DESIGNING A SUPPLY CHAIN MAPPING TOOL: A CASE OF A THIRD-PARTY LOGISTIC PROVIDER (WAREHOUSE MANAGEMENT)

JESSE MIKAEL SAARILAHTI

AN INDEPENDENT STUDY REPORT SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

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INDEPENDENT STUDY TITLE	Designing a Supply Chain Mapping tool: A Case of a Third-Party Logistics Provider
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ABSTRACT

Controlling and monitoring Third-Party Logistics service (3PL) providers to achieve a competitive advantage in global markets, requires a lot of collaboration and coordination between different parties. To keep logistics operations running in efficient level, monitoring and improving the operational and communicational channels becomes vital for all of the parties. 3PL service providers might become hardly to control over time, since they mostly follow their own business strategy and operational structure. By providing a simple tool to collect & analyze data, 3PL service providers can be guided to the more efficient and collaborative path. This study focuses on finding the key issues of a company's supply chain from 3PL warehouse perspective by forming a supply chain mapping tool to help collecting data and find the main problems occurring in different levels, and how the decisions made in each of the decision-making levels are affecting to each other's from warehouse perspective.

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TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF ACRONYMS

3PL	Third Part Logistics Service Provider
SCOR	Supply Chain Operations Reference Model
CCMM	Cause & Consequence Mapping Model
OTIF	On Time In Full
FTZ	Free Trade Zone
JIT	Just In Time
WMS	Warehouse Management System
KPI	Key Performance Indicator

CHAPTER 1
INTRODUCTION

1.1 Research Background

Research started from getting empirical findings from different warehouses and organizations over the visits and field work. The author was able to see the same problems occurring time after time in communication between different parties, silo thinking and in the level of understanding the cause-effect relationships by different actions. The research focuses to find reasons and causes from the warehouse management perspective by creating a mapping tool.

The focus in this research was to create a solid level of understanding how the supply chain and logistics operations looks like from the Third-party logistics (3PL) warehouse perspective and how they could be identified and managed better after mapping the operations.

By focusing on one perspective and mapping the cause of the actions from that point of view can help identifying the key problems and points of improvements together with building a knowledge to get over of a silo thinking by creating a wider picture of "how our actions affect to the other sectors along the supply chain?". The lack of motivation from the 3PL service providers might be a problem to change or improve the processes, since they mostly have their own working culture, rules and processes inside the organization.

1.2 Problem Statement

In countless of companies and business units the silo thinking is strongly rooted into the organization and its operations. A term “Silo thinking” is defined to be an attitude where several departments or groups within an organization do not want to share information or knowledge with other individuals in the same organization (Investopedia, n.d). The figure below illustrates the network of companies and business units where they silo thinking occurs.

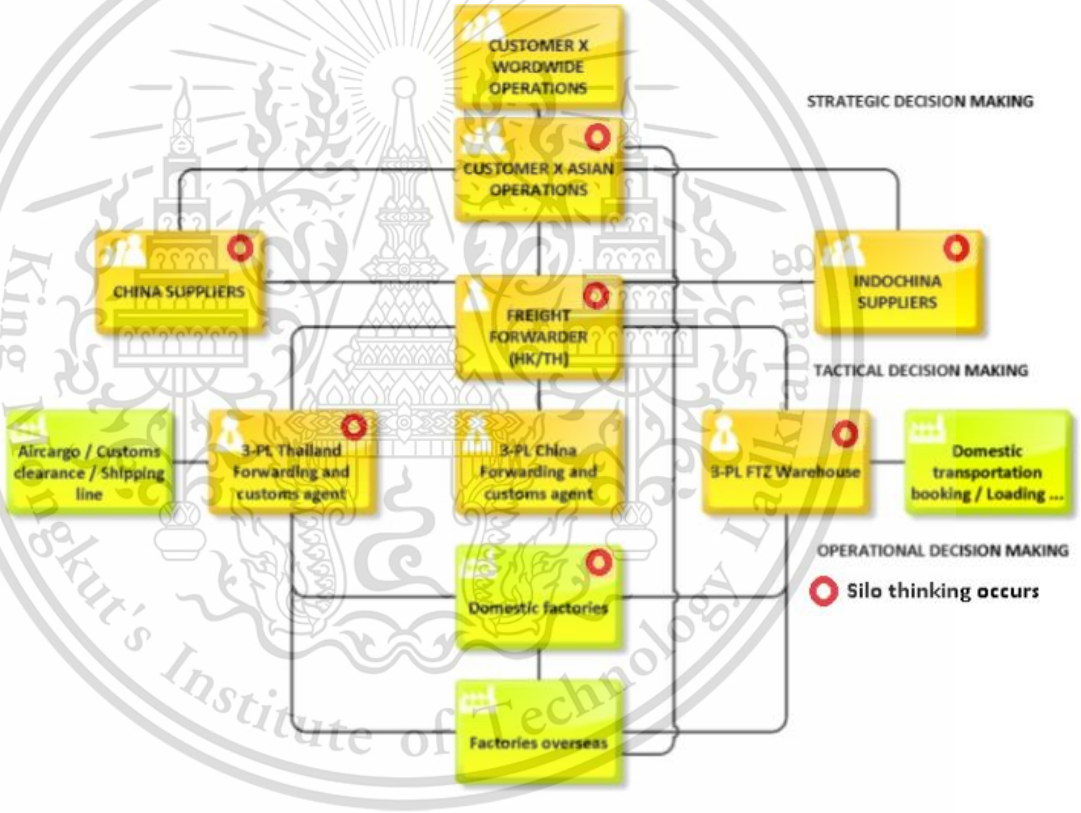

Figure 1.1 Network of a case study

The problem of controlling different parties and make them understand the real meaning and cause of each others actions, can provide the win-win situation for each party by reducing the waste caused by lack of understanding. In order to improve the movement, storage and flow of industrial spareparts what the warehouse is handling,

the research must be done. To be able to improve the operational as well as communicational efficiency and flow of information between different parties, it requires a fact finder person who can find and present the problems, causes and effects in 3-decision making level. By locating and proving the weakest points which might have an direct or indirect impact for supply chain from the case study warehouse perspective, the wider knowledge between the different parties can be created and operations and communications aligned and improved towards the same goal.

1.3 Objectives of the Study

The objective of this study is to design and form a supply chain mapping tool by combining some already existing parts and ideas from different models and ideas such as Supply Chain Operation Reference model, Mediation model and Architecture of Logistics or 3-levels of decision making. The mapping tool is aimed to be helpful as a part of warehouse management tool but from the actual process and flow perspective. The mapping tool is based on the data collection from warehousing perspective and the research objectives are the following:

- To identify the problem from the 3PL warehouse perspective
- Understand the external and internal influencers to warehouse operations
- To form a supply chain mapping model and adapt it to a warehouse to collect data through it.
- Monitor the metrics set in mapping tool
- Form a table of results which shows the connections of different decision levels.

1.4 Scope of the Study

The scope of this study is to identify the problems in communication and flow of information between 3PL service provider, customer clearance agent, Freight forwarder, customer and the factories and to form a tool to collect data to improve the problems. Focusing on the warehouse case study by collecting and analyzing the data in order to design a supply chain mapping model and applying the model into the same case study.

The research will be limited to the designing and applying the mapping model into the Free Trade zone warehouse in Thailand and analyzing the results. The main focus of the research is on data collection, designing and in applying the designed model into real life case study. The created model will also be tested by external individual parties and the feedback will be used to validate the model from different perspective.

CHAPTER 2
LITERATURE REVIEW

This chapter will discuss about the internal and external supply chain drivers and the importance of understand their possible effect to a 3-level decision making inside the supply chain from any perspective. Firstly, the chapter will focus on the purpose of warehousing and the different warehousing styles in order to create basic understanding of warehousing and where the mapping model will be applied. Secondly, the chapter will present the external supply chain influencers and trends which might have an impact to a company's supply chain and model creation. Thirdly the chapter will discuss about the different models and studies, which could be used to identify supply chain internal influencers, but which alone or together as a fully would not suitable be applied into a 3PL warehouse when there is no collaboration provided.

2.1 Warehousing

In the global business world, the importance of the warehousing is even more highlighted than before because of the international business and trade have spread all over the world by forcing the companies to follow in order to achieve competitive advantage from the sourcing, manufacturing and purchasing goods and raw materials factors. This increased world market trend has created a need for the warehousing operations.

Warehousing can defined to be a combination of different functions such as temporary storage, protection of goods, packing, Just in Time (JIT), fulfillment and handling of orders packing depending on the purpose of the warehouse. In modern world, warehouses are considered to operate not only as center of storage, but also as a

hubs for value-addition according to De Koster, et.al, 2017. Without a warehouse or distribution center, the control of the goods might become harder to handle. Warehouse operations can be classified into different main sections such as picking, receiving, storage and shipping as suggested by Gu et al. 2007. Throughout the years of working inside different warehouses, the author of this research has seen the same kind of operational level problems occurring in different warehouses around the world. Different researcher has found out that the performance of one can be affected by the issues of another one and it was summed up in the research of "A Comprehensive Review of Warehouse Operational Issues" by Shah & Khanzode, 2017. In another words, there might be a cause-effect connection between the issues in each decision-making level.

Sometimes a company does not need a warehouse or they want to save in costs by having a direct process without building any safety stocks. This method can be considered as a lean method, but before the company wants to consider applying the lean concept to their supply chain, it requires a good forecasting, On-time in full deliveries and perfect communication between the different parties along the supply chain. Lean is considered to be a philosophy where the idea is to maximize the customer value while minimizing the waste defined by Lean Enterprise Institute.

In case the lean supply chain is successfully adapted, the warehousing is not necessary, but on the other cases warehousing is a necessary step along the supply chain to enable building safety stocks and consolidate the goods before the last mile delivery. There are three different elements in warehousing stated by Lambert & Stock, 1993, and can be seen in table 2.1 Three basic warehousing elements:

Table 2.1 Three basic warehousing elements

Movement	Storage	Information transfer
Receive inbound goods and do quality & quantity check	Temporary storage for stock replenishment pupose (short-term)	Record the movements in and out
Handling and moving the goods inside the warehouse from the loading dock to storage and back	Semi-permanent storage for building the safety stocks (medium-long term)	Information of what is stored, where, how much, when it arrived, what is the production information, model etc.
Deliver outbound goods to customers		Used for monitoring, space utilization and planning

Source: Stock, J.R., & Lambert D.M. (2001). Strategic Logistics Management. 4th edition, New York: McGraw-Hill.

