DESIGNING AN INTERNAL LEAN DISTRIBUTION PROCESS FOR AN ENGINEERING COMPANY IN THAILAND

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ABSTRACT

The project described in this article is concerned with using 'Lean' concepts in designing a distribution processes to improve a firm's operation and performance in supply chain functions. It focuses on an engineering company in Thailand. The aim is to make the company increasingly competitive in delivering value to the customer on price, quality, and on-time delivery. Although applying 'Lean' is new in Thailand especially in administrative processes, it is widespread in Japanese and American organizations. 'Lean' is used to find and eliminate all non value-adding activities from a firm's processes so as to improve efficiency and effectiveness.

This paper simulates the process design using lean thinking by focusing on one of the core support functions in the supply chain, the distribution processes, to identify and removing waste from the processes. This will dramatically improve the reliable performance of assets (people, method, and fixed assets). Reliable assets become an absolute prerequisite for running a competitive business. The results from the simulation provide the optimal solution before actual implementation. This solution will impact the flow efficiency of distribution and produce considerable saving of resources and create value in the supply chain.

In summary, the new proposed distribution processes will be designed to replace the existing processes. This lean distribution system will reduce the number of administrative staff, solve the problem of redundant functions, decrease waste time and waiting time, and make cost reductions.

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INTRODUCTION

Many Thai companies fight to survive, because their market has changed from local to global, and customers can source their needs through Internet technology. Market competition means that firms must have lower prices, less inventory (stock), quick response to the customer, and good quality products. Finding the non-added value activities in all sections of the firm and eliminating them is a practical strategy to survive.

Manufacturers are becoming more customer-centric. This philosophy fits well with lean manufacturing, to include all processes that contribute to the bottom line. Lean manufacturing is the result of a manufacturing system design which produces products with the highest quality, shortest response time, predictable output and greater variety.

Lean thinking is increasingly being applied to all areas within the firm, from sales and marketing to engineering and production through to finance and post-sale service. Its focus is on reducing lead time, reducing lot sizes, and increasing reliability, yielding the flexibility and simplicity required to achieve consistent results. Lean Distribution takes a very different approach from an optimization and planning approach that is based on fixed lead times and lot sizes. Lean Distribution provides capabilities that address a variety of business situations and challenges. It is not necessarily a total solution, but it can provide the necessary responsiveness and cost reduction to address the underlying issues driving many current topics on executive agendas. From customer-driven cost reduction to considering the implementation of new technologies, the Lean concept can provide a framework to construct approaches for success. Lean Distribution practices link operational cycle times and variability to all aspects of process, enabling a clearer link between operations and results. As various initiatives alter operations or customer demand characteristics, the benefits and implications become more readily apparent and easier to deliver.

The objective of the project is to design new lean processes for the distribution activities of an organization that will result in better customer satisfaction and increased business. Simulation will be used (the Igrax programme) to design new processes particularly in the distribution area. The selected organization is an engineering company in Thailand which supplies motors for air conditioners. The company's current system is batch production and MRP, which results in much work in process (WIP) around the factory, long lead time and slow response to the customer. There are too many redundant processes in the flow of distribution leading to much waste in each process.

Currently there are many steps in the distribution process flow, from the delivery schedule plan until distribution of products to the customer, which cause the following problems:

- Long process time: 2 days in providing all documents for each shipment.
- Late delivery to the customer: the Company cannot catch the vessel in time, so the

company can only ship the product to the customer in the following week (1 week delay).

- Error loading: only a short time for the finished goods staff to prepare shipment, which causes wrong product loading.
- High cost of loading trucks overnight: the Company cannot load the products within a loading day, and has to pay an extra charge to the forwarding agent for the truck to stay overnight.

The scope of the project is therefore to improve efficiency and effectiveness in the distribution system by developing a new design through simulation, using 'lean' concepts. The major parts of whole processes to be covered are:

- Distribution processes.
- Internal information flow between customer service and distribution center.

LITERATURE REVIEW

This section describes distribution processes, the SCOR model, lean concepts, lean distribution, and business process simulation and modeling.

Distribution processes

The role of distribution in the supply chain management model has extended considerably from the conventional view of the activity as being concerned solely with transport and warehousing. The distribution function takes on a wider role as the provider of the final added value in an integrated supply chain, providing a critical link between the customer and the factory (Zylstra, 2006). The distribution process is responsible for successful customer service while under pressure to reduce costs, lead time, and inventory.

The SCOR Model (*Supply Chain Council, 2005*)

The Supply-Chain Operations Reference-model (SCOR) is a process reference model that has been developed and endorsed by the Supply-Chain Council as the cross-industry standard diagnostic tool for supply-chain management. SCOR enables users to address, improve, and communicate supply-chain management practices within and between all interested parties, from supplier's suppliers to customer's customer. By describing supply chains using process building blocks, the Model can describe supply chains that are very simple or very complex using a common set of definitions. As a result, disparate industries can be linked to describe the depth and breadth of virtually any supply chain. The Model has been used elsewhere to provide for global projects as well as site-specific projects.

The SCOR model is a process reference model that expands to analyze processes involving cross-functional activity. For example, the Plan process involves sales, marketing, manufacturing, finance, logistics and others. It draws attention to process gaps (rather than pointing to the performance of specific departments) which can help the company communicate without ambiguity and help measure, manage and refine processes. This Model helps companies capture 'as-is' processes, and define and achieve a desired 'to-be' future state. It also helps to quantify operational performance and set improvement targets based on best practices in similar companies.

Metrics can include a wide variety of performance measures: delivery (in-full, on-time, in-specification), order fulfillment, fill rate (for make-to-stock), lead time or supply-chain response time, production flexibility, total cost, realized margin, warranty costs, returns processing costs and more. The SCOR model excludes sales and marketing, research and technology development, product development and some elements of post-delivery customer support. As these all impact and influence supply chains, they may be included as modeling evolves.

LEAN CONCEPTS

A definition of 'Lean' is: "**A systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection**" (National Institute of Standards and Technology Manufacturing Extension Partnership's Lean Network, 2003).

