2 Problem Statement

A typical of shipping problem is based on the elements that relate with the idle time. Object First problem is about the element in transportation make missed time from the exact time like lack of timing to conduct a bulk of items. Missed time always happen in shipping company if has problem in element of shipping. Then is about the cost of shipping that relates to the idle time, cost is important to customer and customer need the lowest cost to make a shipping service and then is about the the type of element that effect time scheduling is about the weighted edge, source and destination. Idle time can be happen with the element problem, so analyses the data of shipping is important to reduce cost and make shipping service send item on time. Then the destination of the shipping departure also as a problem when the ship needs to go a long destination before touch down to the port.

## 1.3 RESEARCH OBJECTIVE

For the purpose of meeting the idle time of shipping company with the main of element of shipping problem, and to avoid the missed or delayed time also effect the business and loss profit and money due to the inability to optimization the line of shipping; this study aims to meets to following objective;

1. To investigate the element of transportation problem that effect idle time.
2. To identify the shipping tariff of product that effect idle time cost.
3. To analyses the data of shipping with element of transportation by simulation model.

## 1.4 RESEARCH METHOD

The method that to use is simulation with arena software, Simulation models are the base of simulations. They could be physical or logical and are done in different ways, to suit the circumstances. It could be possible to physical simulation and test a system, e.g. building a Starbucks in-house, have an online voting system, or traffic lights to control the traffic driving onto a highway. In comparison though, some systems are too big or critical to play with; a flight control system or emergency room protocols. The physical system could not be there yet: an underground parking lot, which needs to fulfill service and profitability criteria and still needs to be built. The logical, also called mathematical model, addresses problems where mathematical solutions have been worked out. We are able to computer analyze the behavior of a valid logical model with assumptions and approximations. Simulations can be used, when the valid models become too complicated or exact mathematical solutions are not worked out. Simulation development has an own process due to the system information accuracy level, which has to be qualitatively high for the simulation to fulfill its goal of giving insight on the system. If we are implementing a simulation for a real system, we collect input and output data where applicable to use during the validation and simulation process. For a virtual system, the quality of the data and understanding its origin is significant to the validation process according to Law and Kelton. A simulation produces a result, which is analyzed and processed. The model is adjusted and the experiments are repeated or new ones are run. The goal of the simulation indirectly specifies the result processing steps: If just confirmation was needed for a system, the design or model is hereby confirmed or demented. With a system where an optimal solution is part of the goal, as in our supply chain, an optimization process is included in the result processing. The system is optimized and experiments are run again with the optimized model until with necessary accuracy a solution has been found. The iterative validation process is part of result processing and is integrated in the Data Specification as well as in the Process Specification. (Prof. Dr. Andreas Rinkel, 2011) from the method is about the simulation that we run is to compare the real data with the simulator that have we made to improve the real situation. Simulation also provides the much better framework to solve the main problem that relate with idle time. The advantage of using simulation method is like very easy to use, can made interface that like reality, and dynamic graphical animation system component as they move around and change.

The software that we used to run the simulator is the arena software, using this environment software you can build simulation method using drag and drop construction process. The arena software Environment facilities the model building process, the model running process, and the output analysis process. It is a simple model to introduce and provide an overview of the modeling capabilities in the Arena Environment. Arena has been completely with the view, draw, and animate transfer toolbars detached in the environment. Arena has a strong academic and industrial user base, and is very competitive in the simulation marketplace. Arena is fundamentally a process that an entity experiences while flowing through or using the elements of the system. Arena is the preeminent solution for better business decision with simulation. Arena is an easy to use, powerful tool that allows us to create and run experiments on models of the systems. By testing out the ideas in the computer, we can predict the future with confidence and without disrupting our current business environment. Any business environment, from customer service to manufacturing to health care, can benefit from simulation. And weather the analyzing an existing supply chain or a new emergency room layout, in the Arena we have five easy step to follow is create a basic model, refine the model, simulate the model, analyze simulations results and select the best alternative. (Manuel D.Rossetti, 2010) so from the arena software we have general purpose simulation package, process oriented and we have high –level that is very easy to use by graphical user interfaces, menu and dialogues. Once you learn one simulation language well, it is much easier to switch to another language and to understand which languages will be more appropriate for certain modeling situations. This method is use for made new system to reduce idle time that relate with the shipping problem elements.

## 1.5 SCOPE OF STUDY

The scope of the study is on the shipping line process in the shipping company in Malaysia. The shipping line basically operates with some idle time compared to other shipping company. The simulation model will be structured based on the shipping line process, from how the product be conducted, and how long time the shipping line need to reach the destination and how many idle time that can be reduce.

To facilitate the purpose of this study, a local private shipping company situated in Port Kelang, Selangor will be used as the platform of study. Data for the simulation model will be collected from the shipping line process with the permission along with the site visits to the company to witness the processing line and to comprehend data process involved even further. What was aimed in the simulation model is to observe the utilization of the current shipping line in the shipping company; whether the processing of the shipping is fully utilized and how to improve so if there is space for improvements in the sense of time and costs of shipping line.

## 1.6 SIGNIFICANT OF STUDY

The idea of using simulation modeling to observe the numerous entities, variables and factors of the process flow is not the something new in the western companies. However, for country like Malaysia, it is still not be explored and it is still considered as a relatively uncommon form of technology and there are still multitudes of area to be explored locally by using modeling and simulation. The logistic sector especially the shipping industry definitely could use the simulation method as a way to improve its shipping line efficiency and to highlight the cause of idle time errors and problems. The study of simulation method on shipping line from the view of observing and improving its process efficiency of time consuming is which therefore brings to the significance of this study.

## 1.7 OPERATIONAL DEFINITION

i. Simulation: The process that attempting to predict aspect of the behavior of some system by creating an approximate by mathematical model for it. The process of structuring and running a model or imitation of realistic system that is for observation and evaluation

ii. Process flow: A flow of action that passes materials or information/data as it purpose through one phase to another phase.

iii. Logistics: Logistics is the management of the flow of goods between the point of origin and the point of consumption in order to meet some requirements, for example, of customers or corporations.

iv. Idle time: Unproductive time on the part of employees or machines as a result of factors beyond their control. Idle time is the time associated with waiting, or when a piece of machinery is not being used but could be.

## 1.8 EXPECTED RESULT

Based on this study, the expected result from the simulation by using Arena Environment that has built is it will be able to improve the efficiency of the shipping flow process by reducing idle time, identified the best way of shipping line to reduce time to reach destination, and solving the elements problem that effect idle time. Then, at the same moment, this simulation model can also drive for improving logistic and supply system.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

This purpose of this chapter is to provide a review of past research efforts related to simulation model to minimize the idle time at the shipping transportation, shipping carrier, idle time, optimization, and simulation model. A review of other relevant research studies is also provided. Substantial literature has been studied on idle time of shipping transportation, element of transportation problem that related with idle time and how to solve it. The review is organized chronologically to offer insight to how past research efforts have laid the groundwork for subsequent studies, including the present research effort. The review is detailed so that the present research effort can be properly tailored to add to present body of literature as well as to justly the scope and direction of the present research effort.

## 2.2 OVERVIEW OF SHIPPING TRANSPORTATION

The change has been fast moving and driven by many factors. Today we live in a global environment in which shipping and trade are inextricably linked as never before. The shipper is driving the shipping industry and the response is to focus continuously on ship productivity with a strong interface integrated with other transport modes: overland/inland waterways/air (Alan e. Branch, 1964). Ships of all types spend large part of their lives in port, and these idle ads substantially to the cost of providing shipping service. Technological progress has made possible the construction of larger, faster and more economical ships, but organization and cargo handling in ports have not kept pace (Trevor D, Heaver and Keith, 1972). This section discussed the shipping transportation line for reducing idle time by element of transportation problem effect, design of shipping line, methods of shipping process and decision to support system.

### 2.2.1 History of Shipping Transportation

Into the 1950s, most goods transported on water over long distances were shipped by what is called break bulk shipping, in which goods were transported loose or packaged in boxes, bags, barrels, or other relatively small containers that varied depending on the type of good. A major cost in break bulk shipping is time and labor spent loading and unloading ships at portside in ways that avoid damage to the goods (John Tomlinson, 2009). The idea of using some type of shipping container was not completely novel. Boxes similar to modern containers had been used for combined rail- and horse-drawn transport in England as early as 1792. The US government used small standard-sized containers during the Second World War, which proved a means of quickly and efficiently unloading and distributing supplies. However, in 1955, Malcom P. McLean, a trucking entrepreneur from North Carolina, USA, bought a steamship company with the idea of transporting entire truck trailers with their cargo still inside. He realized it would be much simpler and quicker to have one container that could be lifted from a vehicle directly on to a ship without first having to unload its contents (Alphaliner, 2009). The history of maritime shipping stretches back thousands of years to the times of the earliest humans, for as long as there have been people they have wanted to explore what was beyond the seas. Today, maritime shipping is just as important as it has ever been, although the countries benefiting from these trade routes have shifted throughout history (Rupert Colley, 2011). Figured 2.1 are shows the evolution of container ships that make improvement by the generation. It is compared the present year and the quantity of container that improve the quantity of container.

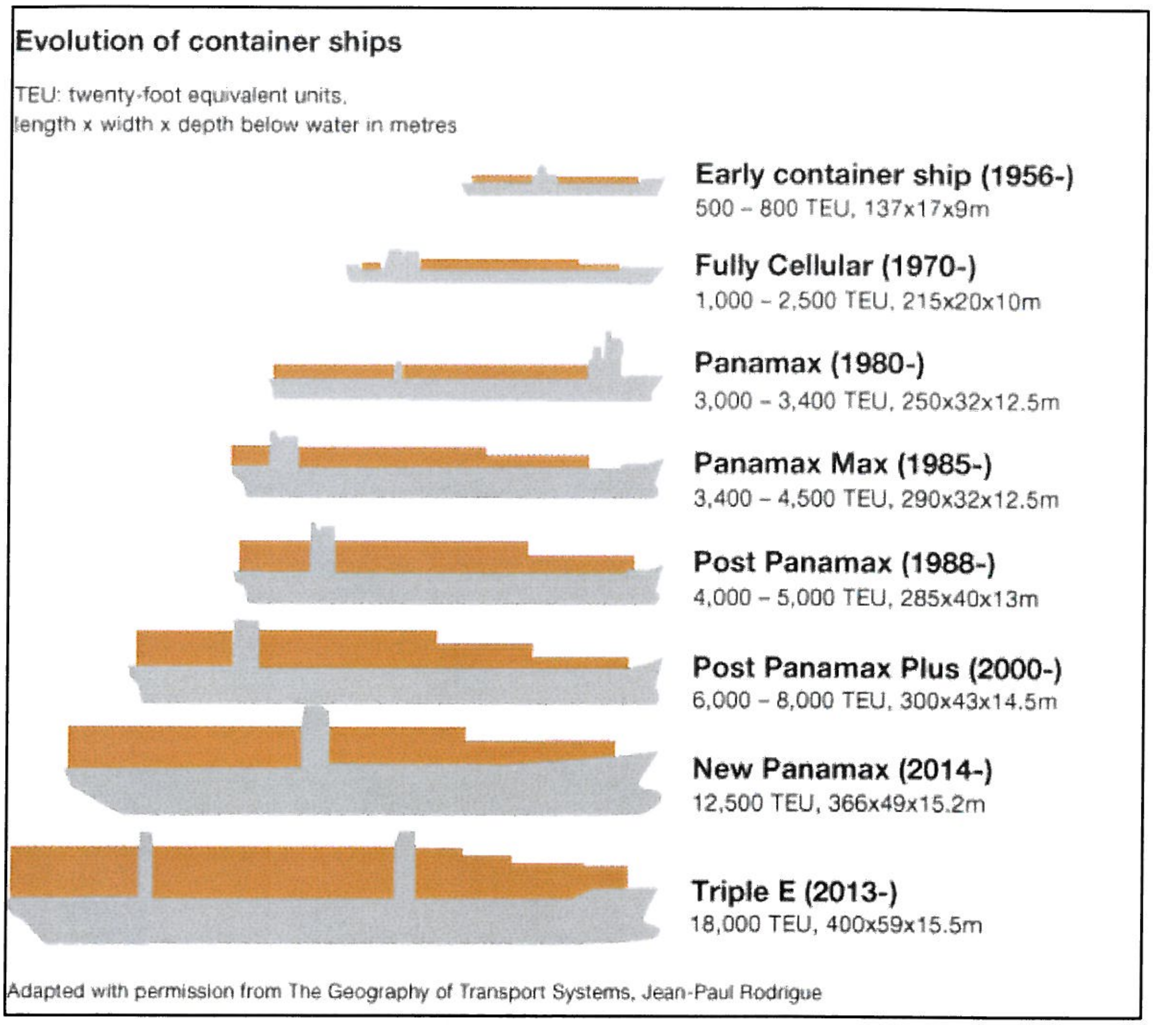


**Figure 2.1:** The evaluation/ the history of improvement

The advancement of technology has contributed to the improvement of the effective of the quantity of one shipment and shipping line also time consuming. Many studies of shipping line focused on applying model and statistical technology. This enabled managers in the shipment industries to achieve their business targets such as satisfying customers' demands and obtaining high profit by reducing idle time.

### 2.2.2 Design of Shipping Line

Initially, the design of shipping line started as only a line with the destination was a quite simple. It consisted of a few stages and each stage consisted of several step/procedure. The shipping line was developed according to the element of shipping that relate with the line of shipment. The shipping line should have a high scheduling to run the operations among the stages. For the reasons, researchers proposed certain design of shipping line to achieve the highest reducing idle time that related to the element of shipment. Figure 2.2 shows one stages of the shipping line that is the container arriving the Brunei Port.


**Figure 2.2:** Example of shipment part

In 2012, Almieda proposed how to design more efficient ships which was recently that evaluated a number of new technologies and design concepts aimed at cutting operating costs, while at the same time reducing ship emissions (Almieda, 2012). Figure 2.3 present the technologies are grouped under four main headings.


**Figure 2.3:** The main part of operation

Mcgraw-hill (2005) proposed a ship design these other skills include marine engineering, structural design, and production engineering. The ship design process is iterative, and is subdivided into several phases during which the design is developed in increasing degrees of detail. Typically, the owner's requirements specify the mission that the new ship must perform and define such parameters as required speed, fuel endurance, and cargo weight and capacity. The addition to unique mission requirements and constraints, every ship must satisfy certain physical principles. The fundamental principles are that (1) the ship hull and superstructure must have adequate storage space, and (2) the ship must float at an acceptable waterline (draft neither too great nor too small) when it is fully loaded. Another principle is that the ship must be statically stable; that is, when it is displaced from its equilibrium condition, it must tend to return to that condition. Figure 2.4 shows the typical hub and stoke liner shipping network (network design).

