LOGISTICS IMPROVEMENT FOR A CHEMICAL SUPPLIER COMPANY

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งานวิจัยนี้มีจุดประสงค์เพื่อปรับปรุงการจัดการและกระบวนการทำงานในหน่วยงานโลจิสติกส์ของบริษัทจัดหาสินค้าประเภทเคมีภัณฑ์ ซึ่งมีครอบคลุมพื้นที่การจัดหาทั่วประเทศไทย โดยงานวิจัยนี้จะมุ่งเน้นกลุ่มลูกค้าประเภทอุตสาหกรรมปิโตรเคมี, อุตสาหกรรมคมี, อุตสาหกรรมยานยนต์ และ อุตสาหกรรมการผลิตโลหะ ซึ่งอยุ่ในเขตระยะรัศมี 200 กิโลเมตร จากคลังสินค้าของบริษัทในกรณีศึกษา

ก่อนการปรับปรุง บริษัทได้ประสบปัญหาอัตราการส่งสินค้าล่าช้าเพิ่มขึ้น และมีอัตราการส่งสินค้าทันเวลาในปี 2013 ลดลงอยู่ที่ ประมาณ 86 เปอร์เซ็นต์ ส่งผลให้การสำรวจความพึงพอใจของลูกค้าในปี 2013 มีข้อกังวลในหัวข้อการจัดส่งสินค้าสูงที่สุดโดย คิดเป็น 46 เปอร์เซ็นต์จากข้อกังวลทั้งหมด ทั้งนี้บริษัทได้เสียค่าปรับจากการส่งสินค้าล่าช้าอยู่ที่ 165,000 บาทในปี 2013 เครื่องมือและเทคนิคของลีน (LEAN) ถูกประยุกต์ใช้ในการปรับปรุงความสามารถในการจัดส่งสินค้าในงานวิจัยนี้ หลักการของ Eliminate, Combine, Rearrange and Simplify (ECRS) ถูกนำมาใช้แก้ปัญหาร่วมกับการลดความสูญเปล่าที่สัมพันธ์กับ 7MUDA เพื่อลดเวลาและเพิ่มประสิทธิภาพในการทำงาน

จากการปรับปรุงนี้พบว่าอัตราการส่งสินค้าทันเวลาเพิ่มขึ้นอยู่ที่มากกว่า 96 เปอร์เซ็นต์ ค่าเฉลี่ยของเวลาที่ใช้ตั้งแต่กระบวนการ รับคำสั่งซื้อจนถึงการจัดส่งสินค้าถึงลูกค้า (Delivery Lead time) ลดลงอยู่ที่ 4.1วัน และคาดว่าการวัดความพึงพอใจของลูกค้า ด้านการจัดส่งสินค้าในปี2015 จะมีแนวโน้มดีขึ้น

ภาควิชา ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต
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ลายมือชื่อนิสิต .....
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The main objective of this research is to improve processes and the management system of the logistic department of a chemical supply company. The study focuses on the petrochemical, chemical, automotive and metal industrial customer group, located within 200 kilometres from the warehouse of the company in which the case study is based on.

Prior to the improvement, the company faced a product delivery delay problem and had the on-time delivery rate reduced to 86%. As a result, the customer satisfaction survey conducted in 2013 showed that 46% of the responses have highlighted major concerns in relation to product delivery lead-time. Consequently, in the same year, the company was charged 165,000 Baht (Thai currency) as a penalty for the product delivery delay. It is claimed that Lean tools are applied to improve the efficacy of the company's delivery system. In this investigation, the Eliminate, Combine, Rearrange and Simplify (ECRS) is applied to overcome the problem through reducing wastes associated with the "Seven Wastes" (7MUDA) in order to reduce lead time and improve work efficiency.

The results show that the outcome of the improvement is very satisfactory, as it resulted in an increase to the on-time delivery rate to more than 96%. The average delivery lead-time is also reduced to 4.1 days. More importantly, in spite of the promising outcomes of this investigation, it is expected to have an increase in the customer satisfaction in relation product delivery by 2015.

Department: Regional Centre for Manufacturing Systems Engineering
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Introduction

1.1. Background of the Research

Petrochemical industries have a significant impact on how the world operates, as their services and products tend to become a vital aspect of every industry. With the increasing number of globalization presently taking place, the vitality of mode of transport has increased significantly. The oil and its similar by-products are the primary essential chemicals that are required by many of the machine-intensive industries around the world. In addition, statistics have shown that the present requirements for petrochemical company products are on the rise, especially when the world is constantly globalizing. Thailand is like other countries, highly dependent on these petrochemical-based energy reserves and materials to continue booming their industries.

However, with the influx of new entrants with the promise of cheaper products and higher services quality have caused a major drop in the market share. The high levels of demand, technological growth and the relaxed-trade barriers have increased the competition. Therefore, just like any other company would do, a struggle to find competitive advantage in an intensively competitive industry is noted. The competitive advantage provides the required ingredient to continue sustaining business amongst its major and minor competitors. Taking a look at Thailand, it is the minor players in the industry that are quickly consuming up the market share, by taking out the big players in a gradual process. This indeed is not an immediate threat but it is a long-term threat that can affect the very foundations of these petrochemical giants. (Christopher, 2011) suggests that by the help of a well-defined and systematic supply chain management, petrochemical giants are able to sustain competitive advantage in the field that in return improves customer satisfaction and enhances customer loyalty. Customer's major requirement is not only a lowered price, but a product that arrives on time. As a result, logistic management in term of delivery time is without the doubt the most essential and

effective way to improve the customer satisfaction level, that can be achieved with a strong customer-supplier relationship.

1.2. Company Background

The company in case study, the company, is a chemicals supplier to industries such as petrochemical, refinery, chemical, steel and power plant. The company alone does not specialize in just one area. However, has a several different product and service focuses. The company is a chemical supply company that deals greatly with the processing of chemicals to a large portion of the Thai industries. The head office of the company is located in Bangkok, Thailand and has a sale office in Rayong, Thailand, Bangkok. The corporate additionally includes a native manufactory within the eastern coast Industrial Estate, Rayong. The corporate presently serves many regular customers in Thailand in most industrial sectors. In Petrochemicals and Refinery sector, Chemicals is very essential to use in their production. As the Nature of the industry, Petrochemicals and refinery companies works on a 24hour shift, thereby all the chemicals that are used and supplied are constantly utilized. The company, same as competitors, is a supplier who provides chemical, service and solution including know-how and technology to these petrochemical and refinery companies. These activities are all about providing world class solutions that help reduce operating costs, increase plant productivity, and meet environmental requirements to customer. The company manufacturing site is locate in Pluak Daeng, Rayong. It is from here, where the re-packaging is conducted, whereby the product is placed in standardized sizes before the products are delivered to various customers.

1.3. Statement of Problem

As mentioned earlier, with the influx of new entrants and higher competitions can effect a drops in the company's market share. Moreover, the company has realized that improving customer satisfaction and enhancing customer loyalty is necessary to maintain the company's position in an industrial value chain. Hence,

the company has started to survey customer satisfaction in order to get the feedback for improving company service level.

Refer to the customer satisfaction survey 2013, the result from the primal customers, the customers accounted for 58 percent of company total revenue, shows that there are four main customer concerns, which are delivery, staff and service, price and product respectively.

The delivery in full on time is inarguably important concerned issue for a business. However, for the company delivery on time is a significant issue for her customers comparing to other factors, staff and service, price and product. This is supported by the result of customer satisfaction survey which shown that out of the 100 percent of the customers that were asked, 46.15 percent of them claim to face some form of delivery time issues.

From the customer concern area in customer satisfaction feedback, it was tracked back the delivery data record along the year 2013 and found that there were some delays from the total deliveries each month as present in table below.

Table 1.1 Record of Delay in Delivery Frequency along 2013

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Deliveries delayed	12	14	19	9	13	23	11	5	27	31	43	36
Total Deliveries	92	103	143	125	132	128	156	56	189	176	195	215
% of total deliveries delayed	13.04	13.59	13.29	7.20	9.85	17.97	7.05	8.93	14.29	17.61	22.05	16.74
% of total deliveries on time	86.96	86.41	86.71	92.80	90.15	82.03	92.95	91.07	85.71	82.39	77.95	83.26

As seen in the table 1.1, it is delay in the product delivery, which is quite a frustrating experience for the customers. Although this might not be significant in figures, when noted based on the frequency of delays per month, it was noted that it ranges between 7 percent to 22 percent each month. The highest numbers of delivery delays are noted during the high season, between Septembers to December. This creates a considerable amount of concern for the company in terms of customer satisfaction.

Regarding the company's KPI, the delivery time is set at five days with 96 percent delivery on time. However, the delivery data record found the percentage of deliveries on time is substantial less than company's target. Therefore, the problem is significant and if the strategy implemented in this study can indeed improve the speed of delivery and delivery time delays, this study is henceforth strived for answering why does the delay occur and how to address it in order to increase the company competitiveness in long run. This study aims at contributing not solely to the delivering process as a whole.

1.4. Objective of the Research

Objective of Thesis is to improve logistics management of the company in order to decrease delivery time.

The following are the research questions that would be focused on for this study:

a) How will the company can improve its logistics in term of delivery time
b) How will the company benefit from improved logistics

1.5. Scope of the Research

As a problem state earlier, this has therefore called for an improvement whereby the company would be able to increase customer satisfaction. Logistic management improvements of the company would be the primary focus of this study as means to improve customer satisfaction and maintain competitiveness. The focus would be in Thai market however the case studies of different companies from

international areas would be considered in order to do a comparative analysis on strategies for improving delivery time delays.

1.6. Research Procedure

The research procedure would follow the following steps:

Table 1.2 Research Procedure

Step 1	Literature review/Previous studies review.
Step 2	Study work process/step of the company case study.
Step 3	Problem analysis and data finding, identify factors that affect time consuming and find a relationship between factors and work process in the company case study.
Step 4	Develop a potential model of work process/plan actions to shorten delivery time.
Step 5	Implementation of the developed model of work process with the company case study.
Step 6	Assess with before-after comparison
Step 7	Assess the potential benefits of this improvement/ Further study

1.7. Expected Benefits

1. To ensure that the course of movement from customer ordering to delivery is quicker and the number of delay can be decreased.
2. To ensure that the company is able to improve customer satisfaction levels.
3. To continue develop long term plan for further improvement of logistics management of the company.

2. Chapter II

Literature Survey and Theoretical Considerations

2.1. Logistic Management in Business Perspective

The main business process of this study is logistics. Logistics can be defined under several different perspectives (Coyle, Langley Jr, Gibson, & Novack, 2012). Perspectives include inventory, customer, dictionary, utility or value, and component support as well as the definitions offered by different organizations such as the International Society of Logistics and the Council of Supply Chain Management Professionals. A general definition of logistics that addresses all of these perspectives is: Logistics is the process of anticipating customer needs and wants; acquiring the capital, materials, people, technologies, and information necessary to meet those needs and wants; optimizing the goods or service-producing network to fulfill customer requests; and utilizing the network to fulfill customer requests in a timely manner. (Coyle et al., 2012).

This definition of logistics is useful because it demonstrates that logistics is a business process. (Porter, 2008) identifies inbound logistics (inventory management) and outbound logistics (order fulfillment) as two of the processes of the firm that contributes to the firm's value in the value chain. This means that the firm's logistics processes potentially comprise a competitive advantage, or a sustainable bundle of resources, processes or capabilities that allow the firm to perform better than its competitors (Porter, 2008). Firms that develop logistics management capabilities can, for example, improve their inventory management and production efficiency or provide goods and/or services to customers more rapidly and less expensively (Coyle et al., 2012). Strong logistics management can also improve relationships with suppliers and buyers, improving the firm's competitive position . (Coyle et al., 2012)Furthermore, logistics management can be considered a core competency, since a strong logistics function will benefit the firm regardless of whatever specific goods

and service they are producing (Porter, 2008). Thus, developing good logistics management capabilities and processes is important for businesses.

2.2. The Advantages of Effective Logistic Management in Business

Effective logistics management has a number of advantages for businesses. One of the fundamental advantages is that effective logistics management offers cost savings to the business from a variety of different mechanisms(Harrison & van Hoek, 2005). Logistics management processes offer the firm an opportunity to predict demand and material requirements and ensure on-time delivery of the appropriate amount of inventory, as well as managing delivery to customers in the outbound delivery stage. Logistics management can also be used to optimize logistics cost when possible (for example by managing shipping or delivery routes)(Harrison & van Hoek, 2005).

Effective logistics management can also have an impact on customer satisfaction of the firm(Zhang, Vonderembse, & Lim, 2005). For example, (Zhang et al., 2005) studied the impact of logistic flexibility on customer satisfaction. Logistics flexibility is the ability of the firm to adapt to changing customer demands rapidly, for example by increasing or decreasing shipping volume or type in order to account for new needs. They found that logistics flexibility competences and capabilities were strongly and directly related to customer satisfaction for manufacturing firms, indicating that flexible logistics is highly valued by customers.

Furthermore, effective logistics management affects the firm's environmental sustainability(Carter & Rogers, 2008). For many firms, logistics is one of the more resource-intensive processes that they engage in, entailing a high carbon emissions cost related to transport of raw materials and finished goods. Logistics management can be used to optimize these activities to minimize emissions and reduces the firm's total carbon load. (This also saves the firm money). This can also protect the firm's other stakeholders, such as the community and employees, by reducing their exposure to environmental pollutants associated with logistics. This is an area that is under-utilized, but potentially very important in future.

2.3. Problems in Logistic

There are a number of problems in logistics management that can occur. Some of the most common issues include timing issues such as delivery lead-time inaccuracies that cause delays; process failures; and customer satisfaction decreases. The problem of delivery lead-time can be difficult to resolve, because firms need to be able to predict demand as well as delivery lead-time, and because unexpected delays such as shipping problems can cause delays (Coyle et al., 2012). One problem is the so-called bullwhip effect, where variations are propagated through the supply chain, resulting in significant delays at the end of the chain (such as inventory or shipping to end customers)(Paik & Bagchi, 2007). Some of the main causes of the bullwhip effect include delays in material, information transmission, and purchasing, as well as complexity and practices like order batching(Paik & Bagchi, 2007). Consequences of bullwhip effects include stock-outs and delivery delays, increased logistics costs, and poor capacity utilization of production and transport facilities(Towill, Zhou, & Disney, 2007). In order to prevent bullwhip effects, the firm's logistics operations need to control delays(Paik & Bagchi, 2007). However, some attempts to control bullwhip effects, such as stockpiling inventory, can actually be counterproductive because it increases cost and reduces efficient utilization of production and logistics capacity (Coyle et al., 2012).

The underlying causes of delays are also important to eliminate(J J Vogt, Pienaar, & de Witt, 2002). There are a number of underlying causes of delays in the production cycle, as well as general causes of long production cycles, according to (J J Vogt et al., 2002). For example, poorly designed procedures and forms can result in delays, because they are too complicated to perform properly and lead to errors or because they miss essential steps in the process. This can result in re-work during all stages the production cycle. There can also be a lack of information about the process, which can create uncertainty and generate delays. If it takes decision makers too long to collect information, this can result in a delay during the production and

logistics processes. Identifying the specific causes of delays in the production cycle is an essential step to eliminating them (J J Vogt et al., 2002).

There are other process failures that can also affect logistics performance. For example, in the case of the Boeing 787 Dreamliner new product development issues prevented on-time delivery of the firm's new product(C. S. Tang, J. D. Zimmerman, & J. I. Nelson, 2009). The firm also suffered manufacturing problems and inconsistencies with the product, which further affected the airplane's delivery. These problems cascaded in order to introduce some years' delay in product delivery (Tang, et al., 2009). In most cases, delays are not that severe, but supply, manufacturing, and quality process problems can all be associated with logistics delays (Coyle et al., 2012). Thus, the firm needs to control its entire process in order to make sure that its logistics performance is not affected.

Firms cannot eliminate all logistics problems because they are sometimes dependent on or caused by external infrastructure and shipping systems(Memedovic, 2008). For example, firms operating in developing countries must deal with problems like poor infrastructure and delays in transit countries, which causes poor performance including long delivery delays and high costs. Hard infrastructure (roads, ports, rail systems, and other facilities) can have a significant impact on cost and time performance of logistics and transport. Furthermore, regulation difficulties and customs clearance slowdowns can reduce the ability of firms to deliver on-time. As a result, firms need to manage their logistics chains to reduce exposure as far as possible to these problems, but they cannot all be avoided(Memedovic, 2008).

Logistics problems leading to delivery delays, stock-outs, and other problems can have an impact on customer satisfaction and other performance measures(Shang & Marlow, 2007). This study, which was conducted in a sample of 1,200 Taiwanese manufacturing firms, found that logistics performance was positively associated with financial performance of the firm, and that customer-focused logistics was one of the main competencies that were associated with logistics performance(Shang & Marlow, 2007). A case study of the Boeing 787 Dreamliner airplane showed that logistics problems and associated delivery delays led to customer dissatisfaction with the plane, including some cancelled orders (C. S. Tang, J. Zimmerman, & J. Nelson, 2009).

These studies reinforce the general observation that logistics performance is a factor in customer satisfaction (Zhang et al., 2005). If firms cannot deliver logistics performance without delays, then the firm will suffer a drop in customer performance.

2.4. Lean Logistics

Lean logistics is a logistics approach designed to eliminate waste in the logistics process, following the principles of lean management(Baudin, 2004). Lean is often described as a philosophy of management, permeating through different aspects of the organization(Bhasin & Burcher, 2006). Since lean management involves large-scale organizational redesign, lean logistics, like lean inventory management and lean production, is likely to be implemented as part of a full organizational strategy(Bhasin & Burcher, 2006).

The intention of lean logistics is to reduce the cost to the firm and consumers by eliminating waste, which raises cost. The process of lean management involves identifying the customer value, mapping out the value stream, creating a product flow, and creating customer pull. Throughout this process, waste is eliminated(Baudin, 2004). Waste, in this context, can include wasted time, wasted human resources or other resources (such as fuel), wasted effort (such as through mis-delivery), or quality defects or failures. The precise way in which lean logistics is implemented varies through the organization, depending on their existing strategies and practices(Baudin, 2004). However, there are common techniques. For example, rather than using fixed delivery routes, lean logistics use route optimization approaches to reduce wasted fuel.

2.5. SCOR Model

The Supply Chain Operations Reference (SCOR) model is a commonly used process reference model that can be used to improve logistics and supply chain operations efficiency, integration and quality(Bolstorff & Rosenbaum, 2007). The SCOR model includes best practices, process modelling and business process re-

engineering, and performance measurement approaches that are designed to reach across three organizational levels(Bolstorff & Rosenbaum, 2007). There are five logistics and supply chain areas addressed by the model, including Plan, Source, Make, Deliver, and Return, which stretch across the inter-organizational framework(L Li, Q Su, & X Chen, 2011). The use of specific metrics and practices helps to standardize the firm's logistics operations and reduce complexity and non-standard practices(Bolstorff & Rosenbaum, 2007). One of the most important aspects of the SCOR model is that it can be used by an organization (or even by a group of organizations) to improve quality within the supply chain (Ling Li, Qin Su, & Xu Chen, 2011). The SCOR framework has a significant impact on firm logistics performance from both the outward (customer-facing) and inward (internal and supplier) perspective. This includes a positive impact on supply chain flexibility, responsiveness and reliability, as well as costs and assets (Ling Li et al., 2011).

