Design of receiving facilities (with focus on decreasing cost effective)

- A case study

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The purpose of this Bachelor's thesis is to design the utilizable and flexible layout for the logistic centre regarding to their future goals and strategies. In this thesis was developed a model, with regard to the principles of logistic system in the unloading process, which is the bottleneck of the case company, because it takes a lot of time, and the reducing the waste time is the significant goal of the case company. The aim of the models has been created, eliminate unnecessary processes and decrease to total process time in the unloading area, at the same time reduce to total cost and provide utilization in the unloading area. This will result in satisfactory
Acknowledgment

We would sincerely like to thank all workers of DynaMate IntraLog AB, who have helped us during our visits and observations with the report. Especially we offer thanks to Gaith Weli Zubair (Production engineer of IntraLog), he has allocated his precious time and kindly has answered our questions.

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1. Introduction
This chapter gives an introduction to the thesis. A description of the background and the problem situation is presented, which leads to the purpose of, and the relevance for, this study. In addition, problem formulation is presented.

1.1 Background
In the last few decades’ importance of transportation and logistics are better understood by companies. The role of logistics in business has increased in both scope and strategic importance. Logistic strategies have influenced customer selection, product design, partnership/alliance building, vendor section and many other core business processes (Caplice and Sheffi, 1995). Since logistics is planning, managing and controlling flow and storage of goods and services, and consisted of many different departments such as transportation, warehousing, material-handling, packaging, maintenance, and disposal, etc. Moreover, according to Ghiani et al.(2004), a logistics system is made up of a set of facilities linked by transportation services. Facilities are sites where materials are processed, e.g. manufactured, stored, sorted, sold or consumed. It includes manufacturing and assembly centres, warehouses, distribution centres (DCs), transhipment points, transportation terminals, retail outlets, mail sorting centres, garbage incinerators, dump sites, etc.

So, logistics is part of the larger integrated process, called supply chain, in which a number of various business entities (i.e., suppliers, manufacturers, distributors and retailers) work together for acquiring raw materials, converting them into specified final products, which in turn have to be delivered to retailers (Beamnon, 1996). The domain of logistics activities is providing the customers of the system with the right product, in the right place, at the right time. This ranges from providing the necessary subcomponents for manufacturing, having inventory on the shelf of a retailer, to having the right amount and type of blood available for hospital surgeries (Ghiani et al., 2004). In the globalising commercial world many companies have a multinational structure and they function in different parts of world, for this reason they require success in logistic network for delivering their product and/or receiving of goods and/or raw materials they need, quickly and on time. Since the 1970s, companies have become more global, resulting in complex production and distribution networks, and in flows of goods across oceans and borders. The management of these complex systems is a real challenge. Firms nowadays face the questions: “Where is the best place to manufacture our products?” and “What is the best way to distribute them to the markets in the different
countries?” (Van de Ven and Ribber, 1993). During the past decade, logistics has grown into a major corporate function separate from marketing and/or production. Many corporations have acknowledged the importance of logistics by placing responsibility for logistics activities at the vice-president level (Lambert, 1992). In order to survive in a global economy, manufacturers must either perform the value-adding activities of inbound logistics, operations, outbound logistics, marketing and sales, and service at a lower cost or perform them in a way which leads to a premium price (Porter and Millar, 1985). Considering all these, it can be said that a good logistics management can increase efficiency and provide benefits in all related departments besides customer satisfaction.

1.2 Problem discussion
Logistics is related to almost all departments of companies and it directly affects these elements of companies. Logistics is a systems approach to planning, operating and controlling the total materials flow (raw-material, in-process inventories and finished goods) within the firm. Effective and efficient logistics management results in the right materials getting to the right place at the right time in useable condition for the lowest total logistics cost (Lambert, 1992). So, one of the major problems of companies is a good logistics management. Due to if they have not had an efficient logistics system and management, and it can trigger other department negatively. For example; when production department need raw materials they order these items, and logistics centre send raw materials to production department according to their order (sort of material, number of material, delivering time, etc.) but if logistics centre send wrong materials or cannot deliver in time, production department may have problems and may be forced to stop production. For this reason, nowadays companies give weight to logistics management and they want to improve their logistics system to coordinate between their companies, suppliers and customers. However, logistics systems have a very complex and dynamics processes as the needs and necessities of each company can be different. Therefore, managing logistics in supply networks will create new demands on logistics management. This could imply that new approaches and methods are needed for managers to understand and deal with logistics processes. However, logistics research has not, as yet, developed its thinking and its methods accordingly (Nilsson, 2006). Thus, companies try to continuously update their systems and they search for new and better alternatives for increase efficiency, reduce costs and provide customer satisfaction by delivering in time.
1.3 Presentation of problem
The presentation of this thesis problem is the logistics. The case company is Scania IntraLog. IntraLog is carrying out the logistic support. There are activities in the division that attempts to decrease costs to transport.

1.4 Problem formulation
The problem formulation of this thesis is based on the above mentioned reasons. It can be expressed as: “How can transportation within a facility be designed to improve space utilization, and reduce delay time?”

1.5 Purpose
The general purpose of this thesis is to design a logistic system for the inbound and outbound of facility and thus satisfy all processes which are related to logistics. Especially provide a utilizable space (to provide smooth flow) and reduce delay time. Besides, to design a flexible logistics system that can be updated if needed in the future. So, it could provide effective services to all related departments by delivering in time, and thus meet the needs of customers.

1.6 Relevance
Logistics has a phenomenal economic growth in world trade. According to Taylor (2008) Increased world trade means higher demand for logistics services to deliver the goods. Expenditures for logistics worldwide are estimated at well over $4 trillion in 2006 and now account for about 15% to 20% of finished goods cost. Growth in world merchandise trade, measured as export volume, has exceeded the growth in the worldwide economy, as measured by Gross Domestic Product (GDP), for close to two decades. Although the worldwide economy slowed to some extent in late 2006 and early 2007, trade volumes are predicted to continue to rise well into the next decade. So, all companies need a useful logistic network for can compete with other companies. Also, in recent years, due to increasing fuel costs which forced transportation companies to operate their vehicles more efficiently and this show importance of logistics (and/or transportation) for budgets of companies.
1.7 Limitations and delimitations

**Limitation**, the time limit to write this thesis work is limited. It is 7 weeks working hours. The author has focused on mostly on the theory chapter. Since IntraLog was building the new logistic center the author was facing the difficulties in collecting the data. Regarding this, the data obtained have been modified.

**Delimitation,**
Besides the time frame to do this thesis, there are delimitations that are taken into account. One of the delimitations is the purpose of the thesis. The sources to write the theory chapter. The author defines the problem formulation which is delimit the frame work of the thesis.

1.8 Timeframe

Here comes the time frame to conduct this thesis.