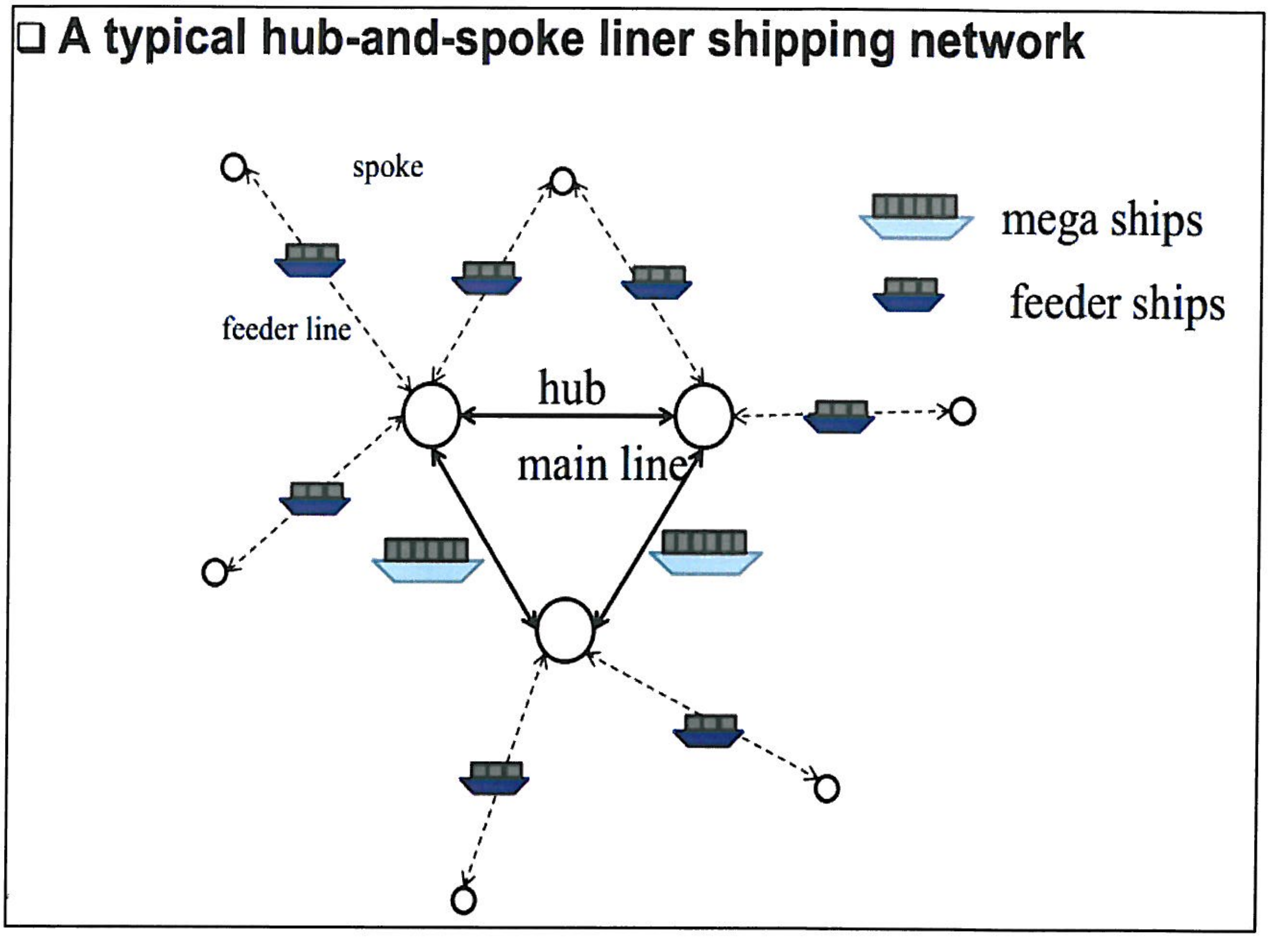


**Figure 2.4:** Example of shipping destination

### 2.2.3 Operation Research Models for the Shipping Line

Maritime transport is an important mode of transport in international trade. It is important for liner shipping companies to maintain cost efficient and robust liner shipping networks. The use of operations research models and techniques in both the construction of liner shipping route networks and the disruption management process is still limited, but it is expected that significant improvements can be made by using such models (Judith Mudler, 2011)

i. Idle time (IT): The amount of ineffective time whereby the available resources are not used e.g. a container in a yard.

ii. In Transit: The status of goods or persons between the outwards customs clearance and inwards customs clearance.

iii. Intermodal Transport: The movement of goods (containers) in one and the same loading unit or vehicle which uses successively several modes of transport without handling of the goods themselves in changing modes.

iv. Schedule: A timetable including arrival/departure times of ocean- and feeder vessels and also inland transportation. It refers to named ports in a specific voyage (journey) within a certain trade indicating the voyage number. In general: The plan of times for starting and/or finishing activities.

v. Simulation: The imitation of the reality for studying the effect of changing parameters in a model as a means of preparing a decision.

vi. Supply chain: A sequence of events in a goods flow which adds to the value of a specific good. These events may include: conversion, assembling and/or disassembling movements and placements.

vii. Queue: A stored arrangement of computer data, programs or messages, waiting to be processed in the order in which they were submitted.

viii. Quality: The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs.

## 2.3 STRUCTURE OF MODEL SHIPPING TRANSPORTATION SYSTEM

The model of shipping transportation system is a flow-line production system which has great performance in the industrial shipping transportation. More recently, it even gained importance in low idle time shipping line in system. The model of shipping line has been active field of research over more than half century. This led to massive body of literature covering a plenty of key pieces of information of shipping model line.

The transportation model uses the principle of 'transplanting' something, like taking a hole from one place and inserting it in another without change. First it assumes that to disturb or change the idea being transported in any way will damage and reduce it somehow. It also assumes that it is possible to take an idea from one person's mind into another person's so that the two people will then understand in exactly the same way. The transportation model is a valuable tool in analyzing and modifying existing transportation systems or the implementation of new ones. In addition, the model is effective in determining resource allocation in existing business structures like in figure 2.5 (Mgorly, 2009).

You cannot carry out transportation planning or creation of shipment after the goods issue has been executed. Once goods issue is done it means that the material has left your premises so there is no need for a transportation planning after it.

In case you need carry out the shipment documents at the end of the day you could just create the delivery documents during the day and at end of the day create the shipment documents and the goods issue (Jyoti Prakash, 2011)

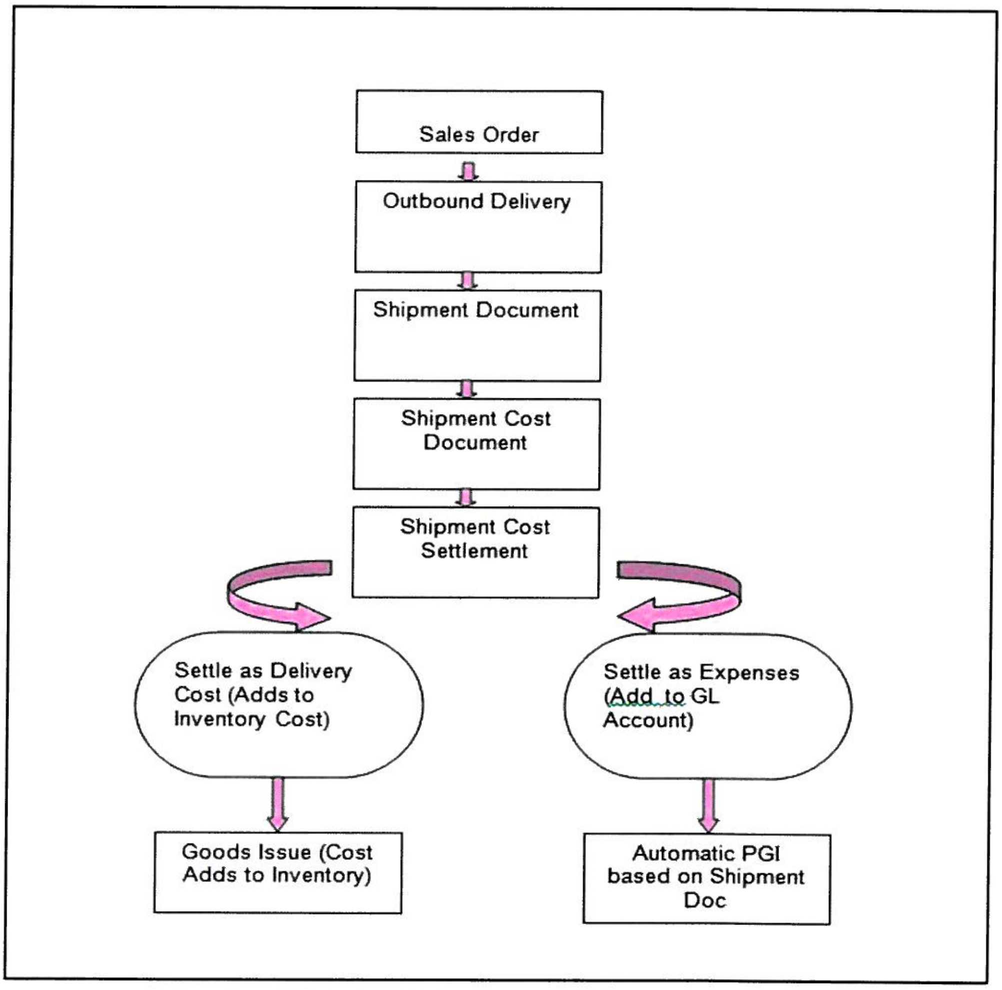


**Figure 2.5:** Shipment Document

The transportation modeling finds the least-cost means of shipping supplies from several origins to several destinations. Origin points can be factories, warehouses, or anything from which goods are shipped. Destinations are any points that receive goods. To use the transportation model, we need to know the following step; first is origin points and the capacity, second is the destination points and the demand period and last is the cost of shipping one unit like figure 2.6 (Drezner.Z, 1995).

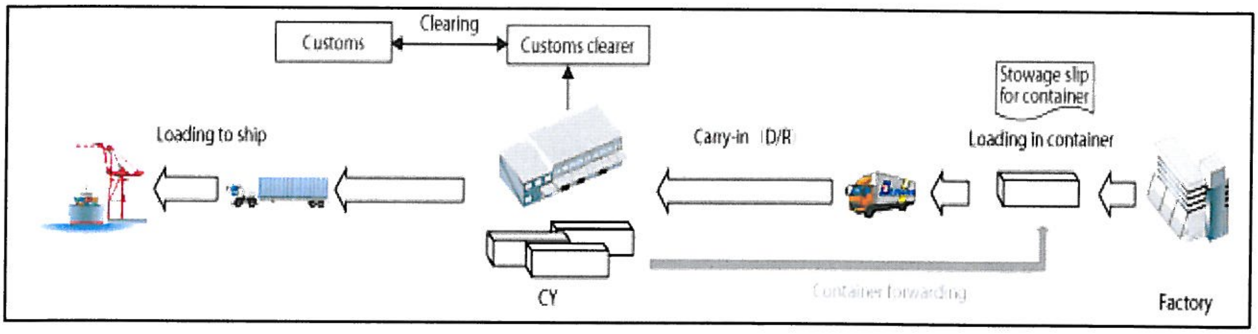


**Figure 2.6:** Shipping line

## 2.4 BACKGROUND OF MODEL LINE SHIPPING SYSTEM PROBLEMS

The shipping systems line model of the logistics industries has two main problems. The first problem is the dual transportation problem of the shipping model line system. Second is unbalanced shipping model line problem that with the amount and location of available supplies and the quantities demanded have problem. The next section will discuss this problem in details.

### 2.4.1 The Dual Transportation Problem

The first problem of the shipping line model is regarding of shipping dual line were the clash of scheduling does not be able to send the product in one way. For the plant under study, usually the shipment will increase the cost or will increase the idle time of shipment. These problems cause the reducing profit of the company and will increase the number of worker and line of shipment. However, to solve this issue, many researchers presented different model and solution to obtain the best solution or the optimum plan of shipping model line.

Every Linear Programming (LP) has dual. The clever method is to notice the transportation problem was written as a minimization (so that the dual will be maximization); it had equality constrained (dual constraint). Here is a way think of the possibility, in the original transportation problem, the seller faces the problem of getting goods from supply centers to demand centers (Jsobel, 2002)

### 2.4.2 Unbalanced

Problems that satisfy this condition are called balanced transportation problems. Techniques have been developed for solving balanced or standard transportation problems only. It follows that any non-standard problem, in which the supplies and demands do not balance, must be converted to a standard transportation problem before it can be solved. This conversion can be achieved by the use of a dummy source/destination. It is the sum of the supplies of all the sources is not equal to sum of the demands of all the destinations, then the problem is termed as unbalanced transportation problem (S.M.Sinha, 2006). However, as time progress and the items are should arrive are getting complex the balanced the problems also getting complex because of the element of shipping consists the destination, time estimation, the source of product and several shipment stages. The number of stages also increased for these operations. Many researchers were attempted to solve this problem. This section shows many researchers involved with this problem.

The main problem of unbalanced transportation system is with the amount and location of available supplies and the quantities demanded. In addition we must know the costs that result from transporting one unit of commodity from various origins to various destinations. At the end of this chapter, some studies in this area will be presented. Figure 2.7 show the cost matrix of transportation problem.

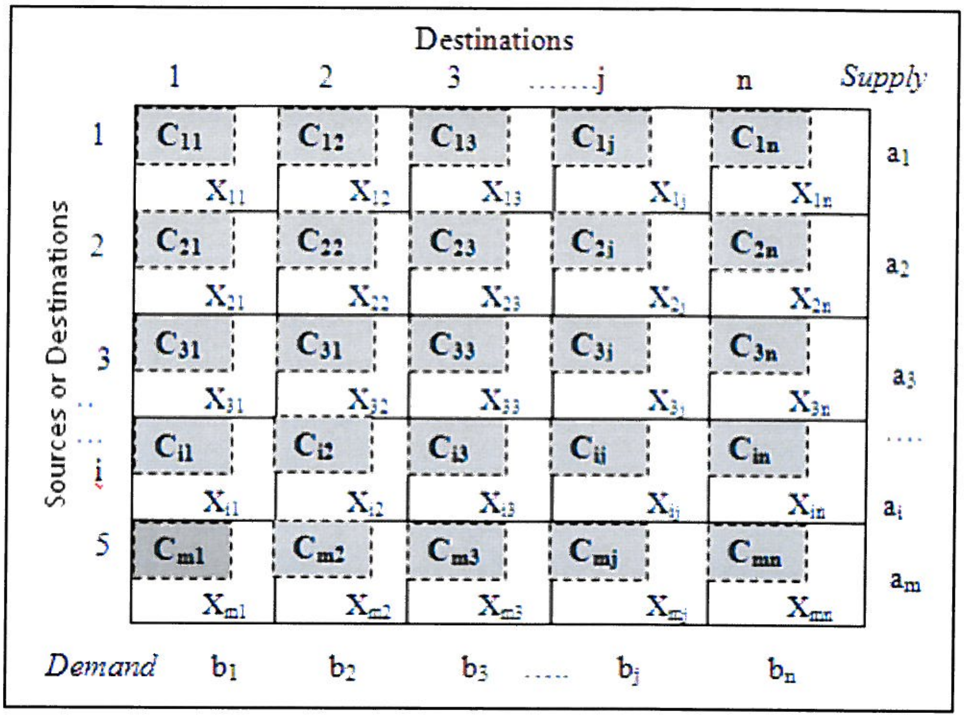


**Figure 2.7:** The cost matrix transportation problem

### 2.4.3 Idle Time

Approximation algorithms is about Interesting discrete optimization problems are everywhere, from traditional operations research planning problems, such as scheduling, facility location, and network design, to computer science problems in databases, to advertising issues in viral marketing for no idle time scheduling on a single machine with release times and delivery times is about processing time, release date and a tail/ delivery time. Every jobs will have no want idle time when their performed the job. The job on scheduling is needed to be performed on a single machine under the no idle time scenario. Every machine should perform or must be performing only one job at given time. The objective of scheduling time is to minimize the maximum lateness by using this equation

$$Lmax = max\ 1 \leq j \leq n\ \{Cj + qj\} \quad (2.1)$$

Figure 2.7 will use this formula to calculate the cost in this study.

The problem from this journal is how to minimize problem when the jobs have different release date and tails/delivery time under the no idle time assumption. It is also, the scheduling cannot contain any idle time between two consecutive jobs on the machine. Then the method that we need to use is approximation algorithms classical rule that have three analyses, first is increasing the release date that to consider the following generalized list scheduling algorithm. Number two analysis is using folklore that divided in two classical heuristics already propose for problem. Folklore is recalling the principle of the Schrage algorithm. It is consist of scheduling the available jobs at each step with the greatest tail. Number three analyze is about constant approximations that is to increase the release dates, then constant have four theorem; first is to has tight worst-case performance ratio of 2 problem, then the 2nd theorem is about to proof the worst case performance of the pots algorithm. 3rd theorem is about to construct an instance by rounding down all release dates and tails to the next multiple and 4th theorem is about PTAS for problem P. The solution from the optimization methods by using approximating algorithms show some performance by proof that using algorithm have interesting feedback and propose a polynomial time approximation scheme.

The conclusion the aimed at designed efficient approximation algorithms to minimize the overload idle time or maximum lateness by using the all theorems is give some proof of success. (Imed Kacema and Hans Kellerer, 2010)

A successful iterated ravenous calculations for the blended no-unmoving stage stream shop booking issue is about the two machine stream shop issue with make compass minimization rule that very nearly 60 years since the fundamental work. In stream shop issue we manage a set N of n occupations, demonstrating customer requests of distinctive items to be produces that have to be created on set M of m machines. This to a degree less complex issue is alluded to as the Permutation Flow shop Scheduling Problem or PFSP. Emulating the work of Johnson, the most considered streamlining measure is the minimization of the maximal occupation consummation time or make-compass (Cmax) which relates to the time at which the last employment in the succession is done at the last machine in the shop.

