IMPLEMENTATION OF A TRANSPORT MANAGEMENT SYSTEM (TMS) A CASE STUDY

CHAYAWICH RAHONG

AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
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KMITL-2017-IC-M-002-005

THESIS TITLE	Implementation by using Transportation Management System
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ABSTRACT

As present, transportation of food and beverage products has various challenges in supply chain. Transportation is an important part in logistics as it drives business. In addition to appropriate transportation management, four additional factors are necessary which include on-time delivery, traceability, fuel cost management and truck utilization. These factors pose challenges to entrepreneur in terms of profit and customer satisfaction. The obstacles of transport management are inexperience in transport management. Fortunately, the Transport Management System (TMS) can manage the operation appropriately, but the important thing is that business owners need know what necessary information is required for operating the TMS and how can they apply TMS to their businesses. Therefore, those who read this work and business operators using the TMS can run their business and follow up the transportation cost from the report generated by the TMS. This study will explain the transport operation flow and how the TMS can be applied in business operation to improve transport operation by reducing manual processes. Moreover, this study will describe the transportation KPI generated from the TMS in order to indicate the operation efficiency. Therefore, the TMS is the valuable tool for supporting the management level.

This study found that effective transportation management related to warehousing and transport subcontractors could be implemented and improved in terms of benefit by using Transport Management System.

ACKNOWLEDGEMENT

Without the contribution of many people, this independent study would not have existed. I am deeply thankful for my Asst. Prof. Dr. Phaophak Sirisuk of International College at King Mongkut's Institute of Technology Ladkrabang, his patient proof reading toward the completion of my independent study. From the depth of my heart, his invaluable advice gave me a fire of hope and made me never give up on fearful days. He always gave me a good technique to fulfill my study that I could apply to my Transport Management System study.

Furthermore, I would like to thank my good classmate, Miss.Chanate Khokham who gave me good guidelines and suggestions and cheered me up. I would like to express my deepest gratitude for the encouragement and supervision to help me get through all obstacles and challenges since the beginning until the end of my study. I would also love to express my gratitude to all respondents who contributed their information and time to this study.

Additionally, I must express my greatest gratitude to my parents and my aunt who support me to pursue my master degree. I would also like to thank the people whose names are not mentioned here who are a part of my independent study.

Chayawich Rahong

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LIST OF SYMBOLS

DFD	Data Flow Diagram
TMS	Transport Management System
AVL	Automatic Location System
KPI	Key Performance Indicator
DC	Distribution center
CE	Cause-And-Effect
DOT	Delivery On time
LPM	Logistics Performance
STM	Smart Transport Management
SCIT	Supply Chain Information Technology

LIST OF DEFINITIONS

CHAPTER 1

INTRODUCTION

1.1 Research Background

Currently, transportations are important for all business sectors such as raw material supply, manufacturing and selling. Transportation costs reflect the costs which influenced the total cost of goods and services. Once the fuel price is increased, traders must bear the burden of transportation. Therefore, they must have good strategies in their business e.g., using alternative energy or using other transportation such as CNG gas, rail transportation mode, air freight etc. However, to get rid of non-value-added cost by using backhauling management strategy is not very efficient due to the unknown demand of product shipping and destination. Importantly, the demands of product shipping at the source and destination are different. If the quantity demand of source and destination are almost equal, the important strategy is using the information technology to support and decrease transportation cost, which is called the transport management system (TMS). This system will cover routing, truck utilization and Automatic Location System (AVL). The important fundamental information consists of protective human error, data accuracy and compatibility with company activity in order to achieve the key performance indicator (KPI).

1.2 Background and Statement of Problem

In 1980, Thailand began fast foods restaurants. Today, there is a company which has launched more than 10 brands and 1,000 restaurants across 13 countries in Asia, all of which are franchised and self-managed, and the company has long had competitors competing against warehouse support in the various growing markets. This company is run under the name Company A.

Currently, the company has become known by those who have just started their restaurant business startups under the name “A”. As the trend of consumer was increased, the logistics and supply chain concept is very important in the business. Stores must forecast customers’ orders to balance the stocks between supply and demand. The Warehouse is considered to be a strategic facility and one important part in supply chain, in addition to serving as an inventory buffer against short term fluctuation of demand or supplies. Transportation is an important part, as products have to be transported to be stored at the right time, right place, right quality, right quantity and right cost.

The main problem of the company is the problem of route planning since most of the process is performed manually. It is the key factor because it associates with transportation and responsiveness to customer needs. Now, there are 2000 stores in the delivery plan, which is separated by windows time and types of product: frozen and ambient. Every day, the transport team will receive the outbound reports categorized by zone (upcountry zone and Bangkok zone). Then, the team will calculate the cube and weight for planning the delivery in the form of excel file manually. After they finish planning the delivery, they have to call subcontractors to ask the availability of truck on hand. Once the subcontractors confirm the available truck, the team will record the subcontractor’s name and truck number in the excel file. On the next day, the truck will come to DC to load the products and get the work sheet to record the delivery details such as on docking time, loading start time, loading finish time, departure time from DC, arrival time to the store and departure time from the store. Then, the team will return the work sheet to DC in order to receive payment from the transport accountant. The accountant will also fill in the delivery record in the excel file and use the formula

in excel software to create the check payment as part of the key performance indicators such as truck utilization report, subcontractor performance report, on dock and dispatch report, etc., which are also calculated manually by the analyst staff. Therefore, there is the need to develop the system to improve delivery planning, payment report and KPI report.

The transport management system must be created by using operation practices. All of the functions in the TMS program have to be used easily. The planner can request the truck automatically. On the other hand, subcontractors can also access the TMS in order to confirm the truck. Furthermore, the TMS can generate the real-time report which helps to make decisions easily when there is a problem with available trucks. It can also decrease accountants' work load. Eventually, all logistics and supply chain can be benefited from the TMS used as a business target planning.

1.3 Objectives of the Study

1. To study and solve the manual processing problems
2. To develop and design the TMS in order to improve the efficiency of delivery
3. To study and implement the delivery report by using the TMS

1.4 Scope of the Study

1. The data used in the study are of year 2017, and the company will use a case study approach to study such data.
2. The delivery management with the TMS program is used for analysis.
3. The management of delivery by using the TMS focuses on the planner, despatcher, analyst, accountant, and subcontractor.

1.5 Research Methodology

This project is divided into seven parts, namely:

1. Identification of the problem: the first step is to identify the problem from the point of operation view, here being Company A.
2. Definition of the problem: after problem identification to find what the problem is which may be related to operations, the definition of the problem will be clearly defined to set the scope, aim and objective of the project.
3. Literature review: the next step is to review literatures, solve the problems by using the knowledge and substantive theory with different models which can be improved by processing or technological techniques.
4. Data collection: the forth step is to collect valuable data which can be analyzed in the project. Data collection is the process of gathering and measuring information systematically. Data can be collected by interviewing or using questionnaires.
5. Problem solving by using several tools
6. Solution and validation analysis
7. Implementation and recommendation: this step is to see whether or not a company can improve and apply the tools.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses all the theories used in the study to improve the transportation process in this company. This chapter will begin with survey and describing the business flow of the company, explaining the theory of data flow diagrams with DFD symbols, explaining the meaning of DFD's components and showing example of DFD level 0-1. The questionnaire design theory and the difference between survey and in depth interview will also be explained in this chapter. After that, the theory of fish bone diagram will be described and used to analyze the problems in Chapter 3.

2.1 Survey

In order to understand the problems, the researcher conducted a survey concerning the transport operation. The survey allowed the researcher to understand each transport operation issue.

2.1.1 Definition of Survey

The researcher defined a survey as “any activity that collects information in an organized and methodical manner concerning characteristics of interest from some or all units of a population using well-defined concepts, methods and procedures before compiling such information into a useful summary form”. [1]

2.1.2 Type of Survey

There are two kinds of surveys: sample survey and census survey.

2.1.2.1 Sample Survey: data are collected for only a fraction (typically a very small fraction) of units of the population.

2.1.2.2 Census Survey: data are collected for all units in the population

2.1.3 Steps of Survey

- Formulation of the statement of objectives
- Selection of a survey frame
- Determination of the sample design
- Questionnaire design
- Data collection
- Data capture and coding
- Editing and imputation
- Estimation
- Data analysis
- Data dissemination
- Documentation

A survey is a much more complicated procedure than simply asking questions and compiling answers to produce statistics. Numerous steps must be carried out following precise methods and procedures, if the results are to yield accurate information. [1]

2.2 Data Flow Diagram

2.2.1 Data Flow Theory

Data flow diagram is a tool to represent the information of business process. It shows the process or activities and the relation of data movement. DFD helps users to understand the process and analyze the system. [2]

2.2.2 Element of Data Flow Diagram

DFD makes users understand the system design clearly and quite effectively. It is a notational language for communication, and it shows the data flow of various

functions in the system, as well as giving an overview of system process. There are symbols of DFD as shown in the table below:

Symbol Name	Symbol	Meaning
Square		Source or Destination of Data
Arrow		Data flow
Circle		Process transforming data flow
Open Rectangle		Data Store

Figure 2. 1 DFD Definitions and Symbol

Process

A process is a symbol to show activities or functions of business. Every process should start with a verb and ending with a noun. It should be short wording with enough information which can easily be understood. There is an arrow to show the direction of input and output.

Data Flow

A data flow is a single piece of data and glue that holds processes together. Every data flow should be named with a noun. The data flow diagram is always drawn from the operational step which shows the relationship and connection among the steps.

Data Store

Data store contains both input and output data. As there are two types of data, the data need to be stored for future use. Every data store is named with a noun. All data stores must have at least one input data flow.

Source or Destination of Data

An external entity is a person, organization or system related to external processes. [2]

2.2.3 Data Flow Level

DFD has several levels. The first level of DFD is a context diagram which shows the overall business process and data flowing to and from external entities and the next level. DFD at Level 1 shows the main processes and secondary data involved in the system, including relevant sub-processes. It is different from Level 0 as there is a diagram in the data store.

The second level of DFD shows the process flow in level 1. This second level consists of a sub-process of the first level using decimal number to define the relationship between the processes. [2]

2.3 Flowchart

A flowchart or process map identifies the sequences of activities of the flow of material and information in a process. The flowchart helps people involved in the process to understand the process much better and more objectively by providing a picture of steps. [3]

2.3.1 Swimlane Flowchart

A special chart showing the relationship between the business process and the functional units, a Swimlane flowchart can help highlight an important function for each department separately. [4]

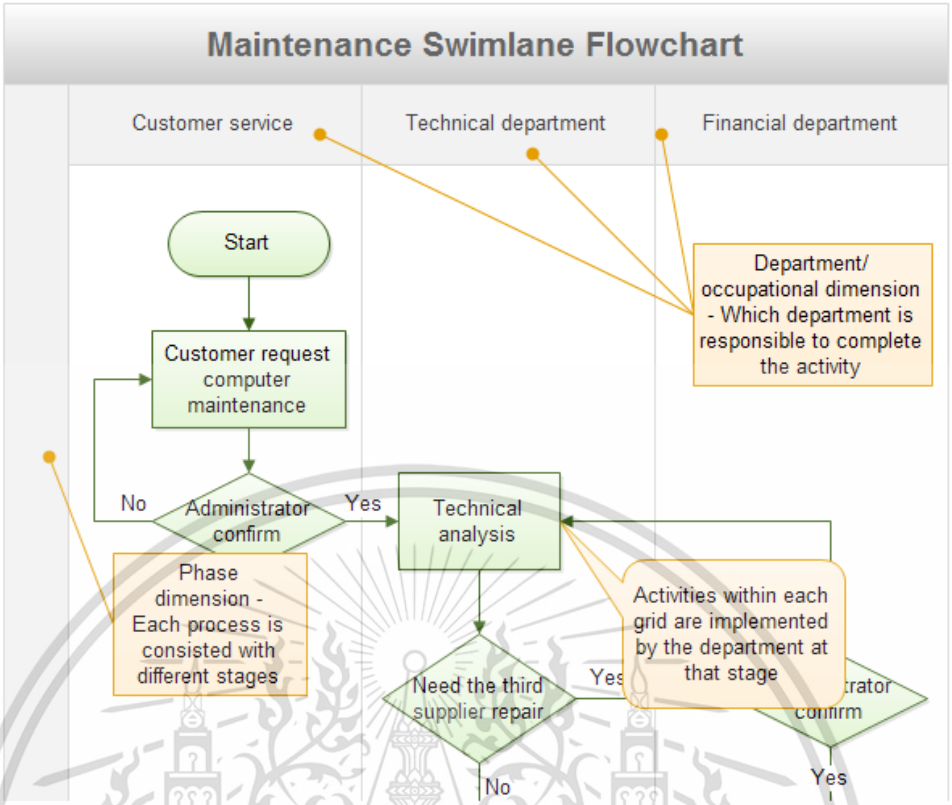


Figure 2. 2 Maintenance Swimlane Flowchart

Source: https://www.edrawsoft.com/how-to-swimlane.php

2.3.2 Work Flow Diagram

A workflow diagrams can help solve specific problematic areas in business processes and show the workflows for business process. It helps employees to know how they are related to other departments. [4]

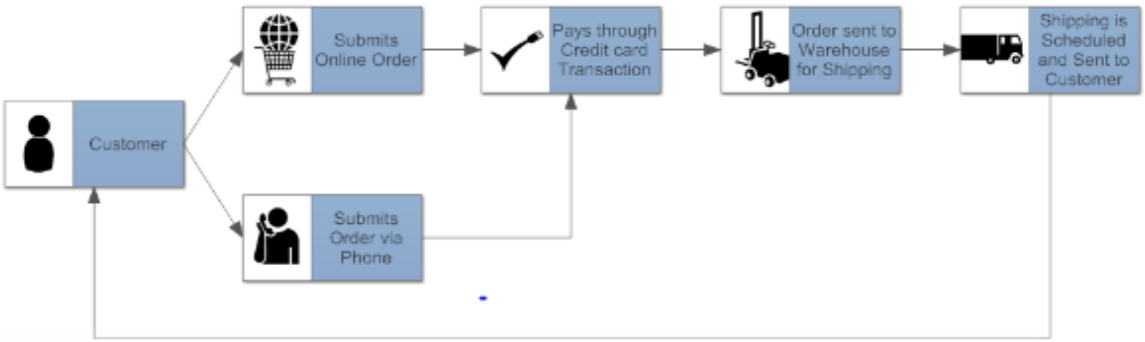


Figure 2. 3 Work Flow Diagram

Source: https://www.smartdraw.com/workflow-diagram/examples/ecommerce-workflow-diagram/

2.4 Fish Bone Diagram

2.4.1 Fish Bone Diagram Theory

The history of fishbone method was discovered in 1943 by Dr. Kaoru Ishikawa who developed the cause-and-effect (CE) diagram which was composed of lines and symbols to represent the relationship between the cause and effect. A fish bone diagram is defined as a tool to identify many possible clauses that resulted in the main problem. The fish bone diagram can determine the problem for each department related to the main problem. Thus, it is easy to understand problems in other department. [5]

2.4.2 Elements of Fish Bone Diagram

The fish bone diagram or CE diagram shows the effect on the right and causes on the left. The effect is the thing that needs to be improved and the causes can be broken down into the major clause, work methods, materials, measurements, people and

environment.

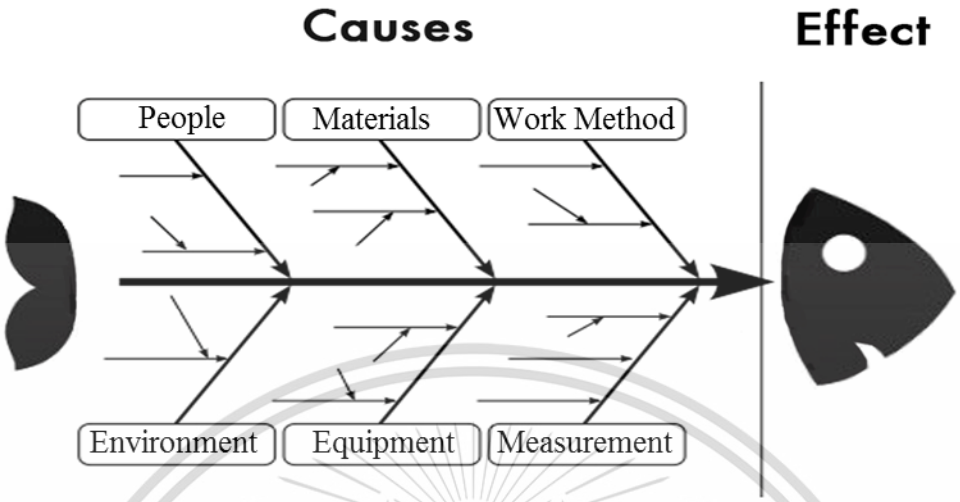


Figure 2.4 Fish Bone Diagram

Source: https://www.leanstrategiesinternational.com/listen-to-the-gemba/the-fish-bone-diagram-7-basic-quality-tools

2.4.3 Steps for Creating Fish Bone Diagram

There are 6 steps to create a fish bone diagram as follows:

1. Determine the problem at the fish head
2. Determine the factors that cause the problem
3. Brainstorm causes of each factor.
4. Find the root cause of the problem
5. Prioritize causes
6. Find ways to improve

2.4.4 Determination of Factors on Fish Bone

The fish head represents the main problem. The fishbone diagram consists of the following sections, and causes can be further subdivided as follows:

1. Team members raise ideas about minor causes during brainstorming.
2. Criticism of an idea is not allowed.

3. Place all the ideas in the diagram.

4. Create a solution by using why, what, where, when, who and how techniques.

2.4.5 Determination of Problem on the Head of the Fish

The main problem is identified at the fish head on the right side, and the problem should be identified correctly and clearly. The problem should be consistent with the method. After determining the problem, the researcher can brainstorm and gather evidences to identify the major clauses and place them on the diagram. [5]

2.5 Questionnaire Design

According to the definition of a questionnaire, a questionnaire is a research instrument used to collect data. It always contains sets of oral or written questions. All question listed will be asked to people, and all the answers obtained will be analyzed according to the purposes of questionnaire. However, the questionnaire cannot be completed by itself, as it is only a vehicle to transfer information. The interviewer should know how many interviews are needed, who will be interviewed and how the interview will be carried out. [6]

2.5.1 Four Purposes of Questionnaire

1. The accurate information is obtained by asking the right question to the right person.
2. The logical sequence of question should drive toward and move smoothly to the next subject.
3. The questionnaire is to provide a standard form on which facts, comments and attitudes can be recorded.
4. The answers from different people are recorded in the place where the processing team can find.