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General plan</td>
<td>10 days</td>
<td>16 Jul 10</td>
<td>16 Jul 24</td>
<td></td>
</tr>
<tr>
<td>2. Theory review</td>
<td>15 days</td>
<td>16 Jul 24</td>
<td>16 Aug 7</td>
<td></td>
</tr>
<tr>
<td>3. Research methodology</td>
<td>6 days</td>
<td>16 Jul 31</td>
<td>16 Aug 7</td>
<td></td>
</tr>
<tr>
<td>4. Data collection</td>
<td>7 days</td>
<td>16 Aug 8</td>
<td>16 Aug 15</td>
<td></td>
</tr>
<tr>
<td>5. Data analysis</td>
<td>6 days</td>
<td>16 Aug 16</td>
<td>16 Aug 22</td>
<td></td>
</tr>
<tr>
<td>6. Thesis writing</td>
<td>15 days</td>
<td>16 Sep 2</td>
<td>16 Sep 16</td>
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<tr>
<td>7. Conclusion</td>
<td>2 days</td>
<td>16 Sep 17</td>
<td>16 Sep 19</td>
<td></td>
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<tr>
<td>8. Proofreading</td>
<td>3 days</td>
<td>16 Sep 20</td>
<td>16 Sep 22</td>
<td></td>
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<tr>
<td>9. Hand in thesis</td>
<td>1 day</td>
<td>16 Sep 28</td>
<td>16 Sep 29</td>
<td></td>
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<tr>
<td>10. Final presentation</td>
<td>1 day</td>
<td>16 Oct 4</td>
<td>16 Oct 5</td>
<td></td>
</tr>
<tr>
<td>11. Final submission</td>
<td>1 day</td>
<td>16 Oct 8</td>
<td>16 Oct 9</td>
<td></td>
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</table>

Figure 1.1: Timeframe
2. Research methodology

In this chapter scientific research methodology approaches are presented. Applicable research methodology approaches used in the thesis will also be presented.

2.1 The scientific method

“The first characteristic of the scientific method is its conventional nature which serves as a framework of the generation of objective knowledge. Hence the reason that multiple characteristics exist according to the perspective with which they are classified, studied, and even named.” M. Jose et al., (2007) Moreover, science is a way of thinking that involves a continuous and systematic interplay of rational thought and empirical observation. Graziano et al., (2007).

The scientific method is created from the philosophy of science, which makes itself different from other type of knowledge. The method excludes all that has subjective nature and therefore is no capable of forming part of what is called scientific knowledge. However, there are things whose nature is precisely subjective. The scientific approach to these elements is complex and normally carried out through the lesser scientific methods which are designed for specific branches of knowledge. In addition, there are three basic types of scientific method, i.e., inductive reasoning, deductive reasoning and hypothetic-deductive or hypothesis testing. These types tend to be applied in the natural science in contrast to the commonly categorized social sciences such as economics, politics, etc. M. Jose et al., (2007)

2.2 Different research methodology

Deductive research approach, this method is trying to reason from more general to more specific. Sometimes, it is called informally “top-down” approach. The water fall model is coming down as theory, hypothesis, observation, and confirmation while the conclusion follows logically from premises. Hussain S. (2008)

Inductive research approach, in opposite site of deductive, the inductive approach works by moving from specific observations to broader generalizations and theories. It is sometimes informally called “bottom-up” approach. Its conclusion is likely based on promises. It is also involved a degree of uncertainty. A new theory can also be built by adding new concept or
relation to the previous theory or model or by deleting an old concept or relation from the previous theory or model. The changes can also be based on empirical observations or generalizations the theory building process. Järvinen P. (2001)

**Hypothetic-deductive**, it is used to testify the theories or hypotheses. In general, in science one needs to use hypothetic-deductive reasoning in all disciplines, for example physics, biology and chemistry. Hypothetic method is used to investigate the theory and then deductive is used to fine the outcomes. Järvinen P. (2001) Furthermore, the relation between deductive and inductive approach can be explained by “V” model. From top-down, theory, hypothesis, observation and confirmation to bottom-up, observation, pattern, tentative hypothesis, and theory is the process for the combination of V model.

### 2.3 Data collection approaches

Research methodology approaches can be classified as two ways, i.e., qualitative and quantitative perspectives. In some case, one can utilize a combination set of both perspectives, called mixed methods approaches, to conduct a study. Qualitative method refers to as a method that involves with qualitative data and also based on judgments. Quantitative method refers to as a method that involves with mathematical calculations and thus processed statistical. John et al. (2009)

**Qualitative method**

Qualitative procedures rely on text and image data and thus using these data to analyze and draw on diverse strategies of inquiry. The result will then come out totally linguistically. The process of research involves emerging questions and procedures, data typically collected in the participant’s setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. John et al. (2009)

**Quantitative method**

Quantitative research is a means for testing objective theories by examining the relationship among variables. The variables can then be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures. So, the final report will mainly come out in mathematical and linguistic setting. John et al. (2009)
In addition, the mixed methods approaches, which will be used in this paper, have evolved a set of procedure that proposal developers can use in planning a mixed method study. It is relatively new in the social and human sciences as a distinct research approach, and it is useful to convey a basic definition and description of the approach in a proposal. Simply understanding of this method is that it is a combination of both quantitative and qualitative research methods. In this mixed method has strategy as follows.

- Design your primary proposed study.
- Consider amount of time you have to collect data.
- Remember that collection and analysis of both quantitative and qualitative is a rigorous, time-consuming, so the study should be reduced in scope and manageable for time.
- Consider using the explanatory sequential approach.
- Study published articles that use different approaches and determine which one makes the most sense for you.
- Find a published mixed methods journal article that uses your design and introduce it to your adviser and faculty committee so that they have a working model for the approach you plan to use in your study. John et al., (2009)

### 2.4 Research Evaluation

**Reliability**

Reliability is the meaning of research methodology is concerned about the results obtained from investigation will be accuracy as the same as repeated investigation. Furthermore, good measures give consistent results, regardless of who does the measuring. The reliability has a connection to quantitative approach. So, the quantitative investigation will be stressed on the stable results. The reason that the concept of reliability of measures is critical in research is that the research needs the accurate result in order to produce useful information. There are three types of reliability, i.e., inter-rater reliability, test-retest reliability, and internal consistency reliability. Grazino et al., (2007)
• **Inter-ratter reliability** concerns if a measure involves behaviour rating made by observers, there should be at least two independent observers to rate the same sample of behaviour. To rate independently, both raters must be blind to the ratings of the other observer, that is, they must be unaware of other observer’s rating. Grazino et al., (2007)

• **Test-retest reliability** concerns if variables that remain stable over time should produce similar scores if participants are tested twice with a period of time between testing’s. Grazino et al., (2007)

• **Internal consistency reliability** is another type of reliability. It is done when several observations are made to obtain a score for each participant. Internal consistency reliability is high if each item or behaviour observation correlates with the other observations. Grazino et al., (2007)

**Validity**
Validity is a major concern in research. It could be resulted in the correction of procedures and conclusions. The term of validity refers to as methodological soundness or appropriateness. The validity can then measure what it is supposed to measure, and what it is supposed to test. In addition, validity is of importance in experimental research. There are more or less four types of validity such as statistical, construct, external, and internal. Grazino et al., (2007)