The issue is about machines can't be sit in the wake of completing one occupation and before beginning the following one in the idle time streams jump. The idle time condition shows up in generation situations where setup times or working expenses of machines are high to the point that closing down machines after the beginning setup is not savvy. Idle time's power additionally not is permitted on machines because of mechanical stipulations. All the more particularly, in the no-unmoving situation, a machine must process all employments in the grouping without interferences. Accordingly, if necessary the beginning of a few occupations is postponed to guarantee the idle time demand. The system that we utilizing as a part of the blended no idle time change stream shop issue first are a blended direct number program with the capacity is the minimization of the make compass. Second in the blended is about make compass figuring that can ascertain the make compass for NPFSP is a long way from straight forward.

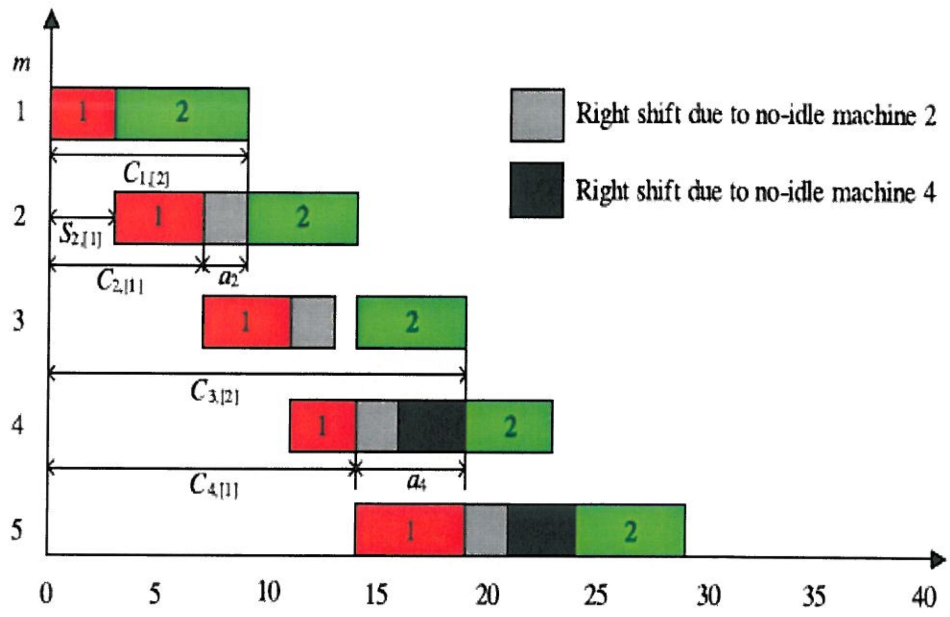


**Fig. 1.** Makespan calculation for the first two jobs in the example.

**Figure 2.8:** Calculation of two Jobs

Third of blended no idle time is a rate up technique for the insertion neighborhood that is about the most broadly utilized neighborhood as a part of the stream shop planning writing. Second technique for covetous calculations is iterated voracious approach that has separated in four; firstly is instatement for employments at first sorted as indicated by aggregate preparing times and afterward the two conceivable changes containing the initial two sorted occupations are figured. Furthermore are demolition, reproduction and acknowledgement measure for employments haphazardly removed from the occupant change $\pi$ and embedded into a rundown of uprooted jobs $\pi$. Thirdly is Local search likely like NEH, which is an insertion useful heuristic to most aggressive neighborhood scan strategies for the PFSP and variations. Ultimately is Calibration of heuristic and proposed IG to plans, development and recreation administrators of iterated greedy IG strategy with temperature and number of employments to destruct in the pulverization stage. Third system that has been examined is Computational examinations and factual investigation is connected with second strategy that is in the wake of aligning the proposed IG technique we contrast it and the condition of the craftsmanship calculations from the writing. The arrangement results demonstrate that the proposed IG calculation out performs existing strategies in the no-unmoving and in the blended idle time situations by a noteworthy edge like in the figure of 2.8.

The conclusion is the best of our insight; this is the first paper to study the blended idle time augmentation where just a few machines have the idle time stipulation. We introduce a blended number programming model for this new issue and the mathematical statements to figure the make compass. We likewise propose a set of equations to quicken the estimation of insertions that is utilized both as a part of heuristics and also in the nearby hunt methods. A powerful iterated insatiable (IG) calculation is proposed. We utilize a NEH-based heuristic to develop an amazing starting arrangement (Quan-KePan a,b, and RubénRuiz, 2013)

An enumeration procedure for the assembly line balancing problem based on branching by non-decreasing idle time is about a mechanical production system is a creation frameworks most generally utilized as a part of the stream line generation of merchandise on a modern scale. Various methodologies have been proposed for taking care of this issue that in the course of the most recent 60 years. The strategies have arranged into three gatherings that is development, enumerative calculations and met heuristic methodology.

The issue is the way to present another accurate calculation and how to tackling straightforward sequential construction system adjusting issue offered that to discover process duration. Than the strategy to utilized is first is Bounding lessening strategies and intelligent tests that isolated into three; first utilizing Lower headed for SALBP utilizes a well-known set of seven lower bound. Second is lessening principles is expand the undertaking operation time then third manage is greatest stream test is to proposed to demonstrate climate attainable arrangement. Second system is upper limits for the issues are gotten by helpful strategy then utilizing heuristic created. Third strategy is extension and a bound calculation that is about identification methodology in the proposed calculation is one of its most different trademarks. At that point requested quest for achievable loads that about contrast between the proposed calculations and definite techniques improvement to date identification system. At that point about strength decides after that about structure of the proposed limb and bound method that need to utilize. Fourth strategy is about computational experience to evaluate the nature of proposed bound and the arrangement technique.

The determination is proposes another and productive bidirectional limb and-headed technique for comprehending SALBP. Its most different qualities are another specification method and new intelligent tests. That investigates the plausible arrangements tree in a non-diminishing idle time request. The method utilizes a few well-known lower limits, predominance guidelines and another consistent test focused around the digestion of the achievability issue for a given process duration and number of stations (SALBP-F) to a most extreme stream issue. (Mariona Vilà and Jordi Pereira, 2012)

## 2.5 MODELLING APPROACH TO SHIPPING LINE MODEL PROBLEM

Simulation model that were used to solve problem of shipping line, such as idle time between the destination, unbalancing tasks among the stations, the element of transportation that related with weather and etc. the aims of these model were to obtain an optimum shipping line system. This section describes the model that was used in the case study. The model used for find the effective way and optimum solutions.

### 2.5.1 Simulation

Simulation model is powerful tools that gain popularity nowadays and was used many areas. This section will explain briefly on Simulation Model.

***Introduction Simulation Model***

The simulation displaying process in a spreadsheet includes the accompanying steps. A machine reenactment is a model that impersonates what may happen in actuality. In the broadest sense, each scientific model is truly a simulation. On the other hand, in this supplement we confine ourselves to circumstances in which there is some instability or haphazardness about some part of the framework under thought and we need to model that vulnerability specifically. Simulation permits us to model this irregular conduct and process framework execution measures, giving significant data to leaders. Reproduction is a standout amongst the most generally utilized explanatory devices (Ancmat, 2006).

Computer systems modeling and simulation was applied by administrators and designers with goals of obtaining the highest performance and the lowest cost. Modeling and simulation of systems design is a trade of good preparation for design and engineering decision in real world jobs (Ricki, 2002)

A simulation brings a model to life and demonstrates how a specific item or wonder will act. It is valuable for testing, examination or preparing where certifiable frameworks/ideas can be spoken to by a model. Simulation model gives duplication of items and forms, and speaks to those items/forms in promptly accessible and operationally legitimate situations (Sokolowski, 2008)

Simulation displaying has been utilized as a part of an extensive variety of physical and social sciences and building fields, extending from atomic combination to financial gauge to monetary figure to space shuttle outline. For diverse sorts of circumstances and frameworks, distinctive sorts of models are utilized. In ordering simulations, there are essential qualifications among the sorts of models that are generally reproduced, and among the sorts of project structures that are utilized to complete the simulations. (Mart, 2002)

The simulation approach is the opposite of the analytical approach, where the method of analytical is purely theoretical. As the approach is more reliable, the simulation approach gives more flexibility and convenience to the user.

Simulation is refers to the broad collection of methods and application to mimic the behavior of real systems, usually on a computer with appropriate software. Simulation also about the methods of numerical evaluation using software designed to imitate the system's operation and characteristics for studying a wide variety of model of real world systems. Simulation is the process of creating a computerized model of a real and designing the proposed systems. Simulation proposes of conducting numerical experiments to give us understanding of the behavior for given set of condition of that system (W.David.Kelton and Randall P.Sadowski, 2000).

Simulation model is one of the most powerful tools available to those responsible for the planning and design operation of complex processes/systems. It is heavily based on computer science, mathematics, probability theory and statistics. The process of simulation modeling and experimentation remains very much an intuitive art. Simulation model is a very general and somewhat ill-defined subject to process of designing a computerized model of a system and conducting experiments with this model for purpose either of understanding the process of simulation is to include both the construction of the model and the analytical use of the model for studying a problem (Jerry, 1998).

The authors attempt to capitalize on these rapid technology and communications advancements using distributed simulations, which features dynamic collections of autonomous simulations interacting with each other and with real-time data in a continuously running, real-time, distributed simulation environment (Wonho Suh, 2012).

***Definition of simulation model***

Simulation model is the imitation of some real thing available, state of affairs, or process. The behavior of a system that evolves over time is studied by developing a simulation model. The act of simulating something generally entails representing certain key characteristics/behaviors of a selected physical or abstract system (Kuo, 2011).

Simulation is use the mathematical model to determine the response of the system in different situations. Discipline is understand and evaluating the interaction of parts of a real or theoretical system by designing its representation (model) and executing (running) the model including the time and space dimension (simulation) (Samir Al-Amer, 2007).

Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be examine, because it may not be accessible, or it may be dangerous or unacceptable to examine, or it is being designed but not yet built, or it may simply not exist (Jet, 1997).

## 2.6 APPLYING SIMULATION MODEL TO SHIPPING TRANSPORTATION

There were many applications of simulation model in the shipping industries. This section discussed the emerging role of simulation model, application of discrete event simulation in the operation of shipping line that can be categorized into many steps of systems shipping line.

Mariam Kotachi, (2013) was research the simulation model and analysis on complex port operations with multimodal transportation. Ports with one or more container terminals are considered complex systems in which many resources, entities and transporters interact to achieve the objective of safely moving containers delivered by ships inland as well as loading containers delivered by trucks and rail onto ships. Ports with multimodal transportation systems are in particular complex as they typically operate with ships arriving to one or more terminals. With several resources of different types working and interacting, the system can be so complex that it is not easy to predict the behavior of the system and its performance metrics without the use of simulation. A generic discrete-event simulation models port operations with different resource types. The analysis will entail studying various scenarios motivated by changes in different inputs to measure their impact on the outputs that include throughput, resource utilization and waiting times.

Meifeng Luo and Thomas A.Grigalunas, (2002) studied over a multimodal transportation recreation model us waterfront compartment ports. The improvement and application of a spatial-financial, multi-modal compartment transportation simulation model for US holder ports. The model is approved and afterward used to estimate (1) yearly holder transportation administration interest for significant compartment ports, and (2) the effect on port interest of changes in port utilization expenses. The fundamental schema accepts shippers minimize the aggregate general expense of moving holders from sources to businesses. Initially, the model is portrayed, concentrating on the fundamental financial thinking. We quickly present the presumptions, computational calculations, and the product construction modeling. At that point, the information utilized as a part of the application are depicted, including exchange information, transportation systems, and financial variables. After that, model reproduction results are represented. Capabilities, required refinements, and future headings are quickly depicted in the last area.

Hans-Otto and Martin (2006) contemplated simulation of transportation exercises in robotized seaport compartment terminals. A reproduction investigation of transportation exercises in compartment terminals is introduced, where computerized vehicles can be utilized in diverse dispatching modes. The outline reproduction study reflects conditions, which are average of a true computerized terminal environment. Major trial elements are the span of the terminal and the level of stochastic varieties. The principle issues tended to in the recreation trials are the relative execution of different transportation modes and dispatching methods and the effect of stochastic varieties in taking care of and transportation times. Likewise, headings of future examination are highlighted, case in point, the application of nearby hunt standards down vehicle booking and methodologies for incorporated planning of cranes and vehicles.

H.Maoh and P. Kanaroglou (2007) studied about simulation model for evaluating the effect of environmental change on transportation. It is to simulation and survey the long haul effect of environmental change on provincial transportation frameworks and economies. This is because of absence of simulation models that have the capacity connection changes in climate occasions to transportation framework execution and entomb territorial exchange streams. Linkage in the middle of transportation and economy are handles through an irregular based multi-provincial info yield model. On other hand, the impact of climate on transportation is handles through pace conformity considers that record for the decrease speed because of changes in recurrence of different climate occasions. Along these lines, changes in recurrence of climate occasions interpret into travel delays, which is turn impact exchange streams between districts. Affectability examination with executes model represents its capacity to evaluate the effect of environmental change on transportation.

## 2.7 SUMMARY

This chapter is discussed the development of simulation in shipping line and how to solve using the simulation model. This chapter is to compile the research of simulation and how the researcher solve the problem such as element of transportation weather and give some example to do simulation of shipping line.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1 INTRODUCTION

This chapter will discuss about the methodology involved in this project of simulation to minimize idle time for shipping transportation. A shipping line is a section in a company of shipping where materials are put through a step of shipping line before sending the materials to the destination.

## 3.2 PROBLEM STATEMENT DETAILS

In the shipping line company, the major problem is idle time of the process of shipping before depart to the destination. Idle time will make some company reduce their profit and will increase lack of worker. Idle time also will make lack of queuing and increase time of using, idle time indicates that time for which wages are paid to the workers but no production is obtained during that time. The causes that make idle time in shipping line is like shipping breakdown, waiting for another instruction, weather problem, element of shipping, and etc. Optimizing production work cell efficiency means to understand that a couple of minutes here and there, in each and every work cell, simply adds up over time and creates backlogs in production.

Element of shipping also will make idle time in shipping line, element of shipping is like the destination, the source of goods and weighted edge. The destination is too far and has many destinations to arrive on time. Then about the source of goods is about the type of goods is not long lasting and the type is not suitable in some weather, so the company need to send the item first even the goods is far destination than other. While the weighted edge is about the items is load of capacity and need to divided in to ship, so the items will arrived in two different time that will make idle time. Some error also makes to take some time to find the solution, so it is about idle time like in the example of figure 3.1.

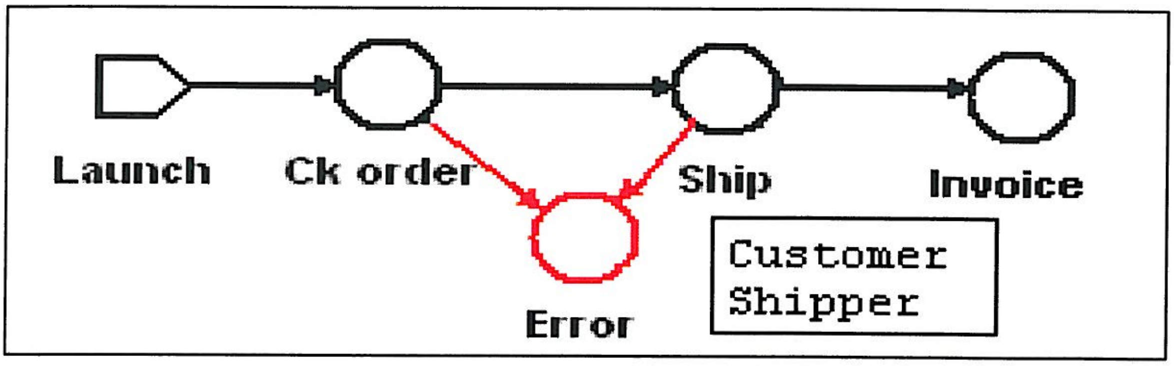


**Figure 3.1:** Example of Error

Shipping breakdown also will make large effect in idle time that need to make some solution rather to exchange ship or to make some solution of breakdown. The two solutions also need to take huge time to solve the problem. Waiting for another instruction is like another department in logistic have any problem that will take some time, it make more idle time. So the problem is anything in department or problem will make some idle time.