Warehousing can be considered as a vital link inside the supply chain, which main purpose is to store the goods during time between production and transportation to customer according to Singh, et.al, 2018. They also mentioned, that warehouse is not only a place for holding the goods, but it is strategically and tactically important place, which must to be able to cooperate with emerging requirements in cost effective way. In their study, the main focus is mostly on finding which location in India-Iran sector is the most cost-effective site. Instead of building a general model, which could be applied anywhere in the world during the decision-making process, their research only focused on selecting a location from India-Iran sector supported by their regionally collected data.

From strategic point of view, warehouse with a correct location and criteria is a must for a globally operating company, by allowing consolidation, building safety stocks to assure the OTIF deliveries and also controlling the quality of goods. Discussed in the study of a warehouse selection, that to be able to be meet the demand in certain areas successfully, a company need to have a warehouse not only to store goods but to know how much to store in each stage and what could be the most suitable location for a warehouse (Gold and Marvick, 1997). As a tactical level perspective, not only the location or the information what to store and how much, but also the selection of warehouse operator (in case of 3PL company) is a really important to be understood. By selecting a wrong warehouse provide, style or location might lead to high losses to the company, and this can be seen in the data collected in Research Methodology.

2.1.1 Warehouse as a fundamental for supply chain

The ultimate purpose of the warehousing is to increase the total supply chain efficiency by providing space for storage raw materials, spare parts or final products and to enable a company to build a safety stock in order exterminate the delays in shipments, which might have serious impact for company's finance. Warehousing can be inspected from three different perspectives according to its many purposes noticed by the author throughout the years of practical work in the field of warehousing.

In strategic level in the long-term the warehousing might be the enabler for a company to expand and move their operations overseas and at the same time increase the competitiveness by lowering the total costs in supply chain which mostly has a direct effect to a product pricing by being able to mass produce and storage the goods.

In tactical level the location and logistical services nearby, might be the key factor for successful planning and delivery of the products as well as adopting the best practices. The failure in tactical decision-making level could build up the problems in

operational level as well as in strategical level for example not allowing a company to change their production strategy because of the bad warehouse location.

To be able to achieve the operational efficiency in the operational level, the core point is to create effective work flow by balancing skilled labors, technology and tools such a WMS and also the management and KPI' monitoring. One of the main factors to be mentioned is the location of the warehouse, which either support or obstruct the efficient flow in each level. According to the study called "warehousing" the following factors should be considered in a warehouse location study according to the (Dimitris and Chorafas, 1974):

- Sufficient space (effective layout)
- Customer service (reverse logistics, fast responsiveness, OTIF)
- Good connectivity (traffic connection with suppliers, factories, key markets.)
- Easy access to highway (Infrastructural preferences, low traffic level)
- Connectivity to Airports, Seaports and to Railway
- Qualified workforce

The importance of the effective layout and design by stating some of the most important factors to be considered was highlighted by (Bloomberg et al. 2002):

- Optimization of the warehouse capacity utilization
- Space utilization by planning where to place the stock and how to store it
- Maximization of the warehouse automatization
- Flexible design to allow changes
- All the goods stored must be protected

2.1.2 Different warehouse styles and their suitability for different situations

Location of the warehouse is not the only factor to be focused on while making a strategical decision. Warehouse style should also be considered as an important factor to minimize the future problems occurring in tactical and operational level. Warehouse style can be seen as a water divider between different approaches. Warehouse style actually defines on:

- What purpose the warehouse is for?
- What type of supply chain the company is following?
- What type of products the company is handling?
- What kind of operations are necessary in warehouse?

The strategic purpose could be for example to avoid import tax, while tactical could be the feeder unit for the local manufacturers and operational to do the actual consolidation of the goods. Each of the warehouse styles has different purpose and might not be suitable for every business. The important to be noticed is that a different countries and continents might consider warehouses a bit different way and the rules and regulations might vary in different countries.

Before selecting a warehouse type, it is highly recommended to study further about the legislation of the target country in order to avoid inefficiency and loss in profit creation. The following table is added to provide general information, but the information may vary depending on the country and continent as mentioned before.

Table 2.2 FTZ vs. BONDED Warehouse. "Advantages of Foreign Trade Zones vs. Bonded warehouse

Function	FTZ warehouse	General warehouse	Bonded warehouse
Customs Entry	Customs entry is filed when goods are removed from the FTZ	Imported goods are subject to the import duty and VAT	Customs entry must be filed for goods to enter the warehouse
Customs Bond	Not required. Admissions to the zone are covered under the FTZ operators Customs Bond		Required for all warehouse entries
Permissible Cargo	Foreign and domestic goods allowed	Domestic goods only allowed	Only foreign goods allowed
State & Local Inventory Tax	Foreign & domestic goods that are to be exported are not taxed	Based on a country's export regulation	All goods are taxed
Manufacture of goods	Permitted within FTZ Duty is payable on either the imported components or final products depending on whichever has lower duty.	Based on a country's manufacturing laws	Not permitted
Storage Period	Unlimited	Unlimited	Limited (1y+1y)
Domestic Goods	May be admitted without customs permit	Admitted	May not be admitted

Control of Goods	Full control of goods 24 hours a day	Full control, usually Vendor or 3-PL managed inventory	Customs has primary control of goods. Can be moved or inspected during regular working hours.
Movement of Goods	Relatively unrestricted in and out of an FTZ	No limitations	Limited movement. Specific customs approval required for each movement.
Permitted Activity	Goods can be sorted, cleaned, graded, consolidated, labelled, assembled, manufactured, exhibited, sold and repacked	Goods cannot be consolidated	Cleaned, repacked, and sorted under customs supervision, Duty is owned on entire shipment entering a bonded warehouse including waste and damaged goods.

Source: Shipping & Logistics Blog. "Head to Head: Foreign Trade Zones vs. Bonded Warehouses" Ashley Boroski MendozaFebruary 19, 2015

2.1.3 Importance of warehouse selection

Warehouse selection and its importance is important to understand, since it is a strategic and tactical decision and it can have a long term effect or cause in operational level and that is the reason why understanding it is relevant for this research and the model formed in chapter 3.

Time after time different companies are facing the difficulties in 3-level decision making. One strategically made decision could favor a company to either help them focus on their core operations or help them to expand the markets and boost their effectiveness by opening a warehouse. Opening a warehouse could be a really beneficial decision, but badly planned it can also lose the company's whole business.

There is already existing studies and researches done about the warehouse selection and how to set the criteria done by Singh, et.al, 2018. Their studies suggested

to set three main categories and nine sub-categories supported by many other studies in order to find the best criteria for a warehouse site selection.

The approach for setting criteria is at the first, to state if the warehouse is built and ran by the company itself, or if the if the warehouse services will be done by 3PL. The first point determines whether the company has full control of the operations or they just pay someone to do the job. In these cases, the criteria should be different and based on the actual needs of a company, because in case if the company is using 3PL warehousing provider, there is no need to buy land nor built a warehouse or invest in a forklifts and other necessary tools to run the warehouse.

13 warehouse selection criteria were set in the research of "Multi-criteria selection of potential warehouse locations" from humanitarian relief logistics perspective done by Trivedi & Singh, 2014. These set criteria were used collected via interviews and analyzed by Analytical hierarchy process (AHP), which is a mathematical procedure to assign weights to different alternatives and use comparison. The set criteria in their study is not really suitable for industrial or e-commerce business strategy, since the focus is on humanitarian relief logistics, which has completely different approaches and aim.

Different criteria that should be considered when choosing a location for a facility from the industrial context but fully focused on warehouse selection perception was mentioned by Alberto, 2010. Alberto categorized the following aspects in 7 groups:

- Environmental aspects
- Cost
- Quality of living
- Local incentives
- Time reliability

- Response flexibility
- Integration with customers

Warehouse decision factors in humanitarian relief logistics was studied in academical journal written by Roh, et.al, 2013. Their study empirically focused in identifying the key factors to be considered when selecting a humanitarian relief warehouse location as a criterion for AHP. The results of their study showed that the most important attribute to select a warehouse location is the cooperation factor which was followed by national stability, cost, logistics and location. From the industrial and traditional supply chain perspective the results of their research are not fully applicable to other forms or fields of supply chain, since the needs, operations and goals are completely different, excluding the fact of operational excellence and efficiency.

In general distribution system such as factories, distribution centers or customers the dimensional role is completely different compared to Humanitarian relief. In generally, the scheduling plans in distribution systems are based from strategic to -operational level 1) Long-term: location 2) Median-Term: transportation 3) Short-term: scheduling and on the Humanitarian the focus is on the urgent decisions based on the available information. The criteria suggested by them includes 5 main criteria (below) and 25 sub-criteria:

- Location
- Logistics
- National Stability
- Cost
- Cooperation

The selection of a warehouse is a remarkable corner stone in a company's supply chain and decision making, which should be understood and studied further

before decision making. The remarkability for this research is to create the basic knowledge of the warehousing and understand how the warehouse selection decision might affect into the operations at any decision making level in future and also to help forming a tool to collect the data from the warehouse management perspective.

2.2 External Supply Chain influencers and approaches

Council of Supply Chain Management Professionals, (CSCMP) states that supply chain is a backbone of most businesses and it is pertinent to achieve customer satisfaction for example by: 1) Boosting a customer service by delivering the products on time in full (OTIF) in right location. 2) By reducing the operating costs by focusing on purchasing, production and total supply chain costs. 3) By improving the financial position by reducing fixed assets and fixed costs and improves the cash flow by increasing the product or service delivery times. The view and definition of a supply chain can be slightly different depending on which side supply chain is viewed. As an example, supply chain can be viewed or approached from suppliers or manufacturers perspective or from any organizational side.