Statistical validity is concerned about the accuracy of some values on which a statistical decision is based. It stresses on whether the statistical conclusion of a research is reasonable and dependable. However, the statistical decision is based on probability. Grazino et al. (2007)

Construct validity deals with the degree to which the theory or theories behind the research study provide the best explanation for the results observed. Also, it refers to how well the study’s results support or constructs behind the research and whether the theory supported by the findings provides the best available explanation of the results. Grazino et al. (2007)
External validity refers to as the extent to which the results of a particular study generalize to other people, places, or conditions. Strictly speaking, the results of experiment are limited to those participants and conditions used in the particular experiment. Grazino et al. (2007)

Internal validity is about the extent to which one can be confident that the observed changes in the dependent variable were due to the effects of the independent variable, and not to effects of extraneous variables. It is also a major concern to researchers in that it involves the very heart of experimentation. Internal validation in a deeper sense has its meaning if the judging between the correlations between several factors is valid. For example, suppose that you are interested in the ability of patients with schizophrenia to identify briefly presented images. You predict that their identification accuracy will be significantly disrupted by intrusive auditory stimulation. You test your patients under two conditions i.e., a high-stimulation condition and a low-stimulation condition. There are some problems concerning schedule in the hospital. The result of testing under high-stimulation conditions will make significantly more errors than those tested under low-stimulation conditions. So, you will probably conclude that external auditory simulation is a significant factor that affects visual processing by patients with schizophrenia. Grazino et al. (2007)

**Generalization**

Generalization can be understood that to make statement about the overall results obtained from investigations. It is based on findings in both quantitative and qualitative approaches. The generalization has three types, i.e., generalization of the results from the participants in a study to the larger population, generalization of the results of the study over time, and generalization of results from study setting to other field settings. The generalization has close correlation to internal validity. Grazino et al., (2007)

**2.5**

In this thesis, the research methodology approaches will be used are the deductive and inductive approach. Since the process of top-down is trying to sum up from more general to more specific, and the process of bottom-up is trying to reach a broader generalizations and theories, it is useful for the investigation.
The data collection methods in this thesis that will be used are the quantitative method. This type of data collection will mainly use for the empirical findings in that the authors will build up some models in order to be able to evaluate their advantages of models. Hence, all data obtained from empirical findings together with the literature review shall be analysed and finally come up with the conclusion. In order to achieve the high evaluation, all the factor associated with i.e., reliability, validity, and generalization, will be investigated.

3. Theory

Literature review
This chapter presents the literature review relevant to the theme of the thesis.

3.1 Logistics
Logistics is a term that seems to be little ignored and by almost anyone not directly correlated with this professional and very significant discipline. Many people when hearing word of logistics, firstly they think of trucks and correlate it with some quantitative, technological, or mathematical practice. In fact, logistics is a very old discipline that has been, currently is, and always will be, considerable to our everyday lives. Logistics is a discipline that has a significant impact on the community’s standard of living. In a modern community, people expect and need excellent logistic services in every areas of life (e.g. mail and cargo delivery, public transportation, waste collection, public utilities, etc.), and tend to notice logistics only
when there is a problem. Relationships between consumers and logistics activity can be described as examples such as:

- The difficulty shopping for food, clothing, and other items if logistical systems do not conveniently bring all of those items together in one place, such as a single store or a shopping mall.
- The challenge in locating the proper size or style of an item if logistical systems do not provide for a wide mix of products, colours, sizes, and styles through the assortment process. This was a continual problem in the former Soviet Union.
- The frustration of going to store to purchase an advertised item, only to find out the store’s shipment is late in arriving (Lambert at al., 1998).

In summary, Logistics works with the planning and control of material flows and related information in organizations, both in the public and private sectors. The major aims of logistics are optimizing a designated performance (e.g. minimizing delivering time or total operating costs) and satisfying a designated constraint (e.g. budget constraint) by to get the right materials to the right place at the right time.

Indeed, first applications of logistics activities have been appeared in early of 1900’s, the earliest form of trade. But, the practice of logistics in the business sector, starting in the latter half of the twentieth century, has been increasingly recognized as a critical discipline. The first professional association of logisticians was formed in 1963, when a group of practitioners and academicians formed the National Council of Physical Distribution Management, which in 1985 became the Council of Logistics Management, and then in 2004 the Council of Supply Chain Management Professionals (Taylor, 2008).

If logistics is compared with many other research fields within the nature of management, it is some young field. Therefore, the development of logistics has been fast in the last few decades. And according to this definition and scope of logistics has been complicated and it is referred in different ways. Thence, logistics has been called by many names, including the following (Lambert at al., 1998):

- Business logistics
- Channel management
- Distribution
What these terms have in common is that they deal with the management of the flow of goods or materials from point of origin to point of consumption, and in some cases even to the point of disposal (Lambert et al., 1998). Also, Logistics is defined by the Council of Logistics Management (CLM) as: “The process of planning, implementing and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements” CLM book, 1998). And this definition comprises both the manufacturing and service sectors withal names of mentioned.

Logistics has different definitions and scopes, but in fact, definition of CLM and all other definitions aim at same things, first one is supplier and producer should satisfy demand and needs of customers on the other hand they should efficiently detect and manage costs aspects, also reduce costs directly dependent to the logistics.

### 3.1.1 Significance of logistics

Logistics is one of the most important activities in modern economies and societies that have a huge share of the world trade. Lambert et., al. (1998) explains importance of logistics such as: “Logistics plays a key role in the economy in two significant ways. Firstly, logistics is one of the major expenditures for business, thereby affecting and being affected by other economic activities. U.S. industry spent approximately $451 billion on transportation of freight and about $311 billion on warehousing, storage, and carrying inventory. Second, logistics supports the movement and flow of many economic transactions; it is an important activity in facilitating the sale of virtually all goods and services. If goods do not arrive in the
proper place, or in the proper condition, no sale can be made. Thus, all economic activity through the supply chain will be suffered. “

3.1.2 Logistics activities
All facilities required some activities for can produce product, these activities are the flow of a product from the raw materials to consumption. So, most of these activities are considered part of the overall logistics process. Some activities related to logistics like below:

- Customer Service
- Purchasing and Sourcing
- Demand Forecasting in Logistics
- Facilities Location and Layout Design
- Inventory Control
- Material Handling System
- Packaging
- Warehousing
- Distribution System Design
- Transportation Systems Overview

Also, all of these activities create costs that are related with logistics process and support logistics process. These costs are customer service, warehousing, transportation, materials handling, etc.