It's relatively easy to identify lost time in shipping line. The key is to be able to put a money value figure on that lost time and put plans in motion to eliminate it altogether. Lower production cycle times means lower costs and increased production throughput. Eliminating lost time at every opportunity, regardless of how small, will improve production and product gross profit.

## 3.3 METHOD OF DATA COLLECTION

### 3.3.1 Technical Data (Reports)

The company has every detailed data on different activities at shipping line. These data are available through their computed system. The managers of shipping lines recorded these data in reports which appeared daily, weekly, monthly, and yearly that contain the details and summaries of all the activities of shipping line such as time, number of task, items, source and etc. this main data used for this study. The data is quite accurate and recorded systematically like an example of figure 3.2. For activities that shows the idle time and non-regulations, the data are recorded separately and are assessed easily.

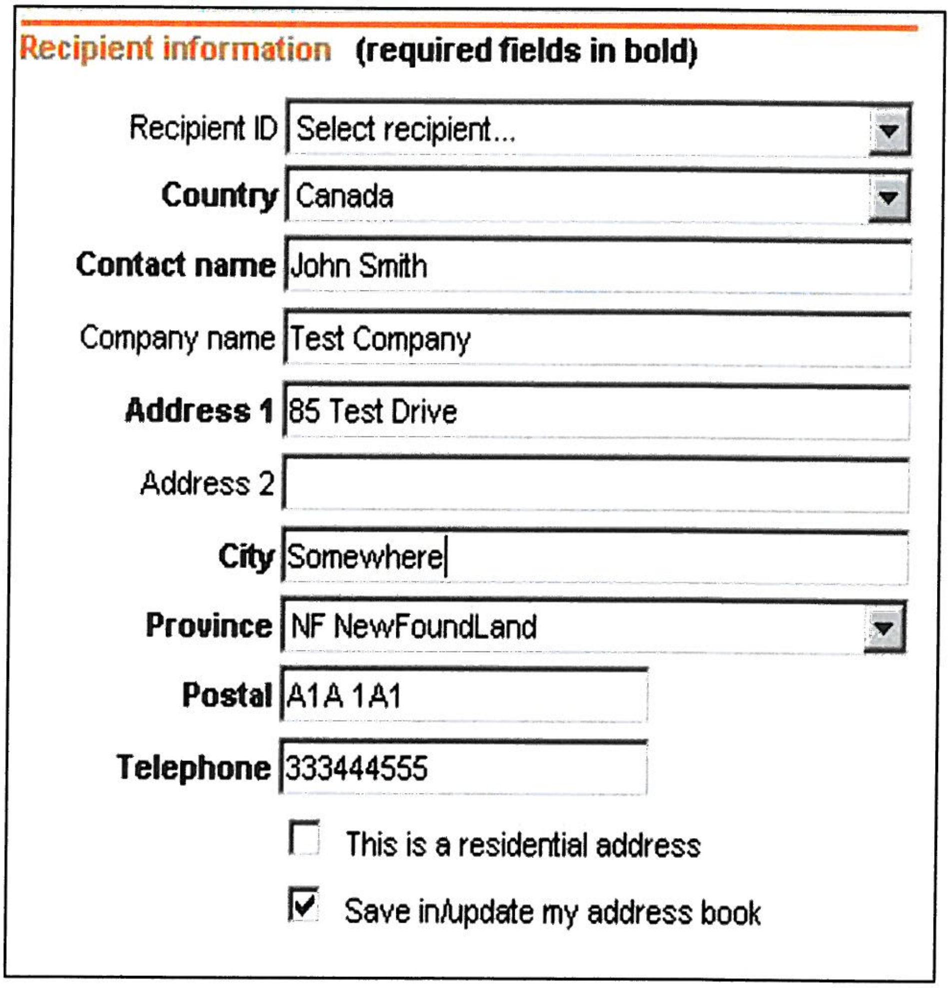


**Figure 3.2:** Example of Shipping Document

### 3.3.2 System Observation

System observation is also done to collect the data for this study like an example of figure 3.3. It is also an important source of data. It is helps to observe the system and to record data directly because sometimes the staff missed some information or they reported the wrong data wrongly. Observation helps in understanding the recorded data and also can used to verify sources of data. This is example of the line of documentation until the shipment.

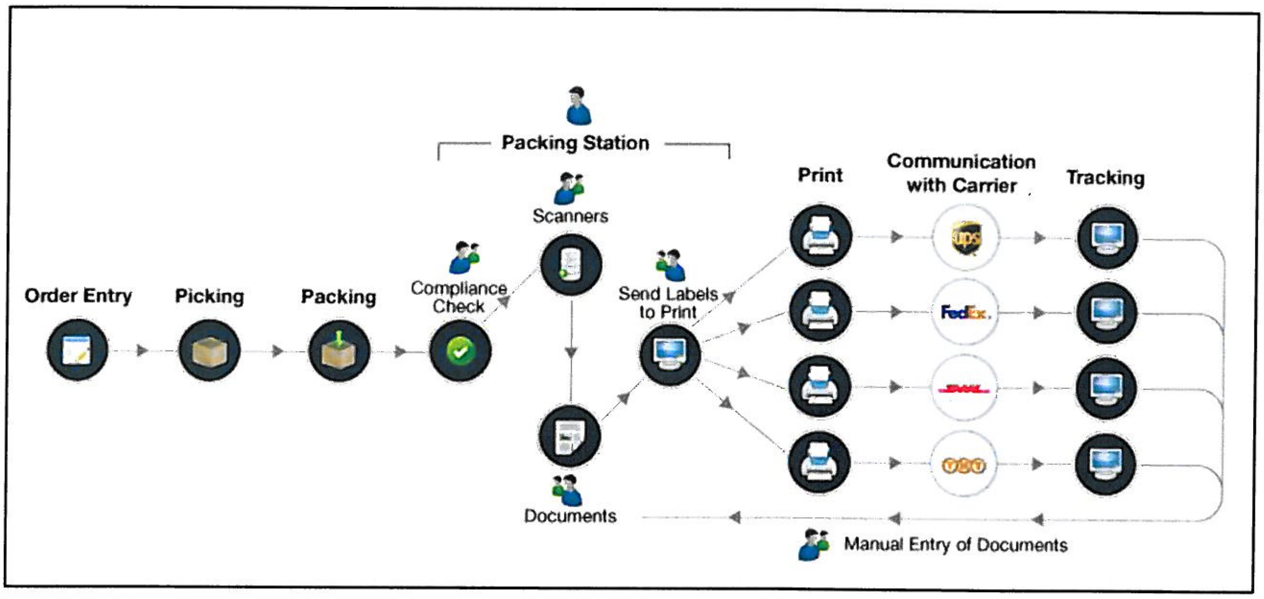


**Figure 3.3:** How the document is save

### 3.3.3 Other Resources

The other resources are will be find in the internet, paper or book that report the way of shipping line. The annual report of that company also can be used for data collection.

## 3.4 SIMULATION MODEL

Simulation models consist of the following components: system entities, input variables, performance measures, and functional relationships. Figure is a schematic of a simulation study. The iterative nature of the process is indicated by the system under study becoming the altered system which then becomes the system under study and the cycle repeats. In a simulation study, human decision making is required at all stages, namely, model development, experiment design, output analysis, conclusion formulation, and making decisions to alter the system under study (Anu Maria, 1997).

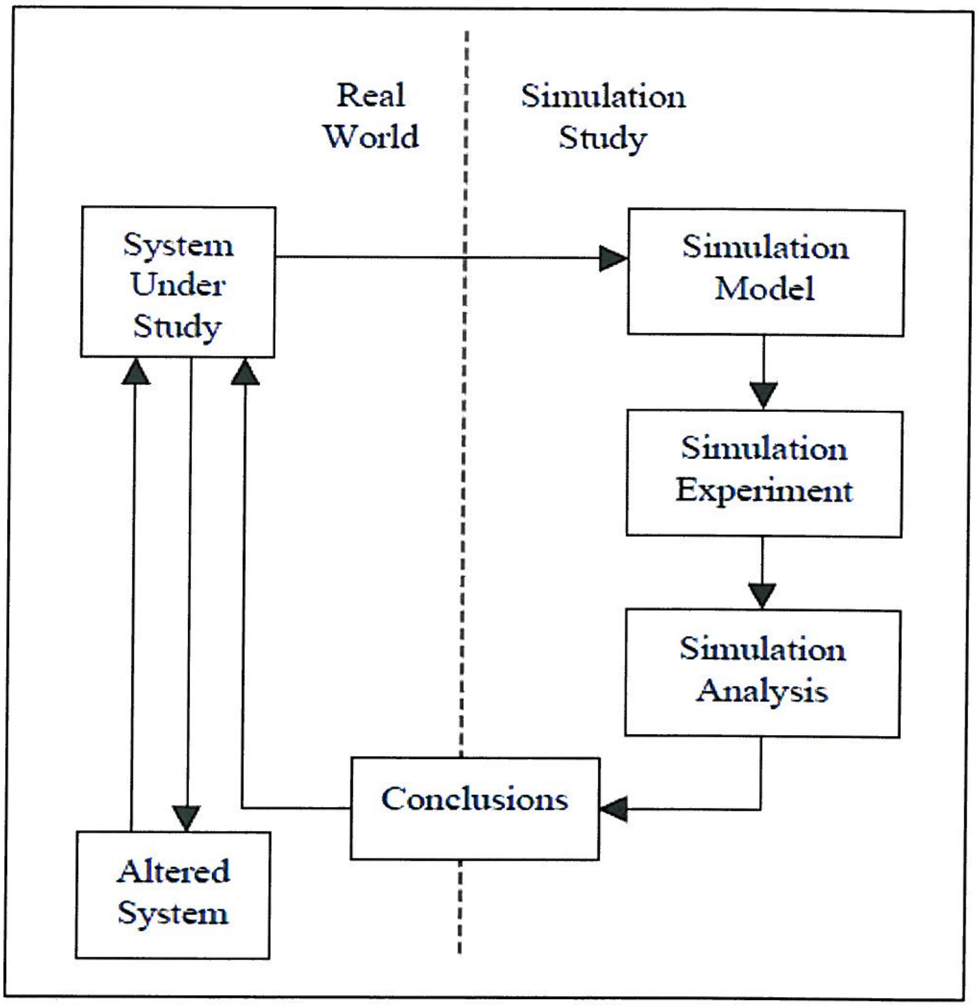


**Figure 3.4:** Example of Simulation Steps

Modeling is arguably the most important part of a simulation study. Indeed, a simulation study is as good as the simulation model like the figure of 3.4. Simulation modeling comprises the following steps:

Step 1: Identify the problem. It is to find the problem that relate to the shipping line such as idle time problem.

Step 2: Formulate the problem. The problem needs to make objective and find criteria of problem.

Step 3: Collect and process real system data. The data collection is will be got at the company and annual report.

Step 4: Formulate and develop a model. Make some flow of shipping line that such a real flow.

Step 5: Validate the model. The model that we develop must be compare with the real model to make the model performance like the real one.

Step 6: Document model for future use. Document the objective and assumption also the input by the new model that we develop after the run of model.

Step 7: Select appropriate experimental design. Find the influence input variables that can be measure.

Step 8: Establish experimental conditions for runs. Stimulate the experiment with the question of obtaining information.

Step 9: Perform simulation runs.

Step 10: Interpret and present results. Compute the numerical estimates for the performance measure for each step.

Step 11: Recommend further course of action. The performance is increasing or the sensitivity that relate with the old model.

***The Advantage of Simulation Model***

Simulation is aims to explicate the mechanisms of social processes and so perhaps could be Calles process-centered analysis. One of the primary advantages of simulators is that they are able to provide users with practical feedback when designing real world systems. This allows the designer to determine the correctness and efficiency of a design before the system is actually constructed. Consequently, the user may explore the merits of alternative designs without actually physically building the systems. Another benefit of simulators is that they permit system designers to study a problem at several different levels of abstraction. By approaching a system at a higher level of abstraction, the designer is better able to understand the behaviors and interactions of all the high level components within the system and is therefore better equipped to counteract the complexity of the overall system. This complexity may simply overwhelm the designer if the problem had been approached from a lower level. As the designer better understands the operation of the higher level components through the use of the simulator, the lower level components may then be designed and subsequently simulated for verification and performance evaluation. Thirdly, simulators can be used as an effective means for teaching or demonstrating concepts to students. This is particularly true of simulators that make intelligent use of computer graphics and animation. Such simulators dynamically show the behavior and relationship of all the simulated system's components, thereby providing the user with a meaningful understanding of the system's nature (Donald Craig, 1996).

First, participants in a simulation are able to learn through performing an action in order to get to a certain outcome. Next, the mistakes participants make in a simulation, no matter if it's a case study or a complex flight simulator, are truly learning experiences. The simulation environment also provides the benefit of consistent, constant, and immediate feedback. The benefits and advantages of using simulations cover not only participants, but also moderators, the training organization, and the organization as a whole (Bryant Nielson, 2011)

***The Disadvantage of Simulation Model***

Notwithstanding the preferences of simulation introduced above, test systems, in the same way as most apparatuses, do have their downsides. A number of these issues can be credited to the computationally escalated preparing needed by a few test systems. The deferrals may be because of an exceedingly extensive number of elements being mimicked or because of the complex cooperation's that happen between the substances inside the framework being reenacted. One of the methods for battling the previously stated unpredictability is to bring rearranging suppositions or heuristics into the test system motor. While this procedure can drastically decrease the recreation time, it might likewise provide for its clients an incorrect feeling that all is well with the world in regards to the exactness of the reproduction results. An alternate method for managing the computational multifaceted nature is to utilize the progressive methodology to plan and reproduction in order to allow the architect to work at a larger amount of outline. On the other hand, this strategy may present it issues too. By working at excessively high a deliberation level, the fashioner may have a tendency to distort or even overlook a portion of the lower level subtle elements of the framework (Donald Craig, 1996).

If the data entered into the model or simulations are inaccurate, the results will also be inaccurate. Running a simulation in a controlled environment is never the same as the real world. There are always additional factors that can affect the outcome.

## 3.5 ARENA

Simulation is a standout among the most effective investigation instruments accessible to those in charge of the configuration and operation of complex procedures or frameworks. In an inexorably focused world, reproduction has turned into an influential instrument for the arranging, outline, and control of frameworks. It is no more viewed as the methodology of it is today seen as a vital critical thinking strategy for engineer, architects, and administrators.

This article introduces some critical peculiarities of the ARENA 3.0 product. This would help the learner to comprehend the fundamental ideas essential for building a straightforward model. This thus could give a springboard to developing complex genuine models (Amar Balachandran, 2000)

A piece graph is a stream diagram delineating the methodology through which the elements in the framework move. The piece graph is developed as an issue of obstructs, the shapes and names of which show their general capacity. The exploratory segment of the system comprises of components which, are tagged intuitively in the Arena demonstrating environment (Leila C. Rabuya, 2000)

**BLOCKS**: The following segment depicts in a word the distinctive pieces utilized by the simulation group.

**CREATE:** It is one of the few instruments by which an element (item) can enter into the model. It is normally used to model landing methods in which elements consecutively enter the model as indicated by a defined example.

**QUEUE:** It gives holding up space to the substances whose developments through the model have been suspended focused around the framework's status.

**SEIZE:** It is utilized as a part of conjunction with the line square and is utilized to model the status delays.

**DELAY:** Once an element has been assigned the vital assets, it ordinarily takes part in time intensive exercises, for example, setup, machining, investigation and so on

**RELEASE:** At the point when an action that obliges assets has been finished, the substance having the assets ordinarily discharges them so they can be apportioned to elements either at present holding up or yet to touch base at QUEUE-SEIZE pieces.

**COUNT:** It is utilized to number the quantity of events of some occasion, example work-pieces entering the framework, leaving the framework or sent through revamp.

**DISPOSE:** It gives a system to displaying the takeoff of substances from the framework.

**GROUP:** It is usually used to gathering a set of substances having specific set qualities.

**SPLIT:** Whenever properties and variables are utilized as a part of a model they have to be doled out qualities amid model execution.