2.5.2 Type of Questionnaire

1. Structured: in the structured interview, the questionnaire contains only closed-ended questions, most questions have predefined answers. The researcher structures the questions used in the interview prior to data collection.
2. Semi-structured: the semi-structure questionnaire contains a mixture of questions with predefined answers. It is more flexible than the structured questionnaire.
3. Unstructured: it used in an informal interview. Questions will be selected during the interview, and the interview is often recorded on a tape.

2.5.3 Setting Up Question

1. Will this question be understood in the way that I intend?
2. How many different ways could this question be interpreted?
3. Is this question likely to annoy or offend?
4. Is there a better way of asking the question?

2.5.4 Layout of Questionnaire

In terms of layout for data processing, it is a large and necessary part concerning how to record answers and how to save time and cost. Most of data processing uses the numerical columns to record individual responses. The numerical columns in the following self-completion example have been placed at the top of the column.

The questionnaire refers to the form of a series of questions. It has been collected systematically to measure facts from the sample group. The questionnaire contains questions to gather information about opinions or facts by submitting the questionnaire to volunteers. [6]

The questionnaire is a popular research tool because it is convenient for data collection. Besides, it can measure samples widely. The questionnaire is can be answered by interview or self-response.

The structure of the questionnaire consists of three main sections: explanations, questions about personal data and questions about features or variables to measure which is the respondent's opinion on the feature or which is the variant. [6]

2.5.5 Steps for Designing a Questionnaire

When the researcher knows the features or issues to measure and define the types of questions that will be included in the questionnaire, the researcher writes questions to cover all the features or issues that will be measured. The principle of creating the query is as follows: [6]

1. Define the exact aims, create questions and see if they are related to the objectives of the research.
2. Create questions according to the purposes and avoid creating questionable issues and too many questions
3. The questions must cover the subject of measurement, and they must be sufficient.
4. The sequence of the questionnaire should be serial to make the reply clear and easy to answer. In addition, a simple question should be the first to induce the respondent to answer the question. The important questions should not be placed at the end of the questionnaire because the respondent may be less interested by then.

2.5.6 Scale and Scoring Measurement in Questionnaire

The significance in the questionnaire is to use a scale that provides the necessary and appropriate information to the respondents. There are two types of response: fixed response and open response. The fixed response consists of yes/no or true/false. [7]

2.6 Important Function of TMS

Transport management system is defined as an information technology tool to plan, optimize and execute transportation operations. The TMS planning application includes the following functions. [8]

2.6.1 Routing and Scheduling is proper planning of delivery with a major impact on customer satisfaction. The TMS software uses mathematical methods and optimization routines to evaluate possible combination in which routes could be run to get the most benefits.

2.6.2 Load Planning in TMS helps transportation planners or managers to build the database of package dimension, load requirements, equipment capacity. All orders with multi- weight, cube and cartons number travel together. The TMS assists and choose the optimization resulting in a more efficient use of space.

2.6.3 Status Tracking of in-transit delivery can be monitored by using the TMS connected to the satellite. The TMS is a tool to provide timely information regarding potential of delivery.

2.6.4 Appointment Scheduling is one of the TMS abilities. It is used to automate the scheduling function and provide real-time visibility which makes it easier for scheduling. The scheduling function can also provide pickup and delivery time at specific dock locations for carriers. These systems help carriers avoid time-intensive phone calls, interim stops and wait time.

2.6.5 Performance Reporting and Score Carding in TMS can automate the collection of data, measurement of KPIs and dissemination of periodic reports. Customized reports such as monthly carrier performance, scorecards and benchmarking analyses can be generated by the TMS. The transportation manager can make proper decisions by using information in future.

2.6.6 Billing of payment made to carriers must reflect the agreed-upon contractual rate and service agreement. The TMS software creates invoices according to the rate specified in the contract with subcontractors automatically. Each route contains details of payment such as type of vehicle, distance, etc., and the payment rate varies. Before this system, staff had to retrieve data from Excel files, but now the TMS calculate the data automatically.

The challenge of technology is that it is forever changing and expanding. Technology helps transport operations to manage vast volumes of data and options in transportation in order to make better decisions regarding modal and carrier selection, routing, packaging, loading and competitive advantage in supply chain. [8]

2.7 Related Works

2.7.1 TMS with Key Performance Indicator

The quality of transportation services is crucial for monitoring activities thorough transportation metrics or key performance indicator (KPIs). It can be used to evaluate current performance to compare with historical results, internal goals and carrier commitments. On-time delivery is the most important KPI, and most of transportation buyer set 95 percent as a minimum acceptable level of performance. [9]

2.7.1.1 Delivery Performance Measurement

At present, the standards of measuring the main performance of supply chain at level-2 of SCOR model consist of four elements as follows:

a) Supplier on time and in full delivery

b) Manufacturing schedule attainment

c) Warehouse on-time and in full

d) Transport provide on-time delivery

In this independent study, the only focus is on the Transport Management System. In order to measure the delivery performance from the TMS, the TMS has been designed to measure the delivery performance automatically. During the transportation, the on-time delivery can be considered as the ratio to measure the performance. The on-time delivery ratio is the number of times the transportation provider (3PL) place trucks on time according to requests.

$$\text{On time delivery} = \frac{\text{No. of times trucks placed on time}}{\text{Total No. of times facility requestedper period}} \quad (2.1)$$

The fast paced business environment and logistics performance are prerequisites in the competition, and the effectiveness of logistics is important for responding to the rapid business change and competition. The researcher found that there was a research study about on-floor truck utilization by using algorithm for SKU mixing. The research revealed that the linear programming model could create algorithm to decrease the frequency of the trucks. The model showed that the algorithm could be applied with multiple SKUs with various sizes and density units in multiple customers. Therefore, if the researcher can apply the algorithm to create the optimal model in the TMS, it will

help to improve the operation and performance as well as decreasing the frequency trucks. [10]

2.7.1.3 Vehicle Utilization by Using Linear Programming Model

The objective is to maximize the weight of each truck in progressive sequence. More weightage is assigned to first shipments and linearly decreasing weights to the consequent shipments. [10]

21(ΣTruck 21 Xi * weight) + 20(ΣTruck 20 Xi * weight) + 19(ΣTruck 19 Xi * weight) +……+ 2(ΣTruck2 Xi * weight) + 1(ΣTruck 1 Xi * weight)

Note: Xi are SKU decision variables and Xi is binary with 1 representing that a SKU has been selected for a shipment, or 0 representing that that SKU has not been selected for a shipment.

Constraints*:*

The weight of each shipment is Σ Wi * Xi <= 7000 kgs (As all capacity trucks used were 7 tonners only).

The volume of each shipment is Σ Cubic * Xi <= 1280,1408,1536,2048 CFT (depending upon truck size 20,22,24,32 feet).

Each SKU is allocated to only one shipment: $\Sigma\ Xj; = 1$

Note: j is the number of shipments (twenty-one in this example)

A detailed analysis of the company data was conducted which concerns the various products' **volume and density**. The products were categorized into three categories:

1. Cube constrained (1.11 to 4.0 Kg/CFT)
2. Neutral (4 to 5 kg/CFT)
3. Weight Constrained (Above 5 Kg/CFT)

Based on the above analysis, to achieve the optimum capacity in terms of cubic fill & weight fill, the mixing of SKUs in terms of percentage was suggested as shown in the table below

Table 3: Categorization of SKU's		
Category	% of Truck Volume (24 Feet truck)	% of Truck Volume (32 Feet truck)
Cube	40%	40%
Neutral	40%	50%
Weight	20%	10%

Table 2. 1 Portion of Categorization of SKU"s

The research found that there was feasibility of linear programming to decrease the frequency of truck by mixing the multiple products which had multiple weights and cubes for loading. Therefore, the model proposed in the analysis can improve truck utilization. [10]

2.7.1.4 Measuring Vehicle Utilization Type

In terms of utilization of vehicle fleets, each type gives a slightly different impression of transport efficiency. [11]

2.7.3.1 Tonne-kilometres per vehicle per annum

2.7.3.2 Weight-based lading factor

2.7.3.3 Space-utilization/vehicle fill

2.7.3.4 Empty running

2.7.2 TMS with Transportation Cost

In this research, the transport system is described as the most important economic activity among the components of logistics systems. Around one thirds to two thirds of the expenses of enterprises' logistics costs are spent on transportation.

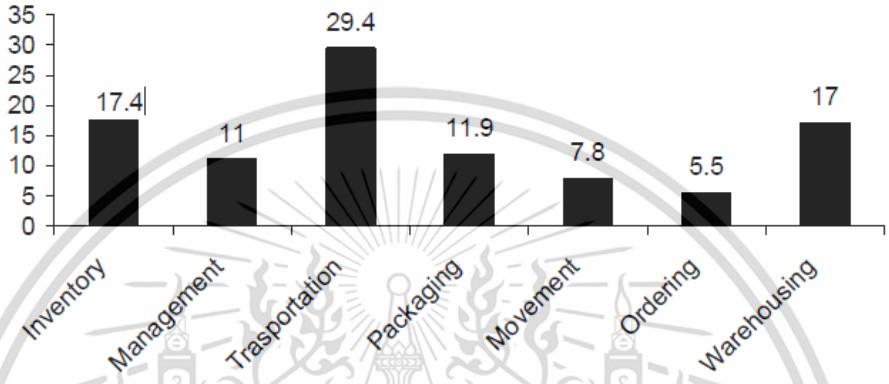


Figure 2.5 Cost Ration in Logistics Items

The researcher found that in the cost ratio in logistics items as shown in Figure 2.6 above, the highest cost incurred in logistics businesses come from transportation cost, inventory, warehousing and packaging, management, movement and ordering, respectively. The transport system makes goods and products movable and provide timely and reginal efficacy. For those products with small volume, low weight and high value, transportation cost simply occupies a very small part of sale and is less regarded. For those big, heavy and low-valued products, transportation occupies a very big part. [12]

2.7.2.1 Transport Optimal Cost Model

The researcher found the relation between cost and performance in supply chain. A simple method can be used to estimate the performance.

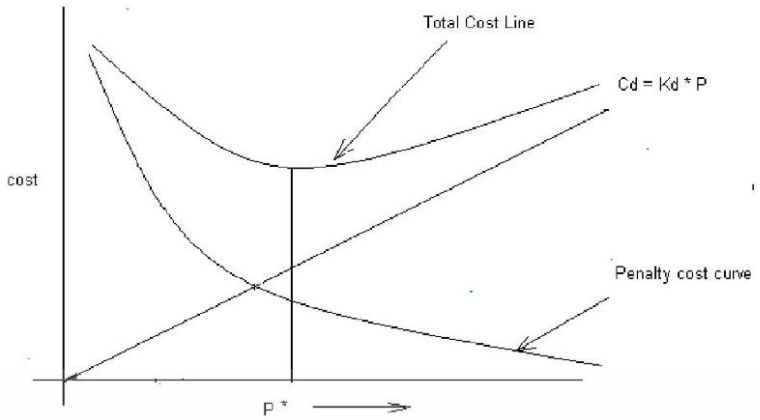


Figure 2 6 Optimal Cost Model

The graph in Figure2.7 above indicates that the optimal level of P is associated with minimum total cost. [12]

2.7.2.2 Transportation Rate

In this study, the researcher perceived the standard factor of transportation rate. The specific transportation rates vary by distance plus a variety of factors, including perishability and value of the product, nature of the competition for the specific route, season of the year, availability of backhauls, destination area, ease of delivery and a variety of standard cost factors. Truck rates change over time due to changes in fuel cost, inflation, etc. [13]

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Transport Operation

In this chapter, the process of transport operation will be described, starting with working process of business studied. All work flow processes will be analyzed and presented by context diagram and DFD level 0-3. The interview was used as a valuable tool to explain the problem which was related to each process, and the problem was furthered identified by using fish bone diagram conducted to consider and evaluate the cause leading to the main problem. Then, the present process and how to improve transport operation working process by using the TMS were identified.

At present, all transport operation processes are conducted manually by using Excel files. This creates work duplication with transport operation, and it is very hard for monitoring transport utilization. Consequently, the TMS application should be created to support the operation, as well as integrating all transport functions. There were four groups of operation users selected for the questionnaire which showed the result of before and after using the TMS application. The system will be applied only to transport operation staffs and subcontractor companies except goods receipt process at the destination store.

The survey questionnaire in this study was designed based on the transport operation process classified by user activities in order to collect data for analysis of problem. Each question contained scores. [1]

The purpose of data collection and analysis is to conduct surveys on the improvement of using the TMS application in foods business which is essential for data collection and analysis in diverse dimensions. The main data collected can be used as the guideline in comparison of benefit.

The procedure of the study consists of 6 steps:

Step 1 Determine the criteria to select appropriate groups of users in collecting date through case studies. This method reveals desirable attributes of users involved in the application.

Step 2 Select the groups of users that fall into the determined criteria

Step 3 Design questionnaires for the survey based on opinions and perspectives of each group of users.

Step 4 Collect data from the selected groups of users.

Step 5 Summarize data by normalizing them into readable and measurable forms.

Step 6 Score and analyze users' data by group and analyze the overall data.

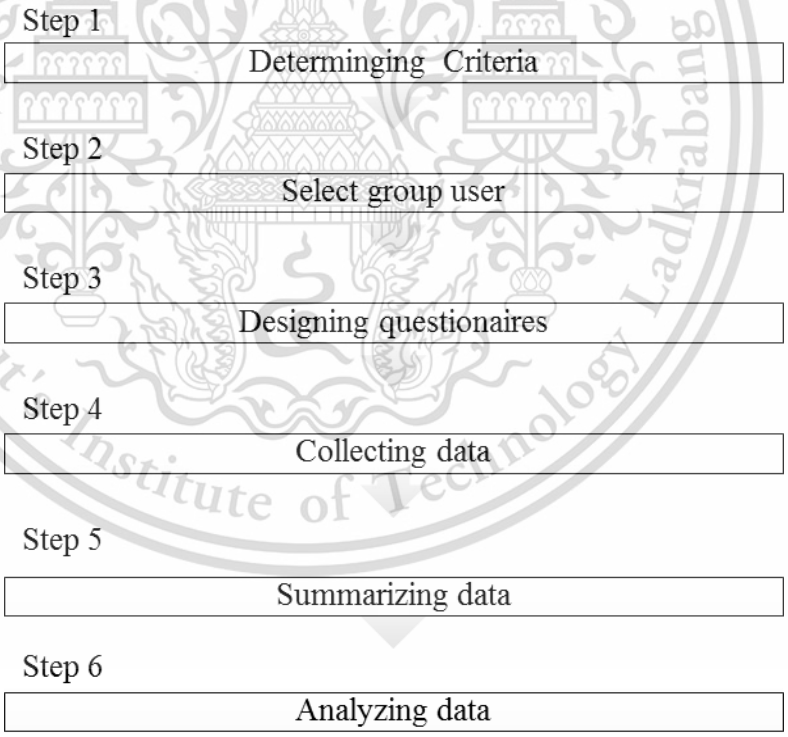


Figure 3. 1 Transportation Operation

The analysis of variance was used to test improvement of transport operation, and all answers will be adjusted to facilitate the data scoring.

3.1.1 Organization Chart

Figure 3.2 shows the organization chart where the operation director and site manager are on top of the chart. There are five managers in company, namely warehouse manager, security manager, accounting manager, customer Service manager and transport manager, and one group of support consisting of IT Technical, Maintenance, Human resources, Safety and Operation Analyst. All head counts would be managed by their line manager. They are in foods and restaurant business which serviced to almost 2,000 stores throughout the country. Moreover, they are experts of the 3rd party logistics company, and there have seven working days. The big challenge is how they manage logistics operation when a new store has been opened and the number increases every year. Thus, they aim to use information technology to support their operation.