The term 'lean' was popularized by Womack et al. (1990) as a system that uses less of all inputs to create outputs similar to the mass production system but offering an increased choice to the end customer. The logic behind lean thinking is that companies jointly identify the value stream for each product from concept to consumption and optimize this value stream regardless of traditional functional or corporate boundaries. In order to facilitate this change process it is necessary to define corporate strategy and to identify key customer-facing processes such as order fulfillment and new product development together with key non-customer-facing processes such as supplier integration of environmental control. Once this is complete, roles and responsibilities can be defined and appropriate structures for improvement put in place (Womack and Jones, 1996).

Lean thinking brings together several stands of process improvement. It starts by defining the purpose of the process (value for the customer), then redesigns the process to deliver this value within parameters for wasted time, effort and cost. It then organizes people and organizations to manage this value delivery process. So the first step in lean thinking is to understand what value is and what activities and resources are absolutely necessary to create that value. Everything else is waste. Since no one wants to consider what they do as waste, the job of

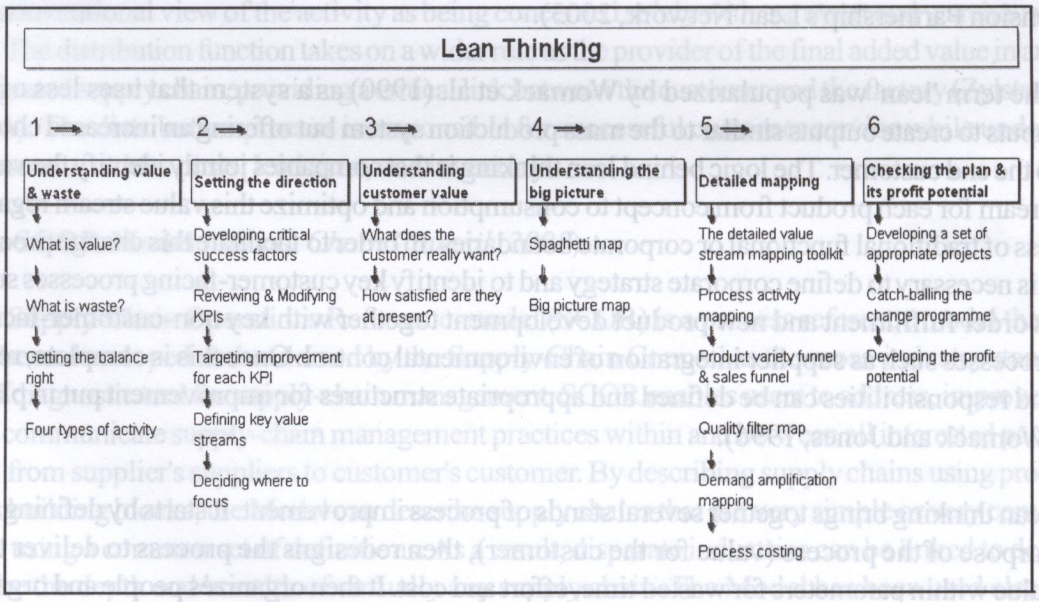
determining what value is and what adds value has to be done at a fairly high level. In short, lean thinking is lean because it provides a way to do more and more with less and less human effort, less equipment, less time, and less space while coming closer and closer to providing customers with exactly what they want. Lean thinking can be summarized in the following five principles (Womack, 1990):

1. Specify what does and does not create value from the customer's perspective and not from the perspective of individual firms, functions and departments.
2. Identify all the steps necessary to design, order and produce the product across the whole value stream to highlight non value-adding waste.
3. Make those actions that create value flow without interruption, detours, backflows, waiting or scrap.
4. Only make what is pulled by the customer.
5. Strive for perfection by continually removing successive layers of waste as they are uncovered.

WASTE AND VALUE

Lean Thinking can also be expressed in a model (Lean Enterprise Research Centre, 2002)

Figure 1: Lean Thinking Model



What is value? - (*Value Stream Management, 2002*)

The rationale behind lean centers on creating value and removing waste inside and between companies. Value is what customers wants. Examples of value attributes include tangible elements such as product features, quality and delivery times, as well as more intangible such as service and relationship. Each customer will have its own set of value attributes for different products and services, although groups of customer may be clustered into distinct market segments. An external view of value is vital, as a company's view is often wrong or distorted.

What is waste? - (*Taiichi Ohno, 1988*)

The wastes are commonly referred to as non-valued-added activities, and are known to Lean practitioners as the Eight Wastes. Taiichi Ohno (co-developer of the Toyota Production System) suggests that these account for up to 95% of all costs in non-Lean manufacturing environments. These wastes are: Overproduction, Waiting, Transportation, Non-Value-Added Processing, Excess Inventory, Defects, Excess Motion, and Underutilized People,

Process costing

An effective lean profit requires proper cost information, such as the critical process costs and the amount of the current value adding, future value adding, support activity and waste costs inside each key process.

Cost data are necessary to:

- identify priorities (which key process should I focus on first?)
- estimate potential benefits of lean initiatives (what is the lean profit potential?)
- set management control systems (what are the links with the budgeting, reporting and incentive systems?)

Lean Distribution

Lean Distribution is the natural extension for companies using Lean practices. The main levers of a Lean Distribution approach are cycle time, variation, and flexibility. These become the drivers for inventory levels, cost profiles, and other aspects of the distribution chain so the relationships and interactions are readily apparent. Lean takes the approach that markets move and the supply must move quickly with them; it is not a forecast-and plan-based approach that attempts to optimize and execute a frozen plan. With Lean, market shifts are expected because variability and flexibility are built in (Zylstra, 2006).