In this sub chapter the discussion will be in the different Supply Chain approaches to increase the basic understanding how the supply chain should be seen and how different approaches describes it. Different approaches are important to be studied so the warehouse management approach in forming a mapping tool would be easier to understand.

Supply chain can be viewed from the information and material flow approach based on the demand and supply. Materials flow from the raw materials to suppliers, but without a good flow of information, the coordination such as delivery times and quantities might increase total logistics costs (Bolstorff & Rosenbaum. 2011.).

Understanding different approaches to increase the holistic view of how things might affect to a company's supply chain the total costst could possibly be reduced. As an example, without any knowledge of the different approaches, it might be extremely hazard for a company to design their supply chain strategy and align it with their business strategy.

In supplier-centric approach the supply chain is assumed to be a network for different suppliers who produce goods along the supply chain and finally reach the customer. This approach requires a buffer planning, inventory-controlling and supply chain design analysis to meet the requested production-demand.

In customer-centric approach all of the indirect or direct stages are involved in a process to fulfill customers demand. This approach requires the market knowledge, customer segmentation and cost-to-serve analysis. These approaches were presented together with customer-supplier approaches, where the supply chain network is recognized and the coordination between different parties are stated in order to provide a market with products and services in global level by Chopra and Meindl, 2015.

From the operational view the objectives are to run all of the operations at the lowest possible cost and fastest possible method. The figure below shows the different approaches and the pivotal goal on the middle, which combines customer and supplier centric approaches together, which can be also applied into the mapping tool formed in chapter 3.

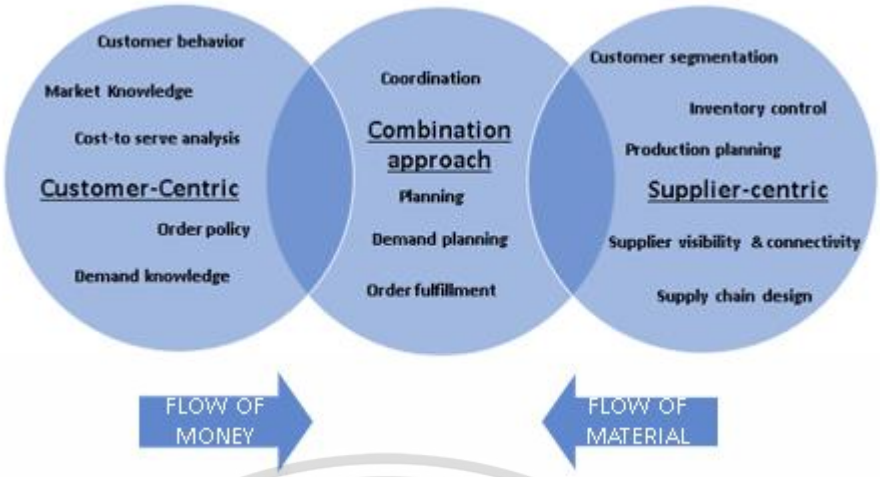

Figure 2.1 Combination approach

Source: Is a Customer-Centric Strategy the Same as Demand-Driven? Outside-In? By Lora Cecere. August 14, 2016.

2.2.1 Push-and pull strategy approach

Every supply chain is following its own structure based on its supply chain strategy approach and the business strategy, which determines how and where the company produce and sell the goods. The business strategy mainly determines the flow of the goods from factory to the customer based on the sales strategy and platform as well as the product type and target market. The determination of the flow of goods and activities lies in the change in supply chain, based on the nature of the demand and the product type. On the demand chain approach the focus is in market demand of suppliers. In demand-pull approach all the requirements and demands are created by customer, however the customer should be willing to wait until the products are processed and moving along the supply chain stated by Sarbjit, S. 2017.

In supply-push approach the products are manufactured and stored until the customer place the order or demand for these products can be created. The production and distribution process together should lead as far possible in order to match with the customers demand. In industry and literature there is few common systems which can

be classified as either pull or push systems (Hopp and Spearman, 2014). By understanding the differences betweem push and pull strategies the purpose of the warehouse can be defined and possible problems identified caused by aligning wrong approach to a warehousing strategy.

2.2.2 Supply Chain modelling approach

Recently, supply chain management has been starting to get acknowledgement as a fundamental of a business process between the different industries and business organizations. Due to globalization and customer awareness, companies must pay more attention to their supply chain processes and the ethics of supply chain. The problematic between effective supply chain modelling and design is often to match it to reflect in real life changes (Ganeshan and Harrison, 1996). The scopes of the supply chain and operations according to real life changes and expectations must be recognized in advance to help managers to find the best practices to control the changes.

Supply chain modelling is mainly used for to spot weaknesses in supply chain, increase the visibility in order to help in decision making and also to evaluate the performance. The main idea to spot weaknesses and increase visibility will be used in the supply chain mapping model forming in chapter 3. Supply chain modelling can be approached in 3 ways in order to compound the 4 major decision areas (location, inventories, production and transportation) according to Ganeshan and Harrison, 1996.

Network design, which allows a company to plan and design their future strategies for carrying out inventory, transportation, location and production. Benefits for the network design is to enable strategical level decision making, for example to make a strategic decision of opening a new distribution center. On the other hand, developing the large model is a time and resources consuming process

Rough Cut method, which has mostly been used in industry to help in operational decision making for example in rough cut capacity planning based on inventory management. This model can also be considered to be a 'multi-level' inventory control model. Each model always has some cons on it and rough-cut model is tend to forget production side and supplier capacities.

Simulations is a dynamic supply chain modelling, which is recommended to be used in studying the supply chain dimensions and characteristics explained by Evans, Naim, & Towill, 1993. It is used to create a case to analyze the different possible outcomes and how to solve them.

2.2.3 Supply chain drivers

Each supply chain consists the flow of goods or services, which should be aligned with the different factors influencing it. By influencing factors, the author means for example, different facilities, processes, transportations, formalities and procedure steps the product or service must go through from the upstream to downstream and what kind of strategy should be used to manage it. This is called the nature of a supply chain management. Once the company has achieved the state where the flow of goods is about to start, the supply chain drivers which might shape the flow at some point, should be defined in order to avoid negative surprises in future.

By defining five supply chain drivers, the wider picture of a supply chain and the possible barriers with linkages between the supply chain operations can be identified. To find a more effective way to perform, a company must adopt the different ways to manage and develop information, transportation, distribution and facilities as well as warehousing and inventory control explained by Soni and Kodali, 2010.

Different drivers are explained into the table 2.3 below with additional steps to consider and the efficiency versus responsiveness in table 2.4

Table 2.3 Supply performance drivers

LEVEL	Supply chain performance drivers by Soni and Kodali	Supply chain drivers by SCM GLOBAL	Additional steps to consider
1	**Facilities**	**Production** (what, how, when to produce)	Production strategy (push-pull make to stock or make to order)
	Sourcing		
2	**Inventory**	**Inventory** (How much to make, how much to stock)	Warehousing strategy, Safetystock creation
3	**Logistics**	**Location** (Where best to do and what activity)	Long-term or short-term contract, subcontracting?
4	**Transportation**	**Transportation** (How and when to move products)	
5	**Information distribution**	**Information** (For making decisions)	Mapping the supply chain, 3-leves of decision making
6	**Pricing**		

Source: Soni, G. and Kodali, R. (2010), "Internal benchmarking for assessment of supply chain performance".

Table 2.4 Supply chain drivers

Source: Supply Chain Drivers. Source: SCM GLOBAL, Five Supply chain drivers

Supply chain drivers	Efficiency	Responsiveness
1.Production	-Little excess capacity -Narrow focus -Few Central plants -Make to-order	-Excess capacity -Flexible manufacturing -Many smaller plants / subcontracting -Make to stock
2.Inventory	-Low inventory levels -Fewer items -Finished goods inventory	-High inventory levels -Wide range of items -Parts, components, subassembly
3. Location	-One or few central locations	-Many distribution hubs
4. Transportation	-Few large shipments -Slower and cheaper modes	-Frequent shipments -Fast & flexible modes
5. Information	-Cost of information drops while other costs increase	-Collect & share timely and accurate data
6. Product lifecycle	-Long	-Short
7. Supply selection	-Low costs -Consistent quality -On time delivery	-Flexibility -Fast delivery -High performance quality

2.2.4 Mismatching business and supply chain strategy

The research of "Framework for choosing supply chain strategies" by Intaher & Badenhorst-Weiss, 2011 states that, often the supply chain strategy is mismatched with the business strategy, which results in poor efficiency and poor operations in supply chain. The reason why it is important to understand the differences between the supply chain strategy and business strategy from this research perspective is to isolate the cause of the problems into internal and external drivers. Mismatching the business and supply chain strategy can be categorized as an internal driver from the strategic decision-making level, because it will most likely have either positive or negative impact to the warehouse management.

Business strategy is based on the questions of what to offer, where to offer, when to offer and who to offer. Once the business strategy is launched, the company should focus on building the supply chain strategy which should be based on the question of from whom to buy, where to store, how much to store, how to move, how to operate etc.

The importance for a company not only to use a same agenda, rules and goals, but also to push supply chain operations to see themselves as a customer handling integral unit serving the competitive goals of the enterprise instead of being just an operational department (Happek, 2005).

A business strategy involves leveraging all the company's core competencies to achieve their ultimate goal was discussed in LinkedIn article by (Ludovica Castiglia, 2017). Supply chain strategy can be an enabler to the business strategy for example, if the business is a low-cost service provider, the sourcing & planning of the resources and movement of the information and materials will be done inside the supply chain. Thence, a successful alignment will reward the business strategy by increasing the

competitive elements. The Figure 2.2. presents the formation of the competitive advantage and the differentiation of the two strategies.