The SCOR process begin by capturing the as-is state of process and extracting the desired future or to-be state. After this, the operational performance has to be appraised and compare to similar companies in order to settle internal targets base on best in class results. Lastly, best-practice is require to be performed in which management practice and software implementation are classify that can result in best-in-class performance(John J. Vogt & Pienaar, 2009)

2.6. Sales and Operations Planning (S&OP)

Sales and operations planning (S&OP) is a business management process that uses routine reviews and forecasting of customer demand in order to plan, re-plan, and integrate business operations across the organization(Burrows, 2012). The purpose of S&OP is to predict future demand and plan to respond to it. S&OP is a fundamentally consumer-oriented process, with the manufacturing operations of the organization being connected to consumer demand and made responsive to it(Burrows, 2012). S&OP typically uses an annual plan, along with monthly plans that adjust the annual plan based on new information. Plans associated with S&OP include sales plans (including agreed-upon and predicted sales), production and

inventory plans, lead time plans, new product development or NPD plans to meet projected new demands, financial plans and strategic plans(Burrows, 2012). S&OP is used by many companies because it offers opportunities for revenue growth along with reduced inventory and operational costs(Prokopets, 2012). However, there are some conditions for effective use of S&OP that some organizations do not meet. For example, the organization needs to have effective top-down and bottom-up forecasting tools. It also needs to be prepared to integrate production into its forecasting practices(Prokopets, 2012).

2.7. Problems Analysis Tools

Firms need ways to identify and prevent problems in the logistics process. In this section, four key tools are identified and discussed. These include the Gantt chart, Pareto chart, Muda (waste), and cause and effect analysis (Fish bone diagrams). These tools are used at different stages in order to identify and control problems.

2.7.1. Gantt Chart

A Gantt chart is a very simple tool for planning and tracking progress for a project or process(T J Goldsby & R Martichenko, 2005). The Gantt chart tracks all tasks and sub-tasks associated with a project, including the resources assigned, critical path (tasks that must be accomplished on-time to deliver the project on-time), and other important characteristics of the project. A sample Gantt chart is shown in Figure X. The Gantt chart is used for a number of purposes(T J Goldsby & R Martichenko, 2005). These purposes include planning, assigning responsibility for specific tasks, tracking completion of the project, and identifying problem areas and diverting more resources if necessary in order to ensure the project completes on time(T J Goldsby & R Martichenko, 2005). On a day-to-day basis, Gantt charts can be used to assign resources and identify gaps in resource requirements, enabling the project to retain forward progress(Richards & Grinsted, 2013). For projects, Gantt charts also enable tollgate meetings, where the project manager and top managers address performance and move forward with the project(T J Goldsby & R Martichenko, 2005). Thus, the Gantt chart is a useful tool both for long-term planning

to avoid logistics problems and identifying problems in the short term and assign resources to avoid them (Richards & Grinsted, 2013)

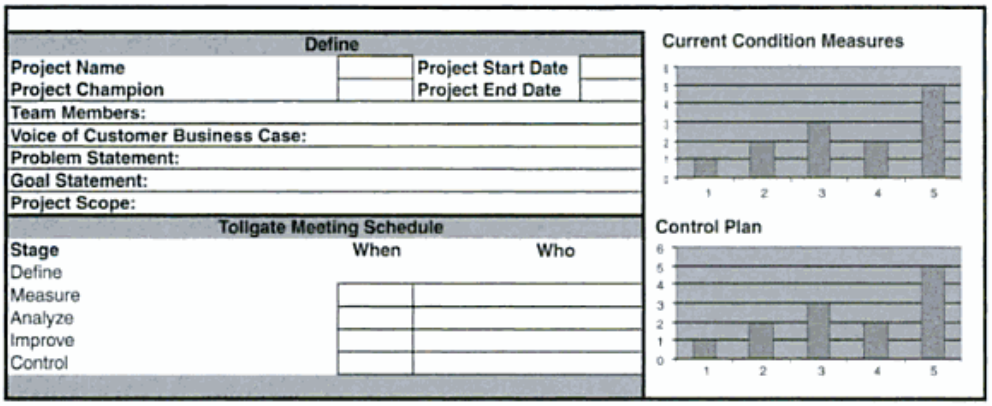


Figure 2.1 Sample Gantt chart (Thomas J. Goldsby & Robert Martichenko, 2005),(p.169)

2.7.2. Pareto Chart

The Pareto chart is a quality control tool that identifies the most common quality defects that occur in a given manufacturing or other environment(Taylor, 2008). The Pareto chart is a histogram, or frequency distribution, representing the most common failures, along with a line graph that represents the cumulative total of the failures. Figure 2.2 shows a sample Pareto chart. In this chart, the defect frequency was used for the Y axis, but the Y axis can also represent another outcome (for example defect cost or time delays)(Taylor, 2008). The Pareto chart is used for tracking and monitoring defects and delays in quality control(Taylor, 2008). However, it can also be used for other purposes, for example tracking the frequency of shipments to specific customers, the amount of business from specific customers, or identifying key root causes of problems(T J Goldsby & R Martichenko, 2005). The Pareto chart is useful because it is very simple and can identify about 80% of the most common problems(Taylor, 2008). However, it is limited in that it does not identify rare problems and issues, and does not identify the most important problems – instead, it identifies the most common problems.

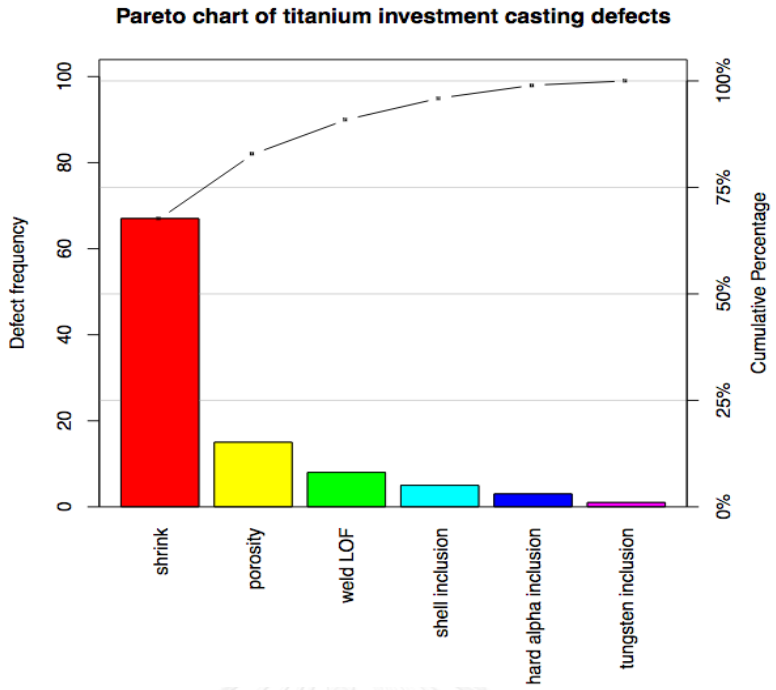


Figure 2.2 Sample Pareto Chart (Penfield, 2010)

2.7.3. MUDA (7 Wastes)

The Toyota Production System (TPS), the foundational system for modern continuous improvement and lean and Six Sigma approaches to production, offers some useful tools for understanding causes of failure in production(Stewart, 2011). These tools include *muda* (waste), *mura* (overburdening), and *muri* (variation). Muda, or waste, is the most easily identified and the category most relevant here. The TPS focuses on identifying waste, on the basis that if waste is identified it can be eliminated more easily. (Stewart, 2011) identifies seven categories of waste that commonly occur in manufacturing processes, several of which are relevant to the logistics function of the firm. For example, transportation of goods or materials is classified as waste because it does not add value to the product(Stewart, 2011). This is an important insight because transportation is expensive, and therefore should be minimized as far as possible. Waiting time is also a waste, since it reduces productivity and introduces lost time(Stewart, 2011). This can be seen in logistics as a time delay, which is expensive and can lead to customer dissatisfaction (Coyle et al., 2012). Overstock, overproduction, overprocessing, and repair are sources of waste

that are more related to the production and inventory management, but still can have a relationship to logistics(Stewart, 2011). For example, if overstock is kept in order to prevent logistics problems such as bullwhip effects or stock-outs, this results in waste. The *muda* tool is particularly helpful for understanding how the firm can eliminate waste and reduce costs in logistics as well as in other activities(Stewart, 2011). The focus on time delays and transportation are particularly relevant because they address the types of waste that can occur in the logistics management function.

2.7.4 Cause and Effect Analysis (Fish-Bone Diagram)

The fourth analysis tool examined is the fishbone diagram, also called the cause-and-effect or Ishikawa diagram. This diagram relates causes and effects derived from an analysis such as the "five whys" analysis technique(Waters, 2011). Figure 3 shows a sample fishbone diagram, demonstrating the causes and effects of a truck breakdown. Fishbone diagrams can include actual and potential causes and effects of risk factors; this means they can become complicated. The fishbone diagram is a qualitative approach, with causes and effects being added based on existing knowledge and assessment of the situation(T J Goldsby & R Martichenko, 2005).

There are a number of situations where a fishbone diagram can be used to improve performance and reduce risks(Gulati, 2012). For example, it can be used to identify the potential and actual root causes of problems after they occur. The fishbone diagram can also be used to assess possible causes of problems that are beginning to occur, as well as identify their possible outcomes and determine how the outcomes can be changed. Fishbone diagrams are useful for understanding how processes are failing and what can be changed in order to improve outcomes. They can also be particularly useful for exploring problems that are highly complex or that have not yielded to other types of analysis. However, the fishbone analysis approach does have some weaknesses. The technique is complex and should mainly be used when the problem is complicated enough to justify the effort. The fishbone analysis is also more effective in situations where there is extensive knowledge about the problem and there are no significant communication problems(Gulati, 2012).

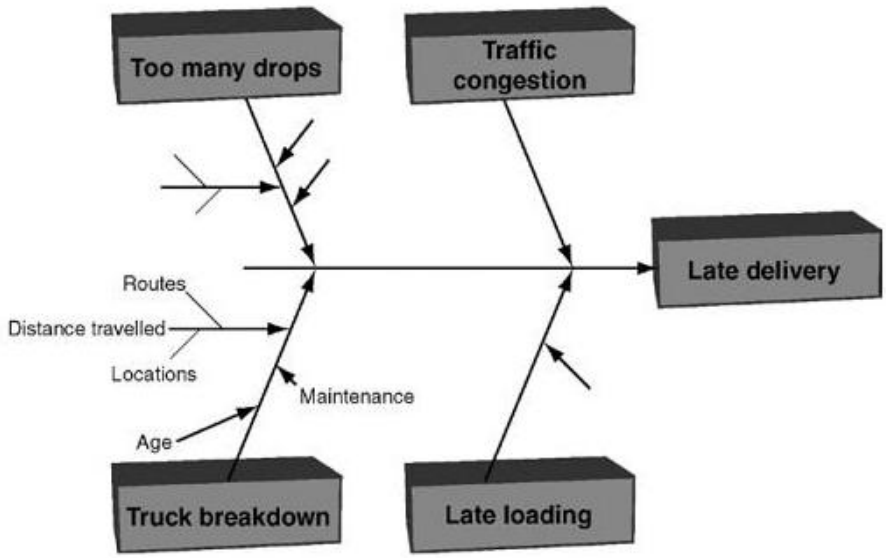


Figure 2.3 Sample fishbone diagram(Waters, 2011),(p. 112)

2.8. Problem Resolution Tools

Following identification of the root causes of problems in the logistics environment, it is important to resolve the problems successfully. Three tools, including change management, ECRS, and SMED, have been identified as appropriate for controlling and managing change in logistics.

2.8.1 Change Management

An important set of tools is found in change management. Change management is a systematic approach to introducing change in an organization's processes, procedures, culture, or other areas(E Cameron & M Green, 2015). As Cameron and (Esther Cameron & Mike Green, 2015) point out, change cannot be prevented. The purpose of change management is to ensure that the change process leads to the expected outcome without introducing negative effects such as resistance or fear and without imposing excess costs(E Cameron & M Green, 2015).

There are many different models of change management that can be drawn on in order to organize change effectively. A useful set of tools were introduced by

Kurt Lewin, including force field analysis and the three stage model of change(E Cameron & M Green, 2015). Force field analysis (illustrated in Figure 4) compares the driving and resisting forces that are either supporting or rejecting a planned change, identifying potential changes that should (or conversely should not) take place. The force field model requires that the driving forces are stronger than the resisting forces in order to affect change(E Cameron & M Green, 2015). Thus, this tool offers a way to understand how change should be managed, as well as whether it should take place.

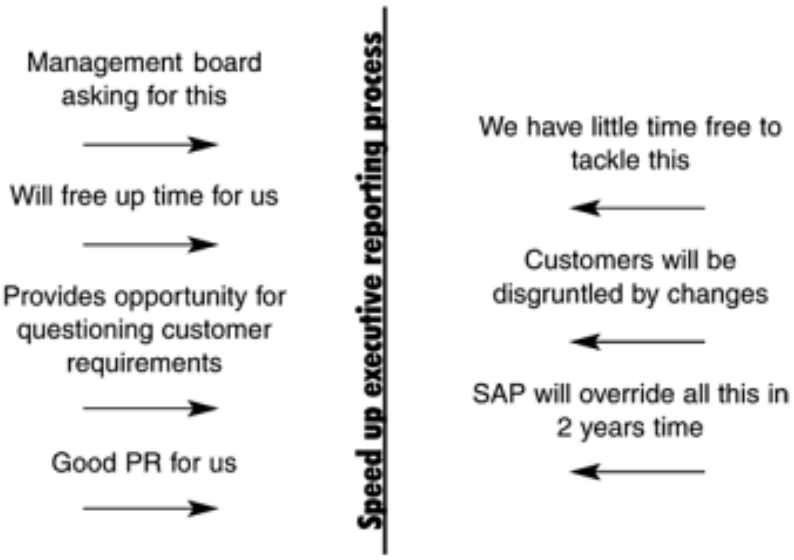


Figure 2.4 Example of force field analysis
(Esther Cameron & Mike Green, 2015), (p. 106)

Lewin's three-stage change model proposes that organizations exist in homeostasis, or a balanced state(E Cameron & M Green, 2015). Change occurs when this state is disrupted, either intentionally or unintentionally. In order to implement a change, the first step is unfreezing, or disrupting the current state of homeostasis in the organization. Next, the change is made (for example implementation of a new procedure). Finally, the organization is refrozen, or in other words regains its homeostasis balance(E Cameron & M Green, 2015). This change model is one of the simpler models for change available, and is useful because it demonstrates that

change management is a straightforward and systematic process(E Cameron & M Green, 2015). However, it does not identify the specific changes that need to be made.

2.8.2 ECRS

One of the basic ways to eliminate problems in materials handling and logistics is ECRS, which stands for eliminate, combine, rearrange (reroute), and simplify(Stephens & Meyers, 2013). This heuristic suggests that the following steps should be used to determine the appropriate solution for a problem.

- **Eliminate:** if the step of the process that is causing the problem can simply be eliminated, this should be the first action(Stephens & Meyers, 2013). If the step can be eliminated without affecting the outcome, then it is probably wasteful anyway, so there is no need to continue using it(Stewart, 2011).
- **Combine:** If the step can be combined with another step, this can reduce the complexity of the problem and therefore the risk involved in the process(Stephens & Meyers, 2013). For example, if there are two paperwork processes associated with a shipment that could be combined into a single paperwork process, then there is less opportunity for process failure because there are fewer steps to go wrong.
- **Rearrange (or reroute):** Some process failures can be resolved by rearranging or rerouting the process(Stephens & Meyers, 2013). In logistics, for example, there could be problems such as a traffic failure that prevents effective delivery of an order. If the order can be rerouted via another road, or rearranged (for example sent on an alternative logistics provider or moved to another truck) then delays can be reduced or prevented.
- **Simplify:** Finally, if a problem cannot be treated any other way, it can be simplified in order to reduce the complexity(Stephens & Meyers, 2013). For example, logistics can be improved through the introduction of automation techniques or the use of enterprise resource planning (ERP) software, order fulfillment software or other types of software(Stephens & Meyers, 2013).

The ECRS tool is particularly helpful for reducing risk and complexity within a known problem environment(Stephens & Meyers, 2013). However, it does require that the root causes of the problem be identified, using one of the techniques above or other similar technique. Otherwise, this process will only treat the symptoms and will not be successful in resolving difficulties in the long term.

2.8.3 SMED

A final process that can be used to resolve logistics problems is SMED (Single Minute Exchange of Die), which is another technique derived from the TPS and integrated into later iterations such as lean production(J R Henry, 2013). SMED is designed to reduce the amount of time spent changing over from one process to another, which can be a significant source of waste in the production process. In manufacturing, the goal is to reduce the amount of time needed for changeover to less than ten minutes. This increases the flexibility of the firm to move from production of one product to another.

Although the application of SMED to logistics may not be obvious, there are still opportunities for it to make a difference(J R Henry, 2013). One example given by Henry (2013) is in regard to the design and labeling of the shipping boxes used by a firm to pack and ship their products. A firm using several sizes of shipping boxes with different label positions for different products lost time in the packaging process because of the five minutes required to change the position of the labeler head each time the the process be packaging run changed. By changing the packaging process to use fewer sizes of boxes and standardizing the position of the label, it was possible to eliminate most of the time involved in resetting the packaging line(J R Henry, 2013). This type of improvement can be found in other areas of logistics as well, which makes SMED a powerful tool for eliminating or reducing the amount of change involved in the logistics process. SMED may be a more difficult tool to use because of the need to find ways to reduce turnover time(J R Henry, 2013). It also requires that the problems in understood, so that they can be effectively eliminated. Once again, a root cause analysis is required before implementing this tool.

2.9. Previous Studies

Previous studies have been examined in the area of interest for this study in order to provide empirical support for the case study. Studies in improving aspects of logistics including delivery time, delivery reliability, flexibility and market coverage are all important, but the main focus is on reducing delivery lead time. Table 1 summarizes the key findings of these studies.

The studies reviewed used either case study methodologies of a single firm or a small number of firms or a broader survey in a more general industrial or national topic area. A number of industries and contexts were included. However, there were relatively few studies on Thailand, with the main study found being in the paper industry. This was an older study that relied only on simulation, and as a result is inadequate.

The studies have some significant similarities. First, formal SCM practices and ECRS are commonly identified with improved production cycle performance, including reduced lead time, improved quality, and other metrics(Chong, Chan, Ooi, & Sim, 2011; Islam & Rahman, 2013; Koh, Demirbag, Bayraktar, Tatoglu, & Zaim, 2007). These studies are critical because they point out the importance of simply *having* a supply chain management practice in place in order to improve logistics. There were also a few studies that addressed the importance of information availability and exchange, through ERP or other organized information and reporting systems(Millet & Botta-Genoulaz, 2008; Molnár, Gellynck, & Weaver, 2010). The insight offered by these studies is that is important to have adequate information about not just the firm's own operations, but the operations of its suppliers, in order to improve logistics performance. (Kumar & Phrommathed, 2006) add the insight that the use of information tools such as simulation can be a significant factor in improving performance. Finally, (Koskinen & Hilmola, 2008) provide a reminder that simply having a large inventory in stock is not usually sufficient for improving efficiency. Instead, the firm needs to have information about what to do with this inventory and free capacity on transport routes in order to make use of this inventory effectively.