Lean Distribution Benefits

The lean distribution approach provides an operational foundation for service excellence and low total costs. A combination of service and cost performance is how a Lean approach simplifies the business and delivers results. Service and cost are usually seen as conflicting objectives, but Lean focuses efforts on changing the dynamics of the trade-offs involved by reducing cycle time, improving reliability, and increasing flexibility. This deliver benefits in customer service, total costs, and asset utilization. Customer service benefits accrue from improvements in service policies and value provided to customers with Pull. By formalizing service policies, improvements result from:

- Providing differentiated levels of customer service
- Improving execution of service delivery
- Examining and segmenting customers for price/value
- Directly linking (Pull) with customer usage to improve the customer's material flows

Within Distribution processes, Lean improves the flow of business processes to mitigate waste in distribution. Benefits also accrue across downstream operations both internally and with suppliers. Lean further improves flexibility, reliability, and costs without the distractions of daily disruptions to meet spikes in demand. Cycle time is a parameter that improves with lean and can be related to distribution lead time. As cycle time is reduced, the improvements in lead time are readily apparent (Zylstra, 2006)

The benefits of implementing Lean can be broken down into three broad categories; Operational, Administrative, and Strategic Improvements. The NIST Manufacturing Extension Partnership recently surveyed forty of their clients who had implemented Lean Manufacturing. Typical improvements were reported as follows:

Lead Time (Cycle Time) reduced by 90%
Work-In-Process Inventory reduced by 80%
Space Utilization reduced by 75%
Productivity increased by 50%
Quality improved by 80%

Barriers to Successful Implementation

Many companies that attempt to implement Lean experience difficulties and/or are not able to achieve the anticipated benefits (Kilpatrick, 2003).

- The company fails to tie the improvement metrics to financial statements. In other words, the company only reports the percent improvement and does not convert this to a monetary measure.
- Choosing a difficult or low-impact project as the first one. Lean is not difficult, but can be complicated because of all the variables and communication involved.
- Overlooking administrative areas. Some manufacturing environments, especially continuous processes have only small or insignificant opportunities in the production or operations areas.

- The company spends too much time on training and not 'doing,' or they start at the wrong place.
- Failing to expand lean implementation to the supply chain. Companies need to bring suppliers into the improvement efforts. The development of a lean supply chain is probably one of the most difficult, but more financially rewarding, aspects of implementing Lean.
- Lean radically impacts every person in every function of an organization, and changes organizational culture. This causes discomfort, which many companies are unable to cope with.

Business Process Simulation & Modeling (Harrington, 2000)

Process simulation is a technique that helps organizations predict, compare, or optimize the performance of a process without the cost and risk of disrupting existing operations or implementing a new process. Process simulation is a technique that allows representation of processes, resources, products, and services in a dynamic computer model. A model, when simulated, mimics the operations of the business. Simulation software keeps track of statistics about model elements, and performance metrics can be evaluated by analyzing this data. The interactions of resources with processes, products, and services over time result in a large number of scenarios and outcomes that are impossible to comprehend and evaluate without the help of a computer simulation model. A Process is a logical, related, sequential set of activities that takes an input from a supplier, adds value to it, and produces an output for a customer.

Modeling

A parallel activity to mapping is simulation modeling, building a computer simulation of the manufacturing process. Modeling is an optional and not essential part of the analysis phase. But there are two strong reasons to consider modeling: To confirm understanding of the process; To play 'what if' about the future. Activity modeling for process simulation is different than for static process modeling and analysis. In static modeling, the user simply defines the effects. But in process simulation, the user defines the cause of delay and analyzes the effects of these factors on cycle time and activity cost.

Process simulation allows us to model capacity, cost, schedule, and allocation for resources. During the simulation, the model automatically keeps track of the utilization of resources, the queuing delays, and the costs incurred by activities and transactions using the resources. Typical examples of resources are: Customer Representative; Engineer; Supervisor; Department; Equipment; Money; Materials. Human resources are defined in full-time equivalents. Other resources may be defined by capacity or number of units. A full-time equivalent may be an individual resource as well as part of a work group.

Transactions are the entities that flow through a process simulation model. Transaction can be used to represent physical objects, such as orders or other paperwork, or information objects, such as triggers, signals. They may be assigned attributes to define such characteristics as order size, customer size, and priority.

METHODOLOGY

This project will design the new distribution processes through the following steps;

Collect and analyze the current processes:

1. Describe the current resource of each department, cost structure, working hours and over time structure.
2. Create the current model and run the simulation by using Igrafx program version 2006.
3. Analyze current result from the Igrafx program.
4. Identify waste in the current processes.

Brainstorming for the action support: this is to find the alternatives to improve the non value-adding processes through brainstorming with a team, and then using the weighted scoring method to conclude the actions.

Develop the new processes: this is to develop the new distribution processes by changing the processes and running the simulation to get the optimal benefits.

Analyze the new process design and compare to the current processes: running the simulation of new process design modeling in Igrafx program, and then analyze the result as the same figures as the current process to find the benefit improvement.

Create the implementation plan: this is to estimate the timeline for implementation from all supporting actions.

What will be analyzed?

After completing the simulation, the following key measurements will be used for evaluating the efficiency and effectiveness of each process.

- Cycle times - the total time spent traversing a process.
- Activity cost - number of available units, usage cost, labor cost, and fixed cost.
- Transaction throughput/lead time - total elapsed, or 'wall-clock', simulated time.
- Headcount - number of resources required for running the process.
- Resource utilization - time persistent statistics.

- Wait Time - Amount of time transactions spent waiting at the activity. Includes inactive, blocked and resource wait time.
- Queue length - location of bottleneck (highest cycle time) and inventory level (number of document pending at each process.
- VA/BVA/NVA - value added, business value added, and non-value added work.
- Waste identification - identify waste in the process for improvement.

ANALYSIS OF CURRENT PROCESSES

In the current process, there are 43 process steps crossing 2 external and 4 external parties. The process starts in the customer service department and then goes to the other departments.

Analyzing the performance of the current processes, the modeling and simulation method will be used for evaluating the process performance. Running the current process model: it will be run as one-piece flow for the first two processes and then accumulated as the batch of five for the rest.