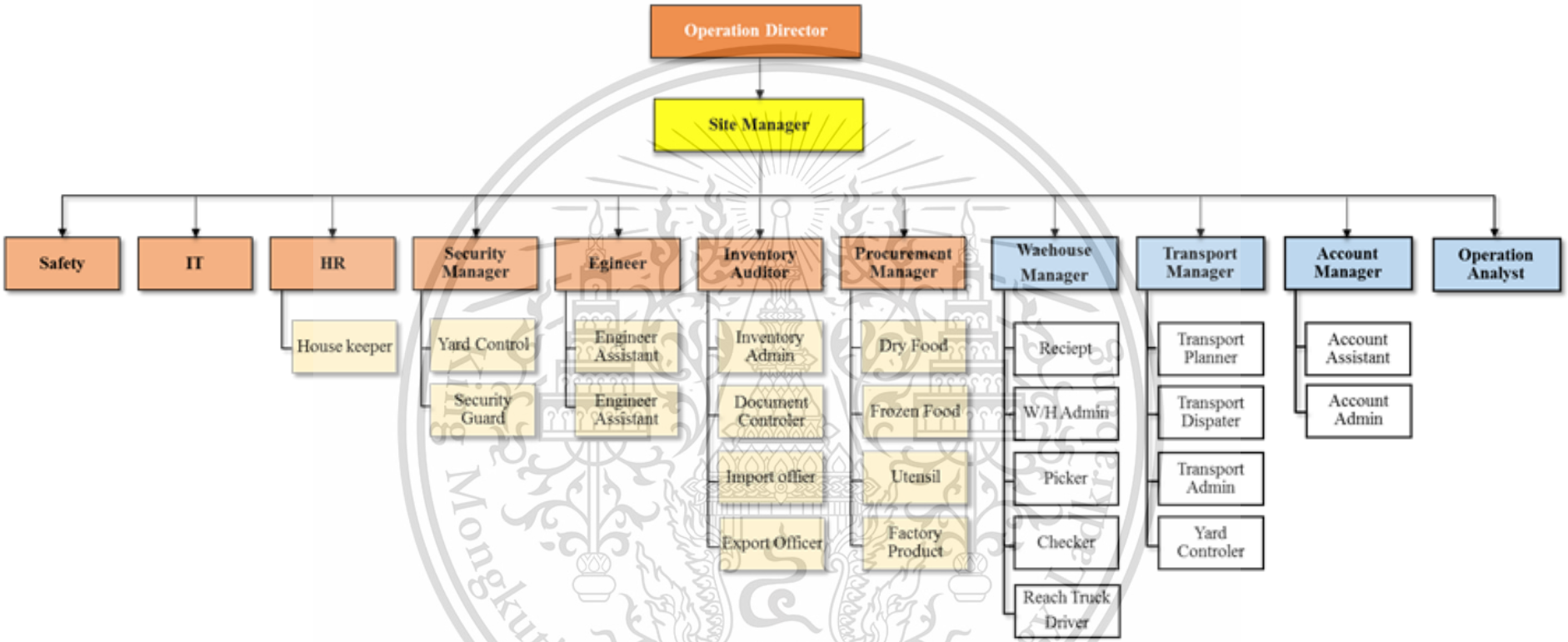


Figure 3. 2 Organization Chart

3.1.2 Overview Process

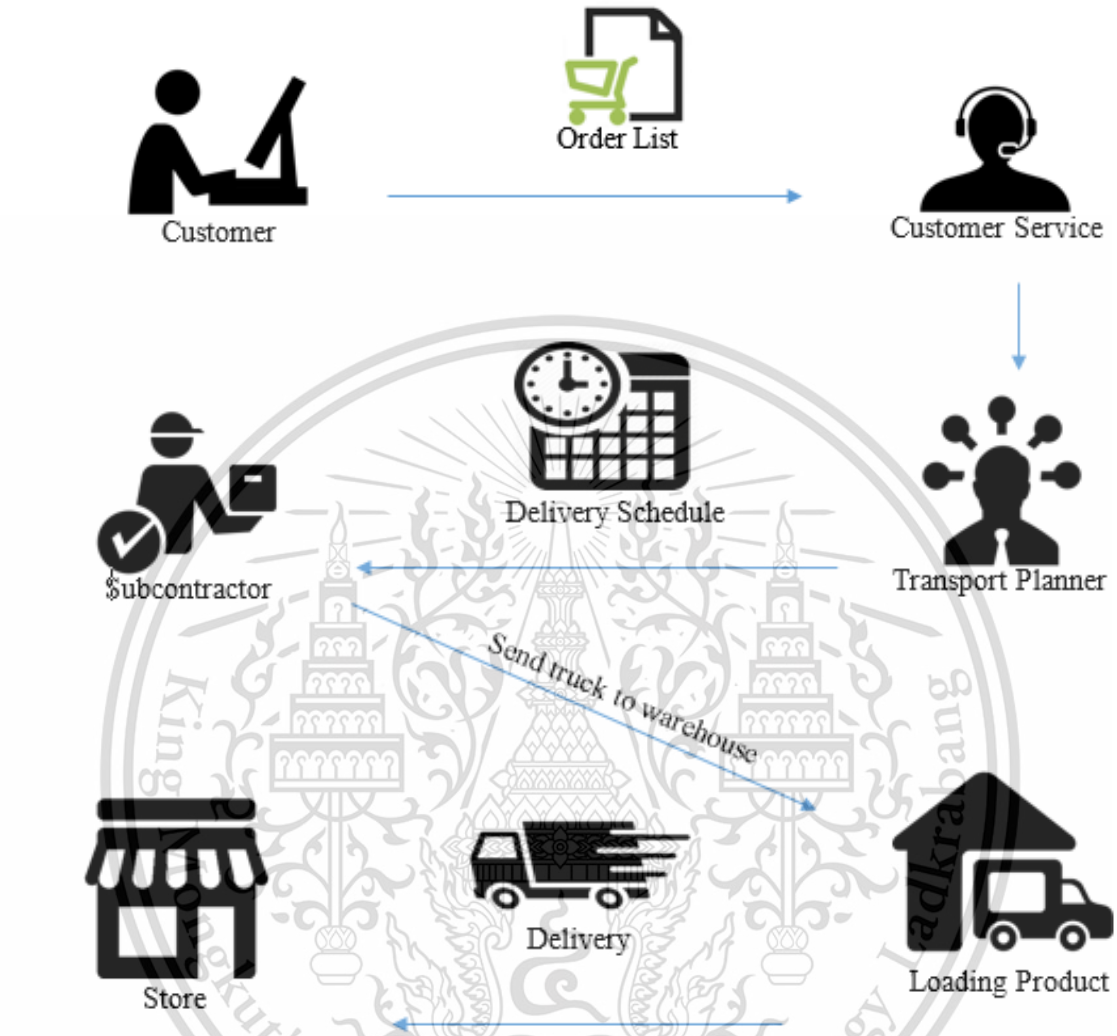


Figure 3. 3 Operation Flow for Product Delivery

3.1.3 Business Flow Diagram

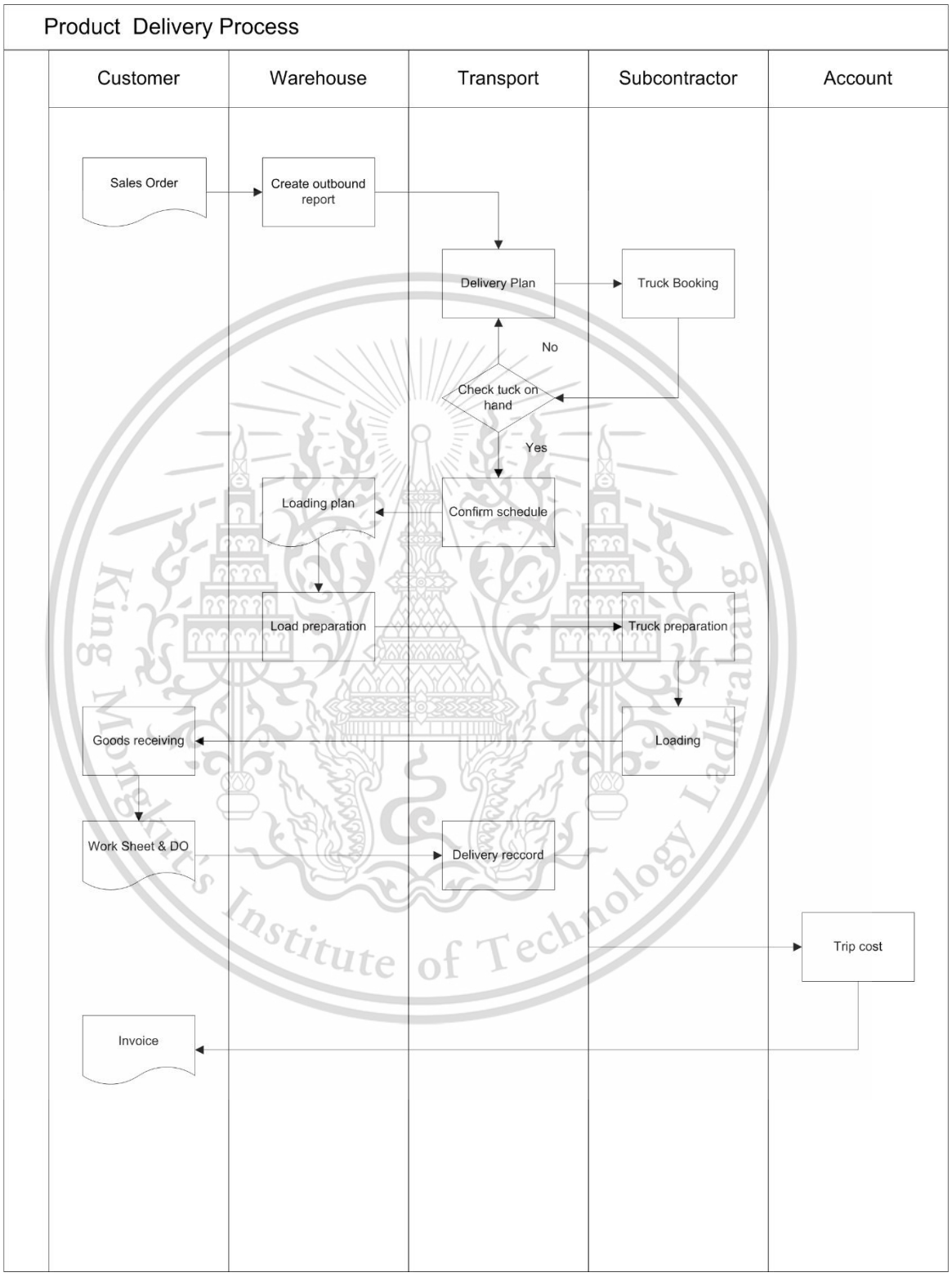


Figure 3. 4 Product Delivery Flow

3.1.4 Working Process in the Business

At present, stores key orders via the interfacing system as order cutoff time. Then, the distribution center system would calculate the stock level by looking at the demand of purchasing order from stores. Once the orders are keyed by the stores, the warehouse starts the outbound process by using the system to create outbound numbers in order to generate picking tasks. In this process, the outbound report completely created by the warehouse team is retrieved from the system in the form of Excel files, and then windows time is checked and outbound report is submitted to the transport planner team. Subsequently, the outbound report is used for delivery planning.

The planner team calculates the outbound volume and delivery weight to see if it fits with a truck type and drop the sequence. The two important things that the planner team must take into account is KPI report. The efficiency of truck utilization is shown on the Floor Utilization KPI report, and the efficiency of delivery will be shown on the Delivery on Time KPI report.

The planner team spends 2 or 3 hours to plan the delivery. When the delivery planning is completed, then the planner team starts to call subcontractors to proceed with the truck booking process. Once the planner team receives the quantity of trucks and truck confirmation from subcontractors, they will know how many trucks are on hand. Then, they record the truck type, truck number, driver's name and on dock time in the load plan and send it to the warehouse team. Afterwards, the warehouse team arranges the products by load sequence number according to the load plan. In this step, the warehouse team must perform dock management in order to ensure that the trucks depart from DC on time. If not, the truck driver may have a problem with on-time delivery and they may face with DOT KPI issue. Once the driver loads and checks the product quantity with the warehouse checker, they will record the departure time in an

excel template and get the delivery order document and work sheet from the transport despatcher. All of the transportation processes at the distribution center will be completed when the truck is dispatched from the warehouse.

The product receipt process starts at the store. The driver records the arrival time at the store, start unloading time, finish loading time, depart from store time, product quantity and kilometer into the trip sheet. However, if the driver finds that there are products missing, excessive or damaged, they must record it into the work sheet. Then, the store signs off the delivery document and seals the delivery document. In the next day after the delivery is completed, the driver must submit the delivery order document and work sheet to the transportation department in order to receive the payment for the trip. The account team checks the delivery document and delivery record submitted by the transport admin in excel files. They match delivery costs with trip rate numbers as agreed upon with subcontractors for payment.

All the processes must be done manually in excel files.

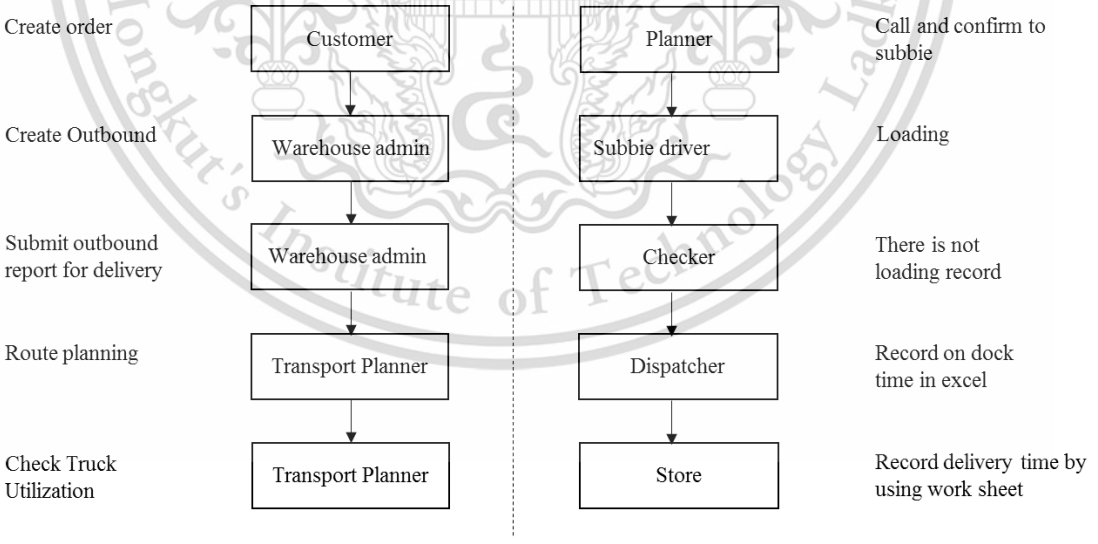


Figure 3. 5 The Working Process in A Business

3.1.5 Departments Targeted

This study focuses on the transport operation, accounting and analyzing. At present, all deliveries are manually recorded in excel files. The planner calculates the KPI and plans the route manually. Therefore, it is difficult to monitor, manage trucks and conduct the KPI report and cost report because many files have been created separately. Consequently, it takes long time to investigate the error to fix the problem or to measure operation performance and subbie performance, especially truck utilization. It is more convenient to use the program to reduce time and increase reliability. Normally, the accounting department has to wait for the operation analysts to conclude the report to do cost allocation every month. The operation analysts have to change the trip rate due to fuel price fluctuation. Likewise, the management team has to wait for the operation analysts to complete the calculation in Excel manually. The transport management system will be the operation database and support cost calculation, KPI report and operation report

3.2 Data Flow of The Company

The data flow theories are discussed in Section 2.2. The diagram model is presented in the figure below displaying the relationship among subcontractors, warehousing department, accounting department and transport department. It is simple to understand the working process in the business with this model.

3.2.1 The Context Level DFD in The Company

The company's process is described in a context diagram, and there are 4 main sections in the Figure. The work process starts from warehouse orders. The load plan is submitted by the transport team, and then the transport planner creates the delivery plan from the outbound report submitted by the warehouse department. After that, the delivery plan is created and the trucks are sent to subcontractors as requested. After

that, the subcontractors would check their truck and send feedbacks to the planner to complete truck booking process. Subsequently, the planner matches the truck with the delivery schedule and load delivery and returns it to the warehouse team for the loading process. The payment process starts at the accounting department; they check the delivery record and match it to the trip cost contract made with each subcontractor. In the same way, the subcontractors prepare an invoice as billing cycle for payment.

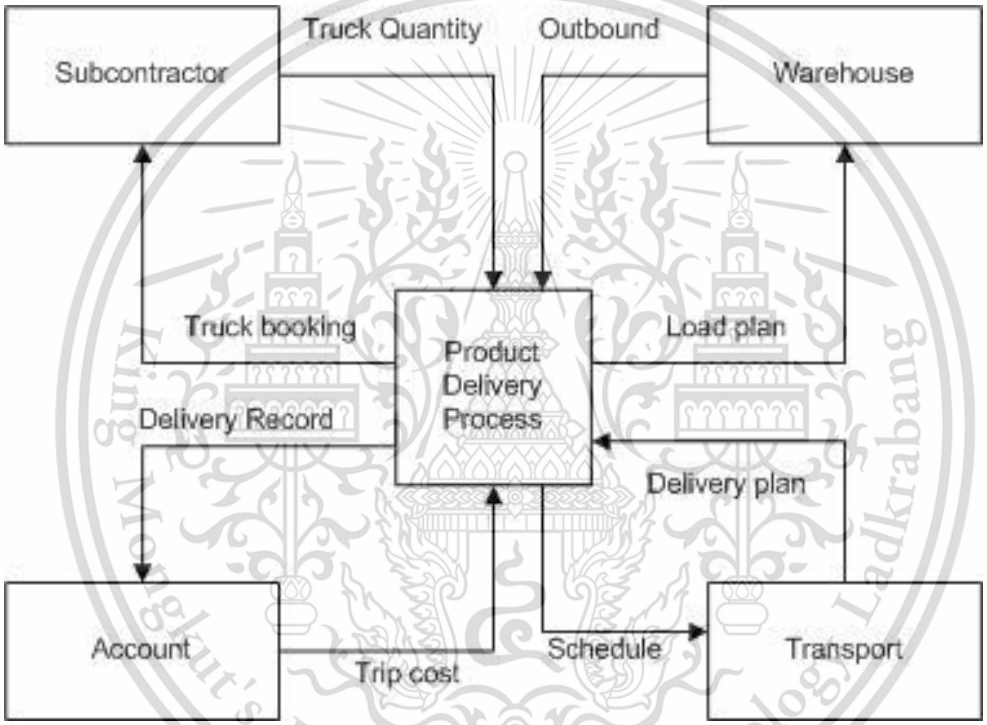


Figure 3. 6 Context diagram of product delivery

3.2.2 The Level 0 DFD in The Company

In level 0 DFD, the figure 3.7 indicates the overview for each transport operation activity. Starting with the warehouse team that receives the PO from the store, the sales order is activated in order to create outbound for production allocation according to the DFD 1.0 controlled by the warehouse department. The delivery

planning of DFD 2.0 is controlled by the transport planner who plans the delivery by using the outbound report created by the warehouse admin, and the delivery plan has to be in accordance with KPI for truck utilization. For the truck request in DFD 3.0, it is created by the transport planner which creates and refers a truck plan to subcontractors. The loading DFD 4.0 is controlled by the warehouse checker and subcontractor driver. It shows the loading process performed in the warehouse area and important data recorded. The trip cost calculation DFD 5.0 is controlled by the operation analysts and accountants. They use the subcontractor's delivery report which corresponds to the trip cost contract for payment. The context diagram shows the overview and relationship among the transport department, subcontractor, warehouse department and accounting department. The first step starts at the warehouse. The outbound report is submitted to the transport department, and the load plan report is conducted when the transport planner complete the delivery plan. The transport planner receives the delivery schedule when they communicate with and receive the truck survey from subcontractors. Once the subcontractors receives the truck request sent the by transport planner, they check their truck and give feedbacks of the available truck to the transport planner. The last function is accounting; this process is the last transport operation. The transport admin receives the worksheet which is returned by subcontractors before recording the information in the excel template. Afterwards, the analysts and accountants check the record and match it to the subcontractors' trip rate report. Then, they confirm the trip cost with subcontractors to start the payment process.