Table 2.1 Summary of Studies on Logistics Improvement

Authors	Topic	Methods	Findings
(Chong et al., 2011)	Improvement of firm performance in Malaysia through introduction of SCM	Survey (n = 163)	Formal SCM practices (including those discussed above) were associated with significant improvement in lead time, inventory turnover, product rejection and other indicators.
(Islam & Rahman, 2013)	Improving quality in Bangladesh garment industry	Case study	The authors used Kaizen and other TQM practices and a traffic-light quality system to improve production quality within the factory. This resulted in fewer reworks and reduced returns, reducing the number of days required for production and thus reducing lead time.
(Koh et al., 2007)	Impact of SCM practices on small and medium enterprises in Turkish metal fabrication industry	Survey (n = 203)	Standard SCM practices including TQM-related practices were found to impact operational performance including lead time. Multiple outsourcing and supply partners also improved lead time and other operational indicators.
(Koskinen & Hilmola, 2008)	Supply chain management in the paper industry	Case study of Northern European international paper producer	Lead time was dependent on factors including free capacity on shipping lines (rail, sea, etc) and procedures. The firm kept 45 days inventory but this did not improve lead time.

Table 2.2 Summary of Studies on Logistics Improvement (Cont.)

Authors	Topic	Methods	Findings
(Kumar & Phrommathed, 2006)	Using simulation mapping to improve operations in a firm	Case study of Thai paper producer	The authors used simulation to identify key obstacles in the supply chain and remove them. This could potentially lead to reduced lead time and improved quality, but results were not implemented in the firm.
(Millet & Botta-Genoulaz, 2008)	Process maturity, ERP implementation and effects on supply chain	Qualitative study of French firms	This study found that introducing Enterprise Resource Planning (ERP) systems was not sufficient to improve logistics. Instead, the firm needed to improve its processes, introducing TQM aspects and developing information and reports in order to gain benefits, including reduced lead-time and improved reliability.
(Molnár et al., 2010)	Differences in supply chains in food industry	Case studies	This study found that supplier choice and information exchange made a significant difference in reducing lead time and improving general performance. Lead time was particularly important in this study because logistics lead time makes a significant difference in perceived quality for perishable food.

Table 2.3 Summary of Studies on Logistics Improvement (Cont.)

Authors	Topic	Methods	Findings
Ongkunaruk and Wongsatit (2014)	An ECRS-based line balancing concept: a case study of a frozen chicken producer	Case study	The studied is aim to improve the productivity of a large size of frozen chicken manufacturer in Thailand .Authors found that one option for improvement can be done by adjusting step of work. Using ECRS to reduce lead time and number of employees.

The research demonstrates that a number of techniques such as TQM and ECRS can be applied to improve logistics capabilities. However, few of these studies have taken place in Thailand, despite the logistical issues that are relevant there and the central position of Thailand in Southeast Asia's logistics network. This study will fill a research gap in this area. It will also fill a pragmatic gap for the company. The following research questions will be posed for this study:

1. How will the company improve its logistics management to reduce delivery lead-time?
2. How will the company benefit from improved logistics?

2.10. Conclusion

This chapter has provided a comprehensive overview of logistics and logistics management in the business context. It began by discussing the definition of logistics and why it was important to the business, and then addressed the specific benefits that logistics management offers to the firm. Third, it examined some of the problems that can occur with logistics, such as delivery lead time problems, work processes, and customer satisfaction problems. The chapter then introduced several problem analysis and problem resolution tools that can be used to identify, reduce, and prevent problems from occurring in the logistics process.

The review of the literature has made it clear that logistics is an important business process that can provide a lot of value to the firm. However, there are some serious problems that can occur, and which can prevent the logistics management process from being effective. These problems are not mysterious and are commonly shared by different firms. Problems such as delays, process difficulties, and falling customer satisfaction can cancel out the potential benefits of effective management processes. This makes it worthwhile to implement formal logistic management processes, which include the problem analysis and logistics problem solving tools that are known to resolve these problems. This process of analyzing and resolving problems means that the logistics process will become mature over time, with fewer problems experienced and more consistent ways of dealing with problems that do occur. By considering logistic management part of the process of lean management, the benefits can be maximized, since then it will be connected to the firm's full manufacturing process. In the next chapter, the process for applying the insights from the literature review to the research case study is explained. This takes into account that firm processes need to be considered when implementing logistics management strategies.

3. Chapter III
Methodology

3.1. Selection of Case and Case Attribution

Apart from the theoretical proof, another eminent end goal of this study is to employ the study result so as to establish a tangible profit. The solid result can be evidenced clearer and is measurable by implementing with a real situation. A case study was hence selected. According to (Yin (2014)), the case study research is proper to deploy when the aim of research is to find the solution as well as when the behavioral aspects of the situation's players are rarely controlled by the researcher.

The company was picked because of the most possible and foreseeable benefits. Since the researcher is a permanent employee working with this organization for several years in a position of Senior Sale Executive, who is a direct front line facing with customer. Researcher has been assigned from management team to be a leader for solving a develop a problem solving and improvement of the company together with company's logistic department which are consist of 4 sections, customer service ,warehouse, planning and logistic are counted. Hence, implementing the study findings with the selected company is somehow possible than being implemented in other organizations. A selection of case, the chemical supplying company, is also purposively nominated. The chemical industry is one of Thailand's leading industries driving the whole economy. Overall business would be benefited if players in the market were efficiently operated.

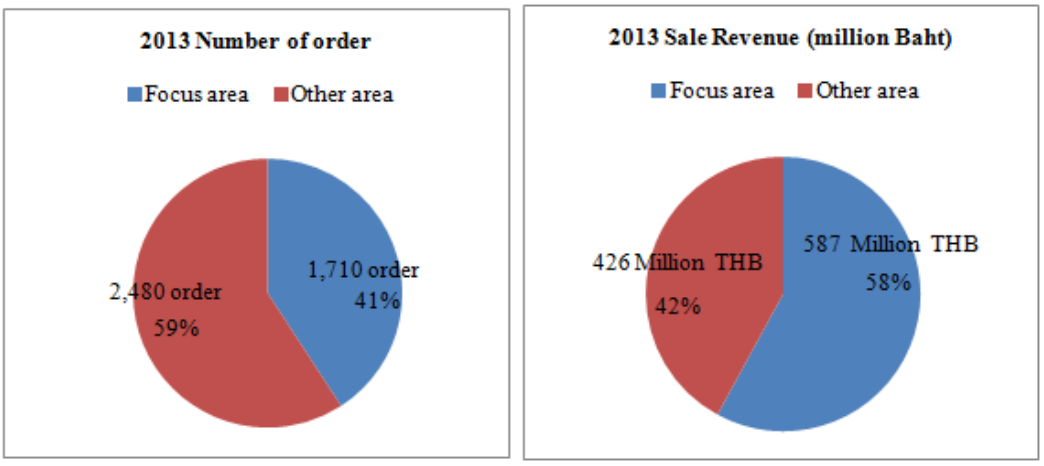
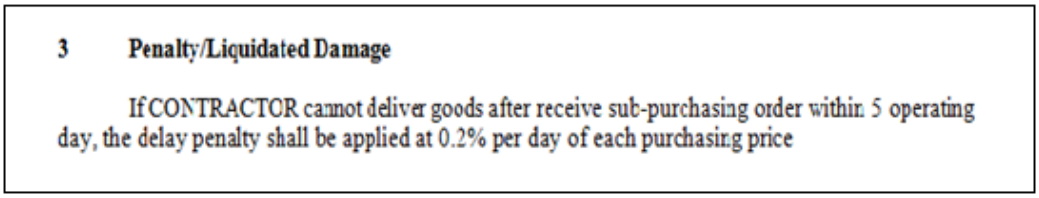


Figure 3.1 Number of order in 2013 Versus Sale Revenue in 2013

The target customer section to be studied is however stratified. Referring to figure 5 , the number of orders in 2013, there are 4,190 received purchasing order and 41 percent of those are owned by 65 principal customers, who contribute a big portion of sale revenue of 587 million Baht or 58 percent of total revenue in 2013. Those clients are businesses concerning petrochemical industry as main portion but also automotive, power plant and steels manufacturing are included. There are thirteen sale executives responsible for this group of customers. More importantly, these customers' locations are within 200 kilometers distance away from the company's warehouse facilities. This is therefore possible for delivering the products within the committed time – five days. The rest of customers, on the other hand, are not a focus of this study since their locations, including but not limited to Nakhon Si Thammarat, Saraburi, Ayuthaya, Nakhonratchasima, Kanchanaburi and Lamphun. Most of their business concern electronics manufacturing, paper, food and beverage industry, and off-shore services.

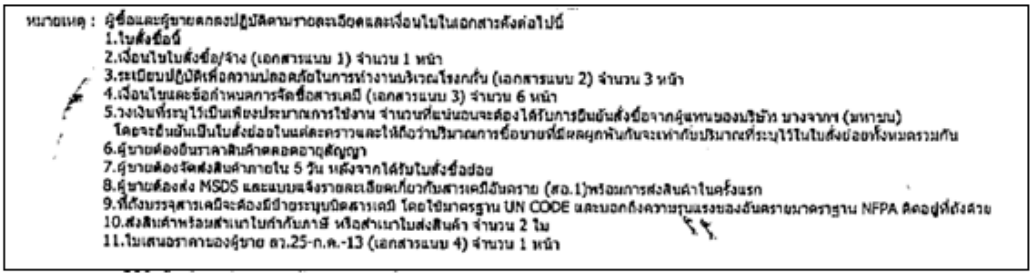
By a mutual agreement between the company's management and customers, the standard five days delivery time is set. This number is devised by company capability in delivering and historical time delivery records. The standard five days delivering time is not only satisfy clients but also could ensure customer's supply reliability. Excerpts from delivery contract could illustrate this figure.



3 **Penalty/Liquidated Damage**

If CONTRACTOR cannot deliver goods after receive sub-purchasing order within 5 operating day, the delay penalty shall be applied at 0.2% per day of each purchasing price

Figure 3.2 Exception of Delivery Contract



หมายเหตุ : ผู้ซื้อและผู้ขายตกลงปฏิบัติตามรายละเอียดและเงื่อนไขในเอกสารดังต่อไปนี้
1.ใบสั่งซื้อนี้
2.เงื่อนไขใบสั่งซื้อ/จ้าง (เอกสารแนบ 1) จำนวน 1 หน้า
3.ระเบียบปฏิบัติเพื่อความปลอดภัยในการทำงานบริเวณโรงกลั่น (เอกสารแนบ 2) จำนวน 3 หน้า
4.เงื่อนไขและข้อกำหนดการจัดซื้อสารเคมี (เอกสารแนบ 3) จำนวน 6 หน้า
5.วงเงินที่ระบุไว้เป็นเพียงประมาณการใช้งาน จำนวนที่แน่นอนจะต้องได้รับการยืนยันสั่งซื้อจากผู้แทนของบริษัท บางจากฯ (มหาชน) โดยจะยืนยันเป็นใบสั่งย่อยในแต่ละคราวและให้ถือว่าปริมาณการซื้อขายที่มีผลผูกพันกันจะเท่ากับปริมาณที่ระบุไว้ในใบสั่งย่อยทั้งหมดรวมกัน
6.ผู้ขายต้องยืนราคาสินค้าตลอดอายุสัญญา
7.ผู้ขายต้องจัดส่งสินค้าภายใน 5 วัน หลังจากได้รับใบสั่งซื้อย่อย
8.ผู้ขายต้องส่ง MSDS และแบบแจ้งรายละเอียดเกี่ยวกับสารเคมีอันตราย (สอ.1)พร้อมการส่งสินค้าในครั้งแรก
9.ที่ถังบรรจุสารเคมีจะต้องมีป้ายระบุชนิดสารเคมี โดยใช้มาตรฐาน UN CODE และบอกถึงความรุนแรงของอันตรายมาตราฐาน NFPA ติดอยู่ที่ถังด้วย
10.ส่งสินค้าพร้อมสำเนาใบกำกับภาษี หรือสำเนาใบส่งสินค้า จำนวน 2 ใบ
11.ใบเสนอราคาของผู้ขาย สว.25-ก.ค.-13 (เอกสารแนบ 4) จำนวน 1 หน้า

Figure 3.3 Exception of Delivery Contract

More importantly, because of the study time constraint, limited research funding, as well as the company's budget, the logistics improvement via IT and peripherals installation is excluded from the scope. An application of new IT system needs both high values of investment as well as longer time for adjusting from the old manual system to the new IT based system.

3.2. Research Method

This research is divided into two stages – Stage I and Stage II. The first stage concerns analyzing the current process to identify the problem as well as finding solutions. The Stage II is an implementation of the solutions from Stage I so as to measure the tangible benefits of the study.

3.2.1 Stage I - Problem Identification and Solution finding

Research procedures employed during the stage one can be explained in detail as items below.

3.2.1.1 Document Reviewing

Contracts and related documents were reviewed during this stage to gain initial information concerning time delivering records.

3.2.1.2 Observation

According to (Drury (2001)), an observation method is useful for collecting both quantitative data (e.g. time, numbers of process) as well as qualitative data (e.g. cause of delays). This method also provides very high face validity and is suitable for the event that researcher does not looking for the causality. The observation method is hence appropriate to use since the true operational process as well as time delays are being observed. The rare cases or causalities are not the focus. In this particular, the researcher, who works as front line team contacting the clients and has direct effect with this complain issue, carefully observes the operation.

3.2.1.3 Interview with Key Persons

Interview is a mean of qualitative research. Four targeted interviewees were picked from Sales, Logistics, Customer Services, and Warehouse department. According to Creswell (2009, p. 178), 'the idea behind qualitative research is to purposefully select participants or sites (or documents or visual material) that will best help the researcher understand the problem and the research question' The conducted qualitative interview is believed to be able to define the root cause of delays in delivery. The data gained will then be analysed for devising process improvement tools, which later be implemented into the day-to-day operation.

3.2.1.4 Cross Functional Discussion

Problem analysis was carried out by conducting the cross functional meeting to identify the true cause of the delay. The cause of problem was investigated together with a devising of Gantt chart to identify the current operational time.

Pareto chart were also employed for finding the root cause of the problem. Lastly, MUDA was employed to identify in –process wastes that can be eliminated.

3.2.1.5 Setting up the Counter Measurement

After gaining insight information from the prior steps, the counter measures were identified. As the aforementioned section, the ECRS and SMED were employed to rearrange the new workflow. This section will also discuss the possible tools that can be used for improving logistics process as well.

3.2.1.6 Application of MOC

MOC was also employed to minimise the resistance and risk. By doing so, MOC team members were selected from related departments – Sales, Customer Service, Warehouse, and Logistics. The champion of the change was also selected. Detailed organisation chart of MOC committee will be explained during the next chapter.

3.2.2 Stage II-Implementation

Procedure during the stage II can be explained as the following steps.

3.2.2.1 Implementation of solution finding from Stage I

During this step, the results gained from the stage I were implemented. The Priority – Action – Consider – Eliminate (PACE) were initially employed to prioritize each counter measures for implementation.

3.2.2.2 Solution Reporting

The final step is to write the study report. Theoretical assumptions, research methods, findings, as well as the implementation results will be presented. The implementation results will be explained in both direct and indirect results. Conclusions, limitations, and suggestions will also be mentioned.

It can be argued that the selected methods are quite similar to the previous study in process improvement. For example, Ongkunaruk and Wongsatit (2014) analyses the production process in a large-size frozen chicken producer in order to define the bottlenecks in the flow of information and materials. The improved model of chicken operation was later defined. To conduct the study, Ongkunaruk and Wongsatit firstly analyse the current production process by observing and collecting data from true operation. The bottlenecks were identified from collected data. Several problem solving tools including ECRS were then applied and implemented. These processes are quite identical to methods being used in this study.

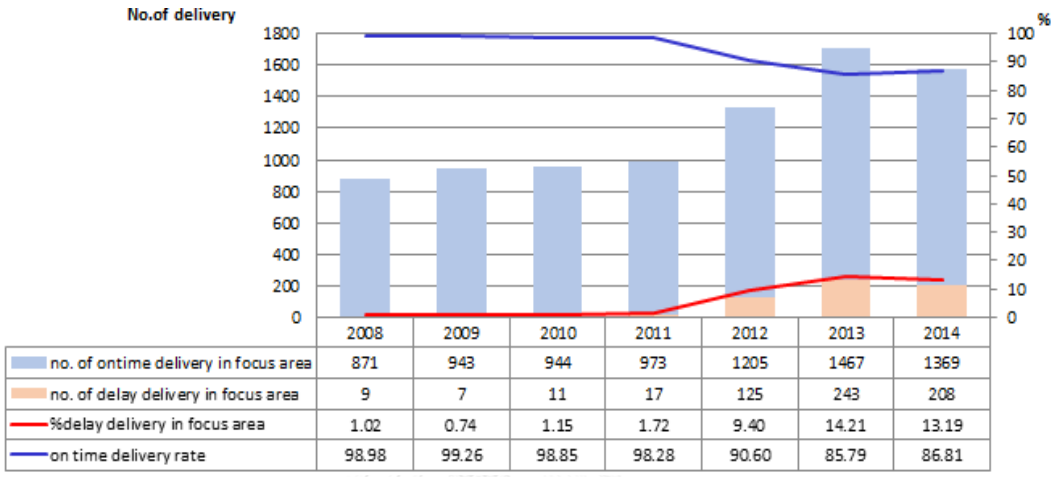
3.3. Problems Analysis Methods

The aforementioned section describes the tools being used for analysing data in the company's logistics process. The four tools have already been identified - Gantt chart, Pareto chart, MUDA (waste), and cause and effect analysis (Fish bone diagrams). These tools are used at different stages in order to identify and address the problems. In addition, implementation of these tools is conducted together with the management of change (MOC) concept so that the resistance is neutralized and the result of study can be fully imposed. All the applications will be discussed in details hereinafter.

4. Chapter IV

Problem Identification and Solution finding

4.1. Problem Analysis



	2008	2009	2010	2011	2012	2013	2014
no. of ontime delivery in focus area	871	943	944	973	1205	1467	1369
no. of delay delivery in focus area	9	7	11	17	125	243	208
%delay delivery in focus area	1.02	0.74	1.15	1.72	9.40	14.21	13.19
on time delivery rate	98.98	99.26	98.85	98.28	90.60	85.79	86.81

Figure 4.1 Delivery Status during 2008 – 2014

The serious delay in delivery affecting customer's satisfaction firstly occurred in 2012. This led to higher fine to clients for delay delivery. The penalty of 165,000 THB in the latter year, 2013, was recorded the highest fine paid out by the company. This is also resulted in a drop of customer satisfaction in 2013. Facts from customer satisfaction survey shows that the main customer concern is delivery (46.15 percent). This is followed by concerns about staff and service (26.15 percent), price (21.54 percent), and product (6.15 percent) respectively.