After running the simulation of current modeling, the total cycle time is 100.45 hours or 9 days running 11 working hours a day. Considering the total average cycle time of all departments, the percentage of work time is approximately only 36% or 3.26 days compared to the rest waiting time at 64% or 5.74 days. Looking in detail at two internal departments and four external departments in the current modeling, the major work time or highest work time is in Customer service department with 41.47% from 24 process steps of the whole processes, and the second highest work time is at the customer side that is 22.27%. This process is very interesting on studying the time reduction; however, this project will focus only on the internal processes. For FG warehouse department the work time is 16.70% from 6 process steps, mainly the activities of product shipment. For Finance and sale department, they consume the work time 15.86% and 2.31% accordingly. Main activities of these departments are to check and confirm the customers' credit and price change. The last part of this process is Freight forwarder agent, which is the external department that spends work time less than the other departments - only 1.39% from the whole process. Although this is an external party the new process design also improves the method of reserving the container as a time reduction in the whole processes.

Investigating in detail the waiting time from the simulation of current modeling, the highest waiting time is 25.22% from the processes located at FG warehouse department as this activity is assigned to check the real product instead of checking from the system. A warehouse supervisor has to assign his staff to check the quantity of products of each invoice to assure that the quantities are correct. Then the warehouse supervisor rechecks and confirms the quantity back to customer service. These redundant activities definitely cause process waiting for each other due to the limited resource.

The second highest, 24.8% is from receiving confirmation from a customer in the United States, whose time zone is different from Thailand by 12 hours. The third one, 22.71%, is waiting for the freight forwarder agent to confirm the booking. At present, the engineering company never sends the forecasting information to the freight forwarder agents that they have to plan themselves, submit the booking requirement to the vessel to check container available, and wait to receive booking details. Then the freight forwarder agent can send the booking details to customer service.

The other major waiting time is 20.04% at the Finance department as there is a long lead-time on issuing the invoice and sending it to the customer. Time constraint and limits on overtime at finance affects this process. For example, if customer service submits the pick slip to finance in the afternoon, the invoice will be issued in the morning of the next day and lead to late delivery to the customer. In turn, if submitting in the morning, they will issue the invoice that same day's afternoon. Next is customer service activity with 5.38% for the function of product information checking. Lastly, 1.86% of waiting time is from the selling price's confirmation from Sales department. This is the only activity from this department, so the waiting time is less than the other departments.

The activities in the current processes can be categorized into three groups -Value adding (VA) activity, Business value adding (BVA) activity, and Non value-adding (NVA) activity. Value-adding activities are at 48%; 23% is the figure for business value-adding activities; the last 29% represents non value-adding activities, which is the big challenge for improvement to eliminate delay and redundant processes from the current processes.

An analysis was made of these 3 types of activity for the 6 departments: Customer, Customer Service,FG Warehouse, Finance, Freight Forwarder Agent, Sales, can be identified based on the SCOR model-Deliver-Make-to-Order Product, and Lean thinking concept. The following are the non-value-added activities:

Customer Department (External department)

There is only one activity, it is customer feedback, a value-adding activity (VA).

Customer Service Department (Internal department)

There are 24 activities identified: 9 activities for Value adding (VA) activity, and 9 activities for Business value adding (BVA) activity. The 6 activities for Non value adding (NVA) activity are:

- Check product information
- Inform shipment to the Finance Dept.
- Generate commercial invoices

- Recheck quantity
- Quantity OK? - Decision
- Delay to FG

FG Warehouse Department (Internal department)

6 activities were identified: 2 activities for Value adding (VA) activity, and 3 activities for Business value adding (BVA) activity, and 1 activity for Non value adding (NVA) activity which is:

- Sign and send back to Customer service

Finance Department (Internal department)

8 activities were identified: 3 activities for Value adding (VA) activity, 2 activities for Business value adding (BVA) activity, and 3 activities for Non value adding (NVA) activity, which are:

- Delay account release
- Send invoice to Customer service
- Delay documents return

Freight Forwarder Agent (External department)

2 activities were identified, 1 Business value adding (BVA) activity and 1 Non value adding (NVA) activity, which is:

- Delay from Freight forwarder agent to Customer service

Sale Department (Internal department)

2 activities were identified; both Non value adding (NVA) activities:

- Confirm price
- Delay to Customer service

Activity Cost - Current Process

Considering the transaction cost of each department based on their working type, Business Value Adding (BVA) cost, Value Adding (VA) cost, Non Value Adding (NVA) cost. There is no activity cost concerning the two external departments, customer and freight forwarder agent because this project will focus only on internal processes. The external cost is disregarded. For all internal departments, the non value-adding transaction cost is the higher of other types, that means many redundancies and wastes in the processes. However, this is a big opportunity for improvement.

Customer Service Department

The ratio of transaction cost in this department, VA:BVA:NVA is 28.46%, 43.91%, and 27.63% respectively. The highest one is from business value-adding activities, especially in the process of checking product information, which cycle time is 4.7 hours or 26.5% of all average cycle times in customer service department. The other major driver is the process of issuing pick slip as value-adding activities and preparing commercial invoice as non value-adding activities.

FG Warehouse Department

The ratio of transaction cost in this department, VA:BVA:NVA is 40.88%, 52.32%, and 6.81% respectively. Most of the transaction costs in this department are from value-adding and business value-adding activities,concerned with shipping the products to the customer. So, the non value-adding activities in this department are a minor focus.

Finance Department

The ratio of transaction cost in this department, VA:NVA is 10.32%, 77.29% respectively. The figure in this department is much different from the other departments as most of its activities are non value-adding activities from the process of checking credit terms and issuing invoices.

Sale Department

There is totally 100 % of Non value adding (NVA) cost in this department.