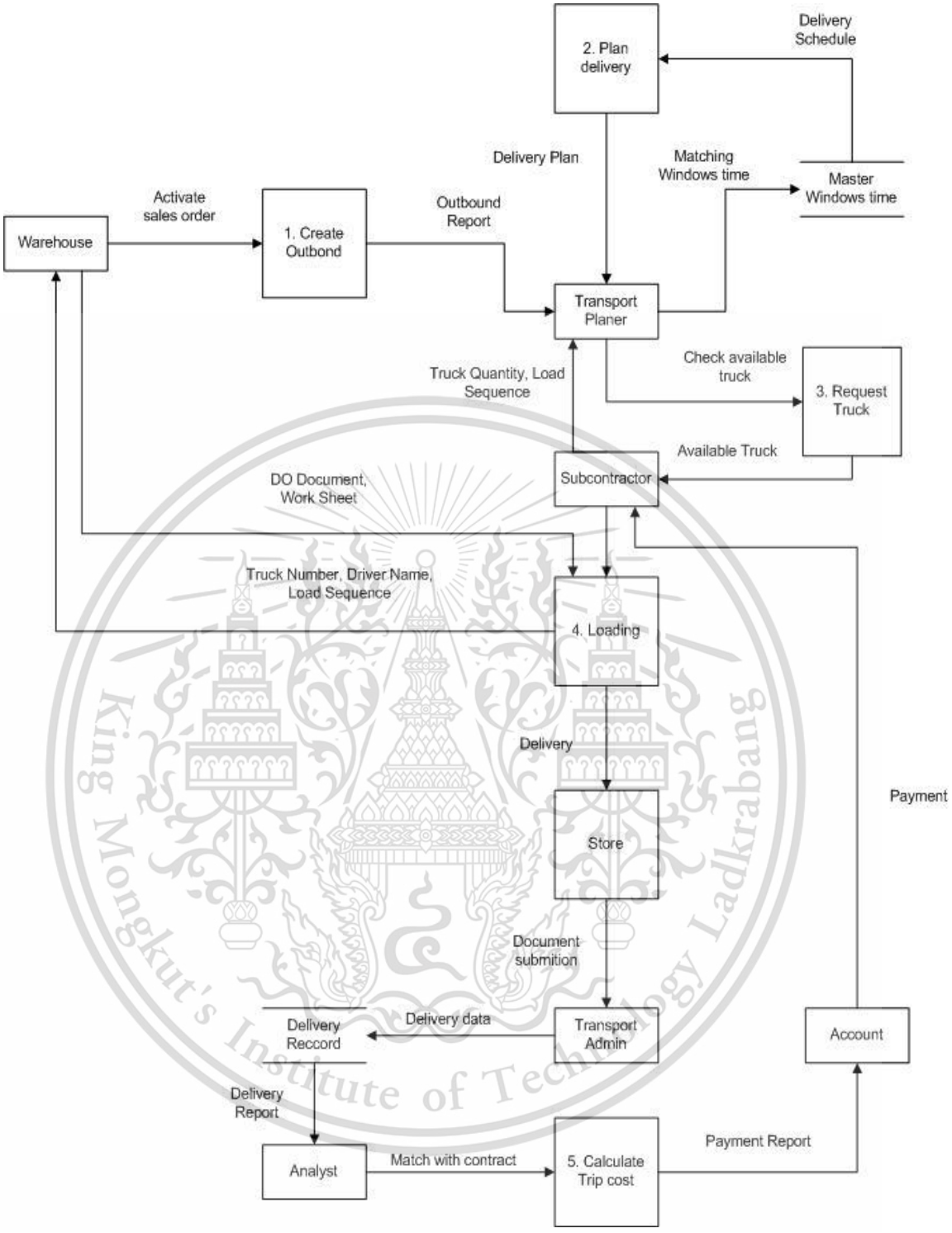


Figure 3. 7 The Level 0 DFD in The Company

3.2.3 The Level 1 DFD in The Company

3.2.3.1 Create Outbound 1.0 DFD

Figure 3.8 below demonstrates the process that initiate the outbound of goods from the warehouse to the store. Level 1.0 DFD which describes the process of warehouse operation and transport operation. Once the customer sends their PO list via the system, the warehouse team checks the PO list with the master data service and confirms the PO to the customer as DFD 1.1. Then, they start allocating the products by looking at stock on hand in the rack location via the system in order to check the inventory as DFD 1.2. If there is available stock on hand, they generate the outbound and send the report to the transport department as DFD 1.3.

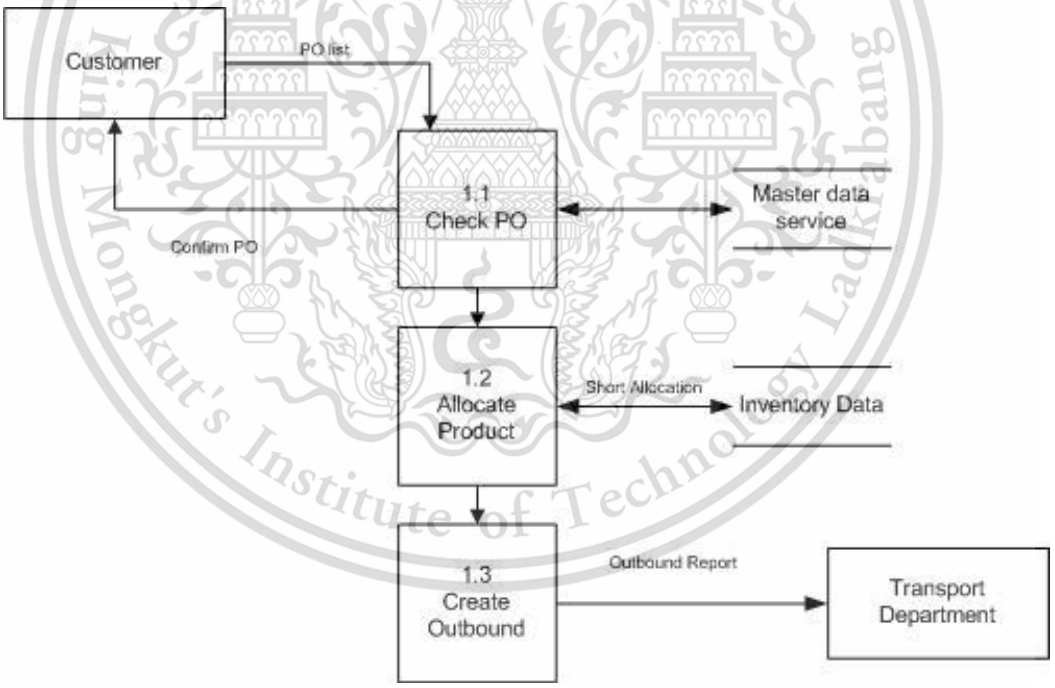


Figure 3. 8 Create Outbound 1.0 DFD

3.2.3.2 Delivery Plan 2.0 DFD

The overview of delivery planning is described in Figure 3.9. When the transport planner team receives the outbound report from the warehouse admin, they match the outbound report to the master windows time by using Excel Look Up function to know the windows time that they have agreed on with the customer as DFD 2.1. Then, the transport planner team obtains the delivery schedule. In DFD 2.2, the planner team finishes checking the windows time. In DFD 2.3, the transport planner team checks the weight and volume of product in order to manage truck utilization. In this step, they check and group the routes. After they know how many trucks are required for the delivery, they start contacting subcontracts to survey available trucks.

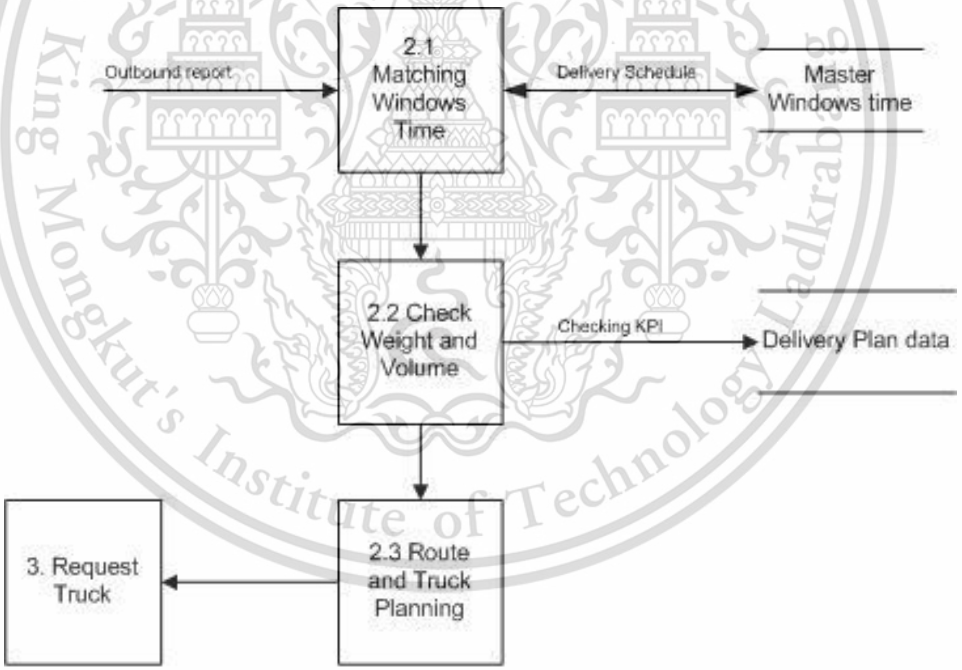


Figure 3. 9 Plan delivery 2.0 DFD

3.2.3.3 Truck Request 3.0 DFD

Figure 3.10 displays the truck request process as DFD 3.0. The KPI target is applied to the truck utilization as DFD2.1. When the planner team completes the delivery planning, they will have the truck quantity in their plan. Then, they start conducting the truck survey as DFD 3.2 by calling subcontractors to check the truck type and available trucks that can serve customer. If the available truck is not enough, the planner team will revise the plan until the delivery plan is complete. Subsequently, the planner team finalizes the delivery plan and sends the confirmation mail to inform the arrival DC, actual on dock date and time for loading to subcontractor as DFD 3.3.

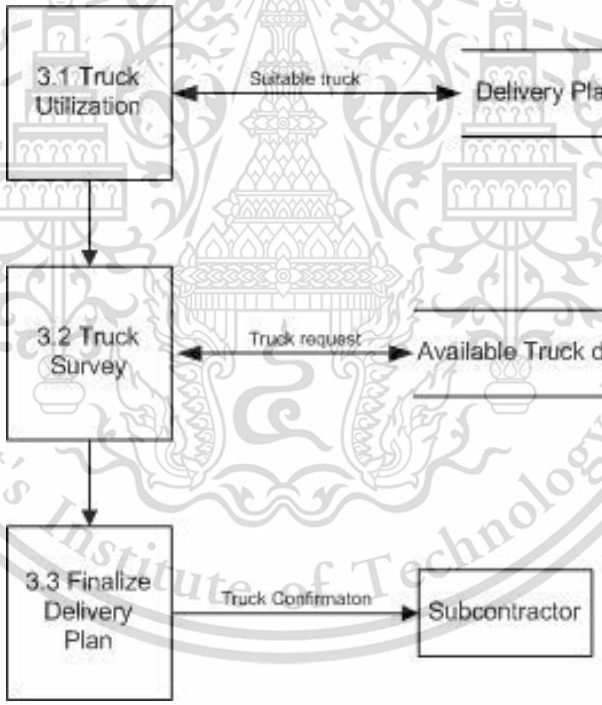


Figure 3. 10 Truck Request 3.0 DFD

3.2.3.4 Loading 4.0 DFD

Figure 3.8 illustrates the loading process in DFD 4.0. The loading process starts from DFD 4.1. Once the subcontractors arrive at the DC on the actual dock date and time according to the data of the load plan, the warehouse checker checks the load

sequence of the truck. Then, the warehouse checker assigns dock numbers for loading. The subcontractors use the truck according loading dock numbers and start loading the products. In DFD 4.2, the subcontractors' driver must check the product quantity and product package to ensure that it is of decent quality at that time. If they depart from the DC and find that the package is damaged or the load quantity is incorrect, the subcontractors must be responsible. In DFD 4.3, the load confirmation can be checked with the loading sheet printed from the warehouse system. The warehouse checker and subcontractors have to use the loading sheet. Once the loading and checking process are completed, the driver would get the work sheet for delivery, time stamp record and delivery order document. Then, the subcontractors can depart the DC for delivery.

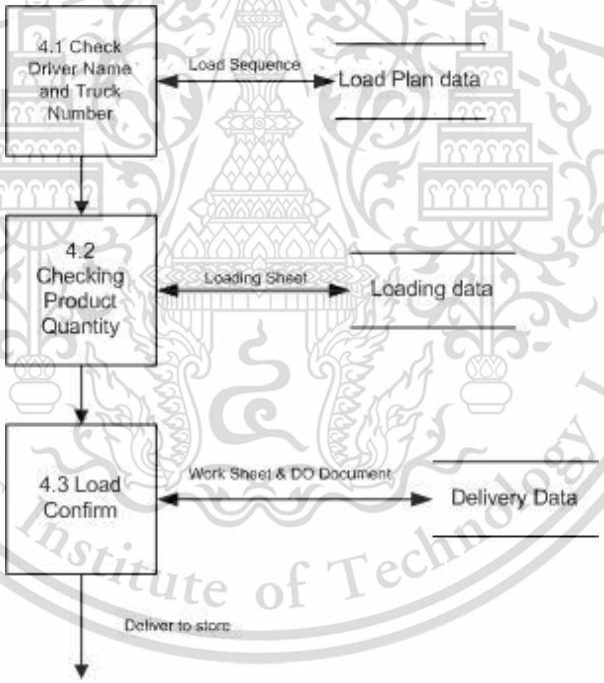


Figure 3. 11 Loading 4.0 DFD

3.2.3.5 Calculation of Trip Cost 5.0 DFD

The calculation of trip cost in Figure 3.12 is controlled by the account team. In DFD5.1, the transport admin checks delivery data in the work sheet. Then, transport admin key information into delivery report in the form of Excel file. After

that, the analysts match the trip rate to the subcontractors' contract as DFD 5.2. In the last process prior to the payment to the subcontractors, the accountants contact and confirm the amount of delivery cost with the subcontractors. In this step, it may incur additional charges as agreed in the delivery contract such as express way fee or parking fee, etc. Therefore, the accountants must confirm the total cost with the subcontractors. If the driver has a problem with missing or damaged products, the damage will be deducted from the cost. Then, the accountants proceed with the payment process as DFD5.3.

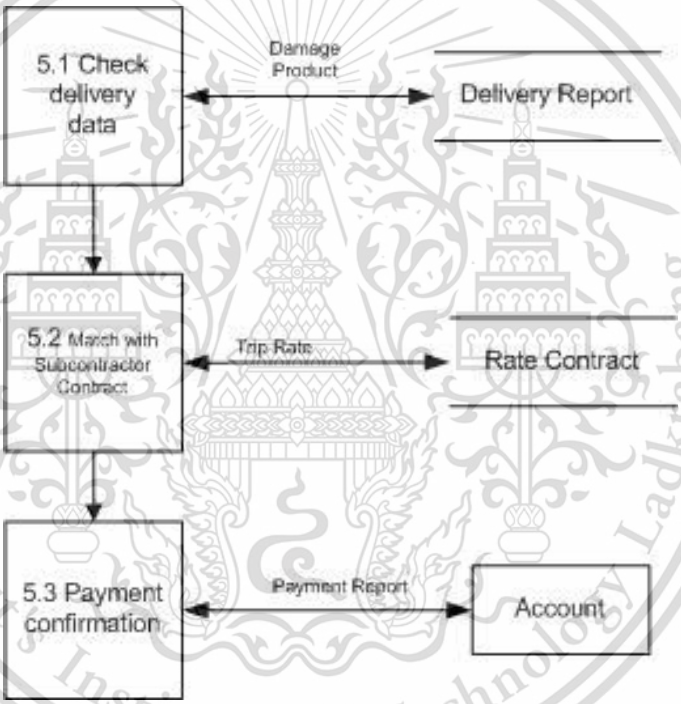


Figure 3.12 Calculation of Trip Cost DFD 5.0

3.3 In-Depth Interview with The Company

The in-depth interview starts with the transport department, warehouse department, account department, operation analysts and subcontractors. The problem is the delay of closing month due to insufficient data and manual work. The interview form designed to survey the problem is described in Section 2.1. This section will show the problems

in the transport operation process. The firs problem leading to the manual process occurs when the driver starts plaining in the excel files and when they finish the planning process. They have to call subcontractors and record the truck number and driver name in Excel. This process consumes some time and result in duplicate works because the planner team has to calculate the volume and weight manually. They must ensure that the vehicle utilization and floor utilization are in the KPI target. If not, they will have a problem with KPI during closing month end due to not meeting the KPI target. The second problem concerns the manual process from the warehouse team. Once they receives the loading plan in the forms of excel files from the transport planner, they will have a problem with the trucks that come to the dock at the same time. Moreover, some trucks miss the arrive DC time and on dock time due to congestion of loading truck or traffic. They only know the tuck number and time slot according to the load plan but the truck quantity that is ready for loading. Furthermore, once the driver finishes loading with the warehouse checker, the driver must confirm the quantity and record the missing product into the DO document. In this step, they will not know the quantity of missing product until the work sheet is returned to DC. The third manual process comes from the operation analysts. They must support the cost allocation of subcontractors, and they must know how the performance of transport planner was. As all data are record in excel files, they are consolidated to make the delivery plan where the delivery time and delivery activity details have already been recorded. Then, the KPI report and cost allocation report are conducted. The gap of many records in excel files is the erroneous record or missing record. It can take around 1 week to complete the KPI report and cost allocation report. The fourth manual process comes from subcontractors. Once the subcontractors get the truck request from the planer via phone, the planner has to record the available truck from subcontractors into

the delivery plan. However, the problem is that the planner does not know how many requested trucks are rejected, which reflects the efficiency of truck utilization. Hence, the company should keep subcontractor companies with superior performance by measuring the KPI with subcontractors. The fifth manual problem is the system. Even though new stores are opened, the transport operation is still kept in Excel files. Consequently, the tracing process runs in Excel, which takes time and is hard to control. When there is a problem from the store or driver, it is a waste of time and there may not be enough time to fix the problem. The last manual process is the document control because all delivery data are recorded in Excel. When they need to track cost allocation data or KPI data, they cannot find the correct answer in a timely manner. They may look at the delivery plan and do calculation manually. All documents are separated by the operation function, so it takes time to locate data or root cause from the issue.