**ASSIGN:** Whenever characteristics and variables are utilized as a part of a model they have to be relegated qualities amid model execution.

**BRANCH:** This is utilized to coordinate the elements to distinctive areas of the model relying on the state of genuine or false.

Models investigate the same methodology to information handling and presentation: utilize the same format record and a joint information base, and in addition the same methodology to inputting information into a model and exhibiting reproduction results. Construction modeling of the reproduction framework, that fuses these segments, is introduced on Figure. 3.5.

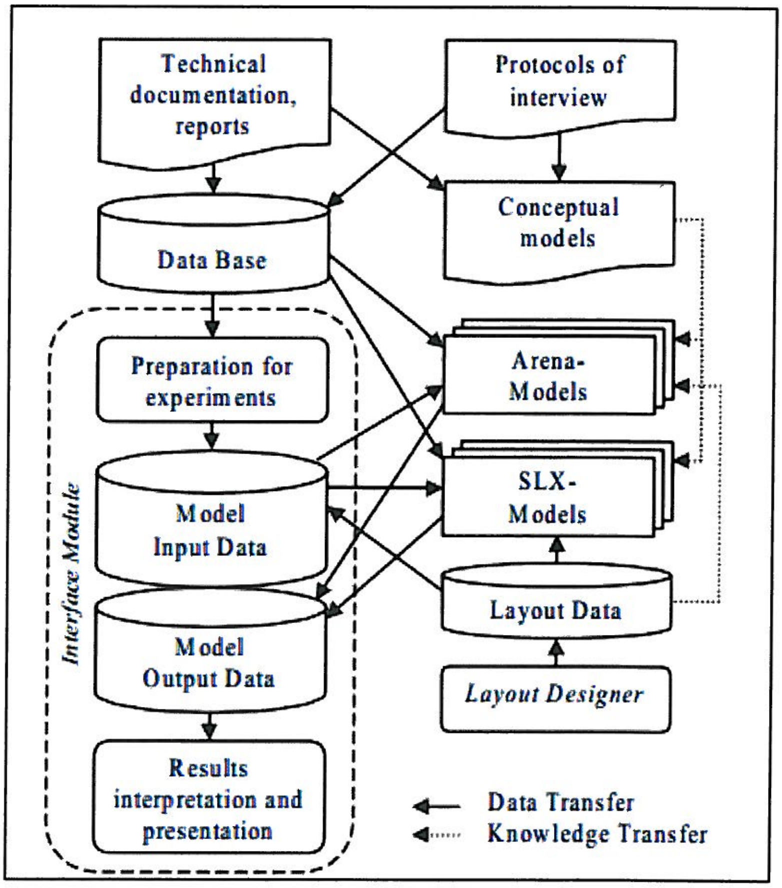


**Figure 3.5:** Steps of Arena

This is example of using simulation ARENA on figure 3.6;

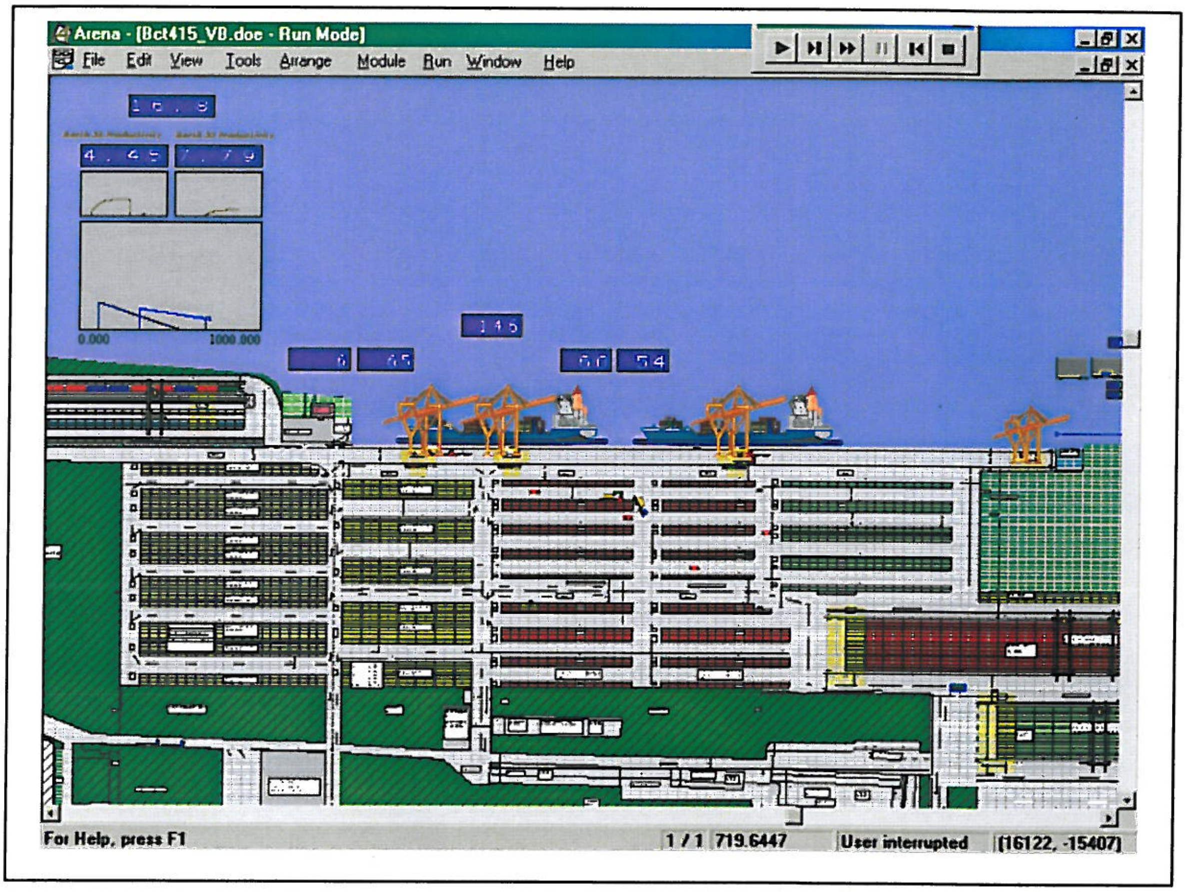


**Figure 3.6:** Animation view of the shipping simulation model

From the problem of shipping line, weather is also main problem that relate with the added of idle time. Because shipping is the unique transportation, so weather also main problem that need to be solved. From the arena, this is the table that relate with weather like on figure 3.7;

| External situation | Discrete factors | | | | | Continuous factors | | | Productivity coefficients | | | | | Throughput (cont/h) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | It's raining | It's snowing | Cowered with snow | It's icy | Thunderstorm | Wind | Temp. outside | Visibility | Q-Crane | Y-Crane | R-Crane | Forklift | Trailer | 20' Import | 20' Export | 40' Import | 40' Export |
| | | | | | | m/sec | °C | m | *k1* | *k2* | *k3* | *k4* | *k5* | | | | |
| 1 | No | No | No | No | No | 5 | 20 | 1000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 17.11 | 10.40 | 13.35 | 7.28 |
| 2 | **Yes** | No | No | No | No | 20 | 14 | 500 | 0.90 | 0.95 | 0.95 | 0.90 | 0.85 | 15.66 | 9.88 | 12.15 | 6.58 |
| 3 | No | **Yes** | No | No | No | 5 | -5 | 200 | 0.80 | 0.70 | 0.70 | 0.80 | 0.70 | 14.02 | 7.72 | 10.90 | 5.84 |
| 4 | No | No | **Yes** | No | No | 5 | -5 | 1000 | 1.00 | 0.90 | 0.90 | 0.80 | 0.80 | 17.04 | 9.42 | 10.93 | 5.99 |
| 5 | No | No | No | **Yes** | No | 5 | -5 | 1000 | 1.00 | 0.90 | 0.90 | 0.60 | 0.50 | 16.91 | 8.66 | 8.36 | 4.46 |
| 6 | **Yes** | No | **Yes** | No | No | 5 | 0 | 500 | 0.90 | 0.90 | 0.90 | 0.80 | 0.70 | 15.70 | 9.24 | 10.95 | 5.86 |
| 7 | No | **Yes** | **Yes** | No | No | 5 | -5 | 200 | 0.80 | 0.70 | 0.70 | 0.70 | 0.70 | 13.98 | 7.69 | 9.64 | 5.28 |
| 8 | **Yes** | No | No | **Yes** | No | 5 | 0 | 500 | 0.90 | 0.90 | 0.90 | 0.60 | 0.40 | 15.59 | 8.19 | 8.38 | 4.27 |
| 9 | No | **Yes** | No | **Yes** | No | 5 | -5 | 200 | 0.80 | 0.70 | 0.70 | 0.50 | 0.40 | 13.85 | 6.98 | 7.08 | 3.73 |
| 10 | No | No | No | No | **Yes** | 5 | 15 | 500 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 0 | 0 | 0 | 0 |

**Figure 3.7:** The weather that that solved by ARENA simulation

## 3.6 SUMMARY

This chapter contains how shipping line will reduce the idle time by using simulation model of ARENA software. This chapter also details the problem statement to make the problem more clear and show the procedure of simulation. It is also make some introduction of ARENA software and how to use it by using the keyword.

# CHAPTER 4

# RESULT AND DISSCUSSION

## 4.1 INTRODUCTION

The purpose of this study is to minimize the idle time at the shipping transportation. This chapter represents an analysis of all data collected from the procedure of export and import shipment, and also about the tariff and bill of lading. In the research at the company, the company gives the normal procedure for export and import shipment (BMMY) via Kamigumi that is import and import only for Japan. Besides, this chapter also discussed about the suitable data collection method in this research. The findings presented in this chapter are based on the main instrument that is software called Arena. Arena is considered significant in this study. The data will be presented and discussed in connection to the research question that has been made in chapter 1.

The basic model of the process will be developed in this chapter. After evaluating the system, experiments will be implemented to optimize the system performance or can be new correction for the system. Changes will be made to the basic model like adding department or process, alter the operator working plan and layout of the system to improve resource utilization and system efficiency with the time. Result obtained from experiments will be analyzed and explained when every single changes made to the model. At the end of the chapter, the validity and reliability of the data collection will testing and analyze to ensure the correct process have been developed properly.

## 4.2 MODEL DEVELOPMENT AND INPUT ANALYSIS

### 4.2.1 Model Development

In this study, the model was developing on the normal procedure for export and import shipment flow chart that will affect the flow throughout. In the flow chart is all about Bill of lading (B/L), Container Movement Order (CMO), K1 and K2 form, Invoice (INV) and many more procedure that related with all documents of shipments. Model development for export has 22 processes that cooperate within BMMY, Kamigumi Malaysia, Forwarding Agent, Hauler and carrier with 27 maximum flow times. In the import also have same cooperation like export but less process that is only 16 processes with 27 days maximum flow times. The model is based on real flow chart that have been given by the forwarding company and then need to transfer into the Arena Software to create the result that relate the main objective that is idle time and elements in shipping transportation. The model was constructing by using modeling shapes called as modules from the Basic Process penal, then parameterized by associated dialog boxes. The model was constructing by using modeling shapes called as modules from the Basic Process penal, then parameterized by associated dialog boxes. One CREATES like figure 4.1 and 4.2, three DECIDE, fourteen PROCESSES and four DISPOSE modules are selected for the model.

The CREATE modules in Arena is the module which giving an instruction of create part to start the process. CREATE is used as the start of process flow and entities enter the simulation. The entity in Arena is the object that flow through the system and the object in this study is log. CREATE module is the source of arriving log into the system. In this study, the create module is name as Log Arrive. The time between arrivals is Random with a value (mean) of 0.5 and the units are set to hours. It can be simply say as each log were enters the process every half hours randomly until the process is stop running.

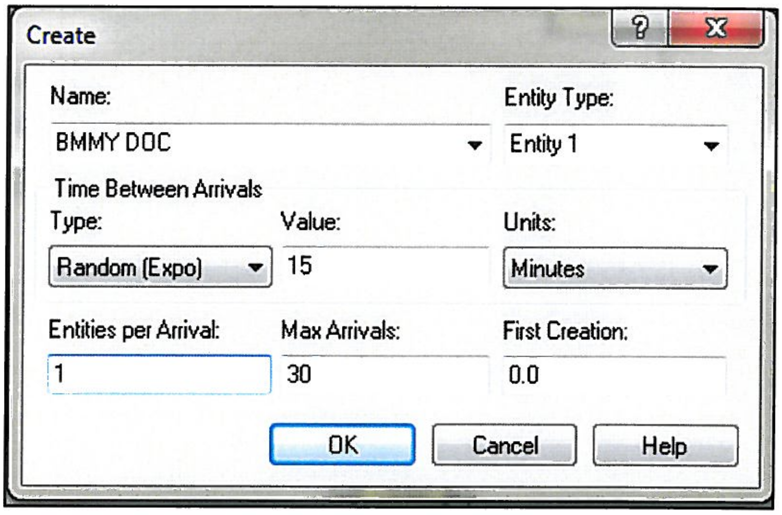


**Figure 4.1**: Create Module for Export

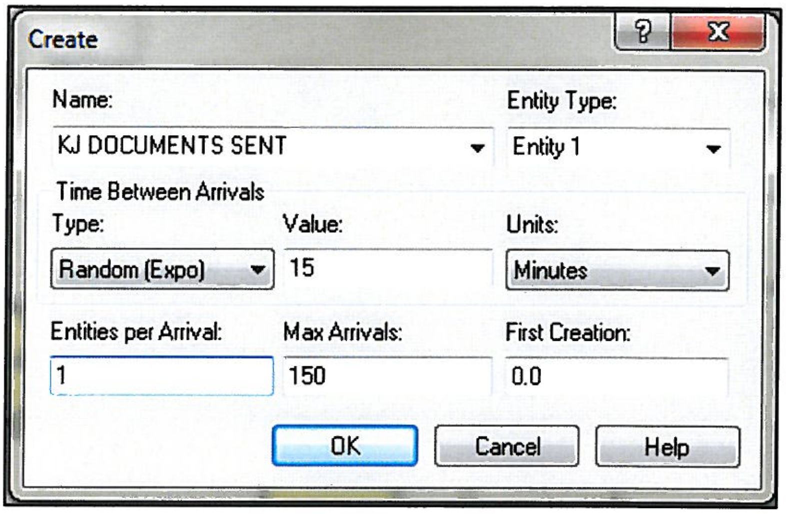


**Figure 4.2**: Create Module for Import

DECIDE in figure 4.3 module is make decisions about where to go next based on condition and chance. In this study, the decide module is known as Transfer based on 2-way by Chance with 50% of true and 50% of false. In the procedure for export that have no decide, but in import have the decide condition.

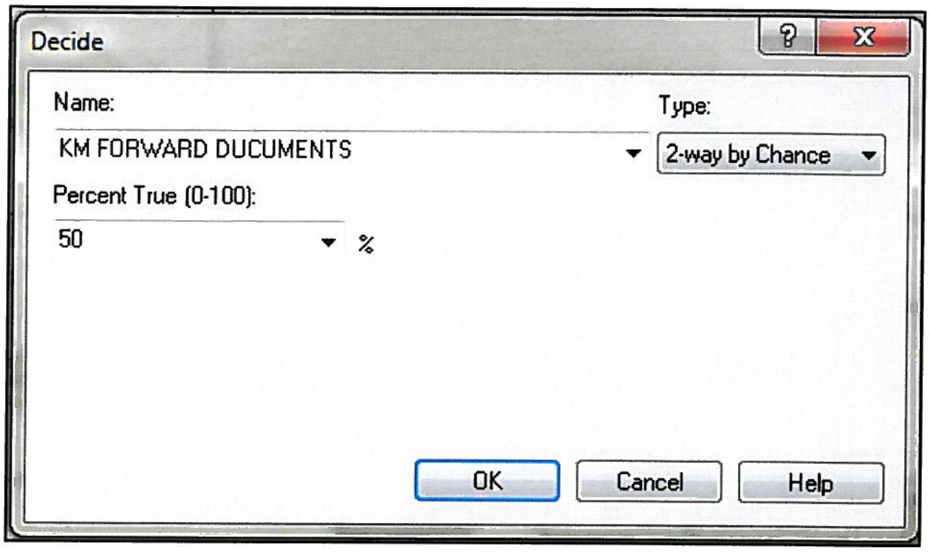


**Figure 4.3**: Decide Module for Import

The PROCESS in figure 4.4 modules is the models of queue-seize-delay-release of resources, or any part of this. Process is the important part in the model flow chat to see the process from the perspective of the entity. During the simulation run, each time an entity enters the process, Arena will calculate a sample from the distribution information that provide from the input analysis. In this study, all of the process is set as triangular. The time taken of each part or station is between minimum, value and maximum for every time the process run. The more detail of the probability distribution can be seen in the input analysis below. Value is the time taken to complete the process for each station of the flow and the unit is set in hours.