Resource Analysis

Resource statistics are used to analyze the data and have been collected. Much information is thus available on Workers, Busy Time, Out of Service Time, Idle Time, Inactive Time, resource Waiting and Non-Waiting Time, Resource Standard Time and resource Overtime, Resource Utilization, and Non-Waiting Resource Utilization. The opportunity to improve utilization is in the internal departments: customer service, finance, FG warehouse, and sale (and especially the customer service department)

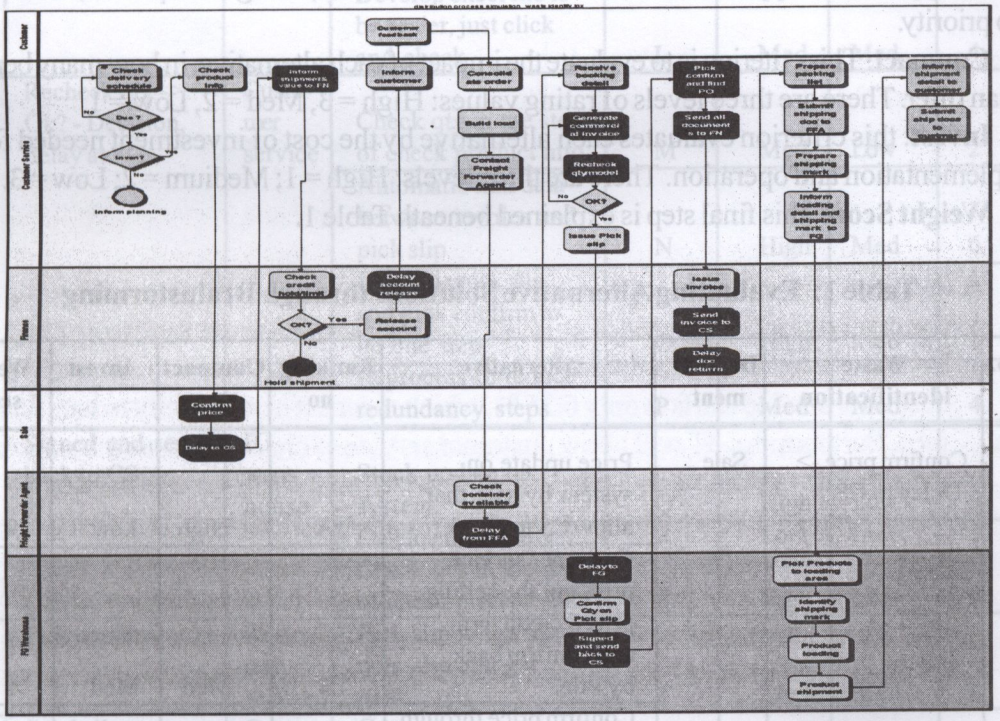
The other figure of concern is the out of service time, which is the time that resources are not available or busy with the other activities. The out of service times in both external and internal department are not much different except Customer service department. In customer service, time is slightly higher than the other departments: it differs by only 0.58%. This is caused by unbalance of time between the resources.

- Customer department: Total average out of service is 4 hours, 16.57%.

- Finance department: Total average out of service is 4 hours, 16.57%.
- FG warehouse department: Total average out of service is 4 hours, 16.57%.
- Freight forwarder agent: Total average out of service is 4 hours, 16.57%.
- Sale department: Total average out of service is 4 hours, 16.57%.
- Customer service department: Total average out of service is 4.14 hours, 17.15%.

Waste identification can be made from the analysis of current processes. The long cycle time and higher cost in the current processes are the result of redundant and wasting activities. The identification of wasting activities is shown in Figure 2.

Figure 2: Waste identification of the current distribution processes



BRAINSTORMING FOR ACTION SUPPORT

A very important next step is for managers involved and affected to participate in brainstorming sessions about what to do. This not only produces more realistic solutions but also gains the involvement and support of these managers, so essential to actual successful implementation later.

The analysis and waste identification of the current processes show many wastes, which cause long cycle times and high cost. To develop and design the new processes, the weighted scoring matrix is applied in identifying the non value-adding activities and finding alternative solutions to improve each.

Identify the non value-adding activities: there are 14 non value-adding activities, which can be grouped into 8 major items as shown in the first two columns in Table 4.4.

Specify and prioritize the needs using a list of criteria: as this project is a simulation in developing a new process design, all non value-adding activities are the focus of this project. The prioritizing is in four steps, each with its own criteria, as follows:

Rank each alternative solution: after listing the non value-adding activities, the brainstorming process is applied to rank each alternative solution, using the alphabet, A being the top priority.

Compact: This criterion is to evaluate the impact of each alternative, in how many benefits it can offer. There are three levels of rating values: High = 3, Med = 2, Low = 1

Invest: this criterion evaluates each alternative by the cost of investment needed for its implementation and operation. There are three levels: High = 1; Medium = 2; Low = 3.

Weight Score: this final step is explained beneath Table 1.

Table 1: Evaluating Alternative Solutions through Brainstorming

No.	Waste identification	Department	Alternative	Ranking no	Compact	Invest	Weight score
1	Confirm price -> Delay to CS	Sale	Price update on system by sale that allow CS to check	A	High	Low	9
			Customer service print out the selling price&credit term and confirm back by sale.	B	Med	Med	4
			Confirm price through e-mail	C	Low	Low	3
2	Inform shipment to FN -> Delay acc release	Customer service	Credit limit update on system by FN that allow CS to check	D	High	Low	9
			Update credit term weekly	E	Med	Low	6
			Automatic block the system if credit term is on hold by FN	F	High	Med	6

3	Delay from FFA	Freight Forwar-Agent	Send forecast to FFA monthly and update weekly to reserve container	G	High	Low	9
			Request for vessel schedule	H	Med	Low	6
			Find the other quicker supplier	I	Low	High	1
4	Generate commercial invoice	Custo-mer Service	Combine commercial and actual invoice to be one form and use multi layer copy	J	High	Med	6
			Print out from the system	K	High	Med	6
			Develop excel file to be easier, just click and check	L	Med	Med	4
5	Recheck qty -> Ok? - Decision, delay at FG	Custo-mer service	Check qty in the step of check product info	M	Med	Low	2
			Automatic link data between invoice and pick slip	N	High	Med	6
			Combine pick slip and pick confirm to be one step	O	High	Med	6
			Reprocess to reduce redundancy steps	P	Med	Med	4
6	Signed and sent back to CS	FG ware house	Stock update on system	Q	High	Low	9
			Call to confirm qty	R	Low	Low	3
			Check qty in the step of check product info	S	High	Low	9
7	Pick confirm	Custo-mer service	Pick slip to use as oder slip and gat pass	T	Med	Med	4
8	Send all documents to FN -> issue invoice	Custo-mer service	Customer service issue the invoice instead Finance. (only Finished product) & Cancel the sale order format.	U	High	Med	6
			Fix time on sending document to FN to avoid waiting time/	V	Med	Low	3
			delay Automatic generateinvoice since pick confirm	W	Med	Med	4

Select the best matching solution: The last step (and the last column in Table 4.4) is to select the optimal alternatives. Each selected alternative has the highest score, from the following formula: Score = Compact rating x Cost rating.