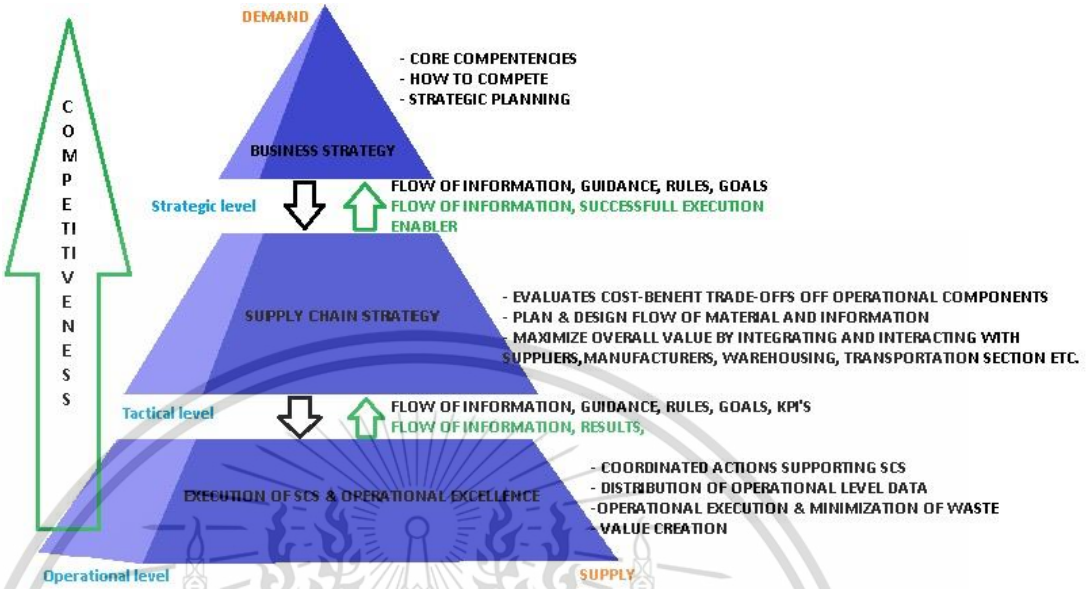

Figure 2.2 Competitive advantage by aligning strategies

2.2.5 Example of new business trends and the possible influence to supply chain decision making

To get a wider picture of the differences between the E-commerce and industrial, the rise of e-commerce trend will be explained in more details in this subchapter. In traditional supply chain the flow of goods is mostly formed from upstream to downstream, but in e-commerce it goes reversely. Rapid growth of e-commerce is caused by the fast development of internet and technology. The new technology allows business to move their sales & marketing platform deeper into online instead of the old-style retail shops, which requires a customer to be physically in there an consume their time for travelling there.

According to a figure 2.4.1, the retail e-commerce sales worldwide has been doubled in past 4 years and it is still expected to be double in 2021. Increasing trend of

Business-to-Customer (B2C) sales in e-commerce platform has not only increased the demand of the latest technologies to keep the platform and sales up, but also it has had a strong impact in logistic services. Throughout the e-commerce platform, the business must be able to provide services according to customer's expectation, which are mainly short leads times and high flexibility.

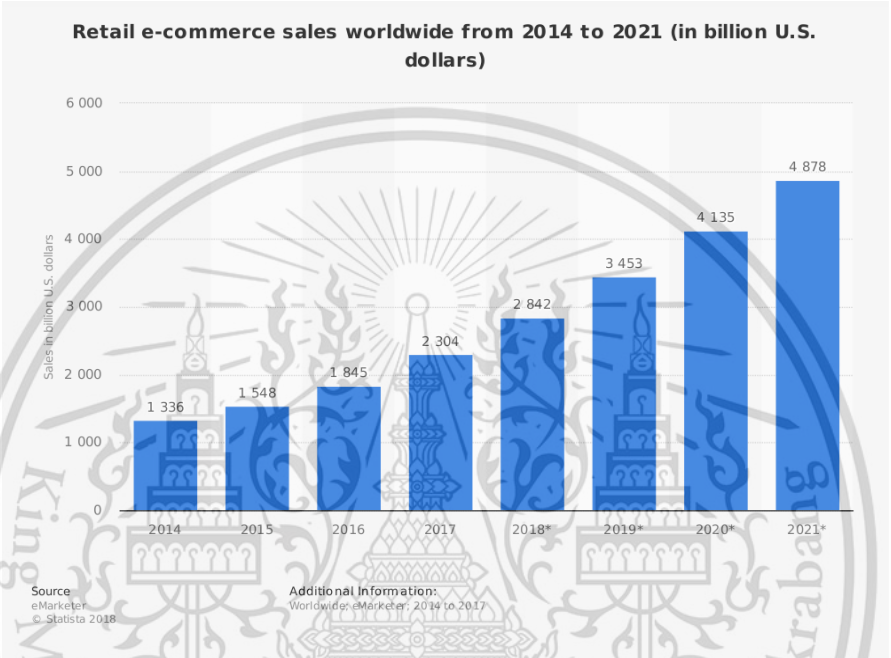

Figure 2.3 Retail e-commerce sales worldwide from 2014 to 2021

Source: Statista, 2018

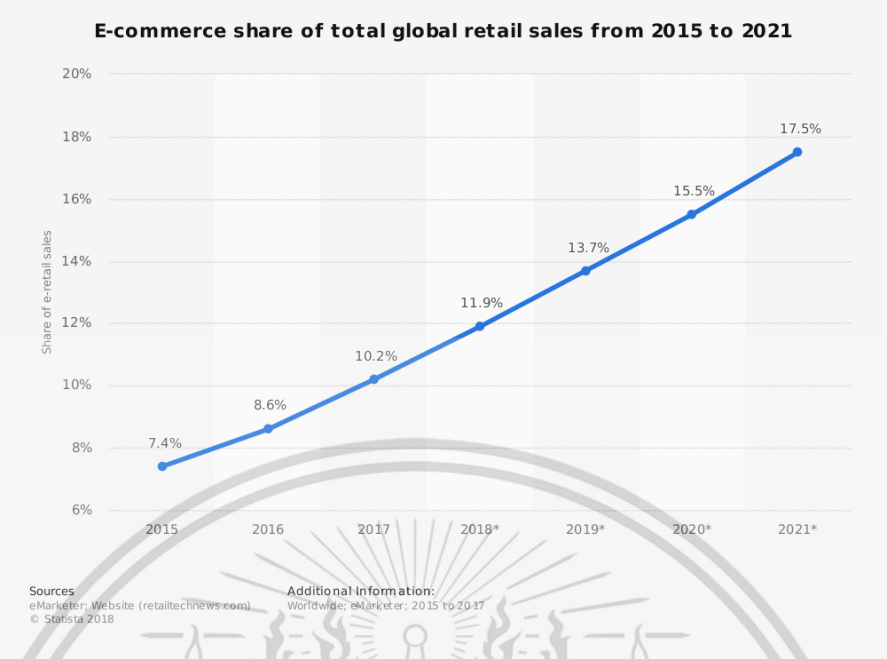

Figure 2.4 E-commerce share of total global retail sales from 2015 to 2021

Source: Statista, 2018

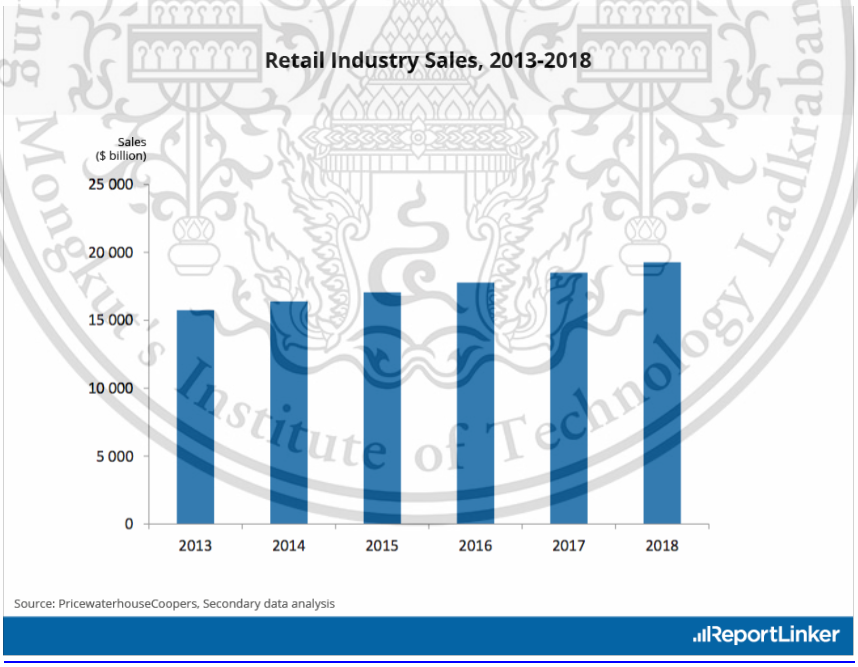

Figure 2.5 Retail Industry sales 2013-2018

Source: Reporter Linker, nd.

Wide range of products requires wide distribution network and storage of the goods, where the traditional supply chain is facing a challenging time to be developed at the same pace with e-commerce. *"The traditional logistics service under the B2C e-commerce is no longer only from the supplier to the buyer entity movement, but in the traditional logistics based on the pursuit of a short time, service flexibility, and high value-added services. Therefore, the quality of logistics distribution has become more and more important to the development of B2C electronic commerce*" (L. Wang, 2015). The same research also states that in China B2C e-commerce enterprises are using 3PL and self-build logistics. Smaller companies cannot afford to build up their own logistics service, so they must use the 3PL services.

The logistics is the keyword for successful supply chain in e-commerce, because that is the gap between the customer and companies is wide and e-commerce mostly needs at least 2-3 times more space for the storage and distribution operations than traditional supply chain requires said by David Egan, CBRE's head of industrial and logistics research in the Americas. While in the traditional approach for supply chain and logistics management, warehousing has mostly inbound and outbound services designed to serve only road transportation, whereas in the e-commerce the trend is changing to "built-to-suit" approach, which customizes warehousing operations to be suitable for intermodal transportation services.

The main problem between industrial and e-supply chain is not the competition of the same customers or markets, but the competition from available future services and resources. According to the Technavio's analyst have forecasted that the expected global market growth of warehousing and storage will be close to 6% at a CARG (compounded annual growth rate) during the 2018-2022 (businesswire.com article,

2018). The expected growth might increase the demand for better infrastructure and connectivity between the logistic hubs due to increased number of movements.