3.4 Fish Bone Diagram

The theory of fishbone diagram is described in Section 2.4. A fish bon diagram is an important tool to analyze a problem. Possible clauses which involve major factors and problem identification are used to identify the transport manual process problem. There are 6 main components: Work Method, Material, People, Environment, Equipment and Measurement.

1. The operation work method has minor factors. Currently, the transport planner has worked manually in the planning process. They create the delivery plan on Excel and check the weight and volume which fit the truck type manually as KPI. There is not application to support them.
2. The materials has minor factors. There are a lot of report in operation activities, and it takes long time to consolidate all reports. There is no database to keep the

record. Most of document have been recorded in paper and there has been some missing document as well.

3. The people has minor factors. The operation team often make mistake in process. Being the Excel data, the operation analyst must calculate them by using the excel formula manually. Therefore, it is quite easy to have some mistakes or errors in the report. During the closing month end period, the operation analyst must consolidate data recorded by the operation team to create the KPI report and cost allocation report. This process takes long time because the record comes from many people of logistics function.
4. The environment minor factors; there are a lot delivery order per day and also have a huge paper document and many data record for each process. they have been recorded in paper or excel files. They might have mistaken, or error happen The more quantity, can bring lack quality.
5. The equipment has minor factors; there is not any system support. So, they have to work manaully such as the despatcher do not know how many trucks are waiting for loading. They must check the pending truck for loading by using the walkie-talkie with the yard controller. Furthermore, the loading process staff also records the missing products in Excel files manually.
6. The measurement has minor factors. Because the transport planner calls the subcontractors to request the truck, there is no record of the rejected trucks from the truck reject from the subcontractors. It is quite difficult to measure the subcontractors' performance, and there is also a problem with monitoring the driver license because all driver licenses are in hard copy.

The fish bone diagram links each factor to the main problem. Hence, in this study, this problem has been analyzed to improve the transport operation. The IT system is used to support and solve this problem, and the new working flow is shown in Section 3.5. Therefore, the manual working process issues will be resolved, and the working performance will be improved.

Fish Bone Diagram

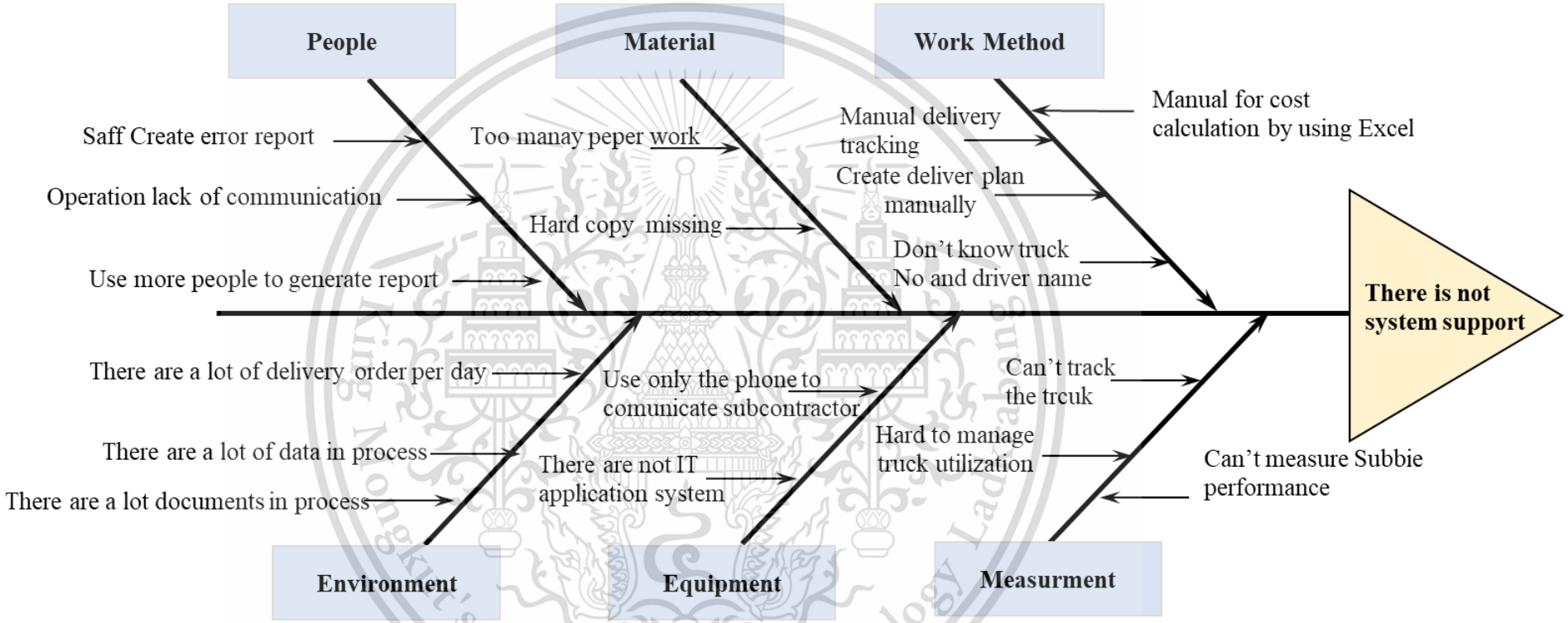


Figure 3. 13 Analyzing Problem by Using Fish Bone Diagram

3.5 Improvement in The Working Flow

The Fish bone diagram shown in Section 3.4 helps solve the problem as follows.

1. **Work Method:** Minor factors concerning the work method: manual delivery tracking, creating delviery plan manaully, not knowing the truck number and driver name, create transportation cost report manually.

   Improvement: The delivery plan is created by using the TMS program, and the tracking function from the TMS is used to follow up the truck. Moreover, the driver master and truck master are recorded into the TMS. Furthermore, the cost report will be generated by TMS automatically.

2. **Material:** Minor factors concerning the material: problem with too many paper work and there were missing hard copy. It quite hard to find the document, if there is a case that require the old document for evidence.

   Improvement: TMS application will keep the important record such as arrival time at DC, Loading time, Departure time from DC, Order quantity, Arrival time at store…etc. It means all data in the form of hard copy are recorded in the TMS.

3. **People:** Minor factors concerning the people: Error report staff, Operation staff lack of communication, waste the time and use more people to gather data and generating the report.

   Improvement: The cost allocation function and KPI report function are created in the TMS to support the analysts. Furthermore, the data recoding process is created for each function in order to consolidate data. So, they won't waste the time to consolidate data for generating report. By the way, TMS also has dash board to show the truck status to improve their communication.

4. **Environment:** Minor factors concerning the environment: there are a lot delivery order number per day, a number of documents in process and a lot of data in process

Improvement: TMS will help to manage a huge daily order instead performing in Excel files and also keep the data record in the TMS. So, it supports operation to perform quickly. Most of delivery came from TMS, so it quite manages and trace easily

5. **Equipment:** Minor factors concerning the equipment: Transport operation won't know available truck. They just call for checking driver name, truck number, truck type that can deliver in the next day.

   Improvement: TMS will sent alarm mail to subcontractor owner to confirm the truck type, driver name, truck number instead using the phone call. Then, the owner opens the TMS and confirm truck request via the system. It helps the planer know available truck shortly.

6. **Measurement:** Minor factors concerning the measurement: there is not any supporting application unable to measure subcontractors' performance, unable to control the drive license, hard to manage truck utilization and traceability tool

   Improvement: The transport management system (TMS) is established to support the transport operation, and a new process for each transport is created in order to reduce miscommunication. The rejected truck report is used to measure subcontractors' performance, and the driver license is controlled by the system. The manager can monitor the delivery performance or vehicle utilization closely.

3.5.1 The Exiting Working Flow

Currently, works in all the transport operation processes is done in Excel files. The process starts from the warehouse team since they create the order and send the order report in Excel to the transport planner. The planner takes 1 or 2 hours to check the weight, volume and windows time to create the delivery plan manually in Excel. Then, they make a call to subcontractors. After the subcontractors confirm and receive

the date and time for loading, they will send their truck to DC and contact the transport despatcher and warehouse. In this step, the despatcher records delivery details in an Excel template. In the next step, the load plan is recorded in an excel template by the warehouse checker. The last step is when the truck departs from DC and delivers the products to the store. In this step, the driver must record the delivery time stamp and get a signoff from the store in the work sheet manually. Once the delivery is completed by the sub-contractors, they have to return the work sheet to DC within the cutoff time. The analyst and accounting team will check data and start the payment process.

Figure 3.1.4 below shows the original working process starting with the transport operation creating the delivery plan and calling subcontractors. If there are 30 subcontractors on hand, the planner must ring subcontractors up to 30 times to check and book the trucks, taking around 1-2 hours. However, the warehouse team does not know the pending tucks for loading. If there is a delivery adjustment request from the customers, the transport planner must revise the delivery plan and walk to the warehouse team to inform the change to the load plan. On the other hand, the existing work flow runs on Excel files manually. If the analysts need to work on the KPI analysis, it will take a long time to consolidate data because the report is generated daily and the recorded files are quite large. Moreover, the manual process can result in human errors.

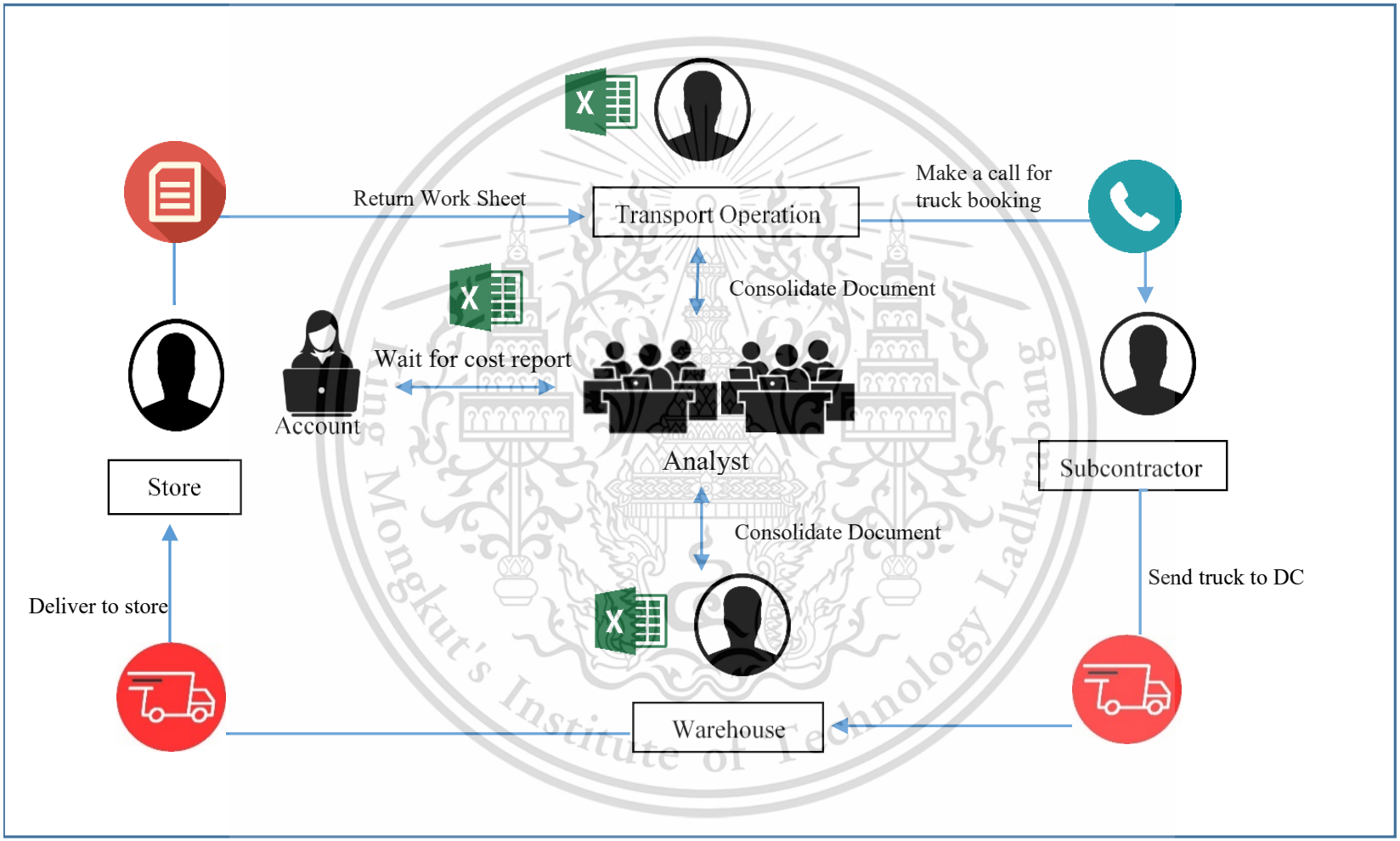


Figure 3. 14 Work Flow (Before)

3.5.2 The New Working Flow

Figure 3.1.5 below shows the new working process for each transport function. The TMS program is used to solve the manual process starting with the transport planner. The TMS system is a tool to help the planer plan the delivery and truck request. The subcontractors get an email notification to confirm the truck. In this process, the subcontractors know the on dock time via the TMS system. If they can serve the trucks as requested by the transport planner, they confirm via the TMS system. The transport planner only controls the on hand trucks by looking at the TMS dashboard which shows the planer the available trucks and idle truck situation allowing the planner to know how many trucks are required for the transportation. The dashboard is a powerful tool to monitor transport operation activities. In case of revision of the delivery plan, the planner only revises the delivery plan in the TMS and only sends an email to the warehouse team because the warehouse team can find the revise details in the TMS application by themselves. Once the truck driver comes to DC for loading, all time stamps are recorded into the TMS via Gate Pass In function. The dashboard is displayed on the warehouse team's computer, and they know the load situation, e.g. how many trucks are waiting for loading or whether it is a normal situation. On the other hand, the accountants receive the cost report in real time because they can access the TMS by themselves. Moreover, they no longer want to wait for the analysts to do manual calculation. The analysts are also benefited by the KPI report because they can access TMS as well.