As an example, there are three alternatives for Item 1 (Confirm price -> delay to CS' process):

- Alternative A: Impact = high or 3, Cost = low or 3, the rating -- > 3x3 = 9.
- Alternative B: Impact = med or 2, Cost = low or 3, the rating -- > 2x3 = 6.
- Alternative C: Impact = high or 3, Cost = med or 2, the rating -- > 3x2 = 6.

So, the selected alternative is alternative A as the highest score.

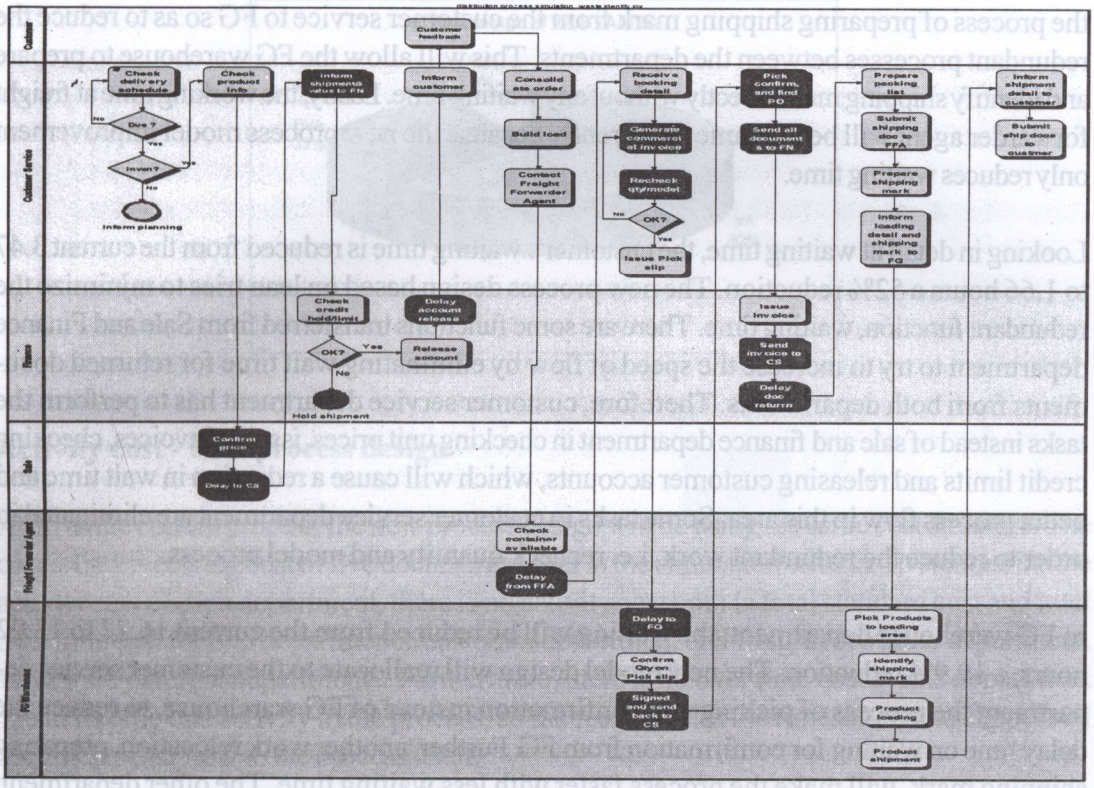
After selecting the alternative solutions for each item, the new processes will be developed from these.

NEW PROPOSED PROCESSES

After evaluating alternatives, in table 4.4, the new proposed process flow is designed, which is different from the current process, in the following details;

- Confirm price -> delay to CS: This process in the current process will be eliminated by having a price update by sale in the system, which will allow the customer service staff to check directly once the delivery schedule is reached.
- Finance department: customer service department to remove the delay time and redundant process between the departments, and will handle the processes of checking credit terms and issuing invoices which are now handled by finance processes in the current process. Data analysis of the current process shows that the utilization of customer service staffs is only 6.35 %, which means it has capacity to handle extra jobs. Furthermore, IT will allow customer service to check credit terms as updated daily by finance department.
- Delay from FFA: this is the wasting time occurred at the external side affecting the whole process. Normally, the external processes are not included in this project; however, it can be improved by giving the forecast to the FFA and updating it weekly.
- The other IT help is to have an automatic data link between invoice and pick slip that allows combining pick slip and pick confirm to be only one step by the customer service. Furthermore, it will help to remove delay time at FG warehouse by having stock update on the system and check quantity as part of the step of check product information at the first stage.
- The last action is to reduce the process of pick confirmation by combining it with the process of picking slip. Furthermore, it also use pick slip as order slip and gate pass when shipping the products out of the factory.

Figure 3: The proposed process flow of distribution process



In the new process design in Figure 3, the process steps are reduced from 43 to 29, and the total number of departments is reduced from six departments to four: two internal departments and two external. The processes are mainly handled by customer service department and then go to the other departments of FG warehouse, Freight Forwarder, and Customer. When running the simulation of the new process design, the resources at each department will be reduced.

After identifying waste in the current processes and running the simulation of new process design modeling, the total cycle time is 53.32 hours or 4.84 days, running 11 working hours, which reduce by 46.92% from the current model. This reduction is from the reallocation of work now handled by Sale department and Finance department, to be handled by customer service in the proposed processes.