3.2 Receiving and shipping operations
Receiving and shipping operations need to be considered properly. It could be affected by the positioning of carriers and their characteristics, which are being interfaced with the receiving and shipping functions. Activities in handling receiving and shipping operations in a facility are of importance since it could lead to the optimization of the overall system's performance. Hence, there are several activities to be considered and some must be required when performing receiving and shipping operations. In addition, the activities and the facilities
requirements that one should take it into account as follows in the table below. Tompkins et al. (2003)

Table 3.1: Summary of receiving and shipping activities required, Tompkins et al. (2003)

<table>
<thead>
<tr>
<th>Receiving</th>
<th>Shipping</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inbound trucker calls the warehouse to get a delivery appointment and provides information about the cargo.</td>
<td>• Accumulate and pack the order.</td>
</tr>
<tr>
<td>• Warehouse receiving person verifies the advance shipping notice (ASN) and confirms it with information received by phone from inbound trucker.</td>
<td>• Stage and check the order.</td>
</tr>
<tr>
<td>• Trucker arrives and is assigned to a specific receiving door (similar dock location is selected for boxcar receipts).</td>
<td>• Reconcile shipping release and customer order.</td>
</tr>
<tr>
<td>• Vehicle is safely secured at the dock.</td>
<td>• Spot and secure the carrier at the dock.</td>
</tr>
<tr>
<td>• Seal is inspected and broken in presence of carrier representative.</td>
<td>• Position and secure dock levellers and locks.</td>
</tr>
<tr>
<td>• Load is inspected and either accepted or refused.</td>
<td>• Load the carrier.</td>
</tr>
<tr>
<td>• Unitized merchandise is unloaded.</td>
<td>• Dispatch the carrier.</td>
</tr>
<tr>
<td>• Floor-loaded or loose merchandise is unloaded.</td>
<td></td>
</tr>
<tr>
<td>• All unloaded material is staged for count and final inspection.</td>
<td></td>
</tr>
<tr>
<td>• Proper disposal is made of carrier</td>
<td></td>
</tr>
</tbody>
</table>
- Load is stored in an assigned location.

Table 3.2: Summary of the facility requirements to perform receiving and shipping, Tompkins et al. (2003)

<table>
<thead>
<tr>
<th>Receiving</th>
<th>Shipping</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sufficient area to stage and spot carriers</td>
<td>• Sufficient area to stage orders</td>
</tr>
<tr>
<td>• Dock levellers and locks to facilitate carrier unloading</td>
<td>• An in-house host information system for shipping releases and customer orders</td>
</tr>
<tr>
<td>• Sufficient staging area to palletize or containerize goods</td>
<td>• Sufficient area to stage and spot carriers</td>
</tr>
<tr>
<td>• Sufficient area to place goods prior to dispatching</td>
<td>• Dock levellers to facilitate carrier loading</td>
</tr>
<tr>
<td>• A host information system for ASN/EDI on purchase orders to allow for report generation</td>
<td></td>
</tr>
</tbody>
</table>

Moreover, some desirable attributes of receiving and shipping facilities plans include:
- Directed flow paths among carriers, buffer or staging area, and storage areas
- A continuous flow without excessive congestion or idleness
- A concentrated area of operation that minimizes material handling and increases the effectiveness of supervision
- Efficient material handling
- Safe operation
- Minimizing damage
- Good housekeeping

Factors that are required such as people, equipment, and space in receiving and shipping also reply on the effectiveness of programs to incorporate pre-receiving and post-shipping considerations. This in turn can result in reducing peak loads at receiving. Pre-receiving and post-shipping are being concerned as they are also dealt with the interface between the operations. Tompkins et al. (2003)

### 3.2.1 Decision in designing the receiving and shipping operations

The design of receiving and shipping functions rely on access to transportation activities. As seen on the figure 3.1 below. In the figure, the opposite side of building is how the transportation facility works. On the top of the figure are the high way or railroad, and the trucks can get in to the warehouse as the arrows have shown. The receiving and shipping will be coordinated. The decision to centralize receiving and shipping depends on many factors such as the nature of activity being performed. Tompkins et al. (2003)
3.2.2 Receiving and shipping principles

In order to ensure the work to be performed when receiving material, there are some principles that one should consider for the minimum required works. The table below is the description, step by step, for the receiving principles.

Receiving principles

Table 3.3: Summary of the principles for receiving, Tompkins et al. (2003)

<table>
<thead>
<tr>
<th>Principles</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don't receive</td>
<td>For some materials, the best receiving is no receiving. Often, drop shipping- having the vendor ship to the customer directly- can save the time and labour associated with receiving and shipping. Large, bulky items lend themselves to drop shipping. For example, a large camp and sportswear mail-order distributor drop-shipping canoes and large tents is one example of this.</td>
</tr>
<tr>
<td>Pre-receive</td>
<td>The reasons for staging at the receiving dock, the most time and space-intensive activity in the receiving function, are often the need to hold the material for location assignment,</td>
</tr>
</tbody>
</table>
product identification, and so on. With the technology today, it is relatively easy to obtain a detailed manifest with every receipt of merchandise, i.e., advance shipping notice (ASN). At the present time, ASN has been used to unload the materials. The ASN should include seal numbers to verify that the load was not tampered with.

- Cross dock

Since the ultimate objective of the receiving activity is to prepare material for the shipment of orders, the fastest, most productive receiving process is cross-docking-and the simplest kind of cross-docking activity is one in which an entire inbound load is sorted and then reloaded onto one or more outbound vehicles. Cross-docking also involves the blending of material on an inbound vehicle with material that is already in the warehouse.

- Put away directly to primary of reserve location

When material cannot be cross docked, material handling steps can be minimized by bypassing receiving stages and putting material away directly to primary picking locations, essentially replenishing those locations from receiving. When there are no severe constraints on product rotation, this may be possible. Otherwise, material should be directly put away to reserve locations. For direct put-away system, there is no
inspections and staging. Then, the time, space, and labour associated with those operations are also eliminated. For example, counterbalanced lift trucks can be equipped with scales, cubing devices, and on-line RF terminals to streamline the unloading and put-away function. In addition, the material handling technologies that facilitate direct put-away include roller-bed trailers and extendable conveyors.

| Stage in storage locations | If material has to be staged, the floor space required for staging can be minimized by providing storage locations for receiving staging. There should be storage spaces over dock doors. |
| Complete all necessary steps for efficient load decomposition and movement at receiving | In this principle, when the demand for the product has been received, there is precious little time available for any preparation prior to shipment. There are some activities that should be accomplished ahead of time as followings.  

a. Pre-package in issue increment.  

b. Apply necessary labelling and tags.  

c. Cube and weigh for storage and transport planning. |
• Sort inbound material for efficient put-away

In this principle, inbound material can be sorted for put-away by warehouse zone and by location sequence. Material handling activity should be done in this step.

• Combine put-away and retrievals when possible

At this step, put-away and retrieval transactions can be combined in a dual command to reduce amount of empty travel on industrial vehicles. This technique is especially geared for pallet storage-and-retrieval operations.

• Balance the use of resources at receiving by scheduling carriers and shifting time-consuming receipts to off-peak hours

Schedule information about inbound and outbound loads shall be done in this step.

• Minimize or eliminate walking by flowing inbound material past workstations

The strategies that should be employed for receipts shall be taken into account.

**Shipping principles**

The following lines are the descriptions of the principles for shipping.