Increasing competition between e-supply and traditional supply companies is driving the 3PL providers to favor e-commerce companies instead of the traditional industrial or retail practitioners, due to the higher competitive level in e-commerce. Higher competitive level factor has a direct influence to market price increasement of logistics service cost-level according to law of supply and demand (Ahrmen, 2006).

According to the figures 2.4 and 2.5 the retail industry sales has grown 12.5 percent unit during the period of 2014 – 2018, whereas retail e-commerce has increased 112.724 percent unit during the same period. On average e-commerce has grown 22.545 percentage unit per year where the industrial has grown only 2.5 percent unit per year on average. Forecasted global market growth of warehousing and storage is 6%, which would be enough to cover industrial retail demand, but only 26.61 percent unit from the average annually increasing demand of e-commerce. This indicates a lack of warehousing services in future, and especially the lack of external available resources which both industrial and e-supply chain have to compete of.

2.3 Supply Chain models and tools

The literature review chapter have already discussed about the fundamental of the warehousing as well as the role of warehousing in supply chain. In this chapter the focus will be in explaining shortly some different supply chain models and tools, which are partly used to help forming a supply chain mapping tool, and later in this research to be applied into the warehouse operations. Different supply chain models are necessary tools for managers, who are required to make good decisions in every 3-different level (Strategic, Tactical, Operational). By understanding the main idea of the

following models, the research is talking about in coming sub chapter, the managers can expand their knowledge and form a wider picture of the supply chain they are working with.

2.3.1 Mediation model

Mediation is a statistical model which tries to identify the process between the independent variable and dependent variable by adding a mediator variable into the process (Baron & Kenny, 1986). In the world of supply chain management and especially in decision making in any 3-levels, the decision is most of the times based on the hypothesis where the input of one action is supposed to give certain output of the other action without having any external influences to the wanted output.

This research is not explaining the mediation model deeply, but it explains shortly why the mediation model should be considered from the warehousing point of view. The more complicated the supply chain is, the more likely warehousing will play a part as a mediator of a flow and storage of goods. If warehouse is considered to be point Y where the point X is the supplier who deliver the goods to warehouse, there might not be any mediators between the simple process. But mostly in wider picture, the warehouse is playing the role of mediator, since without the warehouse operations all the delivering and purchasing operations must be 100% accurate, and still some mistakes occurs time after time.

On the other hand, warehouse might not be the mediator if the flow of goods is normal, but in case the normal flow of a product through the warehouse is somehow disturbed the mediation effect might occur. For example: discrepancies on stock report or the warehouse accidentally ship out wrong product without having extra safety stock and it might affect to the manufacturing process which might affect to sales, which

might affect to losing customers. So, warehouse might be or become as a mediator or it can be affected by other mediator as well in supply chain.

1) As an example: a company X invest to expand a warehouse and they expect it to automatically to increase the profits once the expansion is completed and running without considering the possible mediator which might affect to the final output. In this case the input would be money and time and the wanted outcome is efficient and cost saving warehouse solution, but without a good contractor who has sourced their building materials carefully, the materials might cause a problem to the output.

2) The other example could be, where the supplier changes their packing material and size to help decreasing the transportation costs from the supplier to factory or to customer, but there will be a warehouse on the middle where the products are stored first. This warehouse might play a role of a mediator and it might cannot store the goods anymore as efficient as before or the loading and unloading process requires more manpower and time because of the new package is not suitable for the old layout. This affect to the total warehousing costs and increase the workload and the handling the products might not be as safe as it used to be with better packing.

Normally each process has its own expected input requirements in order to achieve the wanted output. If there is no relationship between two points, but the output is received, there must be a mediator affecting to the transaction. The figure below shows the points of (X= Independent variable, Y= Dependent variable, M=Mediator

variable). X is the starting point of a process and Y is the end point of the process. A supposition in many cases would be that Point X provides the Point Y, but the real outcome could be the result of the point M or how the point M have been interacting to the final output.

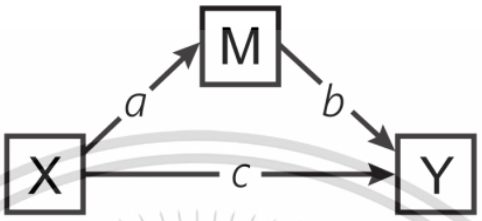

Figure 2.6 Mediation model

Source: R-bloggers, 2017.

2.3.2 Supply Chain Operation Reference Model (SCOR)

The supply chain operations reference model (SCOR) is a management tool which can be used to address, improve and communicate supply chain management decision within a company and with its suppliers and customers (SCRC SME, 2004)

SCOR model focuses to define and redefine the needed business processes to satisfy customer's demands. In shortly, SCOR model is a tool for modelling a company's processes and help them to align the processes with the supply chain in order to achieve improvements. SCOR model has 5 different major area and 3 different levels, which can be seen from the figure below.

- Plan= Planning section is the first step which aims to balance resources together with requirements and also determines the way form of communication in supply chain. The ultimate purpose of the planning is to align the supply chain operations with the financial plan

- Source= Sourcing focuses on each step of where to buy and how to buy and also how to manage the inventory. It also discusses how to handle payments and deliveries
- Make= Is focused on manufacturing and what is the most efficient way to produce the wanted outcome. It requires understanding of how to manage the transportation, Labor force, facilities and equipment's.
- Deliver= Warehousing, transportation and order management are the key focuses on delivering stage and it aims to define how those processes are done and should be done.
- Return= Return policies must be created and evaluated for each return. Return could be a return of full or empty container, packaging or defective product and all those policies must be aligned and managed according to a company's business rules.

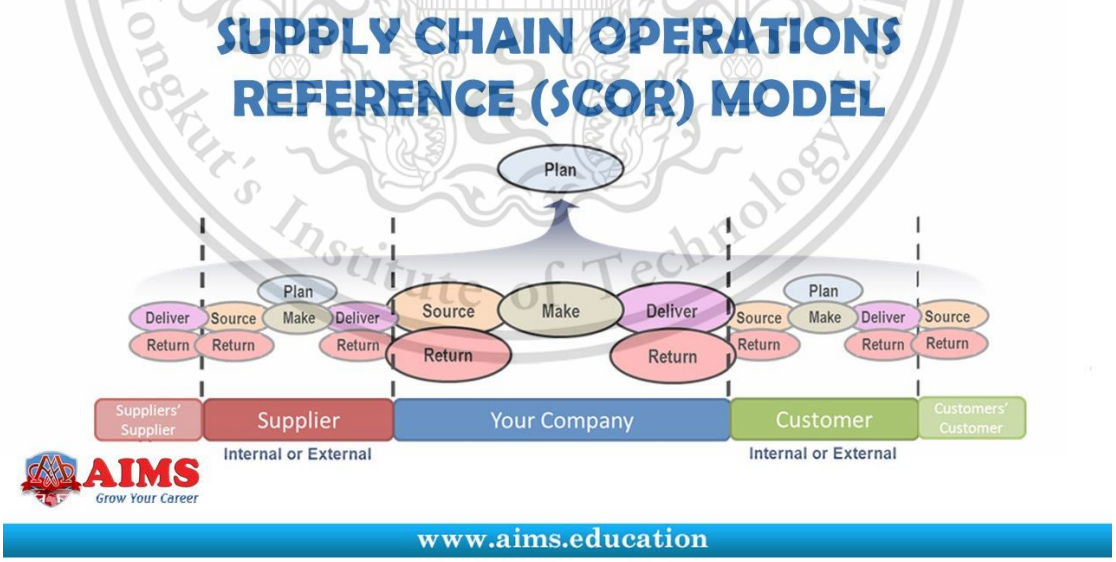

Figure 2.7 SCOR model

Source : Aims Education, nd.

In warehousing SCOR model could be applied to help identify key problems and help to find, determine and apply best practices. SCOR model can be adopted to anywhere in the supply chain, but due to some restrictions, it is not smart to be applied every time to every process.

In complicated supply chain including countless of 3PL service providers, SCOR model is hard to be applied to each different level, due to there is so many individual companies who do not have enough resources to follow up or align their processes with the SCOR model. Under many circumstances 3-pl service providers such as warehousing service providers are not interested or they do not want to put too much effort to study and apply the SCOR model, since they need to focus to satisfy the in many cases other customers as well. Applying a SCOR model requires a full commitment and long-term contracting to make it useful for each party.

On the other hand, the SCOR model as mentioned above is suitable for every company inside the supply chain who are willing to improve their internal operations and affect to the external operations. Applying a SCOR model to a warehouse could lead to better visibility between the companies in same supply chain, reduction in produced waste and reductions in overall costs by understanding how the operations are actually running and how the different decisions could help to make supply chain more efficient.

A SCOR model was applied to a warehouse in order to link the best practices, operations, performance measurement, requirements and resources in a research from (Duvenage, 2008). The results of the research were improvements in planning, integration of operations and total operational cost reductions.

Due to the nature of this research the warehouse as case study where the new mapping model will be applied is ran by 3PL company, which means the SCOR model is not the most ideal and suitable model to be applied. Cause & Consequence Mapping Model (CCMM) will be formed and discussed wider in Research Methodology chapter.

Based on the suitable elements from the SCOR model version and easier to adapt compared to SCOR model, and it can bring the results, which can be read by everyone on the site. CCMM can also be used to set and monitor metrics, understand the cause and effect relationship of the actions and help to improve the processes and decision-making.

2.3.3 3-Levels of decision making

According to business dictionary, "*the decision making is process of selecting a logical choice from the available options*". Making a decision requires setting different options and weighting the most suitable one for each purpose. Decision making is inevitable part of anything in life, where the good decisions gives the positive and wanted output and the bad decisions results the negative outcome. Decision making is divided into three-levels, where each of the levels have different purpose and different impact.