Moreover, more delays have occurred in the following years. Delays log in 2014 shows that there were 208 delays amongst 1,577 orders. The number is quite similar to the previous year, 2013. As per the aforementioned fact, the first significant delay started in 2012, the year that there were several changes in the organization. The company was acquired which in turn led to a change in staff including operational level staffs. Newly recruited staffs have low job competency. This fact can exacerbate the weak operation system. Also, an increase of orders from the growth of automotive and petro-chemical market in Thailand during 2013 can worsen

the company's capability in delivering. This in turn led to the more serious delay in delivery.

Although company's clients continuously order chemical products as the sale value increases consecutively, delays must be attenuated. An on-time delivery can increase customer's satisfaction that in turn increases company's revenue and competitiveness in a long run.

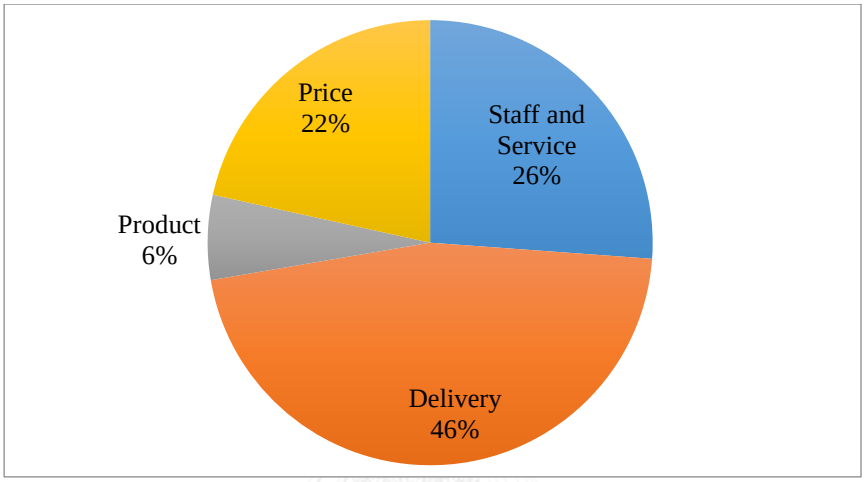


Figure 4.2 Customer View from Customer Satisfaction Feedback Survey 2013 (65 Samples)

4.2. Cause of Delay Identification

4.2.1 Most Capable Lead-Time Identification

In order to verify the company's capability in delivering products within five days, Gantt chart was employed. The capability is considered from company's internal processes as well as the focused customer's locations. Cross-functional meeting with key departments, which are customer service, sales, logistics, and warehouse, was conducted. They were asked to clarify their internal process together with the lead-time of each process. For example, sales have to define how long will they take to create an order form and send it to customer service for the next process. They were also encouraged to put the waiting time due to a delay of prior process into consideration. In other word, the most capable lead time is yet a lean process. It is found that the total time being spent after sales receive the order from customer until the goods were safely delivered to the customer custody is 4.6 days

(see appendix A – Gantt chart). This perfectly supports company delivering policy committing to transport the goods within five days.

The information and material flow chart representing the most capable and possible process was hence drawn, which could illustrate the detail process performed by each department.

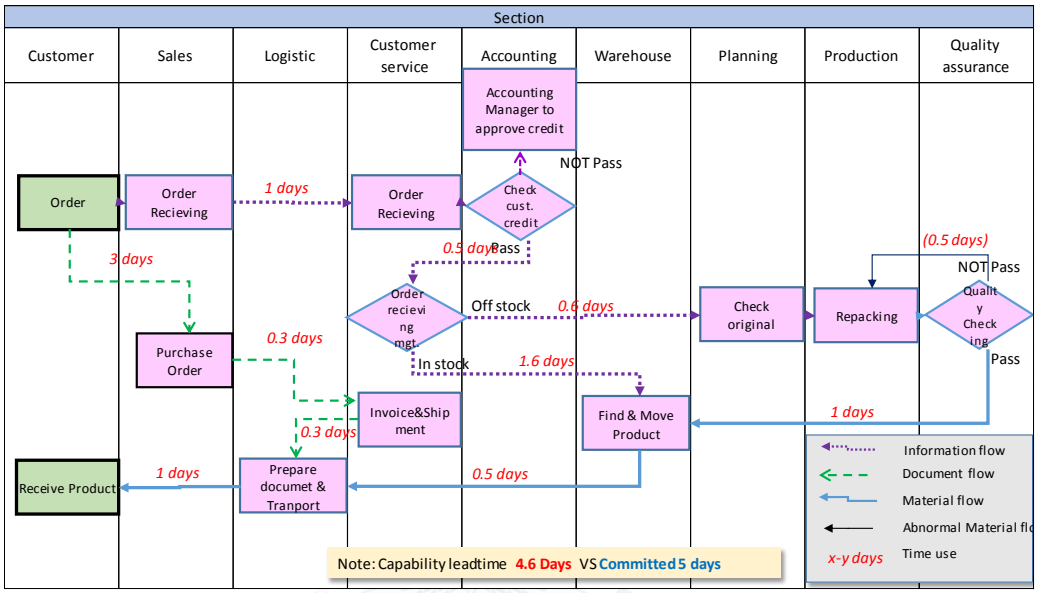


Figure 4.3 Most Capable Information and Material Flow

4.2.2 As-Is Process Identification

From the review of contracts and delivering records as well as the observation, it is found that the current lead-time, which is started from receiving an order from client until product arrival at customer site, is varied around three to nine days. The large range of delivering time, including some extra days from standard five days, implies that company cannot efficiently control the overall process. This in turn could make the delay in delivery.

The information and material flow is delicately drawn from the most capable information and material flow and is illustrated in figure 9. In details, the process starts from sale receives order from customer via email before creating order form and send to customer service team. The customer service will check details in the order form and contact accounting officer to verify if the customer has credit limit for ordering. After accounting officer verifying and confirming, the customer service

places order into a shared drive. The financial and accounting manager will be asked to consider customer credit limit extension if the order value is higher than the existing credit limit otherwise. The warehouse staff collects placed orders from shared drive on daily basis before going the check stocks and product's batch number in a warehouse. These two processes normally take one day. The warehouse office will then inform the batch number to warehouse operator in order to prepare for delivery in the next day. By the mean time, logistics officer receives deliver order (DO) from customer service. He will then schedule the transportation with the third party logistics provider as well as collecting delivery documents prepared by customer service (i.e. certificate of analysis from laboratory, invoice and PO). Normally, the logistics provider will pick up goods for delivering in the following day. The time for transportation to the focused client's site, located within 200 kilometers from company's premise, is around two to three hours. *(see Appendix C – work flow chart of logistic department of the company)*

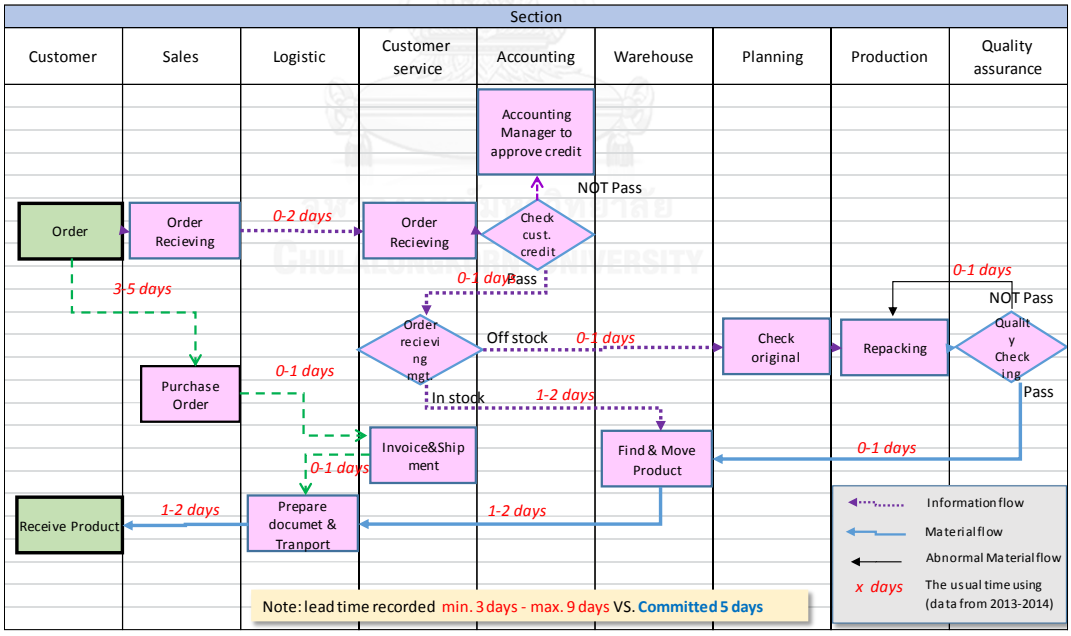


Figure 4.4 As-Is Information and Material's Flow

As the delivery record, found that the average delivery lead-time is 4.62 and 4.58 days in 2013 and 2014 respectively. However, late delivery was noted at 14.21 percent and 13.19 percent in 2013 and 2014. The present process varied from three

to nine days, which does not meet a standard lead-time of five days as well as much higher than the most possible lead-time of 4.6 days. There are therefore 4.4 days discrepancies. The process improvement should be employed so as to improve the overall delivering process.

It is found from the illustrated figure that eight departments are related to the overall delivery process. These all departments were examined if how do they participate in each activity of delivery. Besides, It can be seen from the appendix C for the work flow chart of logistic department of the company that is a numbers of sub-working processes involve in delivering process. However, It is found from the delay delivery record in 2014 that 208 delay history were from sub-working processes which are defined as appear in figure 12. The sub-processes contribute the delay in 2014 comprise of thirteen activities, which are order management, order form correction, customer credit verification, information collection, submission of order to customer service department, inventory check and confirmation, shipment documentation, vehicle inspection, loading and discharging of products, product picking (from shelves in warehouse), product repacking into desired size, information exchange via shared drive, and laboratory quality assurance.

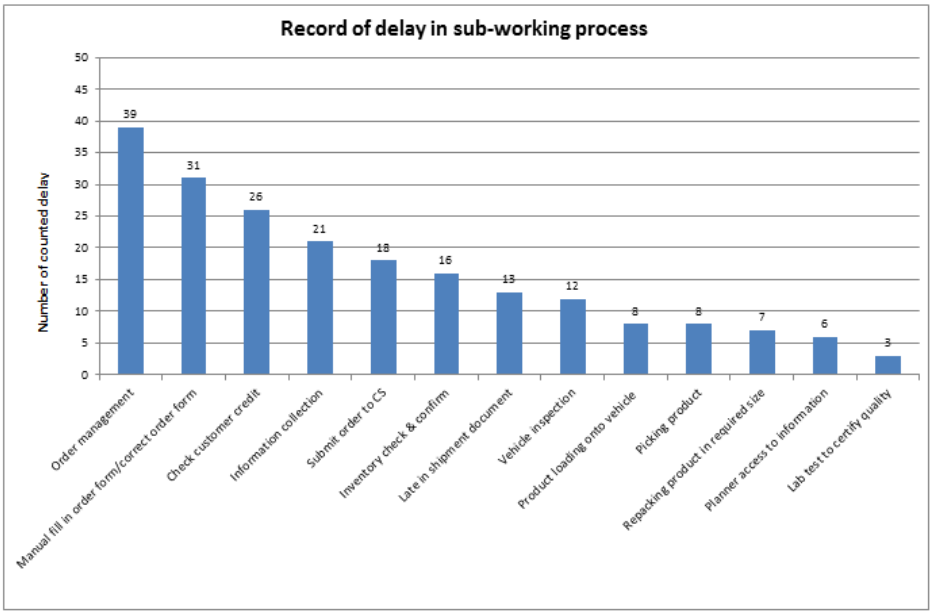


Figure 4.5 Record of Delay in Sub-Working Process in 2014

It is found that most of the time spent on overall delivering process falls into four departments – Sales, Logistics, Customer Services, and Warehouse. The overall operating time spent by these four departments accounts for eighty percent of overall process time. On top of that, every single sub-process in each department was examined in order to define the true operational time. This was conducted together with identifying the numbers of delay in each sub-process

By taking the numbers of delays in each sub-process into consideration, the new Pareto chart was drawn. Although the numbers of delay own by each department were overall attenuated and are more being able to represent the true delay, Customer Service, Sales, Logistics, and Warehouse department are the top department who cause (and are affected by the prior) delays.

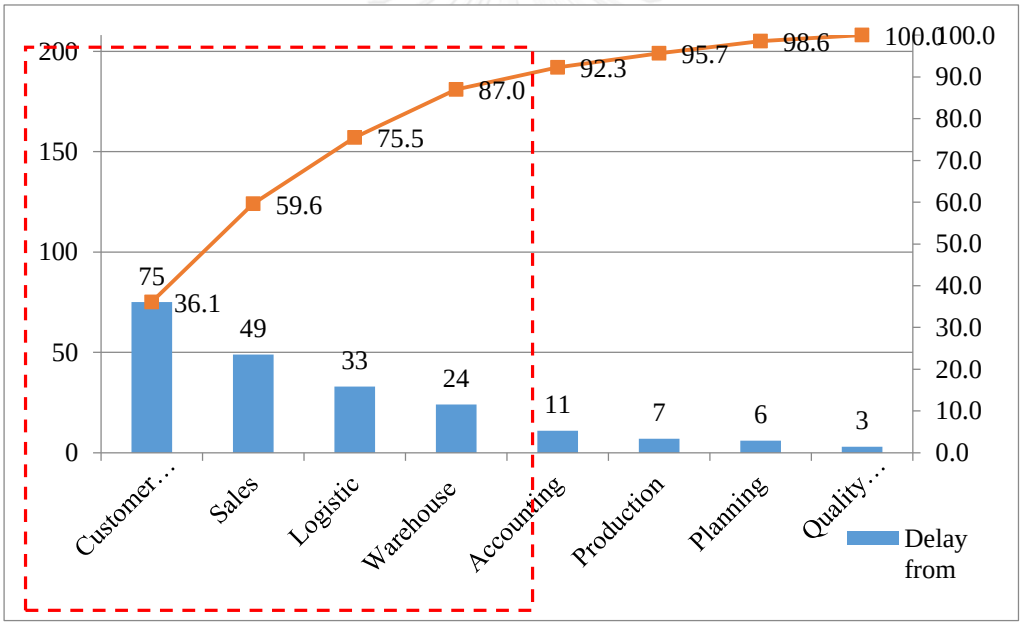


Figure 4.6 Pareto Chart of Departments Causing/Being Affected Delay in Sub-Process

4.2.3 5W1H Problem Analysis

In order to ensure that the problem is thoroughly understood before discussing the solutions, this issue is analyzed through 5W1H. Results are as shown below:

Table 4.15 W1H Problem Analysis

5W1H	Description
What	Company cannot fully deliver product within the committed time (five days). There are 9.4, 14.21, and 13.19 percent delay of delivery in 2012 to 2014 respectively.
Where	There is no change of location for both company's and customer's warehouse. Delivering area is 200 kilometres from company's warehouse.
When	From year 2012, the year that sales dramatically increased as well as there was the change in management.
Who	There are several players related to the cause of delays; however, only four main departments should be focused, as they are key of delivering process. There are sales, logistics, customer service, and warehouse department.
Why	The delay is from four main causes – man, material, method, and machine. These facets will be rigorously discussed hereinafter.
How	An analysis of overall process is required in order to solve the problem of delay

4.3. Process Analysis

After an identification of the cause of the problem as well as the keys improvement of the whole delivering process had been conducted, a careful process analysis were later employed by using Fish-Bone Diagram. The process analysis by applying this tool is believed to be able to identify wastes in the process. Each department analysis is presented through the fishbone diagram dimensions – man, material, method, and machine.

4.3.1 Analysis of Customer Service Process

The most challenging task faced by customer service department is a handling of high volume of both in and out flow of information. Due to an information overload, staffs may accidentally neglect some important information. In sum, there are three main causes influence the late in stock delivery within customer service department. They are man (unskilled employee), material (wrong and incomplete data in the order form), and method (credit checking and order management).

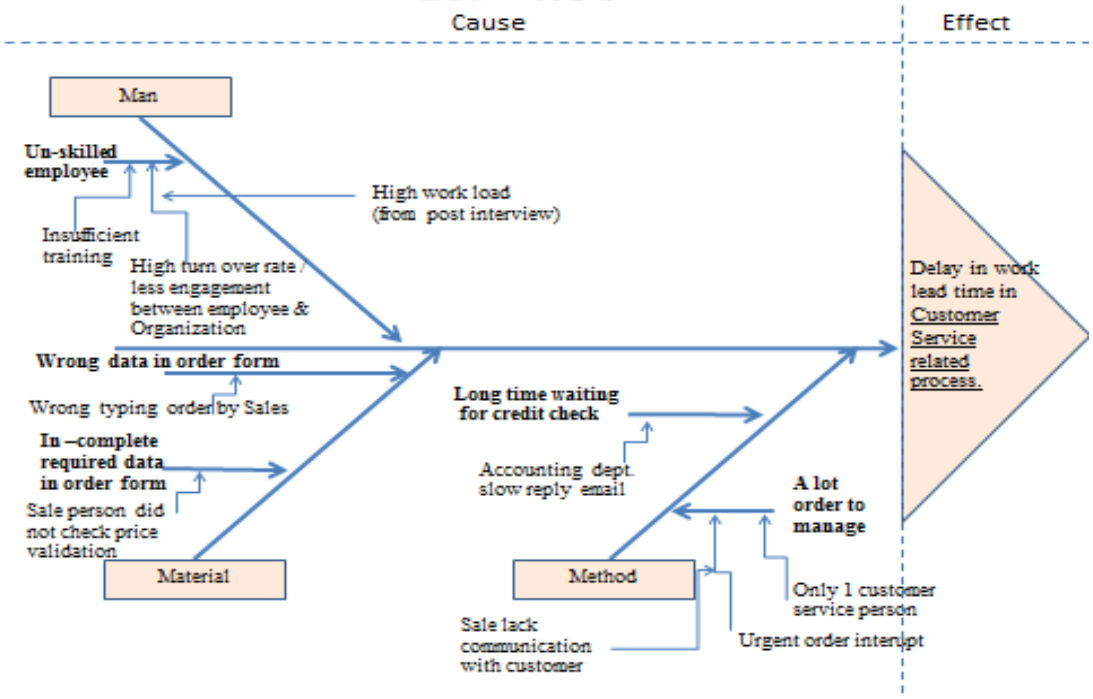


Figure 4.7 Fishbone Diagram of Customer Service Process

1) Man

An employee's skill is the main concern. It is found that many employees have low job competency which in turn makes them to work slowly and inefficiently. This can be attributed to the high turnover rate and insufficient training. In addition, an increase of sales in 2012 can contribute to the higher workload. This could make employee to work over-time. Current full-time equivalent requirement (FTE

requirement) of overall employees is higher than 100 percent. It is believed to cause the inefficient work (see appendix 2 – workload analysis).