1. *Select cost-and-space effective handling units,*

   a. For lose cases, the pallets have made from many materials, such as wood, plastic, metal, and nest able pallets. The plastic pallets have more advantages than wood in that they are more durable, clean, and colour-coding. The excellent use of coloured plastic pallets is the creating appealing work environment in factories and warehouses. Metal pallets
have been designed for durability and weight capacity. Nest able pallets have good space utilization during pallet storage and return but they do not have a high weight capacity. Some criteria in selecting pallets for unitizing loose cases include initial purchase cost, maintenance costs and requirements, ease of handling, environmental impact, durability, and product protection.

b. For loose items, the reasons for unitizing loose items are the totes and cardboard containers. The selection factors have impacted on the environment, initial purchase cost, life cycle cost, cleanliness, and product protection.

2. **Minimize product damage,**

   a. Unitize and secure loose items in cartons or totes, within the unit load, there must be provided secure when facilitating material handling. For loose items in totes or cartons, those include foam, peanuts, popcorn, bubble wrap, newsprint, and air packs. The selection factors include initial and life-cycle cost, environmental impact, product protection, and reusability.

   b. Unitize and secure loose cases on pallets, though the most popular alternative is stretch wrapping, wrapping loose cases with Velcro belts and adhesive tacking are gaining in popularity as environmentally safe means for securing loose cases on pallets.

   c. Unitize and secure loose pallets in outbound trailers, the most common methods are foam pads and plywood.

3. **Eliminate shipping staging, and direct-load outbound trailers,** to facilitate the direct loading of pallets onto outbound trailers, pallet jacks and counterbalance life trucks can serve as picking and loading vehicles, allowing a bypassing of staging. More step further, automating pallet loading can be accomplished with pallet conveyor interfacing with specially designed trailer beds to allow pallets to be automatically conveyed onto outbound trailers by loading of loose cases is facilitated with extendable conveyors.
4. Use storage racks to minimize floor space requirements for shipping staging, when shipping staging is required; staging in storage racks can minimize the floor space requirements.

5. Route on-site drivers through the site and minimize paperwork and time, with the help of system, the need to improve shipping and receiving docks and trailer drivers. For example, at one brewery, drivers use a smart card to gain access throughout the DC site, to expedite on-site processing, and to ensure shipping accuracy. At another brewery, terminal stands are provided throughout the site to allow drivers on-line access to load status and dock schedules.

6. Use small-parcel shipping, for small-parcel shipment is different from the unit loads. Stretch stations may be replaced by packing lines. Together with conveyors that are also replaced the use of a lift truck. The carrier's bar-coded tracking labels are customarily affixed in the warehouse before the goods are shipped. Tompkins et al. (2003)

3.2.3 Space planning associated with receiving and shipping
Factors involved in planning space for receiving and shipping are the determine what is to be received or shipped, determine the number and type of docks, and determine the space requirements for the receiving and shipping area within the facility.

- Determine what is to be received and shipped, according to appendix 1, the receiving and shipping analysis chart, the information relating to what, how much, and when of items received or shipped. The information can be reused for those which have similar orders. For a new receiving or shipping operation, the part lists and the market analysis information for all products must be analysed to determine reasonable unit loads and order quantities.
- Determine the number and type of docks, in order to determine the number of docks; one can use waiting-line analysis. This includes some factors such as the required service if arrivals and/or services are Poisson-distributed and the arrival and service distributions do not vary significantly over time. According to the chart on appendix 1,
the last two columns on the chart concern the handling of materials on and off a
carrier. Also, time is another concern. The time required to unload or load a carrier
maybe determined for an existing operation from historical data, work sampling, or
time study. Predetermined time elements vary from very general standards to very
detailed standard. Tompkins et al. (2003)

Some considerations for the approach of trucks when they are coming to the warehouse are as
follows, according to Tompkins, recessed or "Y" approaches for trucks, seen in the figure
below.

1. Two-directional service roads should be at least 24 ft wide.

2. One-way service roads should be at least 12 ft wide.

3. If pedestrian travel is to be along service roads, a 4-ft-wide walk physically
separated from the service road should be included.

4. Gate openings for two-directional travel should be at least 28 ft wide.

5. Gate openings for one-way travel should be at least 16 ft wide.

6. Gate openings should be 6 ft wider if pedestrians will also use the gate.

7. All right-angle intersections must have a minimum of a 50-ft radius.

8. If possible, all traffic should circulate counter-clockwise because left turns are
easier and safer to make than right turns

9. Truck waiting areas should be allocated adjacent to the dock apron and need
to be big enough to hold the maximum expected number of trucks waiting at any given time.
Tompkins et al. (2003)
Also, when having considered the space planning in receiving and shipping operations, the overall flow of trucks about a facility may be determined. As seen in figure 3.3, space requirement for 90 degree docks shown.
3.2.4 Determination about internal receiving and shipping area requirements

Space allocations are of importance in the facility in order to meet the need for receiving and shipping operations. The followings are the allocations.

- **Personnel convenience/offices**, they can serve as receiving and shipping supervision clerical activities. It should have around 125 square ft. of office space for each dock employee. The office should be located within the dock area. They will work with receiving and shipping, clerical, and data-processing activities.

- **A receiving hold area**, it is essential for accumulating received material that has been rejected during a receiving or quality-control inspection, and is awaiting return to the vendor or some other form of disposition. Rejected material should be separated from the receiving area. The area for these rejected should be allocated, and factors such as
type of materials, the specific inspection process followed, and the timeliness of the disposition of the rejected merchandise should be arranged.

- **Trash disposal and recycling bins**, at the dock operations, there are many waste materials such as corrugated boxes, binding materials, broken and disposable pallets, bracing and various other packing materials. In order to avoid poor housekeeping, congestion, unsafe working conditions, there should be space for the disposal and recycling of these items. One important point for the dock operations is that one should prepare to manage waste material disposal since the dock operations generate some trash.

- **Pallet and packaging material storage/palletizing equipment**, mostly in the warehouse, the load will come with no pallets, they require palletizing and repalletizing. The empty pallets must be available for the dock area for this activity.

- **The truckers' lounge**, it is an area to which truck drivers are confined when not servicing their trucks. It should be built up to serve workers, like having seating, magazines, refreshment facilities, telephones, and so on, in order to meet normal need while waiting for their trucks to be serviced. The space requirement for the lounge should satisfy the need for truckers.

- **Buffer or staging area**, it is the areas within receiving departments where materials removed from carriers may be placed until dispatched. A buffer area will be required if the operating procedure is to remove materials from the carrier and place them into a holding area prior to dispatching, space must be allocated to store the merchandise.

- **Material handling equipment manoeuvring** space is provided between the backside of the dock-board and the beginning of the buffer or staging areas. Tompkins et al. 2003

In addition, there are some manoeuvring allowances for material handling utilization, as seen on appendix 2. The space utilizing for buffer or staging areas may be determined by considering the number of carriers. Typically, when buffer and staging areas are utilized, sufficient space should be allocated for one full carrier for each dock. Tompkins et al. (2003)
3.2.5 Dock operations planning
The interface between carriers and docks has the relation as performing the receiving and shipping operations. There is dock equipment to perform the operations, such as dock levellers, bumper pad, and dock shelters. The functions of the dock equipment are as follows.