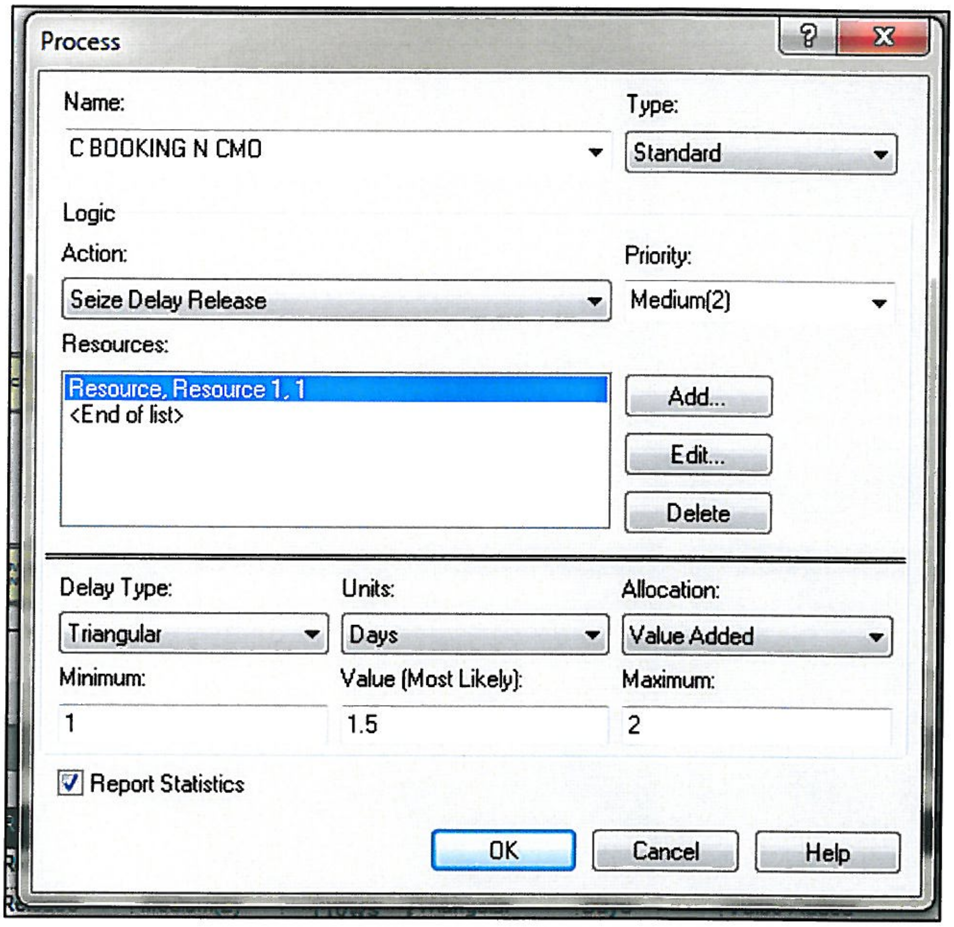


**Figure 4.4**: Process Module

A DISPOSE in figure 4.5 module in the model is take entities out of the model and record statistics. DISPOSE is the end of process flow and entities are removed from the simulation. After the grading and coding process the logs are store in to the warehouse, waiting for shipping to customer.

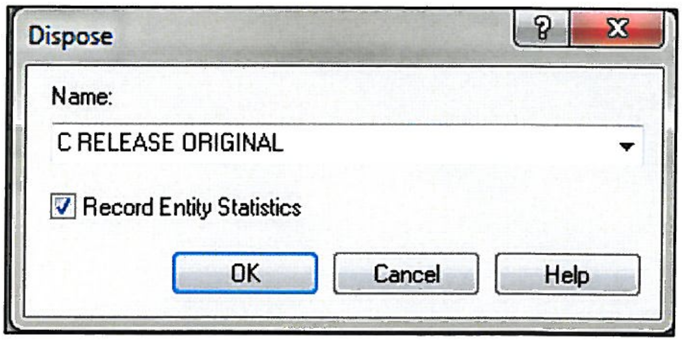


**Figure 4.5**: Dispose Module

The Queue in figure 4.6 is used to calculate the waiting time of the entity in each station. The maximum duration to animate queue arrival of every station of process is set as 15 minutes for export and import is same. Variable is used to show the number of the entity going in or going out from each station.

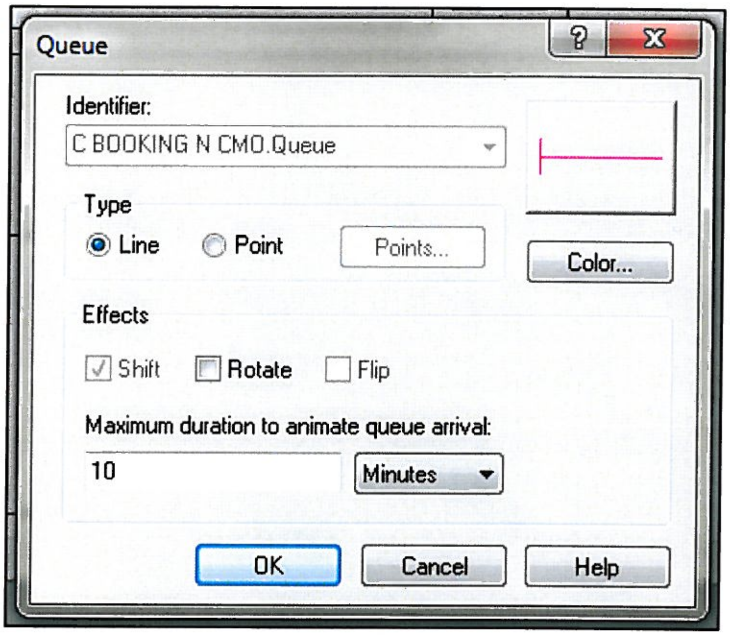


**Figure 4.6**: Queue module

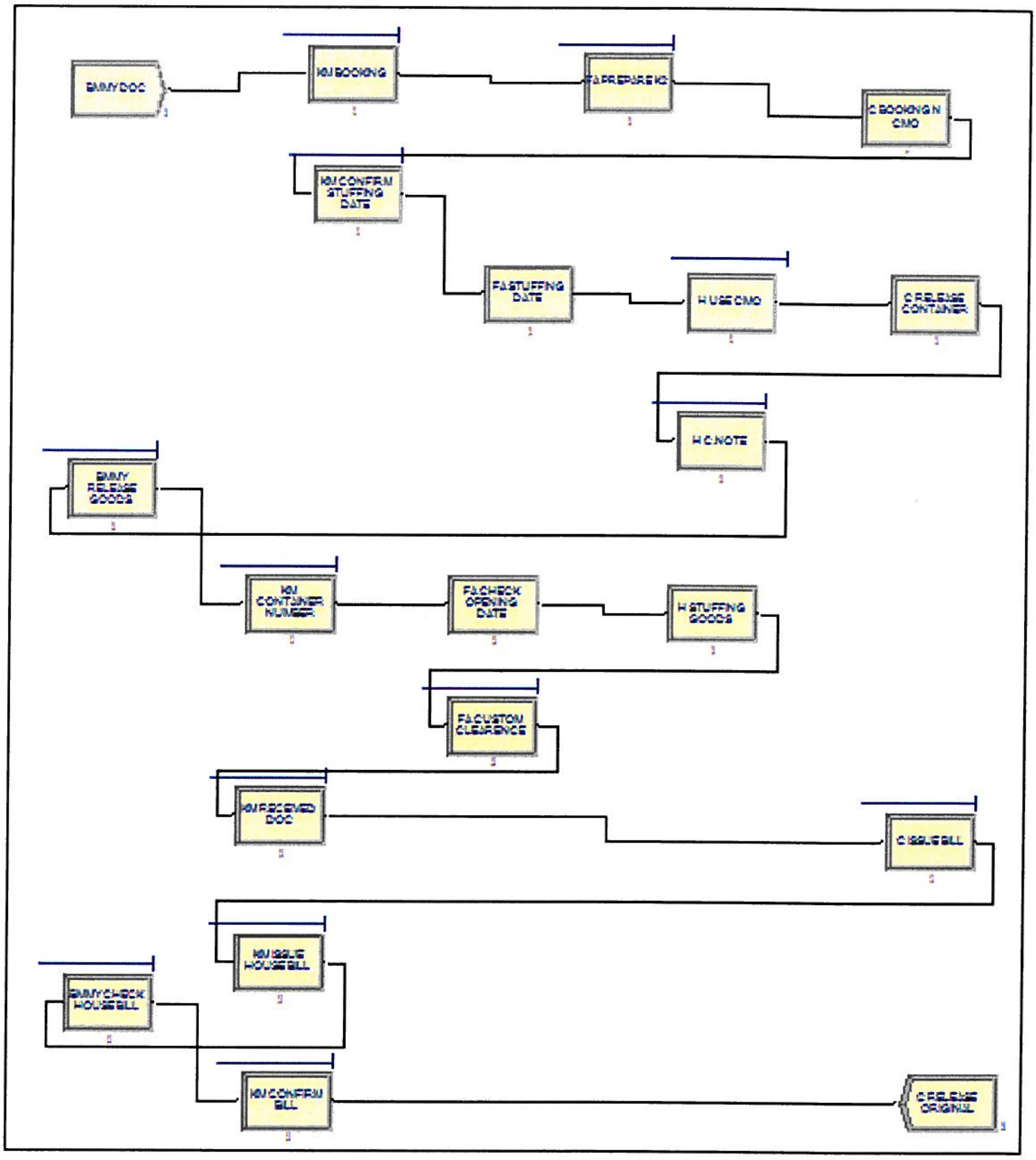


**Figure 4.7**: Normal Procedure for Export Shipment (BMMY) via Kamigumi

In the Normal Procedure for Export Shipment (BMMY) via Kamigumi like in figure 4.7 and also can refer on appendix B1 have 5 parts that take part the shipments flow that is BMMY, Kamigumi Malaysia, Forwarding Agent, Haulier and Carrier. First step is about BMMY need to stuffing and instruction documents send via Emails to Kamigumi Malaysia then at the same day, Kamigumi need to make booking to the carrier is step number two.

Step number three is forwarding agent need to receive clearance instruction and to prepare K2 form. While step number fourth still from Kamigumi need to send to Carrier, then Carrier need to reply booking and Container Movement Order (CMO) to Kamigumi by email. Then step fifth is received booking from carrier, confirm stuffing date to BMMY by email and step sixth is advice stuffing to Kamigumi. Then form step fifth also to step seventh that is 2 days before stuffing date, prepare request for delivery and email to haulier with CMO for booking the truck.

Step eight is one day before stuffing date, driver will use the CMO together with their Consignment Note (C.Note) to pick up empty container form nominated depot. Then step nine is carrier need to release empty container and seal by depot to driver through confirming the CMO and C.Note, depot will update container to port system. Step ten is by haulier that on the stuffing date, driver will bring the C.Note to BMMY for stuffing goods.

Then at the step eleven is from haulier to BMMY that release goods to driver according to the C.note. After that in step twelve is must get the container number and seal number from BMMY according to the cargo stuffing the in step thirteen is forwarding must check the port opening date prior to enter terminal. Then in step forth teen, after stuffing the goods by BMMY, driver will return the full container to terminal and the operation update seal number to port system after that in step five teen forwarding make the custom clearance to customs by submission.

In step six teen is at BMMY that at date stuffing date or next day, provide invoice and Packing List (P/L) to Kamigumi to provide B/L. in step seven teen is after received the documents from BMMY, prepare the B/L details to carrier. The cargoes detailed should follow the invoice, P/L, Shipping instruction to finalize. Step eight teen is issue the B/L draft, through details provided by Kamigumi, after that email to Kamigumi to check. Step nine teen is on or before Estimation Time to Delivery (ETD), received B/L draft from carrier, then issue Kamigumi House Bill of Lading (H.B/L) and email factory to confirm. H.B/L cargoes details follow invoice, P/L, shipper and consignee follow On Board (O/B) table.

Step twenty is check the H.B/L draft, confirm if okay, otherwise advise Kamigumi to do revision. Then step twenty one is after confirming the B/L draft, arrange a staff to pick up the original seaway B/L with original dock receipt and receipts from carrier. At the same time, send shipping advice to destination agent with Master

Bill of Lading (M.B/L) and H.B/L copy. Last point in export procedure is step twenty two is release original B/L to Kamigumi.

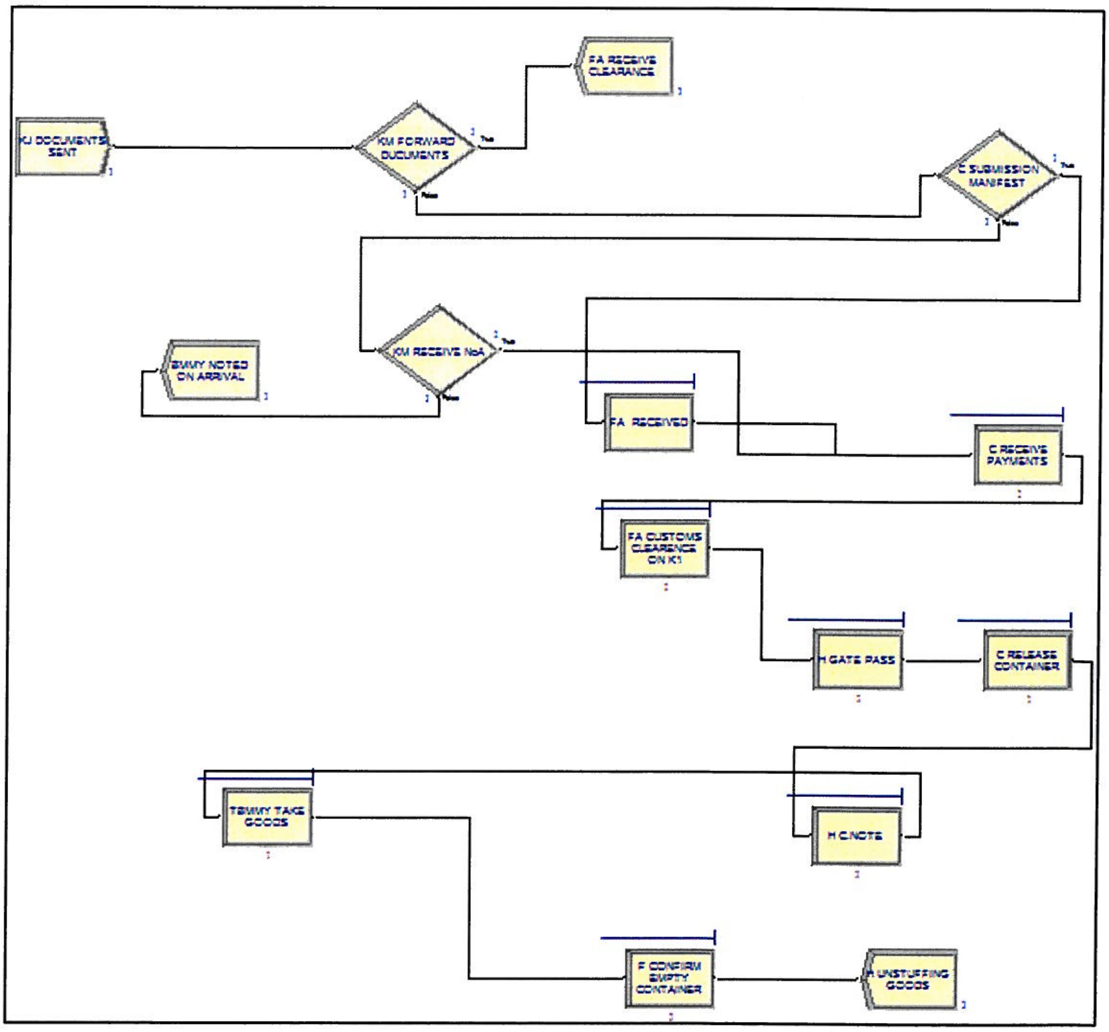


**Figure 4.8:** Normal Procedures for Import Shipment (BMMY) via Kamigumi

In the Normal Procedure for Import Shipment (BMMY) via Kamigumi at figure 4.8 and also at appendix B2 have 6 parts that take part the shipments flow that is Kamigumi Japan, BMMY, Kamigumi Malaysia, Forwarding Agent, Haulier and Carrier. First step start from Kamigumi Japan that sent documents of Invoice and P/L and B/L to Kamigumi Malaysia in step two that need to forward the related documents to appointed agent and request for manifest and NoA. Step three is forwarding agent receive clearance instruction and related documents, and prepare K1 form.