Work time in the new process modeling is sharply decreased from the current 3.26 days to 2 days, a 8.7% reduction. The wait time for new process is very different from now, being reduced from 5.74 to be 2.84 days, a 50.5% reduction. Looking in detail, the work time in customer service department is reduced from 14.9 to 6.76 hours, a 54.6% reduction, caused

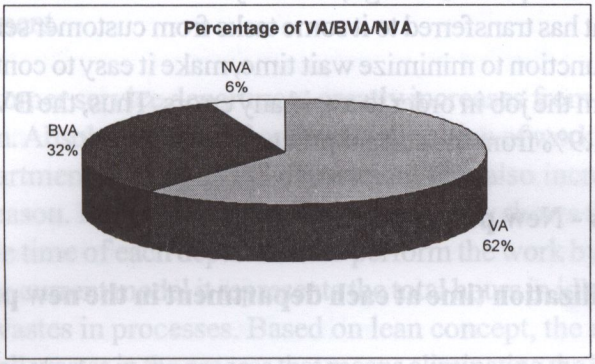
by reducing non value-adding activities of the current process. For the FG warehouse, the work time is increased from 6 hours to 6.75 hours, a 12.5% increase, caused by reallocating the process of preparing shipping mark from the customer service to FG so as to reduce the redundant processes between the departments. This will allow the FG warehouse to prepare and identify shipping mark directly without any waiting time. Lastly, the working time at freight forwarder agent will be the same as currently because the new process model improvement only reduces waiting time.

Looking in detail at waiting time, the customer's waiting time is reduced from the current 3.47 to 1.66 hours a 52% reduction. The new process design based on lean tries to minimize the redundant function, waiting time. There are some functions transferred from Sale and Finance department to try to increase the speed of flow by eliminating wait time for returned documents from both departments. Therefore, customer service department has to perform the tasks instead of sale and finance department in checking unit prices, issuing invoices, checking credit limits and releasing customer accounts, which will cause a reduction in wait time and better process flow in this area. Some tasks in customer service department are eliminated in order to reduce the redundant work, i.e. recheck quantity and model process.

In FG warehouse department, the waiting will be reduced from the current 16.27 to 13.02 hours, a 19.9% reduction. The new model design will reallocate to the customer service department the process of picking slip confirmation instead of FG warehouse, to reduce the delay time on waiting for confirmation from FG. Further, another work relocation, preparing shipping mark, will make the process faster with less waiting time. The other department, whose performance can be greatly improved by the new process design, is freight forwarder agent (FFA). Its waiting time is reduced from the current 14.65 to 0.63 hours, a 95.6% reduction. This is because by good planning and forecasting FFA can reserve a container in advance. Lastly, the external departments: in customer department there are no changes as the feedback to confirm the shipment will be returned to Customer service department the following day after sending the information to customer (this is because of the different time zones involved, USA and Thailand).

Comparing the percentage of VA/BVA/NVA between the current process and new process design, the percentage of value-adding activities will increase from the current 48% to be 62% and the percentage of business value-adding adding activities also increases from the current 23% to be 32% as shown in Figure 4. On the other hand, the percentage of non value-adding activities will reduce from 29% to 6%.

Figure 4: The percentage of VA/BVA/NVA in the new process design



Activity cost - New process design

As in as the current process, the new process design will be using the same cost structure. The cost is the processing cost of five documents as set in the simulation criteria. To summarize the activity cost of each department, there is no activity cost both in total standard cost and total over time cost for two departments, customer department and freight forwarder department, as they are external departments. Furthermore, there is no over time cost at sale department due to its only one activity in the process, so the resource has the time enough to support all documents that flow to the process itself.

Comparing to the current process, the total activity cost is sharply reduced from the current 29, 681.65 to 7,580.40 Thai baht or a cost reduction of 75% per five documents or per week. The activity cost of new process design is from the two main departments, customer service and FG warehouse respectively. Comparing the percentage of overtime cost over the total cost, the new process design will slightly increase from 1.7% to 3.6%. This is because of the reduction of resources at both departments to increase the percentage of utilization.

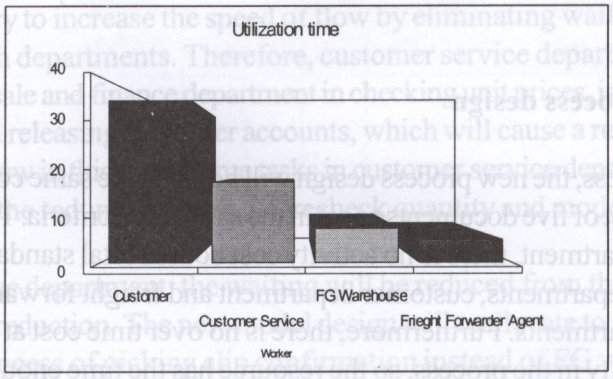
Following Lean thinking, the new process is designed to eliminate non value-adding (NVA) cost from the activity of each department, which can reduce the cost of non value-adding activities from the current of 43% to zero. Comparing VA and BVA costs with the current model, they will increase from 23% and 34% to 43% and 57% respectively, which means the new design can make the activity of more value.

Looking at the details, the most significant benefit for this new process design is the VA cost of Customer service department which increases 32% from the current. Although the VA cost of FG warehouse department decreases by 3.22%, this is a small figure compared with the activities that are minimized from this department. As BVA cost comes from the activity necessary to perform the task, these are all tasks from sale and finance department transferred to

customer service department. So, although the BVA cost in Customer service department slightly increases for new process design, it is only 7.7%. As well as FG warehouse department, this department has transferred to it some tasks from customer service function to flow in the warehousing function to minimize wait time, make it easy to control and make it more convenient to perform the job in order to avoid any errors. Thus, the BVA cost of this department increases by 21.9% from the current process.