- **Dock levellers**, it functions as the interface between a dock at a given height and variable height carriers. There are five possible ways to handle when dealing with different height of dock and carriers, as the followings,
  1. Walking up or down a step to accommodate the difference.
  2. A portable ramp between the dock and carriers.
  3. A permanent adjustable ramp between the dock and carriers.
  4. Raising the carrier to the height of the dock.
  5. Raising the dock to the height of carriers.

- **Bumper pads** serve as the interface between a fixed dock and a moveable carrier. Bumper pads will help the carrier to carry materials to the dock easier.

- **Dock shelters** serve as the interface between a heated/air-conditioned dock and an unheated/non-air-conditioned carrier. The advantages of using dock shelters are that, energy saving, increased safety, improved product protection, better security, reduced maintenance, and reduced spotting time. Tompkins et al. (2003)

3.4 MCDM (Multiple Criteria Decision-Making)
Nowadays everything in the world change with time also aim, goals and requirements of organizations are changed and need new design. So, engineering disciplines and optimization plays a critical role in today’s design organization system (structure) and decision-making. The optimization process is actually appeared in system improvement for the purpose of determine and regulate the effective variables. Problems that have multiple objectives and in multiple disciplines are called multiple criteria decision making (MCDM) problems. The main goal of MCDM model approach is to determine different alternatives and to maximize benefits. The mean of decision is to make a choice from more than one alternative. The most
important question in this choice: “how to choose from what alternatives?” therefore, in multiple criteria decision making, the overall performance of the decision alternatives is evaluated with respect to several conflicting decision criteria (Ata and Sennaroğlu, 2008). Also, International Society on MCDM defines MCDM like this: “Multi Criteria Decision Making is the study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process.”

MCDM models are used in various areas of practical applications for example facilities planning, human resources, suppliers and resources evaluation, transportation, sales and marketing strategies, etc. MCDM models when they approach to a problem evaluate different alternatives and to make a choice according to importance of alternatives to reach most beneficial one. For successful decision operators of MCDM needs some serried processes. Robbins and Coulter (2007) define these processes, there is a set of processes that follow each other in decision making and that effective decisions are the results of such processes. These are as follow:

1. Identifying a problem
2. Identifying decision criteria
3. Allocating weights to the criteria
4. Developing alternatives
5. Analysing alternatives
6. Selecting an alternative
7. Implementing the alternative
8. Evaluation of decision effectiveness
4. Empirical Finding

This chapter shows the empirical data gained from the case company, IntraLog, Scania. Gathering raw data on by the visiting at the site, the empirical chapter provides relevant both information and raw data.

4.1 About Intralog
Intralog is subsidiary of Dynamate AB as part of Scania truck company. In addition, Intralog provide Third Party Logistics service for Scania. They have three operation areas that are in Södertälje(headquarters), Mjölby and Oskarshamn. Intralog was established in 2007 and they have totally 160 employees and 60 of these deploy in Oskarshamn. Their main works are packaging and component management. Moreover, their annual sales are approximately SEK 150 million. See figure 4.1 for relationships structure of connection of the company.

![Relationships structure of connected companies.](image)

Intralog is a part of supply chain system of Scania. The main processes and services them are the separating and storage of pallets, washing the plastic boxes, packaging handling, component management (sequencing of items to the assemble lines of Scania), warehousing, distribution and transportation service.
4.2 Activities of Intralog

Intralog has a significant role in material traffic between Scania and suppliers. At the same time they provide services and to apply some proceedings on that materials such as:

- Packaging
- Component management
- Warehousing
- Sequencing
- Washing
- Reassembling of boxes

Scania do not receive materials directly from suppliers, they order materials according to their requirements. Moreover, suppliers send these materials to Intralog, and Intralog apply necessary processes on materials and repackaging these materials, finally they send to Scania. In fact, these traffics consist from 4 steps. See figure 4.2 for traffic between Intralog, Scania, and Suppliers.

![Figure 4.2: traffic between Intralog, Scania and Suppliers](image)

These 4 steps can be explained like this:

1. Suppliers send materials to Intralog. These materials are processed by Intralog.
2. Intralog send processed and repackaged materials to Scania.
3. Scania uses these materials and they send empty boxes to Intralog.
4. These empty boxes are reassembled (clean and repair if needed) by Intralog and finally Intralog send reassembled boxes to suppliers.

4.3 Logistics System of Intralog
Scania gives weight to supply chain management like all big company. Also, Intralog plays significant role in supply chain management system of Scania. Due to it provide the product flow of Scania. Thus, Intralog means a logistics centre and warehouse for Scania.

Proceeding from material management system and physical distribution system, the connection between related companies can be explained as following:

- Intralog receives raw materials from Suppliers as pallets with different sizes, for instance trucks transport and carry containers filled up by big pallets (T,S,M,L); half-pallets (H), (0.6*0.8 m^2); and Euro-pallets (E), (1.2*0.8 m^2).
- Other materials that classified as truck devices and components provided by different suppliers to Intralog and Scania, while Intralog responsible for sequencing the items and afforded to Scania, must be consistent with Scania’s orders.
- In the last step Intralog ships these components to Scania.

Logistic system of Intralog consists of three main steps. See figure 4.3 for main structure of logistics system of Intralog.

![Figure 4.3: Main structure of logistics system of Intralog.](image)

In fact, Intralog is a Third-party logistics company. Because Intralog provides warehousing and transportation services for Scania, so these services according to Scania needs
requirements for their products and materials). When trucks go into Scania’s receiving area the signal order triggered Intralog system in order to shipping the material needed at maximum four hours from signalling processed. Besides, material handling equipment categorized into trucks, forklift, carts and containers that have been used for internal and external transportation. Trucks capacity available for three containers of selected items that could relatively preferable by Scania, each truck contains one empty container and two full container filled up by 16-pallets for door sides, 12-pallets (middle panel), and 16-pallets for DCU (driver control unit). Also, the carts work among the sequence area and other stations in facilitating the passage of following items such as: steering wheel, books instruction, door sides, middle panel, driver control unit, chairs and electrical truck devices, and then forklifts role is to lift the pallets and containers (loading and unloading of trucks and buffer areas).

4.4 Location of new warehouse
IntraLog is located in Oskarshamn, between the suppliers and Scania. As shown in the figure 4.4, it is the transport planning. The transportation route as shown in the figure shows the way they transport material from IntraLog warehouse to Scania and from Scania to the IntraLog warehouse. There are four unloading places in Scania, and at least once an hour for the trucks working in the unloading site. There are 1-2 terminal tractors for the sequence. The new warehouse of IntraLog will be located nearby the existing ones.
4.5 Size of New Logistics Centre

For the present production capacity of Intralog is 250, but in the future they want to increase their production capacity to 450-500 according to their planning. So, they want to build a new facility because existing facility has not enough area for increasing capacity and it cannot provide Intralog capacity in the future. Thus, Intralog is planning to divide two parts their work, with reference to this plan, existing facility will use for empty packaging and new facility will be logistic centre. According to their planning they need an area that about 10 000 m². Intralog has rented an area about 10 000 m², and 5500 m² of it that is covered area.
4.6 General Flow Process Chart of Intralog
For our report we are focused more on the inbound and outbound areas and that’s why we only do the flow chart for from receiving materials from suppliers to shipping processed materials to Scania. See figure 4.4 for the general processes of logistics system of Intralog.