Then step four is carrier needs to make submission manifest to port operator and forward NoA, after that in step five is Kamigumi Malaysia is received NoA and notify BMMY on Estimated Time to Arrival (ETA) and ask for un-stuffing date, request liner to release Electronic Delivery Order (E-Do) by exchanging B/L. Step six is BMMY noted on arrival vessel and advise the un-stuffing date, while in step seven is forwarding agent received NoA form carrier and make local change to carrier. Then in step eight is carrier received payment and Letter of Authorization (LoA) to release does, approve to release e-Do.

Step nine is forwarding agent need to customs clearance on K1 and print port gate pass then submit Request for Delivery (RFD) to haulier. Then step ten is haulier need to un-stuffing done day before date, driver will use the gate pass, copy approved K1 to pick up laden container from port terminal. Then in step eleven that from haulier to carrier is carrier need to release container and Equipment Interchange Receipt (EIR) by port terminal to driver. Then from carrier to haulier back is step number twelve that is on the un-stuffing date, driver will bring the C.Note to BMMY for stuffing goods.

Step thirteen is BMMY need to take goods and K1 copy from driver according the C.note then send to forwarding agent as a step number fourteen that forwarding must confirm the designated empty container return to depot. Last point is on haulier that is after un-stuffing the goods, driver will drive back to return the empty container to designated depot.

### 4.2.2 Input Analysis

The model parameters and distribution is one of the most important parts in the model development. To have a solidity model, it must be well analyses on the structural modeling and the quantitative modeling to get the logical output and result.

Structural modeling is the flow chat of the model which built based of the real process system. The structure is constructing in the Arena software according the logic aspect. The model is emphasis on the part, variable, resources and so on. The logical structure will come out with logic result.

Quantitative modeling is more on the numerical and distribution specification, where the data is put in the software to contribute for developed model. It is almost like the structural modeling which needs to observe shipping flow operation, but it is better if the data is possible to be taken in the model. The logical and accurate output will best fit with the model when it has the number of units of resources, entity of Estimation Date of Arrival for export, Estimation Time Arrival for import shipping and processing time which taken from the real process.

In this study, variability of machine cycle time is recorded in a table 4.1 when the observation is conducted within 2 weeks until 27 days maximum for export and for import is 9 days or less. The cycle time is taken start from the documents sent but the time taken is not constant because of delaying and the error of Bill of Lading or tariff also invoice.

In this study, the workers work for one shift a day. Their working hours are 8 hours within 1 hour of rest. The working days are 5 days/week. 10 of replication are set in the Run Setup on figure 4.9 for export and import to obtain an accurate estimate of the average performance. By putting in the actual working hours and days, this will complete the chart flow of the normal procedure for export/import shipment process in Arena simulation software same with the real system.

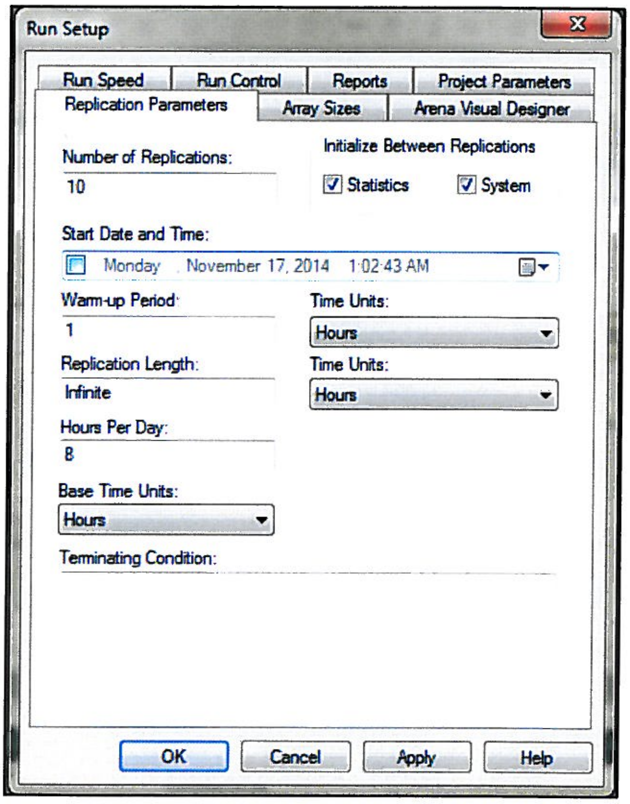


**Figure 4.9:** Run Setup for Export and Import

## 4.3 DATA VERIFICATION AND VALIDATION

Verification and validation are the process to ensure the reliability of model built and simulation. To see whether the results is match with the real system.

David A.cook and James M. Skinner (2005) in an article how to Perform Credible Verification, Validation and accreditation for modeling and Simulation is to ensure that a valid model and a credible simulation exist, verification and validation of the model and the resulting simulation must be completed. D.K.Pace (2004) in an article Modeling and Simulation Verification and Validation Challenge define verification as "Did I build the thing right?" to determine the model and simulation been built are satisfy and indicated in specification or not. However, validation is define as "Did I build the right thing?" The model or simulation is able to support the intended use.

Verification can divide in two aspects which are design and implementation. In the aspect of design it consist all the specification and nothing else are included in the model or simulation design. However in the aspect of implementation it included all the specifications and nothing else are included in the model or simulation as built. To verify the model built in this study, all of the specification setup in the model is same with the process happened in the real normal procedure for export/import shipment process. The flow chat in the model is design same as actual normal procedure for export/import shipment process flow in real system. Furthermore, the time put in, the number of resources and the arrangement of the station which design in the model are same as in real life, to ensure that the computer program of the computerized model of Arena and its implementation are correct.

Validation also can divide in two aspects which are conceptual validation and results validation. Conceptual validation happen when the anticipated fidelity of the model or simulation conceptual model is assessed. In the other hand, results validation is happen when the result from the implemented model or simulation are compared with an appropriate referent to demonstrate that the model or simulation can fact support the intended use. In this study simulation, 10 of replications are set in the replication parameters in Run Setup, and then the averages of the output were recorded. The results of output were compared with the output of the real normal procedure for export/import shipment. To prove the validation of the model, the differences between the actual normal procedure for export/import shipment output and the simulation.

# 4.4 DATA ANALYSIS

## 4.4.1 Introduction

The statistic result that shows in Arena Simulation Result will be collected for analyzing purposes. The statistic result that collected in this study is average waiting time, average queue waiting time, cycle time, and resource utilization those aspect are under the performance measurement and these analyses will be carried on the next, in the result discussion and scenario that have been made in Arena for Normal Procedure for Export/Import Shipment.

## 4.4.2 Result of Simulation for Export

### 4.4.2.1 Categories by Replication

In the categories by replication like in figure 4.10 of the normal procedure for import is has 10 replication for find the accurate and transparency of the results.

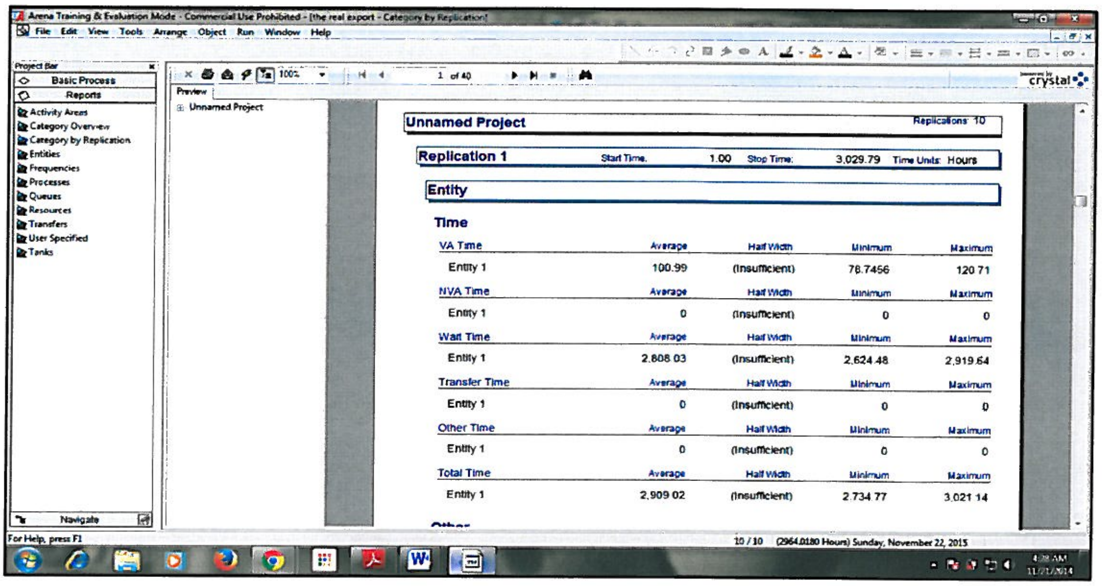


**Figure 4.10**: Replication 1

Entity is Determines whether or not the incoming entity's statistics will be recorded. Statistics include value-added time, non-value-added time, wait time, transfer time, other time, total time, value-added cost, non-value added cost, wait cost, transfer cost, other cost, and total cost. The calculation will display on 4.1 , 4.2 and 4.3 for the export of replication and the time consuming.

TIME;

**Table 4.1:** Categories of Replications 1 for Export

| | AVERAGE | HALF WIDTH | MINIMUM | MAXIMUM |
|---|---|---|---|---|
| VA Time | 100.99 | Insufficient | 78.7456 | 120.71 |
| NVA Time | 0 | Insufficient | 0 | 0 |
| Wait Time | 2808.03 | Insufficient | 2624.48 | 2919.62 |
| Transfer time | 0 | Insufficient | 0 | 0 |
| Other Time | 0 | Insufficient | 0 | 0 |
| Total Time | 2909.02 | Insufficient | 2734.77 | 3021.14 |

VA Time: Value-added Time

NVA Time: Non-Value added Time

#### 4.4.2.2 Queue Time

**Table 4.2**: Waiting Time for Export

| Waiting Time | Average | Half Width | Minimum | Maximum |
|---|---|---|---|---|
| BMMY check house bill | 172.38 | Insufficient | 142.99 | 177.49 |
| BMMY release good | 97.7389 | Insufficient | 95.2604 | 105.99 |
| C booking and CMO | 268.75 | Insufficient | 196.50 | 285.61 |
| C issue Bill | 93.1556 | Insufficient | 90.7523 | 96.0647 |
| C release container | 134.19 | Insufficient | 129.86 | 200.01 |
| FA check Opening date | 98.5297 | Insufficient | 95.9498 | 101.37 |

| | | | | |
|---|---|---|---|---|
| FA custom clearance | 96.4472 | Insufficient | 94.7058 | 98.8727 |
| FA prepare k2 | 194.79 | Insufficient | 90.5871 | 252.15 |
| FA stuffing goods | 310.45 | Insufficient | 260.04 | 378/23 |
| H use c.note | 110.52 | Insufficient | 95.8141 | 131.71 |
| H use stuffing goods | 95.4842 | Insufficient | 93.1998 | 97.1438 |
| H use CMO | 210.03 | Insufficient | 131.71 | 293.62 |
| KM booking | 75.5912 | Insufficient | 3.9922 | 147.37 |
| KM confirm BILL | 199.59 | Insufficient | 172.07 | 222.20 |
| KM confirm stuffing | 327.55 | Insufficient | 268.33 | 383.77 |
| KM container number | 98.0801 | Insufficient | 96.2867 | 100.39 |
| KM issue house of BILL | 131.43 | Insufficient | 91.9062 | 171.08 |
| KM received documents | 95.8342 | Insufficient | 94.0756 | 97.4591 |

**Table 4.3**: Number Waiting for Export

| **Number Waiting** | **Average** |
|---|---|
| BMMY check house bill | 1.71 |
| BMMY release good | 0.97 |
| C booking and CMO | 2.66 |
| C issue Bill | 0.92 |
| C release container | 1.33 |
| FA check Opening date | 0.98 |
| FA custom clearance | 0.96 |
| FA prepare k2 | 1.93 |
| FA stuffing goods | 3.08 |
| H use C.Note | 1.09 |
| H use stuffing goods | 0.95 |
| H use CMO | 2.08 |
| KM booking | 0.72 |
| KM confirm BILL | 1.98 |
| KM confirm stuffing | 3.24 |
| KM container number | 0.97 |

| | |
|---|---|
| KM issue house of BILL | 1.30 |
| KM received documents | 0.95 |

This data module may be utilized to change the ranking rule for a specified queue. The default ranking rule for all queues is First In, First Out unless otherwise specified in this module. There is an additional field that allows the queue to be defined as shared.

### 4.2.3 Result of Simulation for Import

#### 4.2.3.1 Categories by Replications

In the categories by replication of the normal procedure for import is has 10 replication for find the accurate and transparency of the results. Refers figure 4.11;

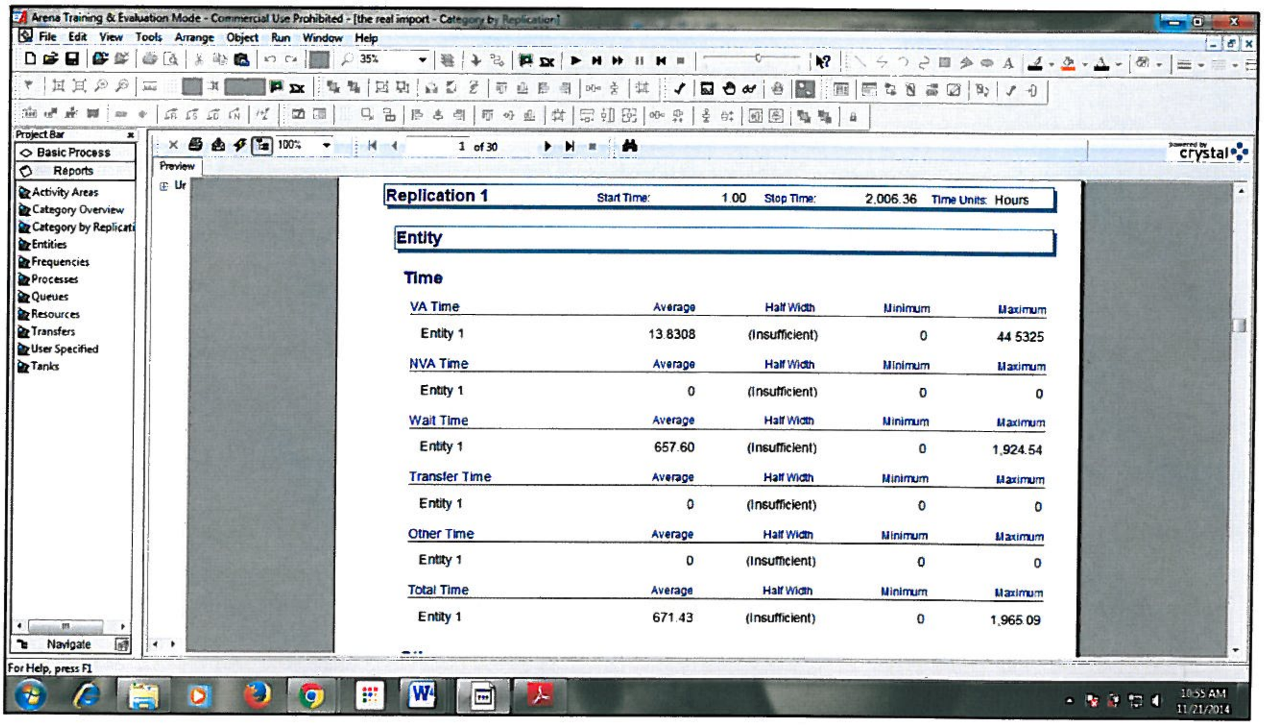


**Figure 4.11:** Replication 1 for Import

Entity is Determines whether or not the incoming entity's statistics will be recorded. Statistics include value-added time, non-value-added time, wait time, transfer time, other time, total time, value-added cost, non-value added cost, wait cost, transfer cost, other cost, and total cost. The calculation and data that have been calculate by arena is on table 4.4, 4.5 and 4.6.