Resources analysis - New process design

Figure 5: Utilization time at each department in the new process design



As shown in Figure 5, there are four departments in the new design, customer department, customer service department, FG warehouse department, freight forwarder agent department (there is no proposed utilization from sale and finance department). Comparing the average of utilization, the highest is in customer department, which increases from the current 24.68 hours to 34.6 hours or 24.5% to 64.89% improvement. Apparently most utilization time is still acquired by the customer, and it is unchanged as this activity has to be performed by the customer in the United States. Even though there are some tasks transferred to customer service department, the utilization increases from 6.35 hours to 17.16 hours, a 6.3% to 32% improvement. This results from some functions being transferred to another department and some are eliminated for speeding the response and improving the flow process with the reduction of the resources in the department from 6 to be 2 people. Actually, it can be reduced to only those people handling all processes in customer service department, but this would be the risky in the new process design when he or she is absent or assigned to a further job in the future. For new process design, FG warehouse is a lower utilization than the others, anyway it will increase from 4.84 hours to 7.31 hours or 4.8% to 13.7% improvement if running the new process design, which lets this department continue to perform their tasks without any interruptions or delays. There is a small portion of utilization in freight forwarder department and it is the same process as the current process that this department performs a check on the

availability of containers and confirms back to Customer service department. However, the new design will find the solution to decrease wait time and improve the speed of flow within the process of this department.

The busy time of customer service department greatly increases from the current 2.2% to 9.4% in the new design. Absolutely, this is from the re-allocation of work and the reduction of resources at this department as well as FG department that also increases from 1.1% to 40.1% for the same reason. For idle time, the figure obviously shows that the new process design reduces the idle time of each department to perform the work by over 50% from the current process. As the current model it represents the total hours in idle time for all departments; these are all wastes in processes. Based on lean concept, the new process design proposes to minimize all wastes in the process that means eliminating the idle time of each task for a better process flow. The highest percentage in reduction of idle time is in Customer service department: it is a 38.25% reduction. Although from new process design many tasks are transferred into this department, it shows that in customer service processes there is less idle time and more value adding activity. So the idle time is absolutely reduced from the current by the new process design. It can be said that the new process makes the functions to be more effective and efficient as there are less wastes compared to the current model. Furthermore, it would be observed that the amount of idle time in each department is quite close that means the balancing of the processes.

Out Of Service (OOS) hours are reduced by nearly 50% from the current, even though the ratio of each department is similar to current processes. The figure for Customer service department is still the highest with 26.29%, but it is only slightly different from the other departments, only 6.5%. This means that the portion of OOS time in each department is not much different between the current process and the proposed process design, but the figure for total OOS time in the new process is less than the current, which means that the new process design is better.

After the data analysis of the new proposed processes, the process flow and its parameters are confirmed so that optimal benefits can be gained from this change. An implementation plan identifying the person to be responsible for each item, is drawn up, with a maximum lead time of 4 weeks.

CONCLUSIONS

With competition now so fierce, there is an urgent requirement for improved business processes. The purpose of this project is to design a new distribution process flow, and therefore the lean approach is the tool to drive the distribution process enabling better improvement, faster processing, lower costs, and greater profitability. With lean thinking concepts, it is pos-

sible to eliminate waste and manage a streamlined flow of value to customers as well as removing non value adding activities from the chain.

The new proposed lean distribution processes are designed to replace those now existing. The new design aims to make improvements, eliminate waste, and maximize business flow, with less time, resources, human effort, and costs, while meeting customer requirements. The major problems in distribution processes are time consumption in processing, redundancy of functions across departments and the information flow among several sections that cause long lead times in the distribution processes. Lean distribution will help to increase the speed of flow and reduce costs much more than the existing model of distribution. The new process design based on lean thinking concept provides several benefits as shown in Table 2.

Table 2: The benefits from the new process design comparing to current process

No.	Item	Description	Current process	New process	Benefit gain	Percentage of gain
1	Process	Process step	43	29	14	32.5
2		No of VA activities	16	16	0	0
3		No of BVA activities	13	11	2	15.4
4		No of NVA activities	14	2	12	85.7
5	Time	Total cycle time (days)	9	4.84	4.16	46.2
6		Total working time	3.26	2	1.26	38.7
7		Total waiting time	5.74	2.84	2.9	50.5
8	Cost	Total cost (THB)	29,681.65	7,580.40	22,101.25	74.5
9		Total Standard cost (THB)	29,174.03	7,309.57	21,864.46	74.9
10		Total OT cost (THB)	507.62	270.83	236.79	46.6
11		Total VA cost (%)	23	43	-20	-20.0
12		Total BVA cost (%)	34	57	-23	-23.0
13		Total NVA cost (%)	43	0	43	43.0
14	Resources	Utilization time (%)	6.6	24	-17.4	-17.4
15		Busy time (%)	8.8	77.56	-68.76	-68.8
16		Idle time (%)	91.2	15.86	75.34	75.3
17		Out of service time	24.14	12.42	11.72	48.6
18	Department	No of headcount	14	7	7	50.0
19		No of department concern	6	4	2	33.3

The main benefits are:

1. Reduce process step and redundant functions.
2. Reduce headcount requirement as well as increasing utilization.
3. Increase speed of flow as shown in cycle time improvement.
4. Reduce total costs of the company.
5. Greater flexibility.
6. Worker participation in problem solving.
7. Better cooperation with the customer through quick response.

However, the methods of securing the benefits as proposed in the new process design will not be easy as there are many barriers along the way such as:

- **Human conflict**: as seen in this project, there are many wasteful activities in the processes. The new design will affect current functions such as the finance department which, it is proposed, should have its function handled by customer service. The current finance operator therefore needs job rotation.
- **Top management support**: It is absolutely essential for support from the top management to drive any changes in the organization.
- **Training: There are two issues for training**. One is to train the operator to understand lean concepts and why we need them. The other is to train for re-allocation of processes.
- **Supporting actions for changes**: The quicker a process can be changed to the new proposed process, the quicker completion of supporting actions would be required.
- **Cooperation and trust between people**: Good collaboration across functional teams would be definitely required to run the improvement process smoothly.

This new process design might not be the best design but the objective is to create a modeling design for distribution in accordance with the concept of lean by simulating the modeling before the actual implementation. However, the benefits revealed by the simulation are not exactly the benefits that will be gained when actually implementing, as slight differences should be expected in reality.

After the proposed new distribution modeling has been implemented, it requires deep study and a well planned implementation. The new distribution model performance has to be evaluated to identify the difficulties that occur during the operation. The evaluation should be discussed among the members of the top management.

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