2) Material

The low skilled employee together with high workload can in turn influence the quality of the later process. Sale department does not validate the customary price before forwarding orders to the later stage. Therefore, orders sent by sales department to the customer service are generally wrong. Firstly, there are some typographic errors which can cause further misunderstandings. Additionally, requirement data in an order form is sometimes incomplete. For example, there are no numbers of package required, agreed price, or the expiry date of goods.

3) Method

Normal process requires customer service to check customer's credit limit with accounting department before place orders to share drive in the later stage. As normal process, an internal email is used. Because of the increased numbers of credit limit validation request and due to the rise in number of orders, accounting department has gradually response the request. Furthermore, there are occasionally urgent orders interrupting a normal process. If there are urgent orders, accounting department have to immediately support in order to deliver the goods to customer's premise on time. Urgent orders are caused by company internal inefficiency – order lost. However, it is caused by customer inefficiency forecasting their inventory. According to the latest record in 2014, there are 88 urgent orders, which accounts for 2.25 percent of overall orders.

4.3.2 Analysis of Sales Process

There are three main contributors increasing the severity of delay in stock delivery by sales department. They are man, material and method. The man dimension represents a slow response in order processing, whereas the latter two dimensions represent in efficient data collection.

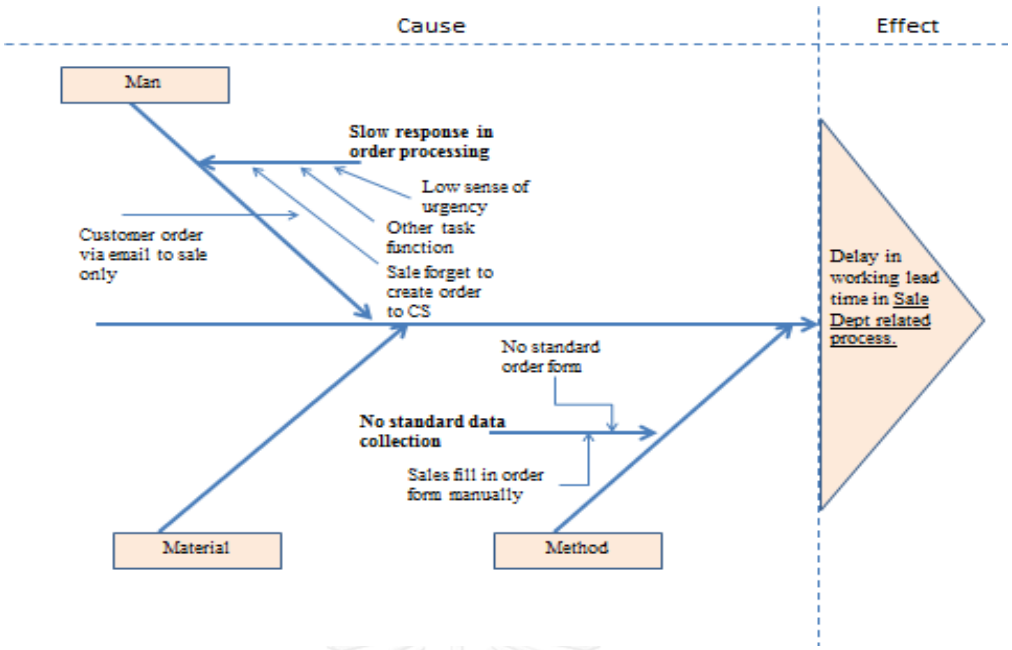


Figure 4.8 Fishbone Diagram of Sales Process

1) Man

A received order may sometimes be slow in processing. This is due to the fact that sales executives do not promptly standby for responding the intermittent orders because other task were doing such as meeting with customer or driving to customer site. They somehow carelessly fail to create the orders that need to be forwarded to customer service department.

2) Material and Method

There is no standard procedure of creating sales' order as well as no standard material being used by sales department for creating or filling the order before forwarding to the customer service department. Some errors in sale's order illustrated below.

REQUEST ORDER

Document No.: _____ Customer Name : PTTGC5

Issued Date : April 28, 2015 Customer Code : P1057

Delivery Date : May 4, 2015 Ship to Address : PTTGC5

Customer Type : TSM

Item	Product No.	Quantity	Pack size	Total Quantity (kgs)	Unit Price	Purchase Order No.
1	N-7330	17	pail	425		

REQUEST ORDER

Document No.: _____ Customer Name : PTTGC

Issued Date : 21-Nov-14 Customer Code : P1049

Delivery Date : 19-Dec-14 Ship to Address : P1049001

Customer Type : Ship & Bill (please select one)

Item	Product No.	Quantity	Pack size	Total Quantity (kgs)	Unit Price(USD)	Total Price(USD)	Purchase Order No.
1	EC1010A	1 tote tank	910	910	5.31	4832.1	
2	EC1005A	1 Tote	1000	1000	5.7	5,700.00	
3	EC3051A	2SPRF	1344	2688	5.31	14,273.28	
4	EC5217A	1SPRF		1308	6.5	8,502.00	
	total					24805.38	

Figure 4.9 Example of Incomplete Versus Complete Sale's Orders by Sale Representative

4.3.3 Analysis of Logistics Process

Machine and method is the dimension identified from logistics process. Although man should also be considered as one of the important dimension, it is found that numbers of staffs in this department is sufficient as well as they play a passive roles as receiving orders from other department before contacting the third party logistics provider. The transporter does not hence belong to the company. People dimension is not viewed as the obstacle in this context.

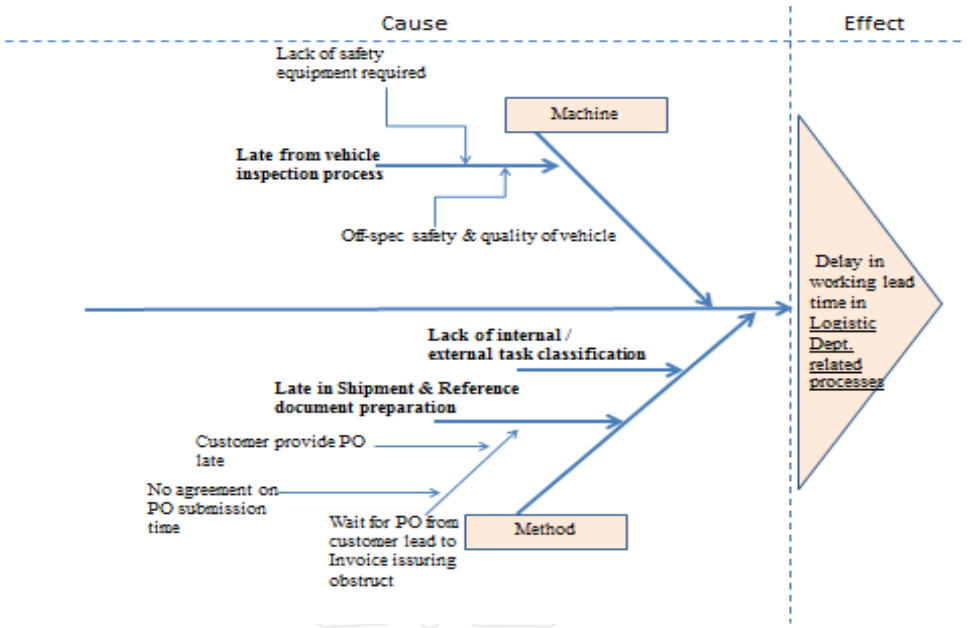


Figure 4.10 Fishbone Diagram of Logistics Process

1) Machine

A vehicle readiness is the main focus causing delay. It was found that there are not only the lacks of safety equipment requirement but also some concerns about the safety quality of vehicle being used in transportation. Due to the fact that the transported goods are chemical product, the safety requirement must be strictly controlled. Moreover, the focus industry is Petro chemical which is highly concern in safety regulation. In other words, the serious inspection must be handled when there is a safety issue. This process normally takes quite a certain period of time.

2) Method

A lack of both internal and external task classification as well as the late in shipment and reference document preparation could contribute to the more serious delay in overall process. The process of preparation is loosely controlled. A reengineering in work method should also be considered.

4.3.4 Analysis of Warehouse Process

An internal managing system of the warehouse is a focus that should be addressed. It is found that there is no proper or standard procedure governing warehouse staffs. Hence, the method is the only dimension being reengineered in the whole warehouse process.

1) Method

It is found there is no competent inventory management system. Warehouse staffs presently monitor stocks by excel tables. The in and out flow of goods are not properly recorded so that the current status of existing stock is unknown. Because of these reasons, warehouse staffs have to validate the batch number of each products following to orders in the warehouse in order that they can confirm if the goods is truly exist. Later that batch number recorded was put in the share drive to confirm and picking list will be created then. Picking product will be made in the following day Therefore, the whole process of validating and picking products up before transporting the customer's premise usually take a very long period of time.

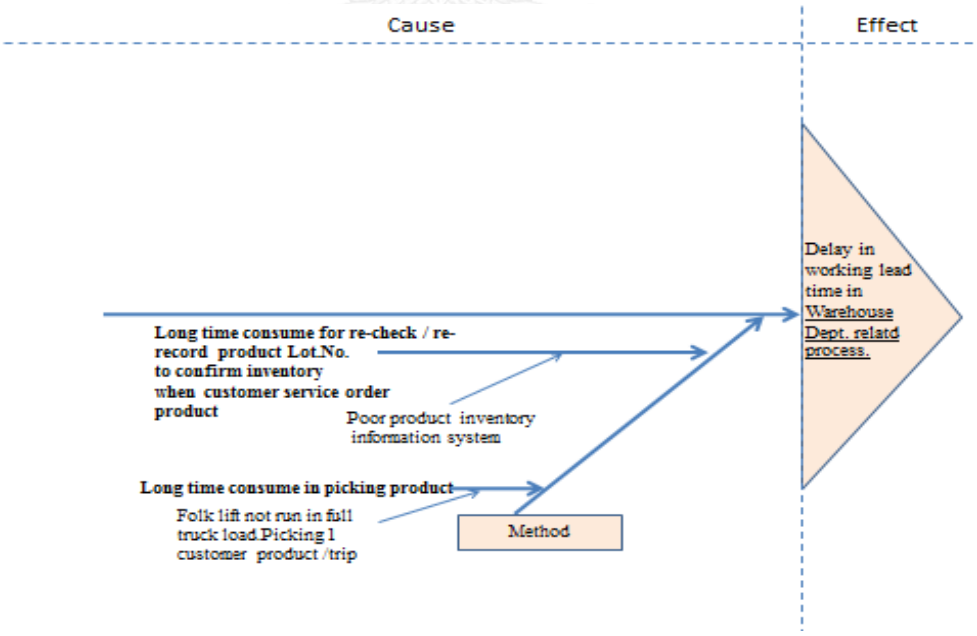


Figure 4.11 Fishbone Diagram of Warehouse Process

Figure 4.12 Warehouse Area of the Company

4.4. In-Process Wastes Analysis

It is found from the cause of delay identification and process analysis that there are not preferred tasks and steps that could be eliminated, combined, rearranged, or simplified. Those tasks and steps are in-process waste. Seven MUDA is deployed to classify the wastes.

Table 4.2 In-process Wastes classified by Seven MUDA

Department	Waste	Seven Muda Dimension
Customer Service	Unskilled employees (including lack of customer's relationship skills, time management skills etc.)	Knowledge disconnect
	Typographical orders by sales	Correction
	No price validation by sales	Correction/ waiting
	Long time validating customer credit limit	Waiting
Sales	Typographical orders by sales	Correction
	Delay in response of order from clients	Waiting

Table 4.3 In-process Wastes classified by Seven MUDA (Cont.)

Department	Waste	Seven Muda Dimension
Logistics	Lack of safety equipment required on vehicle	Correction
	Delay in vehicle inspection process	Waiting
	Delay in documents preparation	Waiting
	Delay in PO submission	Waiting
	Delay in PO submission	Waiting
Warehouse	Poor product inventory information system	Knowledge disconnect
	Long time consuming for re-checking/re-recording batch number	Over processing
	Long time consuming for picking product	Waiting

There are thirteen MUDA that can be eliminated, combined, rearranged, or simplified so as to shorten the delivery lead-time.

4.5. Solution Finding

4.5.1 Process Improvement Options

Process gaps causing delay have been identified. Although most of the delays occur during the sub-process performed by Customer service, Sales, Logistics, and Warehouse department, the headlines of the problem, which will also be used as the key discussion for problem solving, are man, material, method, and machine in the process.

The SCOR Model can provide a bottom line for best practice of how businesses improve their logistics process. The stellar of contemporary logistics process improvement is to employ IT system. An ERP and RFID are widely used in reducing wastes caused by human errors. This option however requires very high investment as well as time to fully apply the system. Due to the fact that company

used as the case study is the medium-size organization which is hardly compared with big regional or global company, Also, the company policy now is cost saving then the high cost of IT implementation is therefore discard as now. It is however focused on finding the root cause to identify the counter measure as well as improving current information system, which is mostly based on MS Excel, to be more user-friendly.

In addition, as it is quite impossible to gain the competitor's information, benchmarking with that global organization that possess the best practices may be misleading. Thereby, the delivery performance, lead time improvement, and overall customer will be focus.

Another tool that can be used for reducing the overall delivering time is the Sales and Operation Planning (S&OP) model. By focusing on the demand forecasting and preparing the response plan, S&OP typically require an extensive plans from every single department and from annual to monthly operational plan in order to quickly and smoothly response to the predicted demand. By considering the current case study, it is found that implementing the S&OP may be somewhat helpful but it may not be able to eliminate wastes in the process. Also, a shortage of demand is not the main problem but ability to deliver products on time is indeed the main focus.

The lean logistics, in addition, is another tool widely used for eliminating wastes in process as well as improving overall performance, especially in a manufacturing industry and its supply chain. A continuous cycle of pursuit of perfection by reducing waste in every single step along the supply chain as well as maximizing the product value lay amongst the central key of lean logistics. It also emphasizes on not pushing costs to the downstream players. By tanking this concept into account, the counter measure using lean logistics may be very helpful in a setting that the improvable area covers the whole process along the supply chain. The company, who is only a small player in the supply chain, may not be able to control the overall logistics process. Only a part of lean logistics, which focus on eliminating internal waste, would be taken into consideration. This will be elaborated in the next section by mentioning the ECRS.

4.5.2 Process Improvement -Counter Measure Setting Up & Plan

Although the improvement in lead-time is an only one combination of improvement of logistics process, the cause of delay may hardly identify especially when in the long chain where there are many related party. Looking into the applicable case, there are only eight departments relating to the delivering process, only four of those are the cause of delay. It is also already argued that the cause of delay does not arise from only one department. It is rather contributed from an inefficient process during the single step of process. This phenomenon can be explained as a bullwhip effect. The bullwhip effect happens when there are variations accumulated along the process flow which eventually resulted in a significant delay at the end of the process (Seung-Kuk & Bachi, 2007). They also argue that some of the main causes of the bullwhip effect include delays in material, information transmission, and purchasing, as well as complexity and practices like order batching. This can perfectly explain the delay within the process of the studied case. For example, the information transfer from one department to another department is not very well handled so that it causes the delay. The selections of tools to tackle with this effect were therefore implemented as priory discussed.

The logistics process improvement in this study simply analyses the problem and key departments concerning the delay of delivery. The current processes were also analysed to find an in-process wastes. These wastes were defined by using Fishbone diagram and seven MUDA before following the ECRS concept – eliminate, combine, rearrange, and simplify. An application of ECRS concept will be discussed together with dimensions of Fishbone diagram, which refer to man, material, method, and machine.

1) Man

The first and foremost dimension that should be emphasized is man. It is apparent from the previous analysis that customer service and sales departments are the keys for manpower improvement. A lack of job skills and high turnover rate are the fore front important causes of process improvement. These problems can be tackled by providing useful training and having effective recruitment. Training

effectiveness in improving employee's capability is evidenced in many studies. Among the most interested selections of findings, Smalley (2005) argues that training is the key in improving human work skills and is imperative to stabilize the business process. This argument supports the needs of training in company A situation. Furthermore, it is also mentioned in Smalley's study that there are three suitable kinds of training that should be priory focused in order to improve work skills. First, job instruction (JI) focuses on skills in transferring knowledge to other colleagues. Looking into the case, this skill can help the old staff to act as a mentor helping new comers about job skills. Second, job methods (JM) emphasizes on a thoroughly understand of the job nature. This skill considers process that could be eliminated, combined with something else, rearranged, or simplified. Customer Service department, for instance, should receive customer orders directly instead of Sale executive. The elimination of process can shorten the overall processing time. Lastly, job relations (JR) concerns relationship management amongst staffs, this training will help staffs to understand the individual differences and make the team. This skill also includes the relationship management with customers. For example, sales should get involve with client's inventory management so that they can understand the true needs of customers as well as being able to forecast sale amount more accurately. Taken together, these trainings support employees to create routine and work specialization. When staffs are familiar with their jobs, they will perform not only efficiently but also effectively.

The training does also increase job engagement. Bakker, Hakanen, Demerouti, and Xanthopoulou (2007) Argue that providing the job resources, which include training and constructive feedback from supervisor, has a direct correlation with work engagement. When considering the studied case, apart from the intensive training, supervisor should provide feedback as well as coaching to subordinates in order to build a good working environment and work engagement.

Lastly, number of manpower should be increased by recruiting additional staffs. The customer service department is the first priority due to the very high workload. According to an analysis, recruiting one new staff can attenuate total

workload from more than one hundred percent to eighty-nine percent. This allows employees to spend their spare times in developing other capabilities.

Work load analysis for Customer Service Function	Year 2015		
	Processing Time		
Work Demand	Hour required/Order	Work Supply	Time Available
Check e-mail, gather information of order, Create order form	0.17	Working Hour/Year/Man	2080
Call to accounting for credit checking	0.05		
Check & Reserve product in inventory share drive (that have product in size that cust	0.13		
Issue DO	0.13		
PO follow up	0.17		
Invoice issuring	0.13		
Prepare related document	0.17		
Total	**0.95**		
Total work balance per year			
Average no. of forecast order/year	3900	No. of employee	2
Total Time required per year (Man-Hour)	**3705**	**Total working hour available**	**4160**
		Workload(%), FTE Requirement	***89***

Figure 4.13 Workload Analysis for Customer Service Function After Improvement

Table 4.4 Training Roadmap of Customer Service Officer

Basic Knowledge	**Service Year (s)**		
	0 – 2	**2 – 4**	**More than 4**
Domestic Sales	Sale Processing		
Credit Administration	Basic Accounting		
Product Delivery	Delivering process		
Customer Relations	Customer relation& communication management	Strategic relation management	

2) Material

The prominent failure factor attached to new process improvement, which will in turn decreases the total lead-time, is an un-standardized documentation. The adjustment in materials will be deployed within three related departments, which are customer services, warehouse and logistics. The material being adjusted includes an internal order form, an inventory control sheet and a vehicle readiness checklist for third-party logistics provider, and the misuse of email communication. A use of standard procedures, which includes the use of stand document, is one of the keys of improvement in logistics. According to Imai (1986), it can be argued that there

cannot be improvement in process without imposing standards. Therefore, the forms used within these departments should be standardized.