The problem between the decision-making levels might be hard to identify because some of the negative effects of strategical decision making can occur over time in operational level. Decision making from the warehousing point of view can be seen in next example: Company needs to build a new warehouse to expand their business = strategic decision. Company needs to find a good location for the warehouse = tactical decision. Company needs to set operational processes for daily basis = operational

decision. The different decisions levels are identified below and also shown in a figure below

- Strategic decision requires a good and careful planning due to the its effect is long-term. Strategic decision making in business is done by the top management and the decisions are based on the external and internal influencers and forecasting. Strategic level decision making requires a lot of knowledge of the surroundings in order to minimize the negative impacts and maximize the positive impacts.
- Tactical decisions are medium-term decisions to help implementing a strategic decision. Tactical decisions create the fundamental for the operational level, for example by designing the processes and working schedules. Tactical decisions are mostly made by middle level managers on monthly basis.
- Operational decisions are made in daily basis depending on the current situations just as placing orders for next weeks or deciding the loading orders of the upcoming shipments.
- Operational execution level is not a real decision-making level, but it is important to be understood, since the negative or positive effects will from decision makings will occur in that level. Operational execution is connected to decisions made in other sectors, which might have some unexpected impact to the results of the daily work.

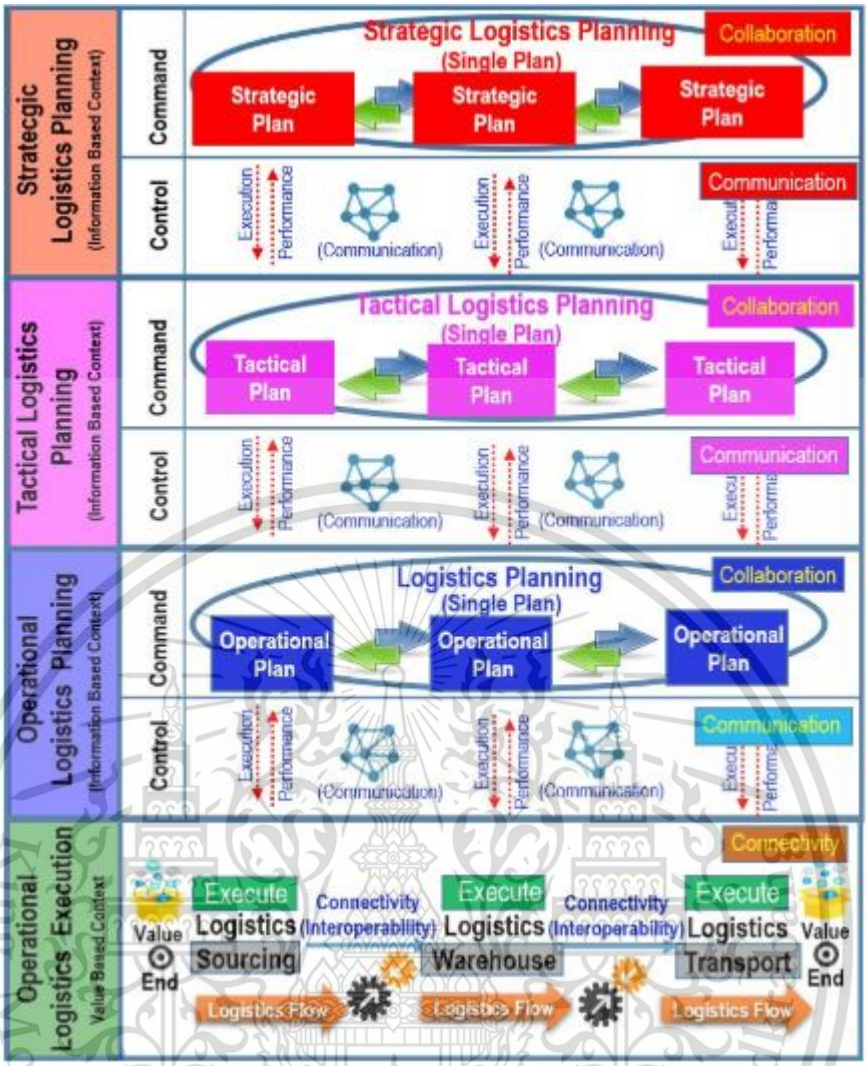

Figure 2.8 Logistics systems architecture

(Source: Logistics system architecture, Vithaya Suharitdamrong, 2018)

CHAPTER 3

RESEARCH METHODOLOGY

This chapter will examine different research methods and models and present what methods are applied in this thesis in chronological order. The research topic and literature are already presented and clarified in previous chapters and this chapter will focus on presenting the chosen research strategy, timeline, data collection methods and forming the necessary models to be used in this research.

Before going deeper into the chapter, the differences between the words methodology and methods shall be defined in order to understand the differences in this chapter. The term "method" refers to procedures and techniques that are used to obtain and analyze data defined by Langkos, 2014. The term "methodology" refers to the theory that how the research should be undertaken according to Langkos, 2014. The results from the presented methods in this chapter will be used further in chapter 4 to receive the results of the used methods based on the research methodology.

3.1 Quantitative or qualitative research method

First of all, it is important to Define the differences between the qualitative and quantitative research approaches in order to find out, which research design approach is most suitable for this research. Saunders et al. 2003 defines the quantitative as a numerical approach to collect, analyze and generate data. This approach is based on the numbers and data, which is mainly used to test certain theory or theories. Quantitative research is mostly associated as a deductive approach, which is defined to develop a hypothesis based on the already existing theory and the design the research to test the set hypothesis by Wilson, 2010.

Qualitative method is mostly used to prove existing or non-existing relationships between different variables by measured in numerically and analyzed by using a statistical technique (Saunders et al. 2003). Qualitative research approach is based on the data collection and procedure technique to analyze a data that creates non-numerical data. In qualitative research the objectives and meanings and the relationships between them are studied by data collection tools and analytical procedures to build a conceptual framework for the research.

Qualitative research can be either inductive or deductive, but more often the abductive approach is used in practice. Both approaches have faced some criticism, for example the deductive approaches are criticized from the lack of clarity in terms of how to select a theory to be tested in order to create a hypotheses and inductive approach is criticized by that there is no amount of empirical data that will enable forming a theory.

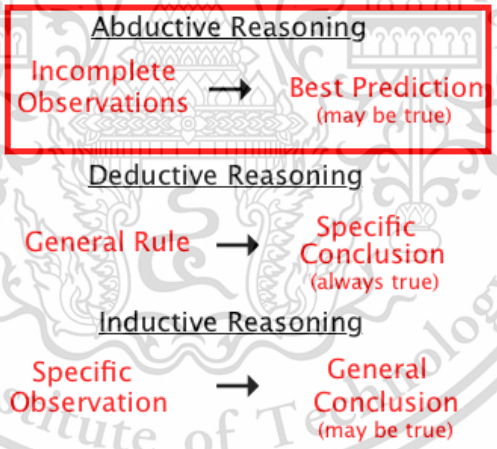

Figure 3.1 Abductive reasoning (abductive approach)

Source: Saunders, M., Lewis, P. & Thornhill, A. (2012) "Research Methods for Business Students" 6th edition, Pearson Education Limited

Based on the data collection and data analysis methods, which will be introduced in further chapter, as well as the findings from the literature review, can be used to define that this research is mainly a qualitative research combining deductive and inductive approach to become a partly abductive, but including a partly quantitative

data from model testing survey part. In abductive approach the research starts with the conclusion and set of premises that tries to prove the conclusion right.

3.2 Recognizing the nature of a research design

Every research has its own nature of design, depending on the author, researcher and the research topic. In order to be able to recognize the research design, it is mandatory to define each of the different designs.

3.2.1 Exploratory studies

An exploratory study tries to find a way to explain by asking questions to discover what is going on in the surrounding world and to highlight the certain phenomenon. Mostly if it is not possible to reveal the research topic background from the literature, it is considered to be an exploratory study. Sekaran, 2003 defines that an exploratory study is used when there is not much available information of the current situation or phenomenon nor the previous researches cannot provide any remarkable solution. As an example, if a researcher wants to build a completely new model to create energy, then it is an exploratory study. First the research idea must be created following by finding an answer for the questions like what, when, where and how by collecting and studying data. For example, the research might take economical perspective and ty to find how the new model would help the society. There are three ways to conduct research information:

- Searching the literature
- Talking to experts from that subject
- Conduct focused interviews

3.2.2 Descriptive studies

Descriptive study is an observational study which tries to find the root of cause between different patterns or different variables such as time, place and condition. Descriptive studies try to understand the different characteristics of certain situation and organizations that mostly follow the certain pattern. For the researchers, the descriptive study tries to provide a pertinent viewpoint of the certain phenomenon, organizational or individual aspects.

3.2.3 Explanatory studies

Explanatory studies try to explain the causal relationship between different variables. Explanatory study can be divided into a further causal study or correlation study. Often, inside the organization there is some decisions or number which are not always the reason for the cause-effect situation, but sometimes there is also a correlation between these numbers or decisions which influence one to another (Sekaran, 2003). Using a laypersons term example could be the correlation between different variables during the transportation of fuel and matches inside the same truck without noticing that the truck has some defection which cause some friction and these different variables might start to correlate. From the cause-effective point of view the decision to put them inside the same truck might be the problem causal relationship.

3.2.4 Concluding the research design

Based on the explanations above section 3.2.1, 3.2.2 and 3.2.3 of different research design perspectives, this research can be concluded to be a combination of exploratory studies by trying to understand and explain the cause of the problems but also to create a model to explain the cause. By creating a mapping model, which will

be discussed further in a data collection methods chapter, the research can be classified to be under the exploratory studies, because this research is trying to create a new model to enhance effectiveness and competitive level inside an organization.

On the other hand, this research has also a cause-effective approach, which can be seen for example in the supply chain mapping model based on the mediation model in further chapter. This mapping model tries to identify the key problem points in supply chain by explaining the actual effect from point A to point B and to point C. To sum up the nature of this research design, it can be noted that this research is following both, exploratory and explanatory research design.

3.3 Research approach and strategy

In order to build a research strategy, it should be formed around the empirical studies and knowledge. Data can be collected in a form of data exchange in a field of practical work as well as from the already existing researches and literature. The problems occurred in practical work in past two years helped the author to gather the knowledge of common problems occurred in warehouse management, which lead forming the further research.