The general process flow chart of Intralog consists of 9 steps;

- 3 operations
- 5 transportations
- 1 delays

<table>
<thead>
<tr>
<th>Chart</th>
<th>Symbols</th>
<th>Process Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>□ □ □ ▷ ▼</td>
<td>Incoming truck time (on the new road)</td>
</tr>
<tr>
<td>●</td>
<td>□ □ □ ▷ ▼</td>
<td>Register the trucks</td>
</tr>
<tr>
<td>○</td>
<td>□ □ □ ▷ ▼</td>
<td>Unload trucks</td>
</tr>
<tr>
<td>○</td>
<td>□ □ □ ▷ ▼</td>
<td>Send to conveyor belt</td>
</tr>
<tr>
<td>○</td>
<td>□ □ □ ▷ ▼</td>
<td>Transportation on conveyor belt</td>
</tr>
<tr>
<td>○</td>
<td>□ □ □ ▷ ▼</td>
<td>Pre-buffer</td>
</tr>
<tr>
<td>●</td>
<td>□ □ □ ▷ ▼</td>
<td>Different operations (sequencing, washing, etc)</td>
</tr>
<tr>
<td>●</td>
<td>□ □ □ ▷ ▼</td>
<td>Loading on the truck</td>
</tr>
<tr>
<td>○</td>
<td>□ □ □ ▷ ▼</td>
<td>Outgoing truck time (on the new road)</td>
</tr>
</tbody>
</table>

4.7 Critical processes
Here comes the description of critical processes for the case company.

4.7.1 Unloading process
The unloading activity is taking place as the first step since the truck reach the facility. When the truck reaches the unloading area, the truck driver register his/her truck at the registration
desk. Then, the forklift driver begins unloading pallets from the truck trailer to put on the conveyor belt. This process takes approximately 45 minutes, 10 minutes for incoming, registration and preparation, 30 minutes for unloading and 5 minutes for outgoing.

4.7.2 Transportation on conveyor belt process
This activity begins in close connection with the unloading process. After the forklift carries pallets from truck to conveyor belt, this process starts automatically by the conveyor belt machine. And, it finishes when all the pallets have been transported to the inside the facility. It takes approximately 12 minutes in total.

4.7.3 Loading process
According to the current system using in the loading process, starting from forklift driver carries pallets from storage area and put them inside the big containers, which are located in the shipping area. It takes approximately 37 minutes to put all the pallets in 3 containers. After that the big containers will be carried from shipping area by forklift to put on the truck trailer. It takes approximately 8 minutes to put all 3 containers on the truck trailer. In the new system which will be applied to the new facility will be different from the current system in that they will use docking. The back of truck trailer will connect to the dock. Forklift will take the pallets and drive into the truck trailer to put the pallets directly inside the trailer.
5. Analysis

In this chapter the analysis of the thesis will be conducted together with alternative models developed and improved.

The analysis will be generated two alternative options for each bottleneck process in order to evaluate their advantages by means of MCDM. In addition, the current layout will be presented. There are three bottleneck processes that have critical aspects i.e., unloading, transportation on conveyor belt, and loading. The two alternative options will be generated for improvement suggestions compared with the current system. The two alternative options will be

Then, evaluation using MCDM will result in the most suitable alternative option to satisfy the new facility.

5.1 Bottlenecks in the particular Processes

Our observation during gathering empirical data in the case company, the processes that are considered bottleneck are unloading, transportation on conveyor belt, and loading. The reasons for why these processes are bottleneck are that the data gathered during the observation show that time consuming in these processes are mostly taken more than other processes and secondly these processes need more improving. Thirdly, the interview provided by the production engineer is that these processes are considered the bottleneck. In this method, the author is using the research methodology mention at the beginning of the thesis.

5.2 The chosen bottleneck process

Since data from empirical findings and interviewing with the production engineer obtained, the most critical aspect for bottleneck processes to be highly taken into account is the unloading process. The focus is on unloading process, because unloading process is directly related to IntraLog, but other bottleneck processes are depending on Scania’s orders.
5.3 Alternatives for unloading process

Alternative options created for solving bottleneck process and reducing the processes time by improving bottleneck process will be described. The critical point for the overall logistic system is the time utilization for processing, hence solutions created are mostly concerned with time reduction in order to satisfy the principle of logistic system.

5.3.1 Alternative 1: Current layout

The figure below is the current layout at the case company. At the receiving area, there is one forklift functioning as unloading pallets from the truck and putting them on the conveyor belt. Whereas there is another truck trailer waiting at the incoming road for the next unloading, the unloading time takes approximately 45 minutes in total process according to the time measured at the working-site (including incoming, registration, preparation, and outgoing). The current area is approximately 1500 square meters. In the current system, the cost will be the operation cost only for one forklift (gas, maintenance etc.) and one forklift driver.
5.3.2 Alternative 2: Increasing number of forklift and conveyor belt

In the current system, unloading process takes approximately 30 minutes (include incoming, registration, preparation and outgoing 45 minutes). Increasing the number of forklifts and conveyor belts from 1 to 2, the expected process time will automatically be reduced approximately 50% and it will be 15 (totally 30) minutes. The area in this layout is the same as the current layout since we don’t need extra area in this layout. In addition, the cost for this alternative will be increased since we increase one more forklift and one conveyor belt. Thus, the cost of having extra equipments and workers will include acquisition cost of forklift, conveyor belt, and one more labour. See the figure 5.2.

Figure 5.2: Increasing number of forklift and conveyor belt
5.3.3 Alternative 3: Multi-truck layout

The figure below is the simulation designed for new receiving layout. The design is modelled to have three truck trailers parking at the receiving area with 45 degree to warehouse. This layout is created based on the size of truck trailer. The size of the truck trailers determines the dimension of the area, which is shown in the figure that the length and width of the new area are 66 meters and 62 meters respectively. The area is approximately 4000 square meters. This will in turn decrease the cost of space. Besides, there is a free space for arranging the rest area for truck drivers. The cost in this layout will be more expensive than those two alternatives since we increase number of equipment, labours, and at the same time increase the area. The unloading process begins with the first truck trailer approaching the receiving area, after this step in order for registration of truck and preparation of truck for unloading to follow it, and these steps totally take around 10 minutes. With the unloading process, there are two forklifts and two conveyor belts for unloading the pallets, thus this will decrease unloading time approximately 50%. Then, the forklifts start unloading pallets to put them on the conveyor belt. It takes approximately 15 minutes to complete the process while the second truck trailer coming to park at the end of the first truck trailer, and the third truck trailer does the same. When the first truck trailer finishes unloading, the forklifts will start unloading the second truck trailer, and this will eliminate to incoming, registration and preparation time of the second and third truck trailers, that will take approximately 20 minutes (10 minutes for each truck). At the same time, this system will eliminate outgoing time of the first and second truck trailers. When the set of three truck trailers is done, the total process time takes around 60 minutes, this mean is 20 minutes for each truck trailer and decreasing of total time more than 50%.
Figure 5.3: Multi-truck layout

Table below shows the process time for 1 truck trailer for each alternative, together with the effect of required area.