It is found that the un-standardized documentation is due to a lack of proper IT system. Al-Mashari and Zairi (1999) propose that IT infrastructure is one of the most important factors in improving a work process. A right selection of IT applications can facilitate employee's work and minimizing difficulties faced by employees. However, an implementation of new IT system would take long time and does not suit the study timeline. The standard IT platform would therefore be started in the further stage. During the material improvement, it is proposed to 'simplify' the process by using one standard template for customer service department to register the order instead of using the plain text in email or various order form. Also other department can access see information in the standard template. The new template can attenuate the chance of miscommunication and missing data.

The checklist for the third party logistics provider should also be created. Logistics department can use this template to check the vehicle readiness before transportation.

Infernal Info

Sale Order

Channel : Sold-To Party Code : Trader Code :	Ship-to Party Code : Delivery Place : Province : Delivery Due Date : Payment Term :	Date Sale Order No. P/O No. Ref. Contract No.

No.	Product	Inhibitor		Shipping Type	Detail	Quantity	Unit	Standard Price (THB/KG)	Discount (THB/KG)	Selling Price (THB/KG)	Amount (THB)
		Type	Dosage								
Value of Goods (THB)											
Vat 7.00%											
Total Amount (THB)											

19/1/2015 11:37

Remark:

Miss..... Issued and Prepared By	Confirmed and Updated Balance By	Considered By.....	Approved by Sales Section manager

Figure 4.14 Internal Standard Order Form

3) Method

Method improvements come from every department, customer service, sales, warehouse, and logistics department. In other words, it is the most important

dimension that will be improved. Firstly, a direct cooperation between sales department and customers must be established. Customers are asked to notify the customer service department directly instead of using the current method that requires customer to send their requirements to sales department. In addition, customers were asked to punctually submit purchase order (PO) within 3 days after order placing. This would also minimize invoice issuing obstruct and shipment document incomplete on the delivery date. It is however found that the customers cannot support this change because, in the customer's internal process, the engineer, who is usually responsible for ordering, will contact internal procurement in order to issue the purchase order and send it to the company. This process usually takes several days and is out of company's control.

Moreover, warehouse department should initiate inventory management information system stock control that can be shared within department and to both sales and customer service departments. This spreadsheet will help aligning numbers of stock maintained by warehouse and other departments. Lastly the full-truck load concept should be applied to loading goods onto folk-lift truck. The numbers of goods loaded to folk-lift truck should follow the new standard picking list. Taken together, an improvement in method of work has to be done by various departments in order to achieve the change in process.

Chemical Name : IONOL K98 (IA) 200 kg/drum

Date	Receive from production		Deliver to customer		SO No.	DO No.	Inventory Balance			หมายเหตุ
	lot no.	Weight	lot no.	Weight			lot no.	Weight	Total available	
24-02-15	I4-14038	11600	I4-14033	2800	2/352-01-00	2/198-02-01	I4-14033	9600	21800	
							I4-14037	600		
							I4-14038	11600		
28-02-15	-	-	I4-14033	2200	2/354-01-00	2/214-02-01	I4-14033	7400	19600	
							I4-14037	600		
							I4-14038	11600		
01-03-15	-	-	-	-	-	-	I4-14033	7400	19400	
							I4-14037	600		
							I4-14038	11600		
04-03-15	-	-	I4-14033	2200	3/027-01-00	3/015-02-01	I4-14033	5200	17400	
							I4-14037	600		
							I4-14038	11600		
09-03-15	-	-	I4-14033	2000	3/054-01-00	3/037-02-01	I4-14033	3200	15400	
							I4-14037	600		
							I4-14038	11600		
12-03-15	-	-	I4-14033	2200	3/104-01-00	3/076-02-01	I4-14033	1000	13200	
							I4-14037	600		
							I4-14038	11600		
19-03-15	-	-	I4-14033	1000	3/198-01-00	3/125-02-01	I4-14033	0	11000	
			I4-14037	600	3/199-01-00	3/125-02-01	I4-14037	0		
			I4-14038	600	3/200-01-00	3/125-02-01	I4-14038	11000		

Cover Page | IO K98 | EC 5217A | EC3051A | EC1005A | N 9901 | AF 412 | AF 424 | ACR 506 | ACR 510 | ACR 516 | SH

Figure 4.15 Sample of New Spread Sheet of Inventory Management

Picking List

User Company

SO no.: Your ref.;
Invoice debtor: Our ref.:
Issue date: Shipping type:
Warehouse:

Item	Description	Location	Lot no.	Quantity	Weight/ Unit	Total weight
	Grand Total					

Remark: Weight per trip/Max. 2,000 Kgs.

Figure 4.16 Sample of New Standard Picking List

4) Machine

Improvement in machine includes the jobs only possessed by logistics department. The vehicle inspection process should be made to external or prior to the day of transportation. This elimination of waste time can help supporting the quick and flow delivery. A reduction of time by performing tasks that can be done

prior to the next process can be explained via SMED concept. John Robert Henry (2013) suggests that SMED is somehow hardly applicable to logistics but it there is a possibility in applying this concept. For example, a use of standard labeling and least different size of boxes can eliminate waste time storing products (John Robert Henry, 2013),. Looking into the case, the vehicle inspection should be done the day or hours before the start of transportation. The third party logistics provider, who will check the vehicle readiness against a standard checklist provided by logistics department, can also do this process (see appendix for a sample of standard checklist and the KPI measurement of the third party logistics provider after implementation).

Table 4.5 Developmental Matrix extracted from Fishbone Diagram and ECRS

Man - Provide training - Work engagement - Recruit new customer service staff - Enhance relationship with clients	**Material** - Create standard template - Create shared point for sharing information - Create checklist for 3PL supplier
Method - Standardize the process - Information sharing between customer service and accounting - Review process and manage internal task - Set agreement with customer to submit PO within 3 days	**Machine** - Change vehicle inspection using SMED

4.5.3 To-Be Process

The MUDA were used in an integrative discussion with related departments. During the cross-functional meeting, participants from customer service department, sales department, logistics department, and warehouse department were convinced

to adjust their work process using ECRS concepts. Details of eliminated, combined, rearranged, and simplified process are illustrated in table as shown in the table below.

Table 4.6 Comparison of Before and After Process with ECRS Procedures

Dept.	Before-Process	Dept.	After-Process	ECRS
Sales	Check e-mail, gather information of order	-	Check e-mail, gather information of order	Eliminated
Sales	Create order information	-	Create order information	Eliminated
Customer service	Receive order	Customer service	Check e-mail, gather information of order, Create order form	Combined
Customer service	e-Mail to accounting for credit limit checking	Customer service	Call to accounting for credit limit checking	Rearranged
Accounting	Check customer credit limit	Accounting	Check customer credit limit	
Customer service	Wait for accounting reply	-	Wait for accounting reply	Eliminated
Customer service	Check product in inventory (that have product in size that customer require or not)	Customer service	Check & Reserve product in inventory share drive (that have product in size that customer require or not)	Simplified
Customer service	Input order to share-drive	Customer service	Check & Reserve product in inventory share drive (that have product in size that customer require or not)	Simplified
Customer service	Issue DO	Customer service	Issue DO	

Table 4.7 Comparison of Before and After Process with ECRS Procedures *(Cont.)*

Dept.	Before-Process	Dept.	After-Process	ECRS
Warehouse	Warehouse will access to share drive everyday	Warehouse	Warehouse will access to share drive everyday & Check batch no. & Inventory from database	Simplified
Warehouse	Walk to find the batch number	-	walk to find the batch number	Eliminated
Warehouse	walk back	-	walk back	Eliminated
Warehouse	Put batch number into shared drive	-	Put batch number in to shared drive	Eliminated
Warehouse	Create picking list	Warehouse	Create picking list with FTL concept (> 50% full load/trip) & virtualisation	Combined
Warehouse	Warehouse staff will bring out product that ready to delivery from inventory to the staging area in order to wait to lift onto transportation in next 2 days.	Warehouse	Warehouse staff will bring out product that ready to delivery from inventory to the staging area in order to wait to lift onto transportation in the next 2 days.	
Sales	PO follow up	Customer service	PO follow up	Rearranged
Sales	Sent PO to CS	-	Sent PO to CS	Eliminated
Customer service	Invoice issuing	Customer service	Invoice issuing	

Table 4.8 Comparison of Before and After Process with ECRS Procedures *(Cont.)*

Dept.	Before-Process	Dept.	After-Process	ECRS
Customer service	Prepare related document	Customer service	Prepare related document	
Logistic	Arrange vehicle for transfer (outsource)	Logistic	Arrange vehicle for transfer (outsource)	
Logistic	Wait for vehicle arrival	-	Wait for vehicle arrival	Eliminated
Logistic	Check and confirm quality &safety equipment of vehicle & driver process	Logistic	Check and confirm quality &safety equipment of vehicle & driver process	
Logistic	Wait for confirm quality &safety of vehicle process	-	Wait for confirm quality &safety of vehicle process	Eliminated
Logistic	Call for product that ready to pack in vehicle	Logistic	Call for product that ready to pack in vehicle	
Logistic	Wait for product that ready to pack in vehicle	-	Wait for product that ready to pack in vehicle	Eliminated
Logistic	Product loading onto vehicle	Logistic	Product loading onto vehicle	
Logistic	Send to customer	Logistic	Send to customer	

From the detail of counter measure, the expected information and material flow was created. New total lead-time is expected to be 3.7 days as show in figure below.

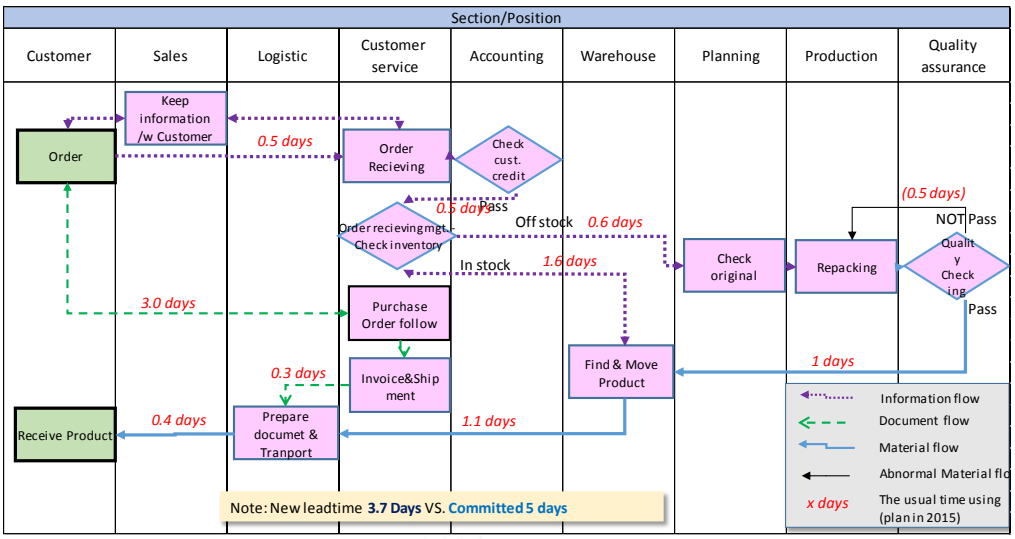


Figure 4.17 To-be information and material flow

4.6. Management of Change

Change management was also considered during the implementation of new process in order to avoid the resistance. According to Esther Cameron and Mike Green (2015), a change management is used as a tool to deal with resistance and minimize the negative outcomes. In other words, new process may provoke unacceptable risks and cause negative consequences. The scope of change not only cover an internal processes belonged to sales, customer service, logistics, and warehouse but also involve minimizing impacts to customers. For example, the intensive communication to customers was applied for informing the key changes and impacts that might affect customer's business. This process has been consecutive held during the transition period. The management of change organization has also been set. It was led by the company's managing director together with managers and experts from every related department. The MOC charter is shown in the appendix.

Champion	Countermeasure	Risk Identification	Risk Evaluation		Risk Result		Risk avoiding plan	Risk Evaluation After		Result	
			Consequence	Likelihood	Accept	Not-accept		Consequence	Likelihood	Accept	Not-accept
Customer Service	-Clear communicate about work scope/KPI	1.Job Describtion not clear enough	2	3		/	Direct boss review & update Job Description,ensure to deliver to employee	2	1	/	
	-Coaching by direct boss weekly	2.Direct boss lack of coaching skill	3	2		/	Set up coaching program training	3	1	/	
	-recruit 1 more customer service person	1.increase cost	1	3	/		Review by HR and Management team	1	1	/	
Sales	-pass order receiving from customer scope to CS directly , communicate with customer to email order directly to CS and copy to sale	1.CS has more work load	3	2		/	Hire 1 more CS	3	2	/	
		2.Customer not familiar with CS	2	3		/	Sale help to public new channal for ordering goods to customer/copy sale in the loop	2	1	/	
	-Create standard template/ move typing order work to customer service	1.CS is not familiar to fill order form - take time	3	2		/	Set work instruction / Training	3	1	/	
	-get involve in inventory management	1.Customer not allow	2	2	/		Clarify with customer , create win-win situation to decrease likelihood	2	1	/	
Logistic	-change from internal task to external	1.staff not familiar with	2	3		/	set up work instruction	2	1	/	
	Set agreement to customer to submit PO within 3 days	1.customer not understand	3	3		/	Clarify with customer	3	1	/	
Warehouse	-improve inventory information system	1.many party(CS,WH,Production),Authorization to modify information should confuse and error	3	2		/	Set authorization to WH	3	1	/	
	-use concept Full truck load to pick up product from shelf	1.Confuse / product mixing	2	2	/		Visualization improvement at forward area,clear sign	2	1	/	

Table 4.9 Change Management Plan

5. Chapter V

Implementation and Outcomes

An application of new information and material flow generates both direct and indirect outcomes. The direct outcome is explicit and measurable in terms of percentage improved, whereas the indirect outcome refers to employee morale and developed relationship with customers. Although the latter outcomes are possible to measure, it does not include in the scope of study and could be investigated in the further research. The integrative discussion and brainstorming were conducted in order to employ the newly adjusted workflow. Ideas were selected using Priority-Action-Consider-Eliminate (PACE) chart suggested by (Martin and Osterling (2007)).

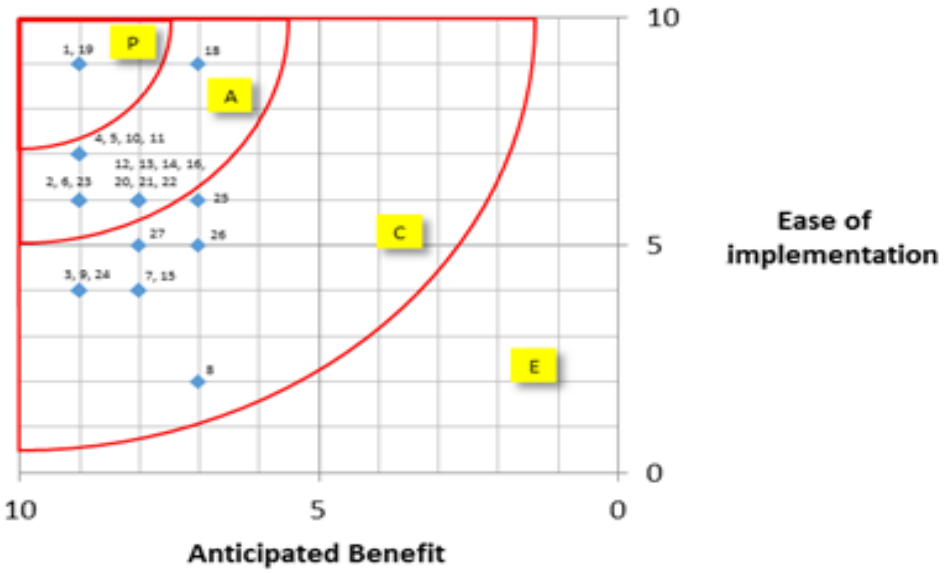


Figure 5.1 4 PACE Chart for Action Plans

Table 5.1 Action Plan Classified by Type of PACE

No.	Action Plan List	Section	Anticipated Benefit	Ease of Implementation	Type of PACE
1	Monthly steering cross functional meeting	Customer Service, Sales, Logistic, Warehouse, HR, Management	9	9	P
2	Pass order receiving from customer scope to CS directly	Sales, Customer Service	9	6	A
3	Direct boss review & update Job Description,ensure to deliver to employee	Sales, Customer Service	9	4	C
4	Communicate with customer to email order directly to CS and copy to sale	Sales, Customer Service	9	7	A
5	Sale help to public new channal for ordering goods to customer/copy in the loop	Sales, Customer Service	9	7	A
6	Create standard template/ move typing order work to customer service	Sales, Customer Service	9	6	A
7	Set work instruction / Training	Sales, Customer Service	8	4	C
8	Get involve in customer's inventory management	Sales	7	2	C
9	Set agreement to customer to submit PO within 3 days	Sales, Customer Service	9	4	C
10	PO direct to Customer service, not pass sale.	Sales, Customer Service	9	7	A
11	Clarify with customer , create win-win situation to decrease likelihood	Sales	9	7	A
12	Increase training	HR, Customer Service	8	6	A
13	Increase engagement in term of work life balance	HR, Customer Service	8	6	A
14	Clear communicate about work scope/KPI	HR, Customer Service	8	6	A
15	Coaching by direct boss weekly	HR, Customer Service	8	4	C
16	Set up coaching program training	HR, Customer Service	8	6	A
17	Recruit 1 more customer service person, Review by HR and Management team	HR	9	6	A
18	In credit limit validation process,use phone instead email	Customer Service, Accounting	7	9	A
19	Cross functional meeting (Build up awareness)	Customer Service, Accounting	9	9	P
20	Create share information of price validation	Sales, Customer Service	8	6	A
21	Change from internal task to external task.	Logistic	8	6	A
22	Set up work instruction	Logistic	8	6	A
23	Create check list for 3PL supplier to submit when vehicle arrive	Logistic	9	6	A
24	Improve inventory information system	Warehouse	9	4	C
25	Set authorization to WH	Warehouse	7	6	C
26	Use concept Full truck load to pick up product from shelf	Warehouse	7	5	C
27	Visualization improvement at forward area,clear sign	Warehouse	8	5	C

Figure 5.2 Brainstorming among 4 Parties

At this stage, the implementation master plan was developed according to the PACE brainstorming.