Saunders et al. 2003 states total eight different research strategies under three different main strategy approaches.

1. Quantitative research design: Experiment strategy & Survey strategy
2. Qualitative research design: Archival research strategy & Case study strategy
3. Quantitative, qualitative or both: Ethnographical, Action Research, Grounded Theory or Narrative Inquiry strategies

3.3.1 Case study strategy

A case study strategy is an empirical study which can be used to answer to questions such as how and why. It is in-depth exploration of the specific group or organization. It is mostly used to identify and study some specific problem the participants or target group is facing or lacking. This strategy is beneficial to be used in a case of a one wishes to build a better level of understanding of the research and the certain phenomenon from the already existing theory suggested by Saunders et al. 2003.

When a research is focused on the organization as a whole the characteristic will be the holistic case study. Case study strategy allows using multiple cases within a one case study. Once the questions are asked, the researcher must understand the facts which might influence to the answers, for example interviewing nurseries night time after 24hours work shift mentioned by Gillham, 2000. He is also highlighting that what questions for what purposes of the research, can be answered by asking people and how those questions are presented, since every question can be written in a manipulating form.

Case study strategy is fitting to this research from the empirical study perspective. This research suggests some problems found inside the organizations as well as the warehouse management problems due to 3PL service providers. Using a case study approach. Using a case study strategy, the author was able to identify the key problem points and based on the monitoring to form a mapping model to help in collecting data and creating a larger map of the problems from warehouse management perspective.

3.4 Research timeline

The proposed research took a form as a new research to develop a new model by combining the already existing tools and research subjects from different approach. The research project unofficially started from identifying the key problems different companies are facing in their supply chain and how could this be improved. KPI' Monitoring and identification started in June 2017 but the actual research started in July 2018 and it is expected to be done before the end of April 2019.

Table 3.1 Gantt chart

Outline	2018									2019	
	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
INTRODUCTION											
LITERATURE REVIEW											
RESEARCH METHODOLOGY											
RESULTS AND DISCUSSION											
CONCLUSION											
KPI' MONITORING (Initial data)	2017										
DATA COLLECTION (ACADEMICAL RESEARCH)											
FORMING A RESEARCH TOPIC											

3.5 Generating research topic

The author decided to form a research topic based on the problems found from the field of practical work. Many companies are forced to expand their business overseas and use 3PL service providers and overseas agents, which might be hard to control. The author has faced the same problems in countless of warehouses around the world, which lead to the formation of the research topic. According to the literature review, effective supply chain mapping together with warehouse selection tool is a necessary in order to keep up competitiveness inside the company's target market, but also in terms of competing from the available resources. Forming the topic of:

"DESIGNING A SUPPLY CHAIN MAPPING TOOL: A CASE OF A THIRD-PARTY LOGISTIC PROVIDER (WAREHOUSE MANAGEMENT)".

3.6 Data collection method

In this research, the data was collected for 2 different purposes. Firstly, supportive data was collected from literature review and from the practical work operations to help identifying the important sectors to form a mapping model. The primary data was collected by using the mapping model to find out real problems inside a case study warehouse. The figure below identifies the complete structure of the data collection methods in different levels.

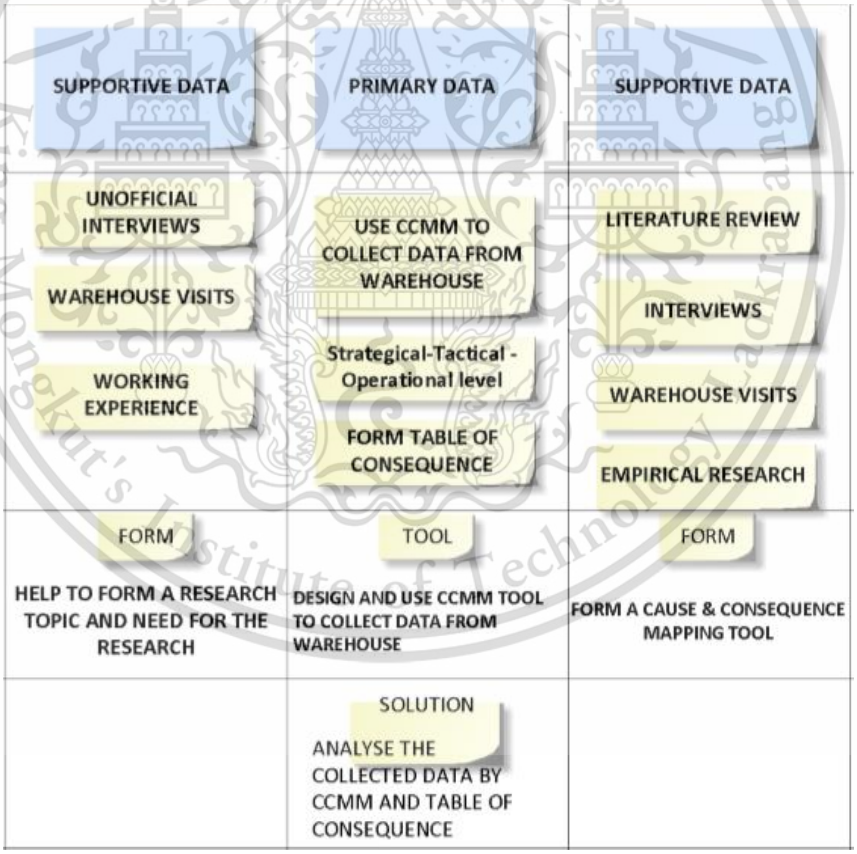

Figure 3.2 Data collection structure

3.6.1 Building the basic knowledge

The author of this research started the supportive data collection on May 2017. The purpose of the supportive data was to find out a research topic by identifying key problems, and then limiting the problems into a one united group of problems, which might have effect on each other's.

To build the general knowledge, the supportive data was collected by visiting different companies and warehouses in different countries to see how they operate in daily basis. Also interviewing people by using an unstructured interview approach and having a discussion with different people, who were working in a different positions and different companies in supply chain was one of the sources to build the initial data. Table of visits to help forming a research topic below:

Table 3.2 Building basic knowledge

When	Method	Where	Purpose	Key points	RESULTS
Summer 2016	Business visit	Shanghai, China	Warehouse visit	Warehouse structure	**The supply chain of the company X was really complicated together with all of its outsourced 3-PL service providers. Most of thse companies are following their own guidance and they are hard to control and they cannot see the benefit of applying same ideas.**
Summer 2016	Interview	Hongkong	Warehousing study	Warehouse purpose	
Summer 2016	Business visit	Shenzhen, China	Quality inspection visit	What is acceptable quality	
Summer 2016	Seminar	Hongkong	SC Seminar about transportation	Financial impact of transportation in generally	
Spring 2017	evelopment meetin	Thailand	Barcoding	What kind, who?	
Summer2017	Warehouse operations	Thailand	Working operational level	How they operate, how to develop, who will listen?	
Summer 2017	Implementation	Thailand	Barcoding implementation	When, how, why?	
Autumn 2017	Warehouse selection meeting	Thailand	New warehouse	What style, where, who?	
Winter 2018	Warehouse development	Thailand	Layout design	What is needed?	
Spring 2018	Development meeting	Thailand	WMS development	What is needed?	

3.6.2 Supportive & Primary data

Supportive data was collected by reading literature and studying different models and tools as well as identifying and monitoring operations in warehouse. By reading the literature, the author was able to be identify some of the common problems, which were commonly faced in warehousing and which is caused by the lack of knowledge in terms of aligning supply chain with business plan as well as identifying the holistic view of the supply chain operations or identifying the connections and effects between different operations. Also, the information and knowledge collected from the field work enabled to form a Cause & Consequence Mapping Model (CCMM).

The author has separated the Primary data and Supportive data into two different approaches, which means the Primary data is the priority to collect actual data and build a table of consequence, where the secondary data is the main source to build and support the formation of CCMM.

Primary data was mainly collected by using the Cause & Consequence Monitoring Model (CCMM) and applying it to the supply chain from warehouse perspective. Once the model was applied to a warehouse and data was collected, the ultimate output was to see a complete map of supply chain connections and a 3-decision level table, which can be used to identify the problems and connections between the spotted problems in warehouse.

The purpose of the data collected via CCMM was to find out:

1) What kind of problems the supply chain is facing from the warehouse management perspective?
2) What is causing the problems and how the warehouse can avoid the problems?
3) How the problems are connected into a different decision-making level.

3.7 Research tools and models

In this research, the author decided to form a mapping tool to help identifying problems occurred in warehouse and to point out the problems which are caused by external and internal sources in supply chain. By forming a mapping tool, a user is able to map to identify the flow of communication and information, set and monitor key points, understand and monitor the suppliers, and collect the data to see cause and consequence of the problems as well as identify in which level the key problems are. By providing this kind of tool, a company will receive a holistic view of their actual supply chain and they are able to make decisions in different levels after mapping the operations.

3.7.1 What is a Cause & Consequence Monitoring Model

Scope of Cause & Consequence Monitoring Model (CCMM) is created to help in analyzing company's supply chain step by step in order to provide a complete view for the logistics operations focusing on specific area, for example focusing on warehousing or manufacturing or purchasing section, by mapping the effects from the others to their section and how they have affected to other stages

CCMM combines five different elements to enable its user to understand the current supply chain functions by mapping the operational functions, mapping the flow of information & goods, mapping each of the stages, mapping the key focus points and also adding the analyzing section of Source, Manufacturing, Deliver and Plan. The model is trying to answer to the question the author has faced countless of times: "What our Supply Chain actually contain and how each process and flow is affecting to each other's". Also, the questions how the processes and decision making can be improved and make it easier to understand. Adding and combining old elements from the different

models with new elements form together a workable tool to answer to the research questions.

Cause & Consequence Mapping Model and its filled example can be seen in chapter 4. Appendix A will also show the model completely applied into case study warehouse to collect data.