TIME;

**Table 4.4:** Categories of Replications for Import

| | AVERAGE | HALF WIDTH | MINIMUM | MAXIMUM |
|---|---|---|---|---|
| VA Time | 13.8308 | Insufficient | 0 | 44.5325 |
| NVA Time | 0 | Insufficient | 0 | 0 |
| Wait Time | 657.60 | Insufficient | 0 | 1924.54 |
| Transfer time | 0 | Insufficient | 0 | 0 |
| Other Time | 0 | Insufficient | 0 | 0 |
| Total Time | 671.43 | Insufficient | 0 | 1965.09 |

**4.4.3.2 Queue Time**

**Table 4.5**: Waiting Time for Import

| Waiting Time | Average | Half Width | Minimum | Maximum |
|---|---|---|---|---|
| C receive payments | 231.73 | Insufficient | 3.2335 | 302.71 |
| C release container | 216.39 | Insufficient | 191.98 | 273.49 |
| F confirm empty container | 233.58 | Insufficient | 194.22 | 258.00 |
| F received | 151.56 | Insufficient | 7.6144 | 297.82 |
| F customs clearance | 264.75 | Insufficient | 44.1941 | 300.10 |
| H C.Note | 217.34 | Insufficient | 192.07 | 260.87 |
| H gate pass | 247.27 | Insufficient | 192.54 | 300.41 |
| BMMY take goods | 230.37 | Insufficient | 192.04 | 257.74 |

**Table 4.6**: Number Waiting for Import

| **Number Waiting** | **Average** |
|---|---|
| C receive payments | 6.2399 |
| C release container | 5.9349 |
| F confirm empty container | 6.4063 |
| F received | 2.6453 |
| F customs clearance | 7.2610 |
| H C.Note | 5.9608 |
| H gate pass | 6.7817 |
| BMMY take goods | 6.3183 |

## 4.5 EXPLANATION OF OUTCOME

In the assembly line at the Company Y, the workers can produce 30 arrival of normal procedure for export and for import are 150 with eight hour working period. After run the simulation test, it shows that so many waiting time that reduce time to complete one shipping line. In every replication show the higher waiting time and number of waiting that need to improve for increase the production of shipping company.

It is also about non-value added that is doesn't need in the simulation that need to be reduce for reducing cost. The increasing of the average of shipment that can be produce within 2 weeks minimum 27 days maximum will affect the number of shipment that the company can produce in a month.

## 4.6 SUMMARY

This results show that the productivity of the company will increase per month compare before run the simulation model at the assembly line to reduce the number of waiting time and the number of waiting also the value that does not important in the flow of shipping.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATION

## 5.1 INTRODUCTION

This chapter will be discuss on the conclusion for the overall of this thesis all about and the data analysis about the assembly line at the shipping Company whether the performance of the production line before and after run simulation test. Cycle time, waiting time and the efficiency of the assembly line also will be concluding in this chapter. The recommendation also will be given in this chapter as the alternatives for the company in improving the efficiency of the production line's performance.

Nowadays, the forwarding agent are had to compete each other in order fulfill the customers demand. Shipping flow lines are one of the most important parts in the shipping industry where the line balancing will give the big impact on the performance of the company.

The line balancing can be defined as the process of assigning the tasks to the workstation in such way so that the workstation will have approximately equal time requirement (Stevenson, 2002). The tasks at the workstation must fulfill the time requirement that had been set by the company. In other words, the workloads at each workstation must be same and the time needed for each workstation also equal. The different cycle time at each workstation will cause the waiting time increase. The most efficient assembly line is the assembly line that had the least amount of waiting time.

Assembly line balancing problem is already known more than 50 years ago. There are lots of methods and solutions are available in order to achieve the most optimize solutions for this problem. One of the methods that can be used to find the optimize solution had been used in this research, simulation model. All of these methods are very important for because these methods can help in the decisions making process.

## 5.2 RECOMMENDATIONS

The recommendation proposed in this section will be focusing on the improving the line efficiency and minimizing the cycle time at each workstation and minimizing the waiting time at the assembly line.

### 5.2.1 Changing the type of line design

There is various type of line layout that can be used in the assembly line. The company had implemented the layer flow layout. There are other types of the layer line layout that suitable for the company to implement for their assembly line in order to increase the efficiency of the production line. The example of the layer line layout that can be implementing is U-shaped assembly line. The implementation of this line layout can reduce the length of waiting time and increase the efficiency of the production line. The length of the waiting time can be decrease from the reducing of the movement of the workers at the assembly line.

However, the company needs to do some research or study first in order to determine whether the line layout is really suitable for their shipping company, suitable for the shipments process and It can overcome the any constraints that will give problems to the company such as space in the bill of lading, number of workers, difference company that will be use and so on. Before that, the company needs to run the analysis for the new layout efficiency, whether it is higher from the existing layout or lower. If the new layout is higher, the company should change the layer line layout.

### 5.2.2 Reducing number of workstation

A layer line with 20 workstations for export and 15 for import, it is a quiet long assembly line. The longest the line of the assembly line will increase the total production time. The movement of the product from one station to another station will take some time, in order to reduce the waiting time; the company can reduce the number workstation because every gap will take time that effect flow time chart.

However, the reducing of the number of workstation will affect the number of work tasks and the cycle time at each station, so the company needs to do some changes with the amount of work tasks at each station and needs to increase the number of workers at each station. If this change can decrease the waiting time and increase the performance of the production line, the company should apply it.

### 5.2.3 Effect elements that affect shipping line

In the objective at chapter 1 there has about elements of natural environment that affect shipping line such as weather. From the research of company, company will note take part of the shipping if have a delay or disaster within the shipment ship to another country but if have insurance it will cover only some part for the loss.

### 5.2.4 Effect bill of lading and classification of product

Bill of lading is the main part of shipping because it is like identification of container. If wrong of identification number, weight, number of container it will be confiscation that will make the higher waiting time/delayed. It is also make an idle time, so the bill of lading needs more departments to check before submit to customs officer for Malaysia. Classifications like in table 5.1 of product also have their own idle time like the dangerous product, the protection product will strictly check for pass the border and take more time to shipping, so it also take waiting time that affect procedure. There is tariff of classification;

**Table 5.1**: Tariff Classification

| | | |
|---|---|---|
| Section 01 | 01- 05. | Live animals ; animal products |

| | | |
|---|---|---|
| Section 02 | 06 - 14. | Vegetable products |
| Section 03 | 15 | Animal or vegetable fats and oils and their cleavage products; prepared edible fats ; animal or vegetable waxes |
| Section 04 | 16 - 24 | Prepared foodstuffs ; beverages, spirits and vinegar ; tobacco and manufactured tobacco substitutes |
| Section 05 | 25 - 27 | Mineral products |
| Section 06 | 28 - 38 | Products of the chemical or allied industries |
| Section 07 | 39 - 40 | Plastics and articles thereof ; rubber and articles thereof |
| Section 08 | 41 - 43 | Raw hides and skins, leather, fur skins and articles thereof ; saddler and harness ; travel goods, handbags and similar containers ; articles of animal gut (other than silkworm gut) |
| Section 09 | 44 - 46 | Wood and articles of wood ; wood charcoal ; cork and articles of cork ; manufactures of straw, of esparto or of other plaiting materials ; basket ware and wickerwork |
| Section 10 | 47 - 49 | Pulp of wood or of other fibrous cellulosic materials ; waste and scrap of paper or paperboard ; paper and paperboard and articles thereof |
| Section 11 | 50 - 63 | Textiles and textile articles |
| Section 12 | 64 - 67 | Footwear, headgear umbrellas, sun umbrellas, walking-sticks, seats tics, whips, riding-crops and parts thereof ; prepared feathers and articles made therewith ; artificial flowers ; articles of human hair |

| | | |
|---|---|---|
| Section 13 | 68 - 70 | Articles of stone, plaster, cement, asbestos, mica or similar materials ; ceramic products ; glass and glassware |
| Section 14 | 71 | Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof ; imitation jewelry ; coin |
| Section 15 | 72 - 83 | Base metals and articles of base metal |
| Section 16 | 84 - 85 | Machinery and mechanical appliances ; electrical equipment ; parts thereof ; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles |
| Section 17 | 86 - 89 | Vehicles, aircraft, vessels and associated transport equipment |
| Section 18 | 90 - 92 | Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus ; clocks and watches ; musical instruments ; parts and accessories thereof |
| Section 19 | 93 | Arms and ammunition ; parts and accessories thereof |
| Section 20 | 94 - 96 | Miscellaneous manufactured articles |
| Section 21 | 97 | Works of art, collectors' pieces, and antiques |

## 5.3 CONCLUSION

A good assembly line balance can lead to the increasing of the company's performance. In this company, in order to increase the efficiency of the assembly line, the company had reduced the number of the workstations.

Originally, the assembly line for normal procedure for export/import shipment at the shipping Company had 20 for export and 15 for import workstations, after doing the research, the company decide to convert one of the workstation and made as the storage station, this action considered as successful because this action had reduce the waiting time for this assembly line. The company also move the tasks from the workstation that had been converted to another workstation equally in order to make the cycle time at each workstations almost same. However this is not the optimum performance for this assembly line, there still alteration that can be made to reduce the waiting time.

Waiting time and the output from the simulation model that had been designed shows that an improvement from the real situation. From the real situation, it is obviously show that the workstations that have short cycle time at the early stage of the assembly process. The number of waiting parts is high at the Workstation 12 for export and number 2 for import.

Simulation model has been developed with the purpose to manage the assembly line balancing at the manufacturing system. This model also decreases the length of the waiting time at the assembly line under study. The research and the simulation model had improved the efficiency of the assembly line.

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## APPENDIX A1

## GANTT CHART PROJECT FINAL YEAR 1

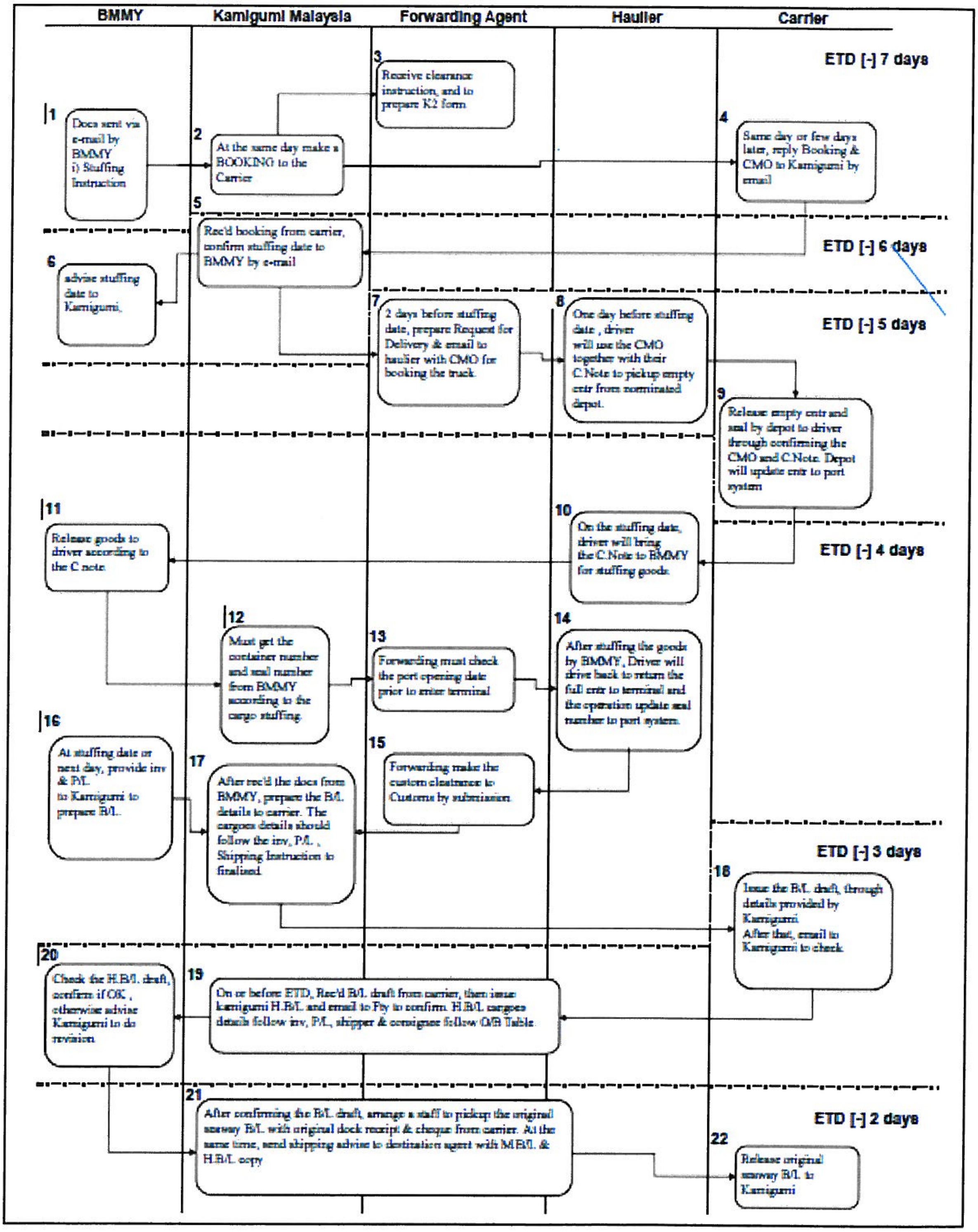
| | | SEMESTER 1 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WEEK | | | | | | | | | | | | | |
| NO | ACTIVITY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 1 | RESEARCH TITLE RELEASED | ■ | | | | | | | | | | | | | |
| 2 | SUPERVISOR APPROVAL | | | | ■ | | | | | | | | | | |
| 3 | WEEKLY MEETING WITH SUPERVISOR | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |
| 4 | RESEARCH STUDY | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 5 | PREPARATION OF THE PROPOSAL | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| 6 | COMPLETE THE PROPOSAL | | | | | | | | | | | ■ | | | |
| 7 | SUMMISSION OF THE PROPOSAL | | | | | | | | | | | | ■ | | |
| 8 | PREPARATION OF SLIDE PRESENTATION | | | | | | | | | | | | ■ | ■ | |
| 9 | PROPOSAL PRESENTATION | | | | | | | | | | | | | | ■ |

## APPENDIX A2

## GANTT CHART PROJECT FINAL YEAR 2

| | | SEMESTER 1 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WEEK | | | | | | | | | | | | | |
| NO | ACTIVITY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 1 | RESEARCH TITLE RELEASED | | | | | | | | | | | | | | |
| 2 | SUPERVISOR APPROVAL | | | | | | | | | | | | | | |
| 3 | WEEKLY MEETING WITH SUPERVISOR | | | | | | | | | | | | | | |
| 4 | RESEARCH STUDY | | | | | | | | | | | | | | |
| 5 | PREPARATION OF THE PROPOSAL | | | | | | | | | | | | | | |
| 6 | COMPLETE THE THESIS | | | | | | | | | | | | | | |
| 7 | SUMMISSION OF THE DRAFT | | | | | | | | | | | | | | |
| 8 | PREPARATION OF SLIDE PRESENTATION | | | | | | | | | | | | | | |
| 9 | PRESENTATION | | | | | | | | | | | | | | |

# APPENDIX B
# PROCEDURE EXPORT



# APPENDIX B2
# PROCEDURE IMPORT