Action Plan	By section	JAN				FEB				MAR			
		W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Monthly steering cross functional meeting	Customer Service, Sales, Logistic, Warehouse, HR, Management	Kick-Off											
Pass order receiving from customer scope to CS directly	Sales, Customer Service												
Direct boss review & update Job Description,ensure to deliver to employee	Sales, Customer Service												
Communicate with customer to email order directly to CS and copy to sale	Sales, Customer Service												
Sale help to public new channal for ordering goods to customer/copy sale in the loop	Sales, Customer Service												
Create standard template/ move typing order work to customer service	Sales, Customer Service												
Set work instruction / Training	Sales, Customer Service												
Get involve in customer's inventory management	Sales												
Set agreement to customer to submit PO within 3 days	Sales, Customer Service												
PO direct to Customer service, not pass sale.	Sales, Customer Service												
Clarify with customer , create win-win situation to decrease likelihood	Sales												
Increase training	HR, Customer Service												
Increase engagement in term of work life balance	HR, Customer Service												
Clear communicate about work scope/KPI	HR, Customer Service												
Coaching by direct boss weekly	HR, Customer Service												
Set up coaching program training	HR, Customer Service												
Recruit 1more customer service person, Review by HR and Management team	HR												
In credit limit validation process,use phone instead email	Customer Service, Accounting												
Cross functional meeting (Build up awareness)	Customer Service, Accounting												
Create share information of price validation	Sales, Customer Service												
Change from internal task to external task.	Logistic												
Set up work instruction	Logistic												
Create check list for 3PL supplier to submit when vehicle arrive	Logistic												
Improve inventory information system	Warehouse												
Set authorization to WH	Warehouse												
Use concept Full truck load to pick up product from shelf	Warehouse												
Visualization improvement at forward area,clear sign	Warehouse												

Figure 5.3 Implementation Master Plan

5.1. Direct Result

During December 2014 to January 2015, action plans had been implemented. Due to the fact that the improvement may be time-lagged, a measurement of change was taken place in the middle of March 2015. It is found that average on-time deliver rate increased from 86.8 in the previous year to 96.4 percent with new average lead-time of 4.1 days, which is slightly higher than expected result of 3.7 days. In addition, it is found the penalty loss from delay delivery can be drop dropped by 74.5 percent. Although there are some investments of 0.3 million Bath.

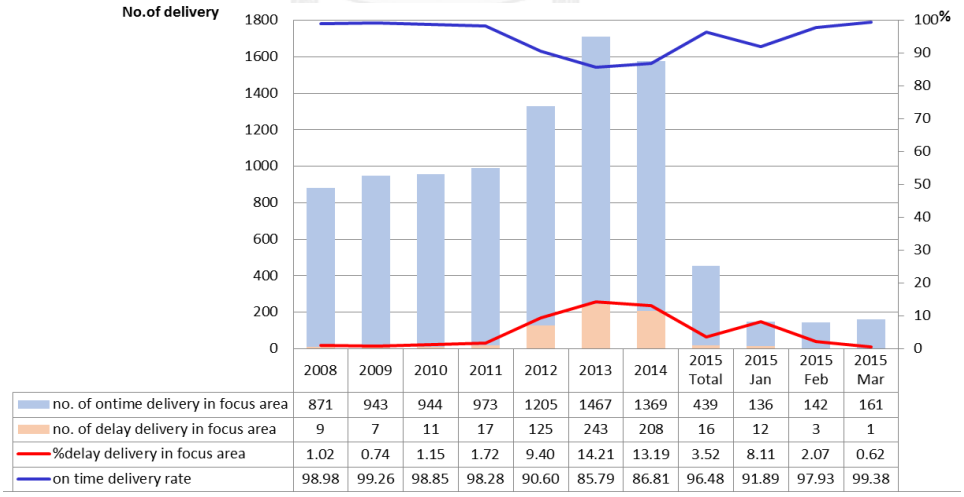
Table 5.2 Direct Outcomes from Implementation of New Work Process

KPI	Unit	Before	After	Percent improvement
On Time Delivery Rate	Percent	85.79	96.4	12.36 percent
Avg. Delivery Lead Time (Mean)	Day	4.6	4.1	10.86 percent
Standard Deviation of Avg. delivery lead time	-	0.6	0.4	33.34 percent
% Delay Delivery	Percent	14.21	3.62	74.5 percent
Penalty loss	Bath/Y	165,000	42,000	74.5 percent
Improvement Investment Cost	MB	-	0.3**	-

Remark:

* Penalty loss after improvement is predicted base on percent of delay delivery improved.

** Improvement investment cost is calculated from new customer service salary.



	2008	2009	2010	2011	2012	2013	2014	2015 Total	2015 Jan	2015 Feb	2015 Mar
no. of ontime delivery in focus area	871	943	944	973	1205	1467	1369	439	136	142	161
no. of delay delivery in focus area	9	7	11	17	125	243	208	16	12	3	1
%delay delivery in focus area	1.02	0.74	1.15	1.72	9.40	14.21	13.19	3.52	8.11	2.07	0.62
on time delivery rate	98.98	99.26	98.85	98.28	90.60	85.79	86.81	96.48	91.89	97.93	99.38

Figure 5.4 Delivery Record During 2008 – 2015

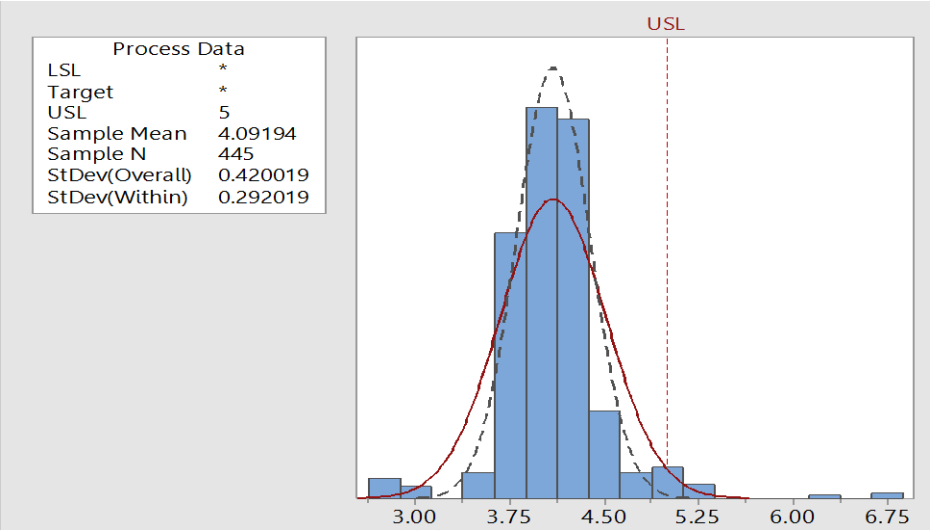


Figure 5.5 Distribution of Improved Delivery

5.2. Indirect Outcome

An observation shows that employee morale is higher as they can perform the old task with shorter time. This can be due to the better job skills gained from intensive trainings. The better performance of internal staffs is expected to help supporting the increase of customer's satisfaction being held at the end of the fiscal year – 2015. The indirect outcome is however not measured, as they are not the focus of this study. Limitations of study will be later discussed.

6. Chapter VI

Conclusion, Limitations and Further study

6.1. Conclusion

This study inspects the important of process improvement representing by the case study of chemical supplying company. A success of process improvement concerns the reliability of delivery lead-time that must not exceed five days. In order to find the best solutions, the problems were analysed to define wastes and means to eliminate those wastes. A process improvement was employed together with a management of change (MOC). The MOC was employed in order to decrease some resistance from related parties.

It is fond that delivery lead-time has significantly decreased from dissatisfied lead-time to 4.1 days. It was noted that 10.8 percent improved. Moreover, On time delivery rate improve for 12.36 percent to meet the company target on time delivery rate at 96 percent. Furthermore, Percentage of delay delivery improved for 74.5 percent. This decrease in delay delivery time contributes to seventy-fifth percent of company's sale revenues as well as satisfying customers. Lastly, employees spent less time at work and have more time to develop other skills. In other words, the company operation is more effective and efficient.

6.2. Limitations

The study has some limitations. First, the implementation of adjusted model was employed during the green seasons where the number of order is not very high and staffs have lower number of tasks to handle. Although the implementation during this period can minimize an operational risk because it can allow more time for adjustment prior to the peak period, the implementation result does not fully reflect company's capability in handling all orders during the busiest months – September to December. Due to this fact, the customer satisfaction survey, which is normally held at the end of the fiscal year, is also omitted. The follow up may be required. Secondly,

the adjusted work process also concerns coordination from customers that requires customer to submit purchase order a bit earlier. This requirement is out of company's control. In addition, implementing new process may provoke various effect of change; while the study measurement only focuses on the direct measureable outcomes, for example percent of improvement, sales revenue, and cost of investment, and omits the indirect outcome e.g. job engagement. The indirect outcome can somehow be argued as study off-scope.

Lastly, a use of case study in investigating the most possible solutions for improving logistics process may limit a generalization. The implemented model may only be applicable to the specific case and hardly transfer to other organization operated in different environment.

6.3. Recommendations and Further Study

The process improvement in this study only covers group of customer generating significant sale revenue to the company. There are some minor customers whose location is far beyond 200 kilometers from the company's warehouse. The process of delivery to this group of customers should also be analyzed. The committed time delivery is however being adjusted according to the different locations and ordering values. An inclusive of all customer concerns would eventually increase company competitive advantage in a long run. Also, the implementation result should be extended in the further study covering the peak period between September and December.

In addition, new IT system e.g. RFID should also be considered in order to decrease the human errors and minimize operation time in picking and relocating goods within the warehouse. The lean logistics emphasizing in eliminating all wastes in the overall supply chain process should also be considered. More importantly, the possible further study should include the indirect outcomes, for example job engagement, in the scope of study since the work engagement has a long theoretical proof of having a very high correlation with work productivity and company performance.

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APPENDIX

Appendix A

Gantt Chart

Gantt Chart of the most acceptable lead-time as commit with customer to delivery in 5 days (Before and After improvement)

A.1. **Before Improvement**

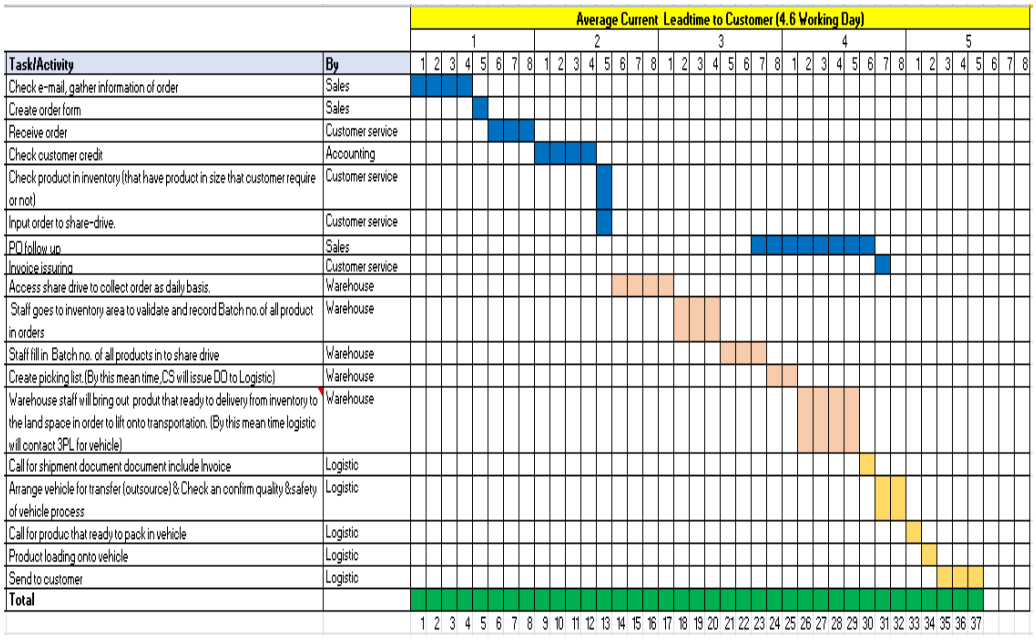

Figure A.1 Gantt Chart - Before Improvement

A.2. **After Improvement**

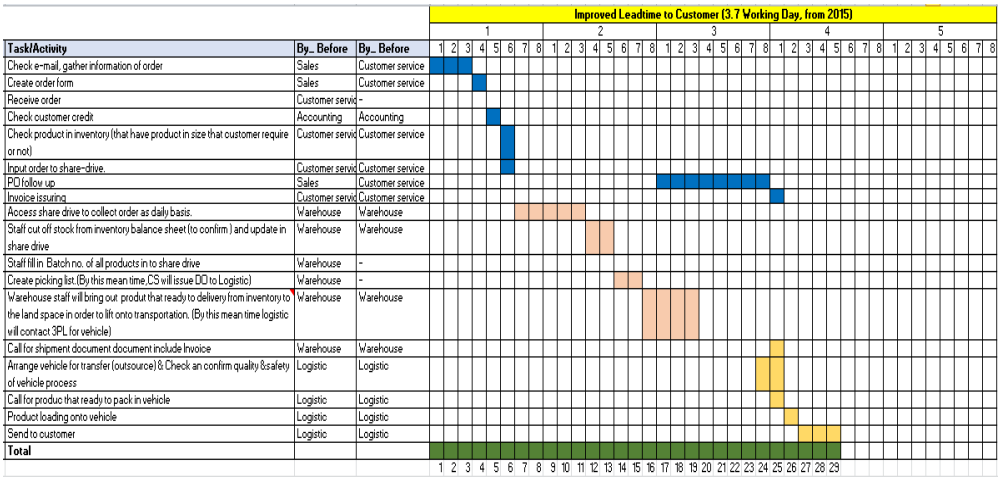

Figure A.2 Gantt Chart - After Improvement

Appendix B

Workload Analysis of Customer Service Officer before Improvement

Work load analysis for Customer Service Function	Year 2014		
	Processing Time		
Work Demand	Hour required/Order	Work Supply	Time Available
Receive order	0.08	Working Hour/Year/Man	2080
e-Mail to accounting for credit checking	0.08		
Check product in inventory (that have product in size that customer require or not)	0.08		
Input order to share-drive by classify to	0.08		
Issue DO	0.13		
Invoice issuring	0.13		
Prepare related document	0.17		
Total	**0.77**		
Total work balance per year			
Average no. of order/year	3900	No. of employee	1
Total Time required per year (Man-Hour)	**2990**	**Total working hour available**	**2080**
		Workload(%), FTE Requirement	***144***
		46	10.43478261

Figure B.1 Before Improvement Workload Analysis

Appendix C

Work Flow Chart of Logistic Department of the Company before Improvement

C.1. Order Management

Registration No.	1) Department	: Logistic	Objective of Section : To make the loading process correct, smooth and indefective.
	2) Section	: Domestic sales	
Job : Process sales and contact with domestic customers			

Step	Organization of job implementation			Documents
	Sale	Customer Sevice	Logistic	
Domestic product delivery	Recieve order from customer via e-mail Send it to Customer Service	Check if the customer credit and stocks are valid & enough for the sales by checking in the share drived (Warehouse, Planing)E:\database\A Product Management Ask credit checking from Accounting Credit evaluation YES NO Ask financial & Accounting manager approve customer's credit		