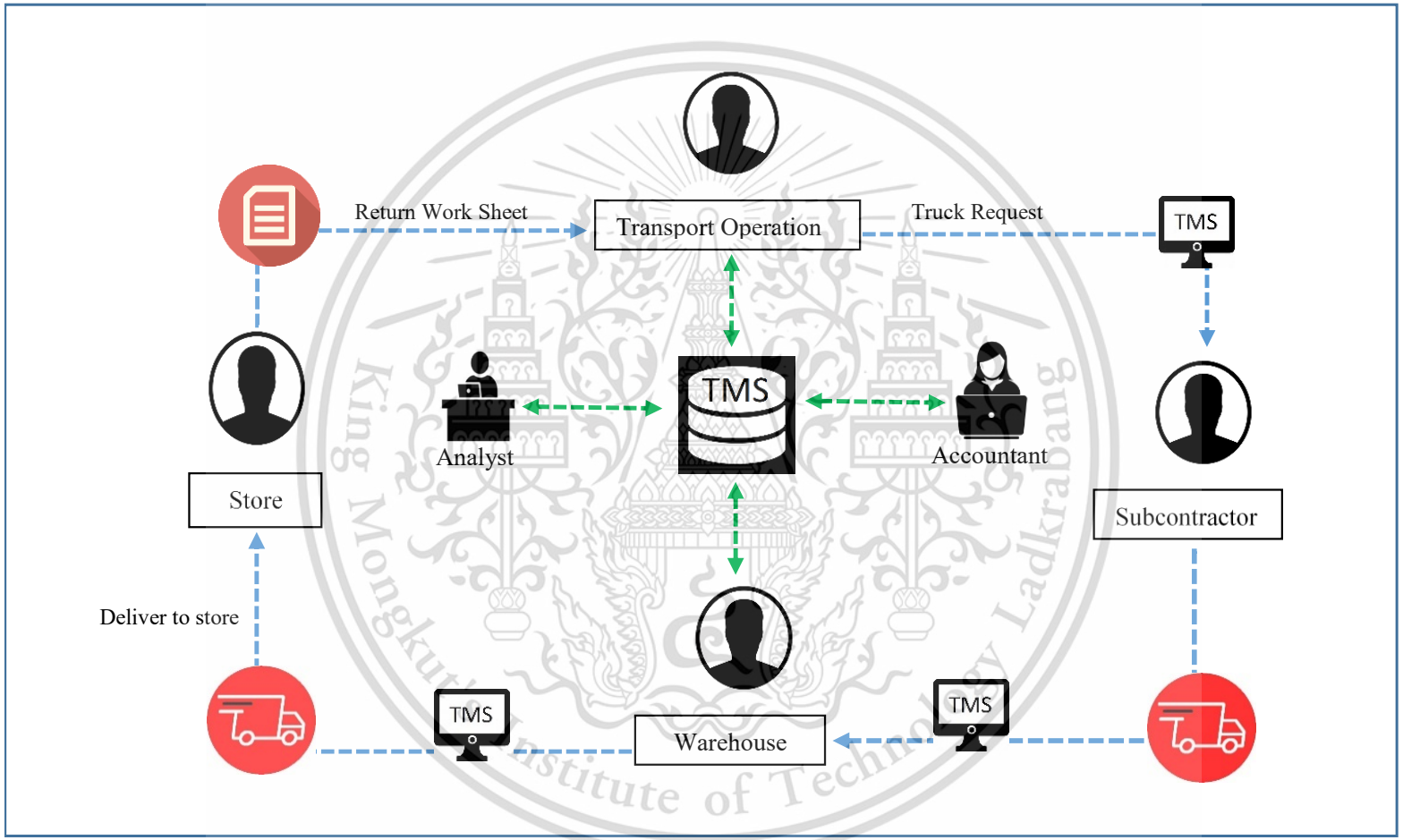
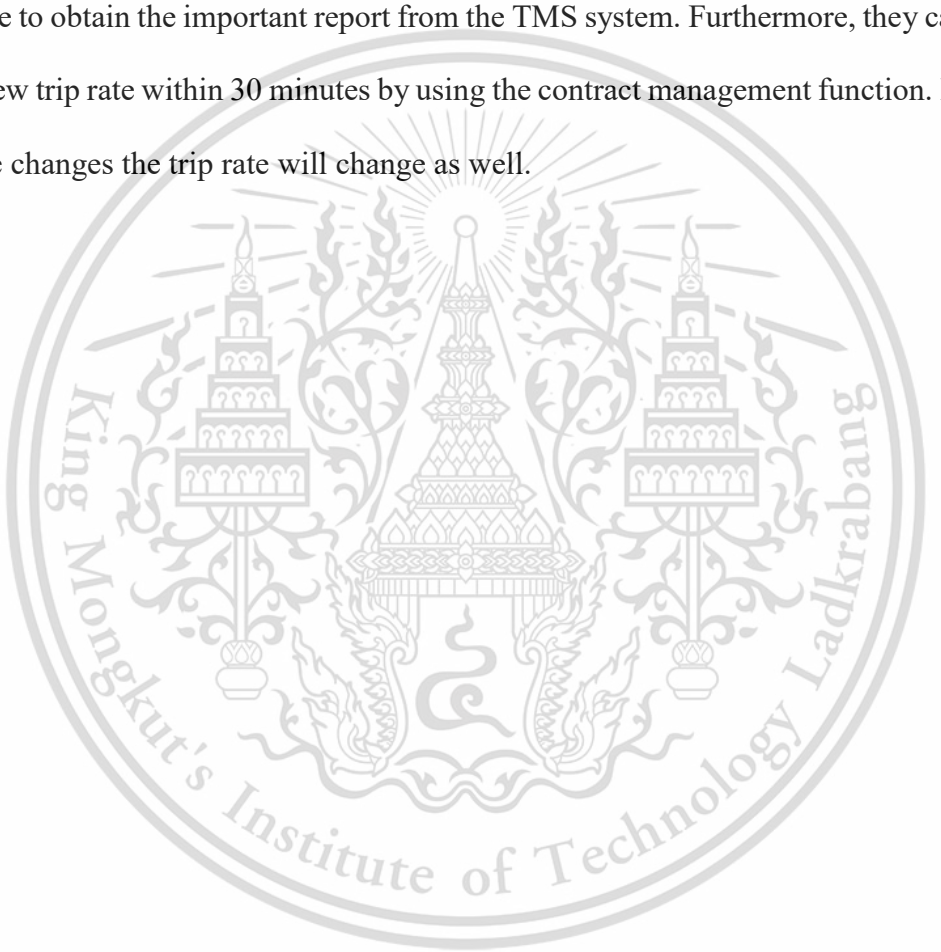


Figure 3. 15 Work Flow (After)

3.5.3 The Program Overview

The program will be created in the next chapter, as well as the important function to support the transport operation as described in Section 2.6. There are interfaces for each function such as transport operation, warehouse, subcontractor, accounting and operation analyst. The overview of the program starts from the transport planners. They use a template for uploading orders received from the warehouse team. Then, they arrange the orders by using the load plan builder to create the delivery plan. In this step, the planner must check the volume, weight and windows time. Once they finish with the plan, they start the truck request function by sending truck requests to subcontractors in order to check the available truck. The subcontractors receive the email alert informing the trip numbers from the TMS system, and they have to confirm or reject the request with transport planner via the TMS system. Once the dashboard shows that the confirmation of the truck is complete, the delivery plan function of the transport planner will be completed. Nevertheless, if there are rejections from the subcontractors. The planner must call another subcontractor and start the rebooking function. The planner must get the driver name and truck number to perform the rebooking function. When they are finished with the rebooking function, the next process will be responsible by the transport despatchers. They record the Gate Pass In details in TMS and check the delivery details when the truck driver arrives at DC and inform the trip number to the despatcher. After that, the warehouse team will see how many trucks are ready for loading in the dashboard. They communicate to the yard controller for loading management, and they key in the start loading date, time and product quantity by using the vehicle loading process. Therefore, this step helps monitor missing products or loading errors. Then, the transport despatchers record departure details by using the Gate Pass Out function. The TMS program does not only

support the transport operation and subcontractors, but it also supports analysts for making the KPI report (DOT, Vehicle Utilization). The principle of DOT is described in Section 2.7.1. In terms of the cost allocation function, the analysts can retrieve the transport operation activities from the operation register report in the report module and retrieve the trip cost of each subcontractor by using the financial function. They only have to select the date range for retrieving data. It is useful for analysts as it takes short time to obtain the important report from the TMS system. Furthermore, they can upload a new trip rate within 30 minutes by using the contract management function. If the fuel rate changes the trip rate will change as well.



CHAPTER 4

RESULTS AND DISCUSSIONS

This chapter will explain the program results and program procedures including the flow chart for each module. The program interfacing of transport management system (TMS) has been designed to record delivery data, cost allocation and KPI report of operation activities. In order to show the improvement of the transport operation after using the transport management system, the measurement of working hour used to generate the report indicates the efficiency as the operation time is reduced. Then, the satisfaction questionnaire will show how much the users are satisfied with this program. Finally, the results will be analyzed in the next chapter.

4.1 Flow Chart of New Improvement

The flow chart theories in Section 2.3 are applied here. Figure 4.1 shows the flow chart of the transport operation in the Transport Management System (TMS). The working process of the TMS starts from the transport planner uploading orders including loading date and time, destination store, delivery date and time, delivery sequence and destinations store in TMS. When the orders are confirmed by subcontractors, the orders will be ready for loading. Then, the despatchers will be responsible when the driver arrives at DC. They record the date and time in the Gate Pass In module and Gate Pass Out module. Once the driver completes the gate pass process by the despatcher, the next process starts at the loading area in the warehouse. The driver loads the products with the checker until the loading is finished. The checker records the time and quantity in TMS. Once the delivery is completed, the drivers submit the work sheet and DO document to the warehouse admin so that they can get the payment after recording the delivery date and time finish. The trip cost us calculated

automatically by TMS, so the accounting department only retrieves the trip cost report from the system. Meanwhile, the analysts can get delivery details and KPI report automatically from TMS as well. As a result, this program reduces the operation time, and it makes the work easier and more convenient.

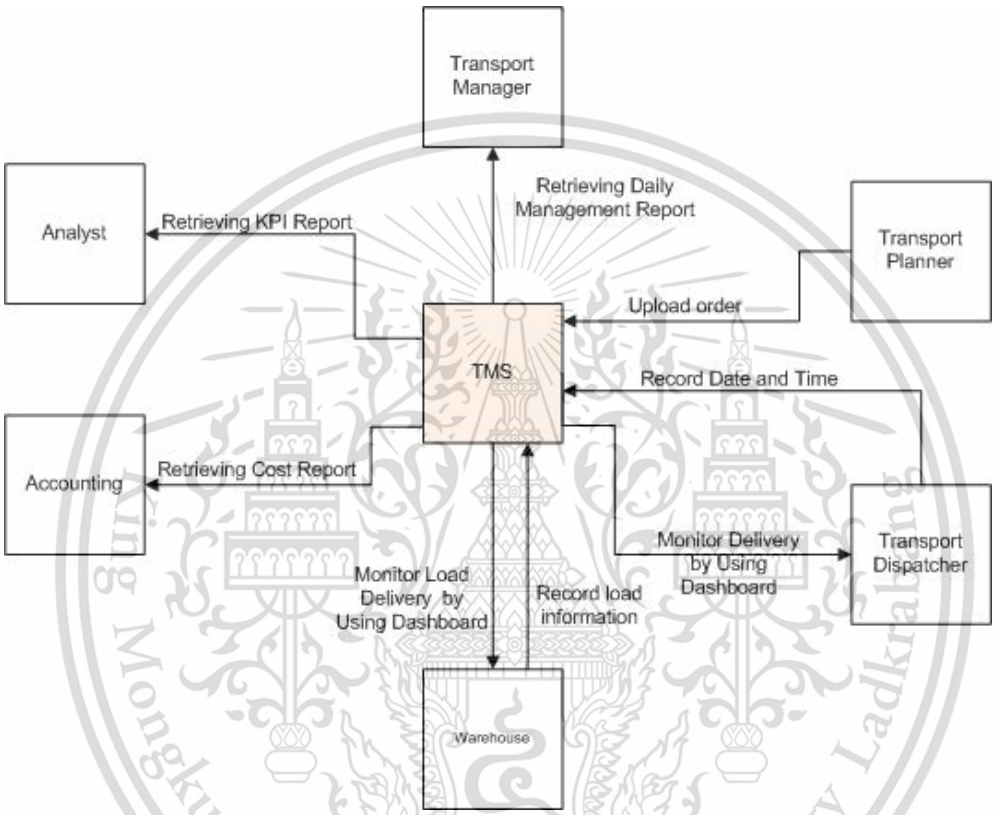


Figure 4.1 New Improvement Flow Chart

The new operation flow by using TMS is activated by the transport planner. Orders are uploaded to TMS by using the order upload function, and the trucks are booked by the truck request function. Then, subcontractors confirm the trucks via the TMS system. After the trucks arrive at DC, the despatchers proceed with Gate Pass In process. Meanwhile, the warehouse team can monitor available trucks that are ready for loading by looking at the main dashboard. Then, the loading finish time and quantity are recorded in the vehicle loading function. In the last step before departing from the store,

the despatchers record the time that trucks depart from DC in the Gate Pass Out function. All completed worksheets with records of time arrive at the store and delivery details are returned and keyed in the TMS by the transport admin using the Vehicle Unloading Function according to the TMS operation flow below.

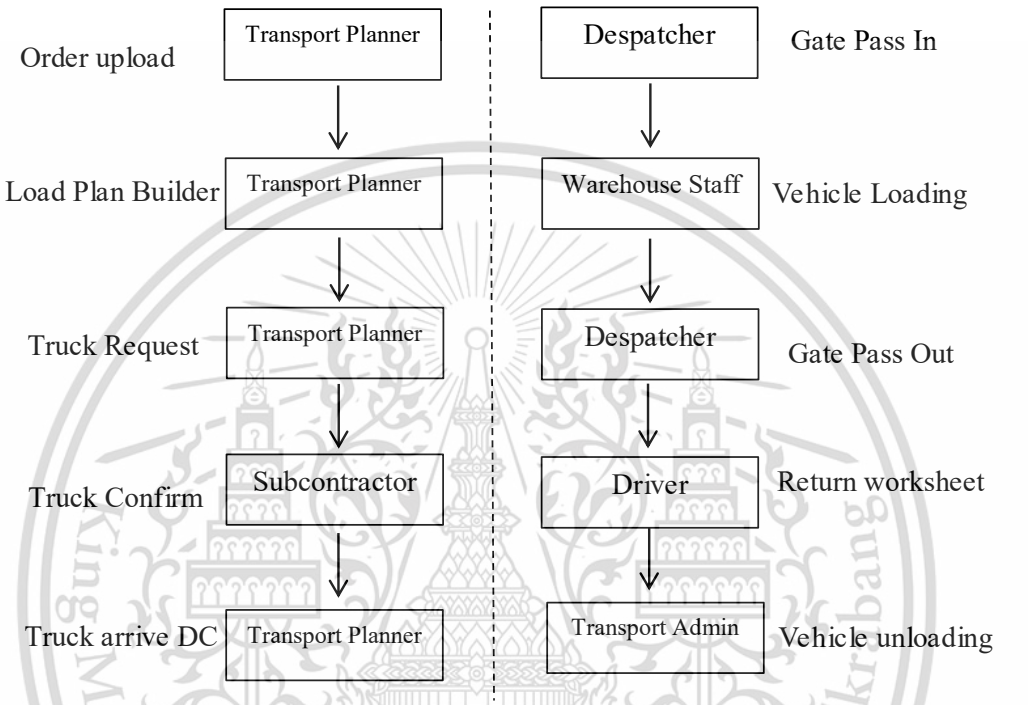


Figure 4. 2 TMS Working Process in A Business

4.2 Program Interface

The program interface shows three important panes of the program. The blue line has been designed for the transport operation dashboard. It shows the number of arriving trucks, loading tucks, in-transit trucks and delivered trucks. Furthermore, the red icon on the dashboard shows truck booking status. The green line shows all orders on that day. On the left side in the orang dash line is the program functions divided by transport operation activities.

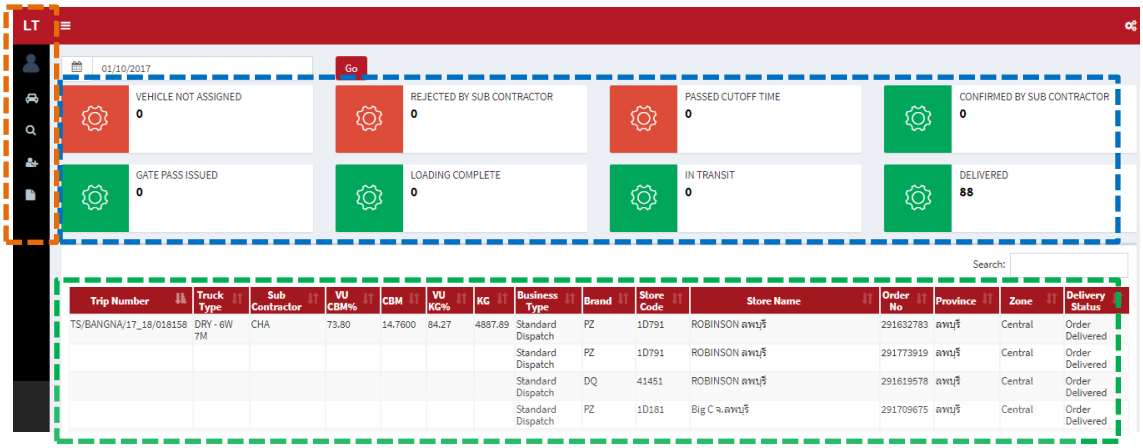


Figure 4. 3 Program Interface

4.2.1 Planner Module

This module is used by the planner and despatcher staff to generate delivery orders and record the time at the warehouse. In this module, it is used by the planner only.

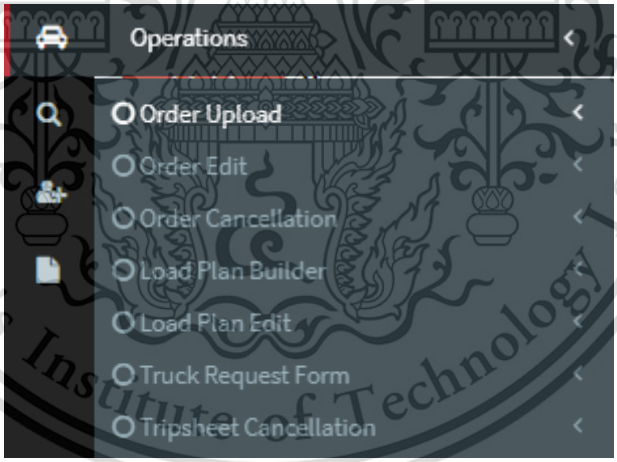


Figure 4. 4 Delivery Planning Function

4.2.1.1 Order Upload: this function is used to create TMS orders. The planner uploads the delivery orders along with the volume, weight and destination store address obtained from the warehouse team.

4.2.1.2 Order Edit: this function is used to edit orders with delivery date or time issues. The planner can change or customize the orders by using the order edit function**.**

4.2.1.3 Order Cancellation: this function is used for orders which are canceled by the store. It can also cancel the order if the planner made the wrong order.

4.2.1.4 Load Plan Builder: this function is used to plan the trucks. The planners have to think about two things when they make a plan. Firstly, they have to think about the weight because it is a requirement according to the regulations that the truck must not be overweight. The second thing to consider is the truck utilization. The planners must make the truck plan according to the product volume of each store which is related to cost per cube. The planning result will be shown on the KPI report. If the planner does the poor planning, the cost per cube will be high, meaning that the products loaded in the truck are less than 90% of the KPI setting.

4.2.1.5 Load Plan Edit: this function is used to edit the plan in case the planner receives a notice from the warehouse admin that there is a new urgent order from the store or urgent product distribution to the store. The planner must use the load plan edit function to change the truck or create a new delivery group in order to reach the KPI target.

4.2.1.6 Truck Request Form: this function is used to communicate with subcontractors. Once the planners finalize the delivery plan, they used the truck request from the function to confirm the available truck with the subcontractors. When the subcontractors get truck requests from the planners, they must log in to the TMS via internet to confirm the trucks

within the cutoff period which is around three hours. If the subcontractors cannot send the truck to DC, they must reject that truck request.

4.2.1.7 Trip Sheet Cancellation: this function is used to cancel the trip sheet in case there is any change to the truck because the truck is broken truck or unable to arrive at the dock for loading on time. However, this situation rarely happens. If it does, the planners will have to make an urgent call to another subcontractor to get an available truck for delivery. The planners have to confirm the truck by themselves.

4.2.2 Despatcher Module

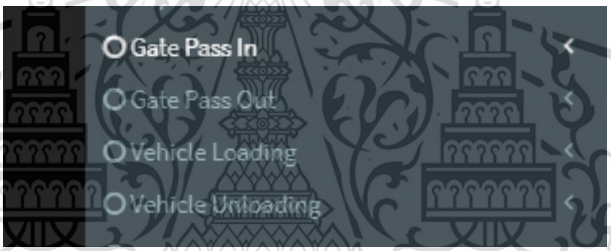


Figure 4. 5 Despatcher Module

4.2.2.1 Gate Pass In: this function is used to record trucks arriving at DC. Once the despatcher records the arrival time at DC, the truck status will be shown on the TMS dashboard indicating that the truck is ready for loading if the dock is available.