Table 5.1: The comparison of time and area for alternatives solution

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incoming, registration,</td>
<td>10</td>
<td>10</td>
<td>3.33</td>
</tr>
<tr>
<td>and preparation time</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rest area for truck drivers

66 m

6 m

5 m

17 m

17 m

17 m

17 m
### 5.4 MCDM analysis

After interview with the production engineer, the importance of criteria’s weighted like in the table. In addition, according to the principle of logistic system, time criterion is prioritized, whereas cost and area criteria are minor concerned with logistic system. Due to the most important criteria of logistic system is delivery on time.

The evaluation of alternative by using MCDM indicates that alternative 3 is the best solution for IntraLog unloading process, see the table 5.2.

#### Table 5.2: The multi criteria decision making for evaluation of alternatives

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
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<tbody>
<tr>
<td>Weight</td>
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<td>3</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Rating</td>
<td>1,5</td>
<td>5</td>
<td>2,5</td>
<td>9</td>
</tr>
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<td>Score</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Rating</td>
<td>0,3</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Cost</td>
<td>2,1</td>
<td>5</td>
<td>1,5</td>
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<tr>
<td>Area</td>
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<tr>
<td>Rating</td>
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</tr>
<tr>
<td><strong>Total Score</strong></td>
<td>5,2</td>
<td>5,6</td>
<td>6,9</td>
<td></td>
</tr>
</tbody>
</table>
6. Results

Chapter 6 presents the results of the thesis.

After empirical data obtained, three alternatives have been created and analysed these by means of MCDM for IntraLog logistic centre. The scores of each alternative gained from the evaluation are shown in the table together the comparisons of alternatives with respect to criteria. Alternative 3 is the best solution compared with those two alternative. However, it is the most expensive because of factors involved in it like area, equipment, labours, and so on. In fact, in the long run according to the concept of cost effectiveness, it will decrease total cost by decreasing operation time. Moreover, the benefits of the cost decreasing is shown on appendix 4.

Table 6.1: The comparison of alternatives

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>5.2</td>
<td>5.6</td>
<td>6.9</td>
</tr>
<tr>
<td>Time</td>
<td>The current layout procedure take the highest time consuming, around 45 minutes.</td>
<td>Increasing number of equipments i.e., conveyor belt and forklift, decrease the operation time to 30 minutes.</td>
<td>Developing from alternative 2 and redesigned the layout, operation time decreases to 20 minutes.</td>
</tr>
<tr>
<td>Cost</td>
<td>The cheapest budget since it is the current system.</td>
<td>The operation cost increase a little more than the current system, depending on the number of equipments and workers.</td>
<td>The cost is the largest since the designed have been created for larger area, more equipments, and more workers.</td>
</tr>
<tr>
<td>Area</td>
<td>The current layout approximately is 1500 m².</td>
<td>The area is the same as the current layout since the area is enough for increased equipment.</td>
<td>Multi trucks layout needs more area for manoeuvring and utilization also safety concerned. The new layout is required approximately 4000 m².</td>
</tr>
</tbody>
</table>
7. Conclusions

This chapter presents the conclusions of the thesis according to the theme.

Comparison of criteria and result of MCDM shows the most effective and the best solution is alternative 3 (multi truck layout). According to the main idea of logistics, which is delivery products on time, and safely, the alternative 3 satisfies this concept. Alternative 3 will provide several aspects of advantages for the new logistic centre. Also, it will help to achieve their future aims. Some advantages of multi truck layout such as;

- Time efficiency
- Efficient area utilization
- Total cost shall be decreased.
- Increase capacity depending time utilization
- Decrease waiting time for truck drivers
- More comfortable for truck drivers
- Increase safety factors
- More flexible in operation

Consequently, the case company will be able to gain this advantages. The case company will be able to increase their capacity to satisfy the future needs and competitive.
References

References used to write this thesis is presented below.

Literatures


Järvinen, P. (2001).“On research methods”, Juvenes-Print


Scientific articles


**Internet sources**


# Appendix 1

**The receiving and shipping analysis chart** Tompkins et al. (2003)

<table>
<thead>
<tr>
<th>Company</th>
<th>Date</th>
<th>Raw Materials</th>
<th>Finished goods</th>
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<tbody>
<tr>
<td>Prepared by</td>
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<td>Plant Suppliers</td>
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<table>
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<th>UNIT LOADS</th>
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<tr>
<td>Description</td>
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<table>
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<th>Mod</th>
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<td>Shipment</td>
<td>on</td>
<td>Method</td>
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Appendix 2

**Minimum Maneuvering Allowances for Receiving and shipping Areas**, Tompkins et al. (2003)

<table>
<thead>
<tr>
<th>Material Handling Equipment Utilized</th>
<th>Minimum Manoeuvring Allowance (ft)</th>
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<td>Tractor</td>
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<tr>
<td>Platform truck</td>
<td>12</td>
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<tr>
<td>Forklift</td>
<td>12</td>
</tr>
<tr>
<td>Narrow-aisle truck</td>
<td>10</td>
</tr>
<tr>
<td>Hand-lift (Jack)</td>
<td>8</td>
</tr>
<tr>
<td>Four-wheel hand truck</td>
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</tr>
<tr>
<td>Two-wheel hand truck</td>
<td>6</td>
</tr>
<tr>
<td>Manual</td>
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Appendix 3

MCDM scale

The MCDM scale has been set up from 1 to 10 units depending on the degree given by prioritizing. Table appendix 3.1 below is the description of MCDM rating.

Table appendix 3: description of MCDM rating

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<th>Descriptions</th>
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<td>4-6</td>
<td>The fairly significant effect</td>
</tr>
<tr>
<td>7-8</td>
<td>The high significant effect</td>
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<td>9-10</td>
<td>The highest and most significant effect</td>
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## Appendix 4

<table>
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<th>daily working hours</th>
<th>A 1</th>
<th>A 2</th>
<th>A 3</th>
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<tr>
<td>16h = 960 minutes</td>
<td>31</td>
<td>20</td>
<td>14</td>
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| number of uploadable trucks | 960/31 = 31 | 960/20 = 48 | 960/14 = 68 |

- Each truck averagely has 11 pallets
- Each pallet averagely has 100 items
- Each item averagely provides 5 kr net benefits for company.
- Annual working days = 260

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<th>Annual net benefit for Alternative</th>
<th>Annual net benefit for Alternative</th>
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NPV = 89869

NPV = 127315

NPV = 5307

NPV = 1689