Figure C.1 Work Flow Chart - Order Management 1

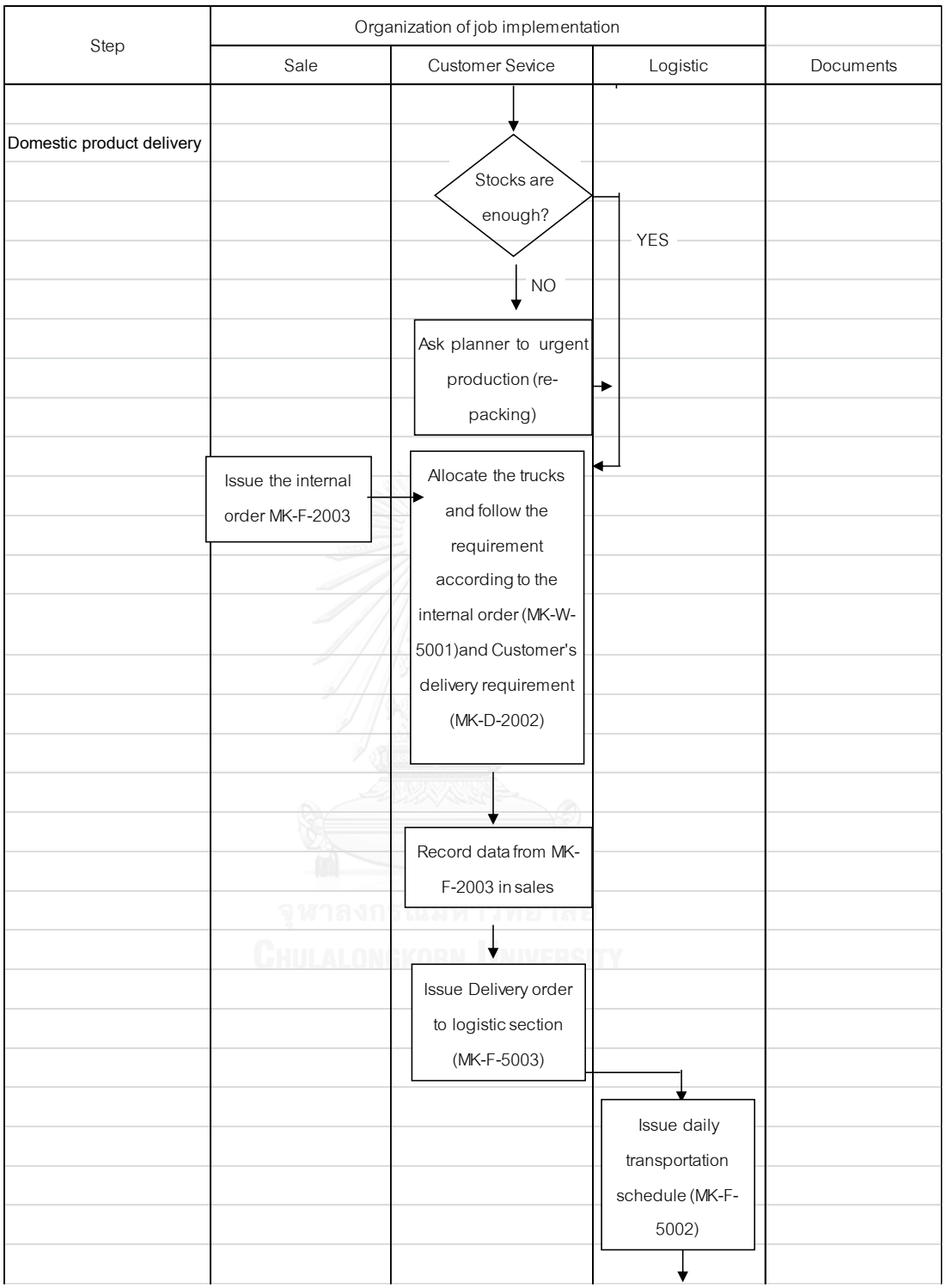

Figure C.2 Work Flow Chart - Order Management 2

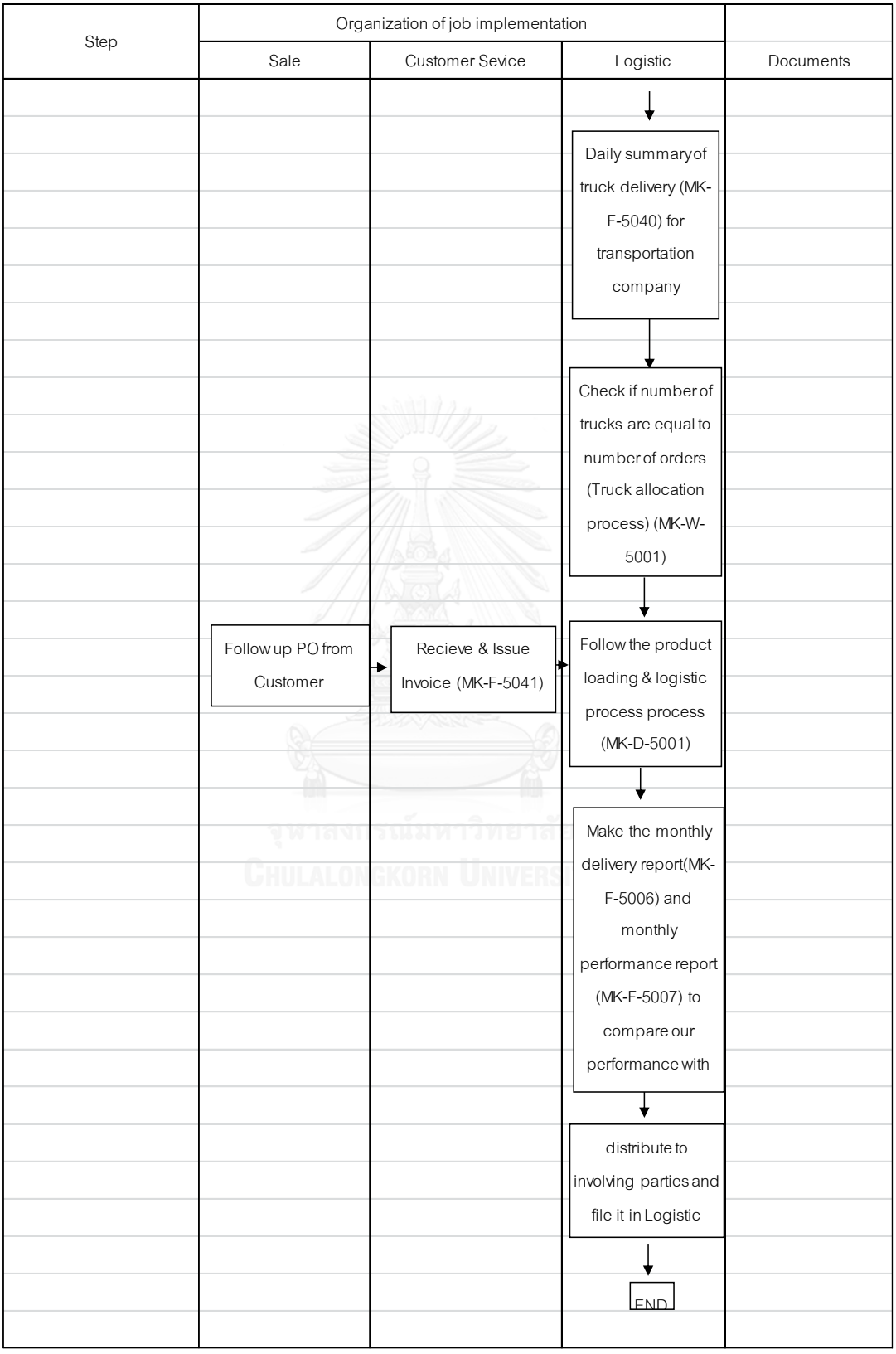

Figure C.3 Work Flow Chart - Order Management 3

C.2. Product Preparation and Loading

Registration No.	1) Department	: Logistic	Work Flow Chart
	2) Section	: Domestic sales	Objective of Section : To make the loading process correct, smooth and indefective.
Job : Process sales and contact with domestic customers			

Step	Organization of job implementation				
	Warehouse	Logistic	Customer Service	Sale	Documents
Warehouse 1. Before load products to truck	Collect order from the share drived at 11am (Warehouse, Planing)E:\database\A Product Management Collect Batch No.of every order to confirm the key batch no into Prepare picking list as WH process(MK-F- Warehouse staff will bring out produt that ready to delivery from	Prepare documents as Logistic process(MK-D-	Follow up PO	Recieve & Issue Invoice	

Figure C.4 Work Flow Chart - Product Preparation and Loading 1

Registration No.	1) Department	: Logistic	Work Flow Chart
	2) Section	: Domestic sales	Objective of Section : To make the loading process correct, smooth and indefective.
Job : Process sales and contact with domestic customers			

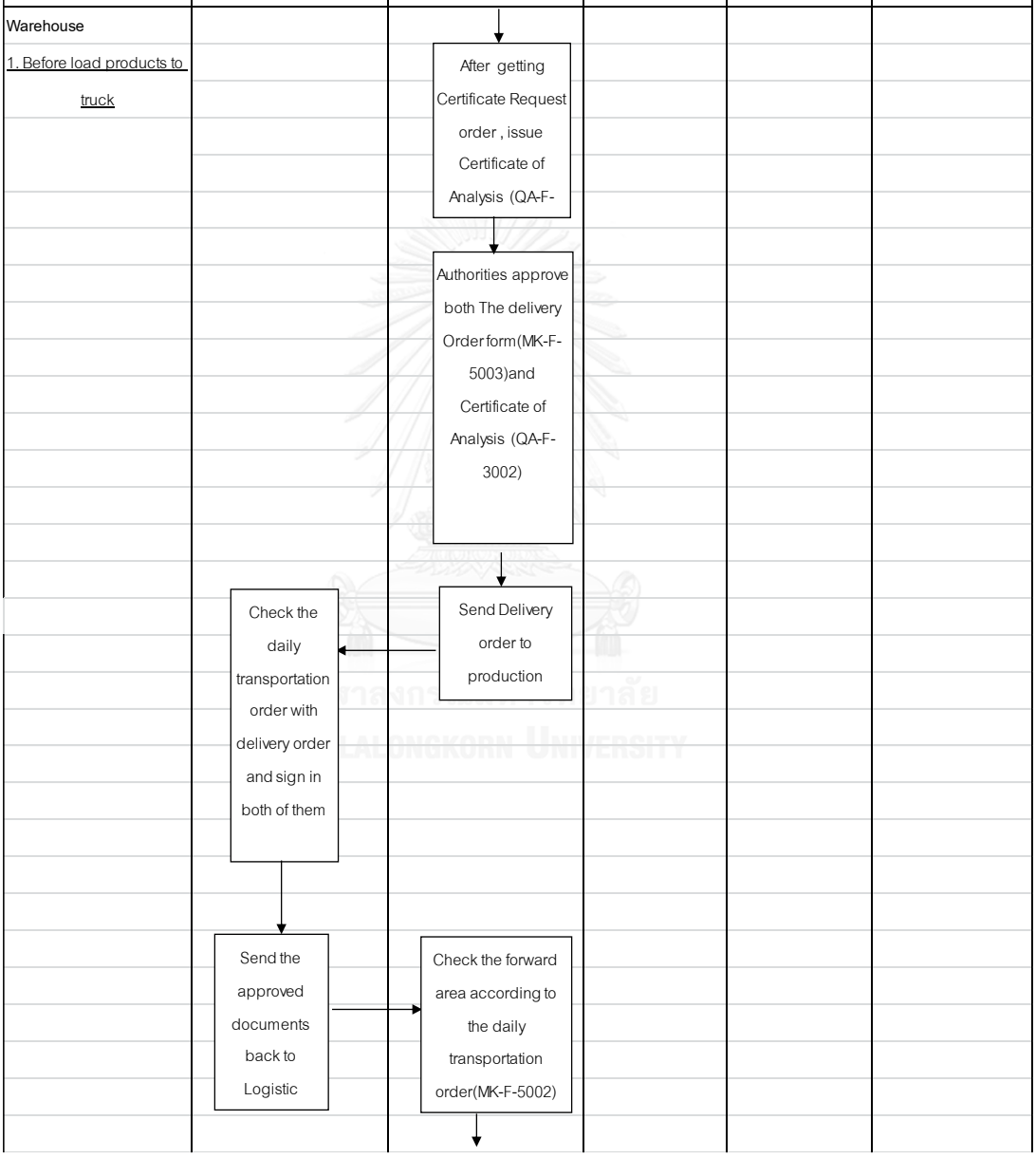

Figure C.5 Work Flow Chart - Product Preparation and Loading 2

Registration No.	1) Department	: Logistic	Work Flow Chart
	2) Section	: Domestic sales	Objective of Section : To make the loading process correct, smooth and indefective.
Job : Process sales and contact with domestic customers			

Step	Organization of job implementation				Documents
	Warehouse	Logistic	Customer Service	Sale	
Warehouse 1. Before load products to truck		The trucks arrive on time?	YES		
		NO			
		Inform supplier to work on it			
		Get ready to load products			
		Move products from forward area to loading ramp			
2.Loading product Load product to vehicle		Check the vehicle conditions by following the evaluation			
		Start loading products by following the product loading			
		Check every points following (MK-F-5037)			
		Prepare the related documents in product loading process			
		Release vehicle to transport porducts			
		END			

Figure C.6 Work Flow Chart - Product Preparation and Loading 3

Appendix D

Standard Vehicle Readiness Checklist

บริษัท.....จำกัด

A Company

แบบประเมินผลการตรวจสภาพรถก่อนรับสินค้าและส่งมอบสารเคมี

บริษัทขนส่ง _____ **วันที่จัดส่ง** _____

การขนสินค้า _____ **ทะเบียนรถเลขที่** _____

ปริมาณสารเคมี (สินค้า) _____ **พนักงานขับรถชื่อ** _____

ทางบริษัทได้ตรวจสภาพรถก่อนจัดส่งแล้ว ตามรายการต่อไปนี้

1.สภาพรถก่อนรับสินค้า (พนักงานขับรถตรวจ)

- ตรวจระดับน้ำมันเครื่อง และสภาพควันดำ ☐
- ตรวจระดับหม้อน้ำ,ฝาครอบแบตเตอรี ยางรถยนต์ ☐
- ตรวจสภาพความสะอาดภายใน Tank ☐
- ตรวจสภาพไอเสียของรถไม่มีควันดำ ☐
- ตรวจสภาพเสียงเครื่องยนต์ไม่ดังผิดปกติ ☐

อุปกรณ์ความปลอดภัย

- มีข้อมูลความปลอดภัยของผลิตภัณฑ์(MSDS) ☐
- ถังดับเพลิง ☐
- หมวกนิรภัย ☐
- รองเท้านิรภัย ☐
- ถุงมือยาง/หนัง/ผ้า ☐
- หน้ากากป้องกันกลิ่นไอระเหยสารเคมี ☐

2.สภาพรถก่อนรับสินค้า (พนักงานจ่ายสินค้าตรวจ)

- ตรวจสภาพความสะอาดภายใน Tank ☐
- สภาพยาง ผ่าน ☐ ไม่ผ่าน ☐
- ตรวจสอบสารเคมีที่ค้างภายใน Tank ☐
- อุปกรณ์ความปลอดภัยครบถ้วนตามข้อ 1. ☐

3. ตรวจสอบระหว่างการเติมสินค้า (พนักงานจ่ายสินค้าตรวจ)

- ตัวTank วาล์วและท่อไม่รั่วซึม ☐
- เติม INHIBITOR
  - ☐ IA _____ กรัม
  - ☐ MEHQ _____ กรัม
- -Flow meter FT-9200
  - ค่าที่ SET _____
  - LOAD ครั้งที่ 1 _____
  - LOAD ครั้งที่ 2 _____

4. ตรวจสอบหลังจากการเติมสินค้า (พนักงานขับรถตรวจ)

	หลังรับสินค้า	ก่อนส่งสินค้า
- อุปกรณ์ในการลงสินค้า (ข้อต่อที่ใช้สำหรับลงสินค้าที่ลูกค้า)	☐	☐
- เอกสารในการนำส่งสินค้า		
ใบส่งสินค้า	☐	☐
ใบกำกับใบชีล	☐	☐
CERTIFICATE OF ANALYSIS	☐	☐
ใบชั่งน้ำหนัก	☐	☐
- ปริมาณสินค้าในใบชั่งน้ำหนัก ตรงกับที่ระบุในใบส่งสินค้า ช่องหมายเหตุ	☐	☐
- เดินตรวจสอบรอบบริเวณรถ และใต้รถ	☐	☐
- ตรวจสอบ Lot Number ตรงสติกเกอร์ ข้างถัง 200 ลิตร. หมายเลข D/O ว่าตรงกับ COA	☐	☐

หมายเหตุ _____

ลงชื่อพนักงานขับรถ _____ ลงชื่อพนักงานจ่ายสินค้า _____

สำหรับเจ้าหน้าที่บริษัทรับสินค้า

การประเมินสภาพรถขนส่งสารเคมี	ใช่	ไม่ใช่	หมายเหตุ
1. มีใบอนุญาตขับขี่รถบรรทุกสารเคมี (ประเภท 4)	☐	☐	
2. การแต่งกายของพนักงานรัดกุม สวมใส่รองเท้าหุ้มส้น	☐	☐	
3. มีอุปกรณ์ความปลอดภัย			
- หมวกนิรภัย	☐	☐	
- รองเท้านิรภัย	☐	☐	
- ถุงมือยาง/หนัง/ผ้า	☐	☐	
- หน้ากากป้องกันกลิ่นไอระเหยสารเคมี	☐	☐	
4. ตั้วสะอาด ไม่ยับ ไม่ฉีกขาด	☐	☐	
5. สภาพรถโดยรวม	☐	☐	

	ดีมาก	ดี	พอใช้	ควรปรับปรุง	
5. กิริยามารยาท	☐	☐	☐	☐	
6. การบริการและการให้ความช่วยเหลือขนถ่ายสินค้า	☐	☐	☐	☐	
7. ความสมบูรณ์ของ Flexible ที่ใช้ขนถ่ายสินค้า	☐	☐	☐	☐	
8. ประเก็นไม่รั่วซึมหลังจากการต่อสายถ่ายสินค้า	☐	☐	☐	☐	
9. ความถูกต้องของเวลาในการส่งสินค้า	☐	☐	☐	☐	
10. เวลาที่ถึงโรงงาน					

ลงชื่อผู้ประเมิน _____

กรุณาประเมินตามความเป็นจริงเพื่อจะใช้ในการปรับปรุง

Figure D.1 Standard Vehicle Readiness Checklist

Appendix E

Work Process Observation

Figure E.1 Management Team are in Management of Change Meeting

Figure E.2 Customer Service Officer

Figure E.3 Warehouse Officer Receive Picking List and Prepare to Pick Products

Figure E.4 Product Picking by Warehouse Officer

Figure E.5 Staging Area

Figure E.6 Loading and Vehicle Checking Area

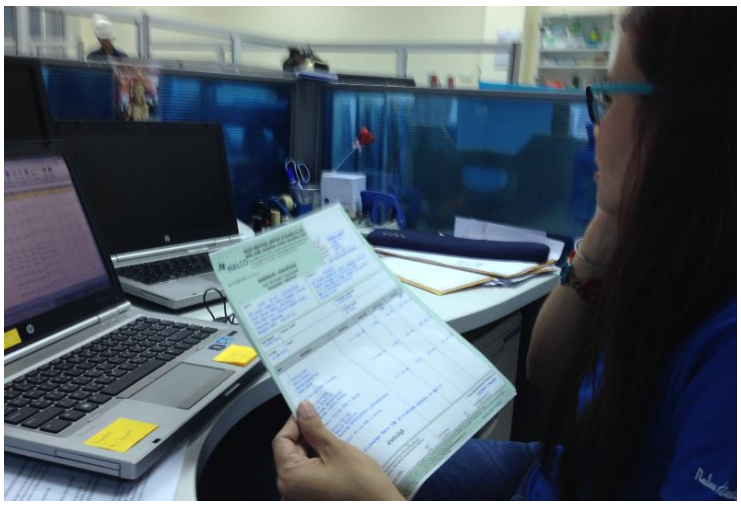

Figure E.7 Logistic Officer Call for Shipment Documents

Figure E.8 Example of Vehicles Use for Transport and Product Loading

Figure E.9 Safety Equipment Required for Vehicle and Driver

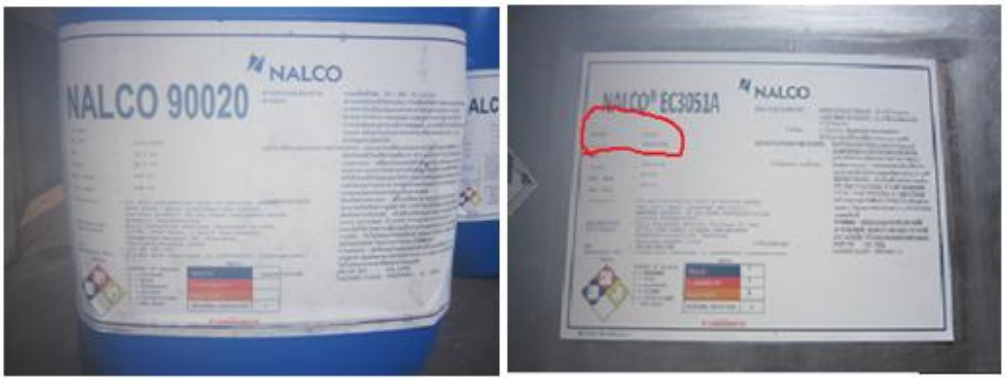

Figure E.10 Product Label and Batch Number (Lot. Number)

Figure E.11 Warehouse Officer and Researcher

Appendix F

MOC Team Membership Charter

The composition of the MOC Committee in each change or improvement shall at minimum include:

- Sponsor – Managing Director
- Chairman – Supply Chain Section Manager
- Core Members - shall be representative and the initiator who would like to change or improve from each section such as Customer service, Sales, Logistics, and Warehouse.
- Secretary - shall be as appointed by the Chairman.

Table F.1 The composition of the MOC Committee

No.	Position	Department	Role in MOC
1	MD	-	MOC sponsor
2	Supply Chain Manager	Supply Chain	MOC chairman
3	Sales manager	Sales	Member/Initiator
4	Customer Service officer	Customer service	Member/Initiator
5	Logistics manager	Logistic	Member/Initiator
6	Warehouse manager	Warehouse	Member/Initiator
7	Sale executive	Manufacturing	Secretary

Roles and Responsibilities

Team Chairs will:

- Lead the team in implementing and overseeing the system
- Design and plan team meetings
- Ensure action plans are completed
- Ensure team deliverables are completed and reported to the sponsor in a timely manner

- Communicate regularly with other team chairs as appropriate

Members/Initiator will:

- Prepare the MOC information that related change in their responsibility
- Assist the chair in achieving team goals and objectives
- Develop analyses and recommendations in support of team deliverables
- Follow-up on action items as assigned by the chair

Appendix G

Performance Measurement of Third Party Logistics Provider

Table G.1 Performance record of third party logistics provider during implementation

Performance record of third party logistics provider during implementation				
Period	**Number of total delivery**	**Number of pass safety inspection**	**Number of fail safety inspection**	**percent of Pass safety inspection**
2015 Jan	148	108	40	73
2015 Feb	145	117	28	81
2015 Mar	162	136	26	84

VITA

Miss Nantida Wongchindaphan was born on 18th July 1986 in Bangkok ,Thailand. In 2007, She earned the bachelor's degree of Science in a major of Petrochemical Technology from King Mongkut Institute of Technology Ladkrabang . After 5 years working , she was continuing her study in the dual master's degree program of Engineer Management and Engineering Business Management provided by Chulalongkorn University,Thailand and University of Warwick, United Kingdom respectively. Recently, She held the position of District Representative at ECOLAB Company (Thailand), a subsidiary of an American global chemical provider.