4.2.2.2 Vehicle Loading: this function is used to record the time that the truck spends for loading and the quantity of loaded products.

4.2.2.3 Gate Pass Out: this function is used to record the truck departing from DC. Once the despatcher records the departure time from DC, the truck status will be shown on the TMS dashboard as In Transit. It helps the

transport operation department know how many trucks are on the road at that time.

4.2.2.4 Vehicle Unloading: this function is used to record the time that the truck arrives at the store, how many products are received by the store and how many products are rejected or returned to the stock at DC. This function is linked to the DOT KPI report.

4.2.3 Trip Adhoc Charge: this function was used to record additional charges such as toll fee, parking fee, lifting cost, etc., depending on the contract with the customer.

4.2.4 TMS Dashboard: this function has been designed for planners and despatchers. It shows the status of the truck.

4.2.4.1 Vehicle Not Assigned: this function shows the status of order which has been uploaded after completing the truck request step in the TMS.

4.2.4.2 Rejected by Subcontractor: this function has been designed to show the available trucks of subcontractors. If the truck is not available, the subcontractor owner will reject the truck request. The number of rejected trucks by subcontractors will be shown on the dashboard. In the next step, the planners must rebook the truck with another subcontractor.

4.2.4.3 Passed Cutoff Time: this function has been designed for truck overdue confirmation. The planners send the truck request to subcontractors, and then the system sets the time for 2 hours from the agreed time. If the subcontractor cannot confirm or reject the truck request within such time, the system will be change the status of the unconfirmed order to "pass cutoff time" status.

4.2.4.4 Confirmed by Subcontractor: this function shows the available trucks confirmed by the subcontractors. The subcontractors will get the trip number generated by the system. Then, the person who confirms the truck request will inform the trip number to the driver in order to load the goods at DC.

4.2.4.5 GATE PASS ISSUED: this function is designed for the despatcher and driver. It happens when the driver arrives at DC. The driver informs the trip number to the despatcher, and then the despatcher checks the driver name, truck number and destination store in the TMS before recording the arrival time at DC. The number of arriving trucks is shown in the "gate pass issued" status.

4.2.4.6 Loading Complete: this function shows the number of the trucks which have completed loading the products and are waiting to record the departure time from DC. In this step, the loading start time and finish time are recorded by the warehouse operation team.

4.2.4.7 In Transit: this function has been designed for trucks which have already recorded the departure time and are on the way to the store.

4.2.4.8 Delivered: this function shows the work sheet which has already been returned to the admin team in order to record the time at the store. Once the admin team completes the record, the trip number will be changed from "in transit" status to "delivered" status.

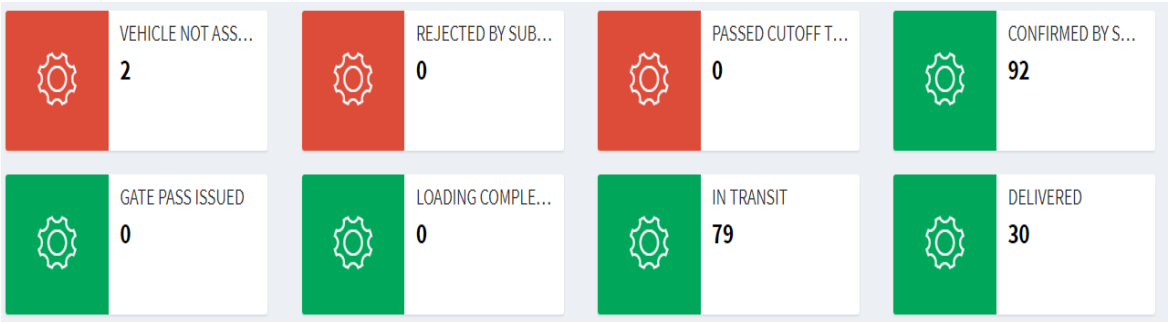


Figure 4. 6 Transport Operation Dashboard

4.2.5 Report Module

4.2.5.1 Operation register report: this function records all delivery data except trip cost. If there is a case concerning the accuracy of transportation or cost, the operation team can track the historical data. It saves time better than finding data in Excel files, and it is an important report.

4.2.5.2 Trip sheet register: this function records all orders whose delivery time has already been keyed in. The status of the trip sheet will be changed from "Open" status to "Closed" status according to the figure of the trip sheet status column below.

Truck Request No	Truck Request Date Time	Load Plan No.	Gate Pass No	Gate Pass Date Time	Sub Con Type	Sub Con Name	Vehicle No	Driver Name	Tripsheet Status	Order No	Brand	Store Name
TOF201709-02685	20/09/2017	LOP/BANGNA/17/016970	GP/BANGNA/1718/016407	21/09/2017	Attached	Light Transport	1ผล-3142	ไพศิฐน์ กล้าหาญ	Closed	58182	AA	เดอะมอลล์ จ. นครราชสีมา
										67667	BB	เดอะมอลล์ จ. นครราชสีมา
										658181	CC	Big C จ. นครราชสีมา

Table 4. 1 Trip Sheet Register Report

4.2.5.3 Daily KPI Report: this function is used to monitor the transportation workload. It shows the volume dispatch (cubic), volume damage, volume dispatch (unit), total load, total drop

and kilometer run. The planners can forecast the trend of delivery by themselves. In addition, the team manager can plan the operation and prepare the truck for utilization.

DC	Company Type	Temp.	Activity	UOM	01/10/2017	02/10/2017
BANGNA	Subcontractor	Dry	Volume Dispatch	Unit	22523	33059
			Volume Damaged	Unit	0	0
			Volume Dispatch	M3	122.912	195.983
			Total Load	Load	28	42
			Total Drop	Drop	134	188
			KM RUN	KM	3314	6371

Table 4. 2 Daily KPI Report

4.2.5.4 Monthly KPI Report: this function is used to monitor Delivery On Time (DOT) KPI. The TMS can consolidate the value of each month and calculate the KPI as shown in the figure below.

DC	Measurement		2017			Total
			July	August	September	
BANGNA	OnTime deliveries	Dry	6391	6456	6274	19121
		Total	6391	6456	6274	19121
	Late deliveries	Dry	1060	1388	1392	3840
		Total	1060	1388	1392	3840
	On time delivery	Dry	85.77	82.3	81.84	83.28
		Total	85.77	82.3	81.84	83.28

Table 4. 3 Monthly KPI Report

4.2.6 Finance Module

Tripsheet	Subcon Name	Despatch Date	Truck Type	Truck Number	Store Code	Mall Name	KMs	Cube	Weight	Order Number	Trip Rate
16_17/013772	JON	11/05/2017	FR - PU	1ฒท-5100	41277	จามจุรีแสควร์	150	0.429	311.57	390354767	1480
16_17/013772	JON	11/05/2017	FR - PU	1ฒท-5100	41278	PZ - พระราม 4	150	0.515	222.1	390422942	1480
16_17/013772	JON	11/05/2017	FR - PU	1ฒท-5100	41279	PZ - พระราม 4	150	0.484	211.2	390422943	1480
16_17/013772	JON	11/05/2017	FR - PU	1ฒท-5100				1.428	744.87	3	1480

Table 4.4 Trip Details Cost Report

4.2.6.1 Subcontractor report: it has been designed for subcontractors' cost report. This report contains delivery details, trip rates for the accounting team and cost per kilometer for truck utilization. Before launching the TMS, the accounting team must wait until the analysts

gather daily data in Excel files and use the calculation on Excel to calculate the delivery cost. It takes almost one week to know how much the cost of delivery is. After launching the TMS, the accounting team can work by themselves. They no longer need the help from the analysts.

4.2.7 Management Module

	6/10/2017	7/10/2017	8/10/2017	9/10/2017	10/10/2017
CBM	561.419	437.308	373.487	314.514	533.512
Weight	223,975.34 KG	183,826.34 KG	146,858.29 KG	138,370.12 KG	206,489.95 KG
Trucks	149	143	112	84	156
Utilization	94.07%	95.14%	98.66%	89.38%	92.71%
Scheduled Orders	859	667	671	519	972
Unscheduled Orders	62	39	26	28	9

Table 4.5 Management Dashboard

4.2.7.1 Management Dashboard: this function is used by the operation director and transport manager. It shows daily volume, weight, truck quantity, truck utilization, schedule order and unscheduled order. The transport management team does not waste the time for investigation as they can find the root cause of delivery issue easily within a brief time and fix the KPI issue before the problem multiplies.

4.3 Satisfaction Questionnaire

The questionnaire design is described in Section 2.5. The users' satisfaction is measured after they have used the TMS in their normal activities, and the satisfaction will be shown the questionnaire result in appendix which has been scaled and rated properly. The rating scale type was used in this satisfaction questionnaire. The respondents who are the software users were evaluated by using five levels. The scores determined for each level are 1 = very dissatisfied, 2 = dissatisfied, 3 = neutral, 4 = satisfied, 5 = very satisfied. This questionnaire was distributed to 2 people from the accounting team, 1 analyst, 5 transport planners, 2 despatchers, 2 transport admins, 2 transport supervisors and 1 transport manager. Then, the respondents were suggested to score the questionnaire without bias, and at the end of the questionnaire, the respondents could give suggestions for the TMS program or notify defects of the program. When the respondents completed the satisfaction questionnaire of the Transport Management System (TMS), the questionnaire was analyzed and the result was presented in the pie graph.

4.4 A Specification of The Programming

The function of the program is to record transport operation activities and show the report or delivery data to users. For example, the accountants can see the cost report in the accounting module (subcontractors' report), the analyst can see the KPI operation in the analyst module (Monthly KPI report) and the transport manger can see the KPI delivery on each day in the daily KPI report and monitor the volume; weight; truck quantity; vehicle utilization; schedule order and unscheduled order in the management module (Management dashboard). In addition, the planners and despatchers can see the delivery activities in the planer and despatcher dashboards, and the warehouse operation department can see if the pending trucks are ready for loading from the summary on the dashboard. The attribute of TMS has been designed to record the delivery data. TMS program has been created by the

ASPX language linked to the cloud server. The oracle is used as the program database. Moreover, the TMS program has been designed to reduce the manual work processes in order to reduce time and human errors.

4.5 Comparison of Time When Using and Not Using A Program

According to the comparison of operation time when using the Transport Management System and the manual working processes, for all reports generated manually and kept in Excel files in various formats, it takes long time to gather data and generate the KPI report, cost report and operation activities report. Meanwhile, the TMS program can create the report automatically because the system processes all delivery data within the same database, and the report calculation has already been programed in the TMS. Therefore, users can retrieve the old delivery information from the data history.

Before using the Transport Management System, all data were not collected in the same place or categorized. Furthermore, the files were in various formats. When using the TMS, the program categorizes necessary information within its database. The percentage of improvement is shown in figures as follows.

Process	Before using a program	After using a program
- Chase up the in-transit truck	5 minutes	2 minutes
-Tracking old data	15 minutes	2 minutes
- Create DOT KPI report	1 hour	4 minutes
- Create Vehicle Utilization report	1:30 hours	4 minutes
- Calculate trip cost	4 hours	15 minutes

Table 4. 6 Time When Using the Program and Not Using the Program

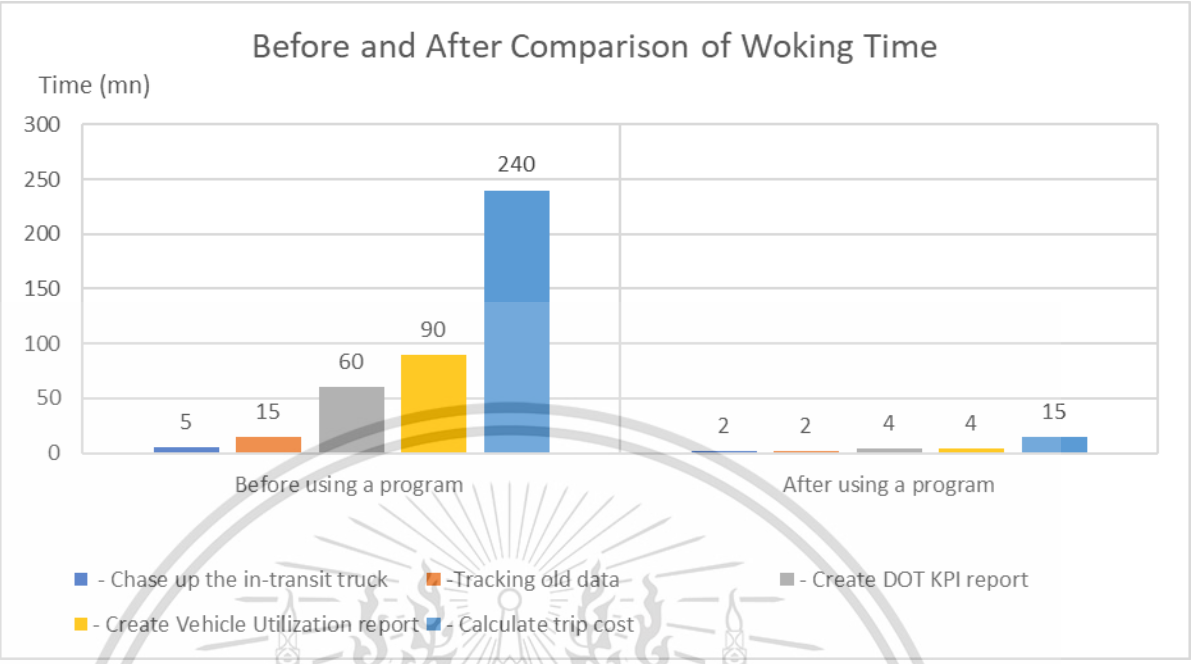


Figure 4.7 Comparison of Operation Time Before and After Using the Program

4.6 TMS Suggestion

As per satisfaction questionnaire result of transport operation when used transport management system (TMS), all 15 users who have used the TMS thought that the TMS could support the transport activities at the operational level. The planners could use the TMS dashboard to plan the trucks, and the despatchers could use the despatcher dashboard to track the drivers when the trucks were in transit. Moreover, the TMS could generate the daily KPI reports such as delivery On Time report, Truck Utilization report at the managerial level. Thus, it helped the transport manager and operation director to monitor the transport activities properly. The benefit of this program for the accounting department was when the fuel price had been changed, the accounting department could change the trip rate immediately, as well as getting the delivery cost at the same time. Moreover, the accounting department could add additional charges such as toll fee, parking fee, etc. in the additional charge module. Therefore, the program was quite flexible for the accounting department. For the

analysts before using the Transport Management System (TMS), it took them almost 1 week to complete the KPI report and cost report. After using the TMS program, the time for making and completing the reports was decreased to 1 day. However, the planners suggested that the TMS should be linked with the warehouse management system so that the planners could reduce the order uploading steps. As a result, the planners will have more time to review the route or truck utilization. Meanwhile, the warehouse admins can create outbound orders without sending the daily load report to the planners because the sales orders will be sent from Warehouse Management System (WMS) to the Transport Management System automatically. Definitely, the operation director and transport manager can use the historical data from the Transport Management System for transport planning during seasonal times. They can plan the truck quantity, utilize the delivery cost and control the KPI. Transport Management System is beneficial and powerful to making profits.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

In this chapter, the improvement of the operation process in the case study will be summarized after the TMS application has been applied to the operation. All the manual process problems have been decreased and solved. According to the findings, the result can be the guideline for the use of information technology to develop the transportation in the future.

5.1 Conclusion

In Chapter 1, the main transport operation problem in the case study has been explained. There were numerous manual process issues concerning the transportation on a daily basis resulting in work duplication, human errors and several information sources which were created separately for each operation function. The major issue was the complexity of making the reports and data collection which took a long time as data had to be consolidated, recorded and calculated manually by the operation analysts. Consequently, it impacted the KPI at the managerial level such as truck utilization, cost per kilometer, delivery on time monitoring, trip rate report, etc. All the KPI reports were created manually, and it took at least one week to complete the KPI report. In order to monitor all transportation operations in real time or on a daily basis, the Transport management application (TMS) was used as an instrument to keep the operation records and link all transportation processes to the logistics database. Moreover, all data were used for data analysis according to the KPI calculation in order to make the KPI report, Daily Operation report and Financial report automatically. Chapter 2 explains the tools, contents and methods that help interpret the processes and enhance the methods for analysis in the study.

Chapter 3 explains the problems of the transport operation by using the survey. Then, the problems were analyzed by using the fish bone diagram to identify the minor causes of each function leading to the major problems. The causes of the problems of each function were also interpreted by the business flow chart in order to understand what the normal process was and who was responsible for each function, as the business flow chart made it clear in a big picture at the operational level. Then, the processes were further analyzed by using the context diagram in order to understand the whole process with inputs and outputs from external factors, including document flow. The context diagram has 4 main parts: accounting team, warehouse team, transport operation team and subcontractors. After understanding the context diagram, the operational processes were further analyzed by using the data flow diagram in level 0-1 in order to understand more about how the data flow worked by using the symbols of the data flow diagram: process symbol, external entities symbol, data stores symbol and data flows symbol. As a result, the developer or implementer could understand the number of the processes and inputs and outputs of each process at the analytical level. Therefore, the previous working flow and the new working flow were compared for differences.

Chapter 4 describes the program overview, flow chart, program interfaces for analyst module, financial module, warehouse module and planner module. Then, the time for making the KPI report, financial report and operation report was measured. The transport operation team can retrieve the reports from the TMS automatically. Thus, the objectives number 1 and 3 of study have been achieved. Furthermore, the satisfaction questionnaire was conducted to measure users' satisfaction after using the TMS application, and the result was shown in the pie graph. The workload and time for

each process have been decreased compared to the manual working process. The objective number 2 of the study have also been achieved.

After the TMS application was applied in the transport operation activities, it showed the benefit of reducing the operation time for transport operation team, accounting team and analysts. This means that the TMS application can fix the manual process issues. Moreover, all the users were satisfied with the Transport Management System (TMS).

5.2 Recommendation

For further study, the Transport Management System can be developed and linked with other information technologies such as electronic proof of delivery (ePOD) system which is an application operated on smart phones. The ePOD system can monitor delivery in real time and reduce the cost of paper used in the delivery. Not only will the system help proactive customer services and management, but it also helps to manage damaged products or missing delivery. Moreover, the TMS should be upgraded to cover more operational activities and to comply with the company policy concerning the working hour and safety of the drivers.

This program should be developed and applied with another business. The TMS needs to be implemented with future technology in order to fulfill transport operations in the future. The project still needs to improve more functions such as delivery optimization and make transport operations more efficiently.

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APPENDIX A

USER SATISFACTION QUESTIONNAIRE OF TRANSPORT MANAGEMENT SYSTEM (TMS)

Explanation: TMS program has been designed to improve the manual work and reduce the workload. Please evaluate the following items by choosing one level of the scales according to your TMS experiences.

Rating Scale: 1= Very Dissatisfied, 2=Dissatisfied, 3=Neutral,

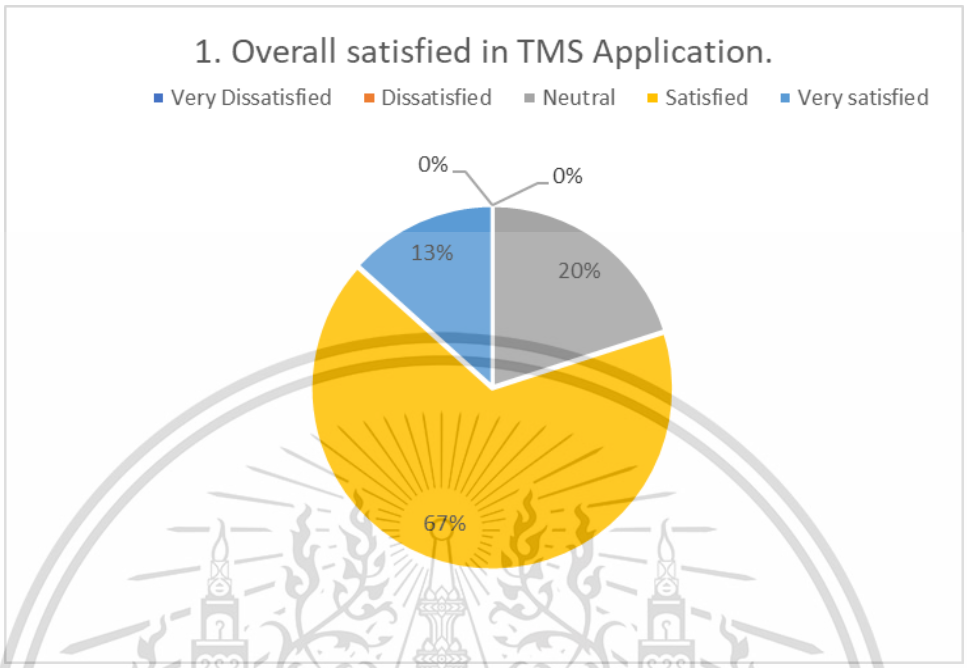
4=Satisfied, 5=Very Satisfied

Question List	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
1. Overall satisfaction in TMS Application.	5	4	3	2	1
2. The TMS system helps me to manage my duty more easily than the exiting process.	5	4	3	2	1
3. Using the TMS program can reduce workload.	5	4	3	2	1
4. Using the TMS program can reduce time.	5	4	3	2	1
5. The TMS system helps to share delivery information for each department.	5	4	3	2	1
6. The TMS system improves the transport performance.	5	4	3	2	1
7. The TMS system can track the delivery history.	5	4	3	2	1
8. This is the program I needed.	5	4	3	2	1

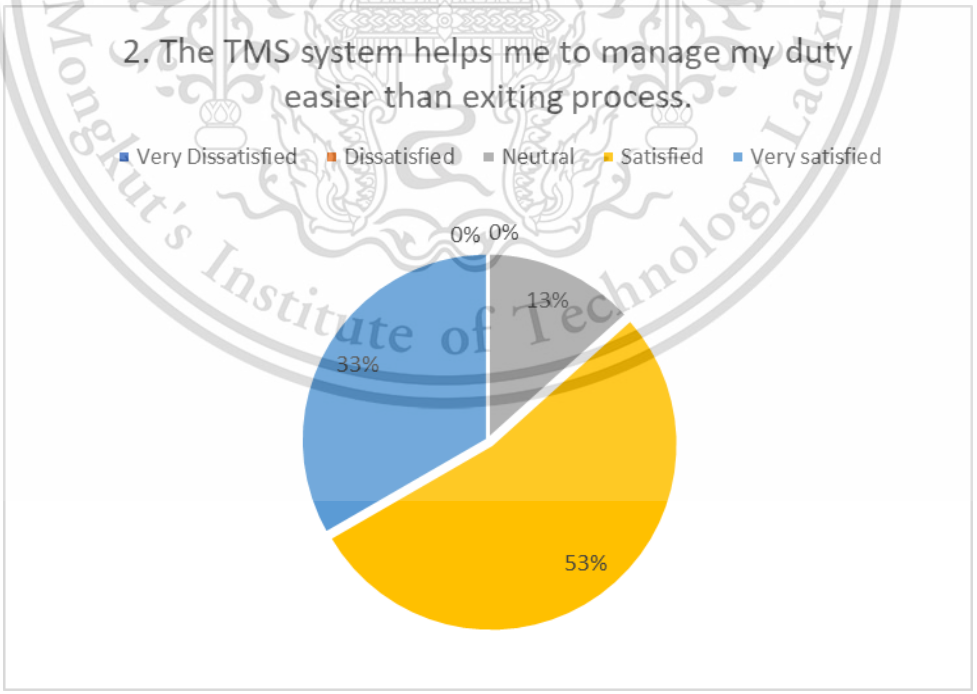
Suggestion……
……

Questionnaire Form

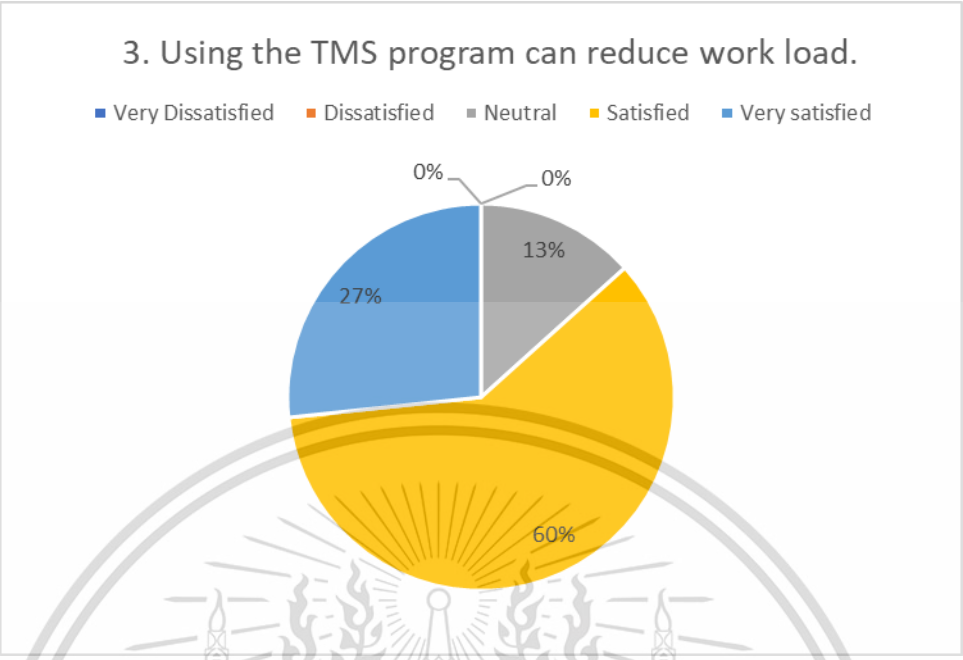
TMS Overall Satisfaction



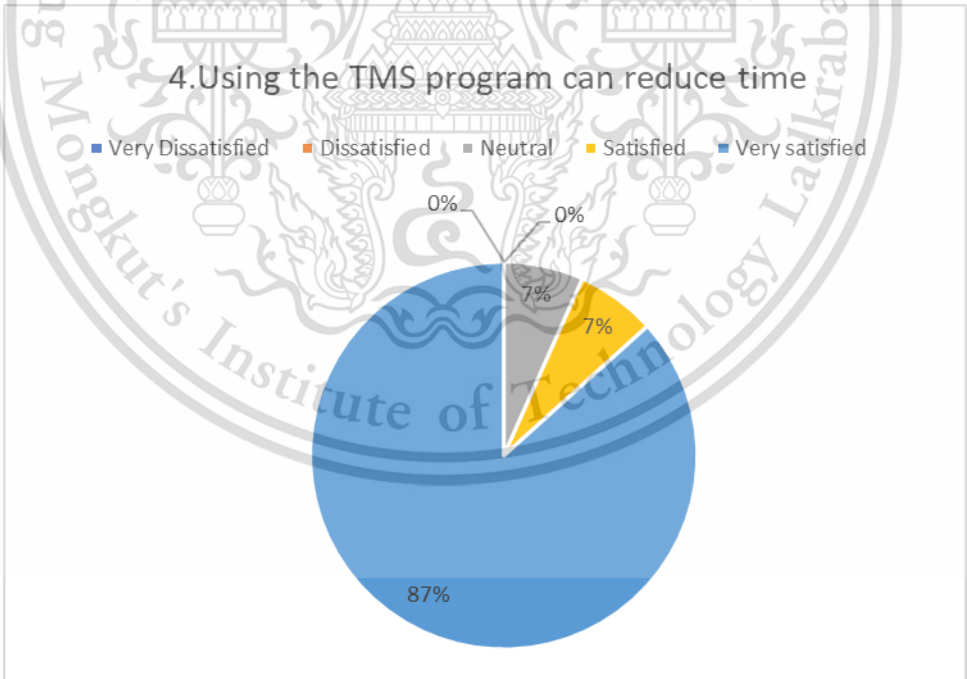
Satisfaction with Work Management



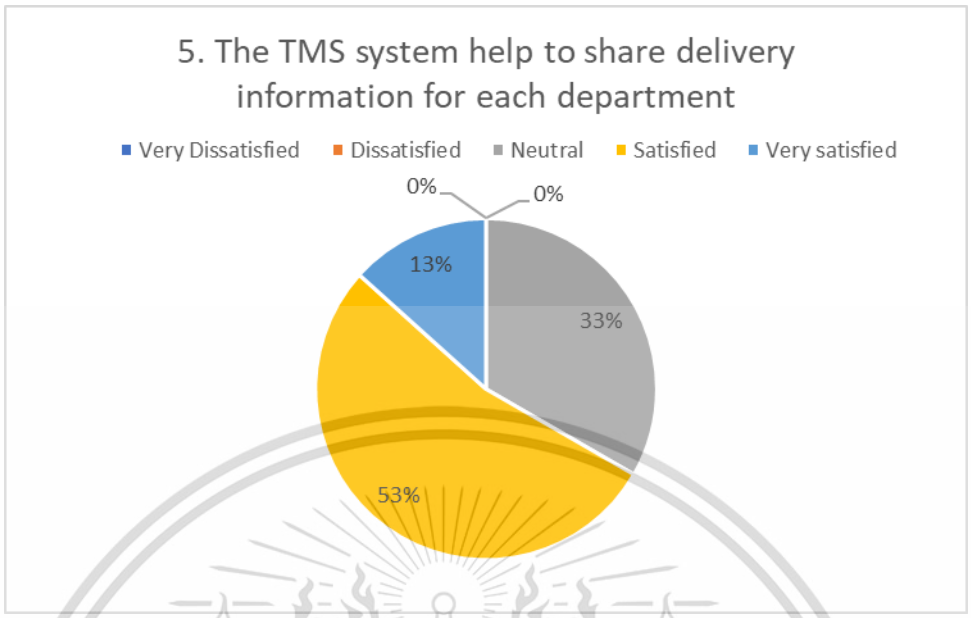
Satisfaction with Reducing Users' Workload



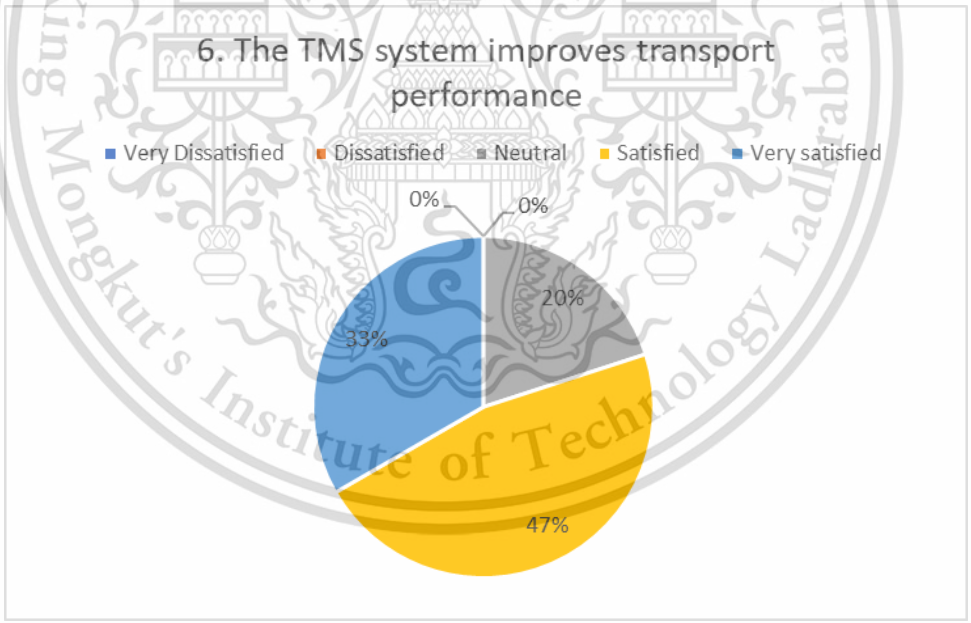
Satisfaction with Reduced Operation Time



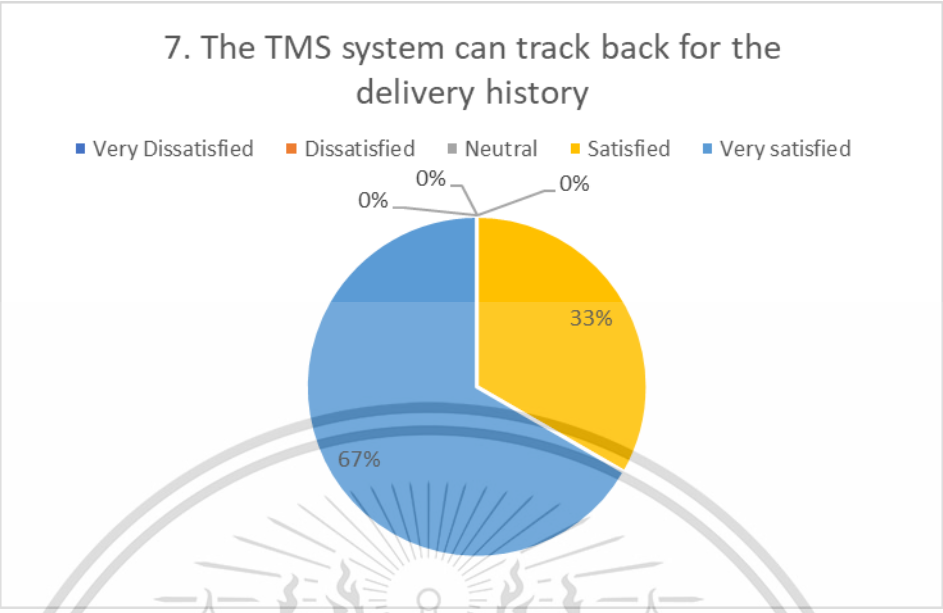
Satisfaction with Information Sharing within Transport Operation Departments



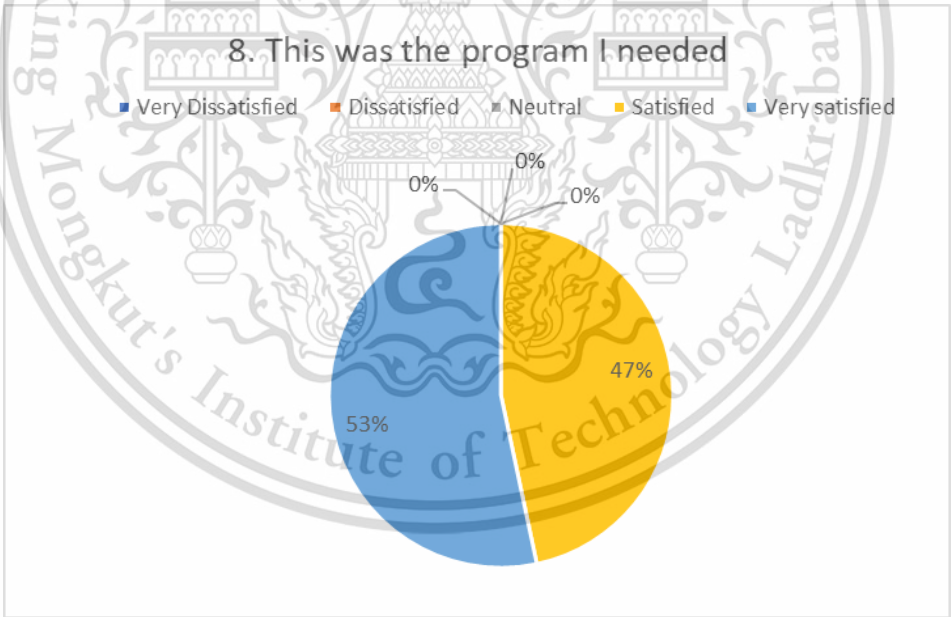
Satisfaction with Transport Improvement



Satisfaction with Data Traceability



Summary of User Satisfaction with TMS



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