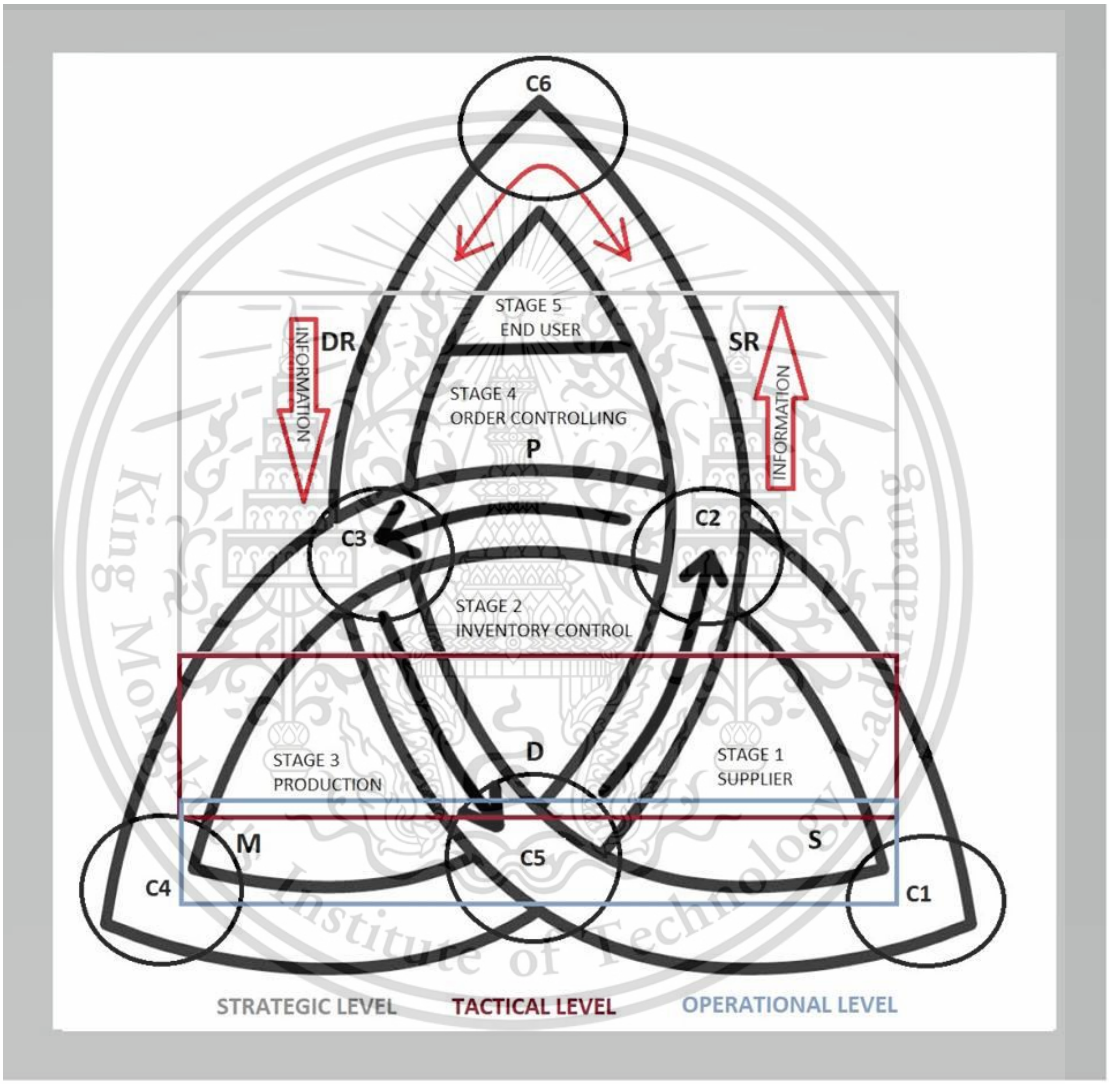

Figure 3.3 Cause & Consequence Mapping Model

3.7.2 How to use the CCMM

1)Fill up stages: To get started with CCMM, the first phase is to identify and fill up the 5 main stages according company's desired flow of goods or services. Stage 1 is the upstream of the supply chain and stage 5 is the downstream of the supply chain. Each stage must be marked down and the main purpose and effect or relationship must be written down. For example, in this research the model is applied into a warehouse perspective, so the stage 1 supplier stage will show the list of suppliers, what products they have, what kind of packing they have etc. All the necessary information concerning the focused point of view. To identify and solve problems inside a supply chain, mapping the supply chain, identifying the bottlenecks, setting the KPI's, identifying the triggering criteria and implementing the Root Cause Analysis (RCA) was suggested by Eckert & Hughes, 2010.

2) Set the flows and lead times: The flow will determine the way how the good, services and data normally flows inside your supply chain. The purpose of the black arrows is to show the direction where the goods flow inside the supply chain. Red arrows are presenting the flow of information. Once the black arrow is added, it is really vital to start thinking about the average lead times from the first stage to the second. The lead time table must be formed to monitor different lead times from different suppliers and manufacturers in order to manage stock levels and plan the orders. Setting the red arrows and monitoring the flow of information and communication, can be helpful to identify possible communication problems or silo thinking inside the supply chain for example by following and tracking barcoding.

3) Set the Check-up circles: The main idea for these circles (Figure points C2, C3, C5) is to help identify the possible error points and discrepancies between the different points. Points C1, C4, C6 are working exactly the same way, but the mistakes

found on those points are having a bigger impact to the final step, since they are the spots where the goods are produced or sold. As a real-life example, based on the primary data, problems in point C2 was spotted and it was caused by the bad quality inspection. Section circle points describes the mistakes spotted in each section and how many parties are involved in it in order to find a solution. By setting these three points; the interactions, collaborations and the occurred problems can be found and solutions to be developed and executed. These points help in data collection and later to form the table of 3-decision levels to see how the decisions are affecting to results.

Table 3.3 Checkpoint table example

C-point	Problem/error	Reason	Status	Solution	Time-frame	Impact
C2 from S1-S2	Defected product	Crashed pallets inside the container	SOLVED 31-Oct-18	Not accepted, supplier sent repairmen to wh		Shortage
C3 from S2-S3	Missing product	Bad inspection	PENDING 5-Nov-18 (Still on the way)	Picking error, sent new product to production immediately		Shortage, discrepancy in stock, customs stock fix
C4 S3-S2	Late order placement	Bad communication/ data flow	SOLVED 12-Dec-18	Setting deadlines for placing an order		Urgent delivery, rush operations.

4) Set up SCOR points: Supply Chain Operational Reference points states the scope of different processes in different stages inside the map and identifies what kind of supply chain strategy is needed to be used in each sector, but from the one main perspective, for example warehousing, to enable the business strategy. (P)lanning, (S)ourcing, (M)anufacturing, (D)elivering points are added to describe and align the supply chain strategy to the business. Once the points P, S, M, D are set, the table below must be filled from the one perspective each department is responsible for. For Example, warehousing will fill the table from their points of view highlighting the (D)elivering part. Once the SCOR points are set, the table below must be filled from the perspective the user is applying the tool. For example. In this research the model will be applied to the 3-pl warehouse, so the sourcing, make, deliver, return must be considered from the warehouse perspective to answer how it benefits us and how it benefits them.

Table 3.4 SCOR table example

PLAN	Planning process brings together resources and the expected demand requirements. Planning compile demand and supply to meet the most suitable sourcing, production and delivery requirements
SOURCE	Where to source, How much control over supplier, Quality, Quantity
MAKE	Where, How much to produce, How often to deliver, How huge safety stock, Material management
DELIVER	Distribution, Tranportation options, Contracts, Customs, Lead times
DELIVER RETURN	How to manage returns, FTZ & customs rules, Who's responsibility?

Source: Supply chain performance measurement using SCOR model in the distribution company in Indonesia.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter focus on going through the applied model step by step and showing what kind of data was received and how it was used to get the wanted results. This chapter proceeds in chronological order starting from the case study background, moving to formation of the Cause & Consequence Mapping Model (CCMM), applying it to the warehouse in order to collect a data and create a holistic view and it ends for the 3-decision level table which identifies all the faced problems and how they are connected to each other's.

4.1 A Case study background

This research started from the idea to improve operational efficiency and reduce silo thinking between the different parties in supply chain. The author of this research collected empirical data over 2 years from the Free trade zone warehouse, which was ran by 3PL company. During these 2 years the author was able to witness how the operations and process improvements were time after time collapsing to lack of knowledge, lack of understanding the real needs of the customer and lack of understanding how each other's processes in supply chain were affecting to the final result. Failing to improve the processes time after time and make each company to understand their effect to the supply chain might lead for each individual company to go back to their silo thinking and this could in worst case scenario to lead in losing a customer and business.

The case study where the CCMM will be applied is a Free trade zone warehouse ran by third party logistics company. Customs clearance and Freight Forwarding are also done both by third party companies. Transportation and shipping are all done by

different companies, that is why freight forwarder is needed to handle the movements. The company who is using the services of the third-party companies is a global company who has production and operations all over the world. In this research focus is on the warehousing which is on the upstream of the supply chain.

The main role of the warehouse is being a feeder unit to the factories all over the world by supporting their needs with On Time In Full (OTIF) principle. The other main role of the warehouse is to build a safety stock for the spare parts and raw materials without forgetting the receiving, dispatching and labelling the goods. For one shipment to reach the warehouse and then finally to reach the factory includes many parties, processes and steps to be filled. To proceed these steps as efficiently as possible, all of the parties needs to know how their actions affect to the other steps and finally to the wanted outcome.

There are thousands of different models, which could be applied to warehouse to improve the efficiency, but since there is a lot of different parties who are focusing on their own processes, it would be a waste of time to apply any model, which none of the parties are willing to follow nor they don't even want to change their processes. That is the reason why the author decided to form the CCMM to help different companies and different level personnel to understand the effect of the actions.

4.2 Formation of the Cause & Consequence Mapping Model

After the case study background introduction, the natural following step was to explain the different stages of the model applying. Before the model was applied to the case study it was formed and explained shortly in chapter 3. The figure below explains the first level before the CCMM was formed, the second level when the CCMM was formed and the third level after the model was used to collect data.

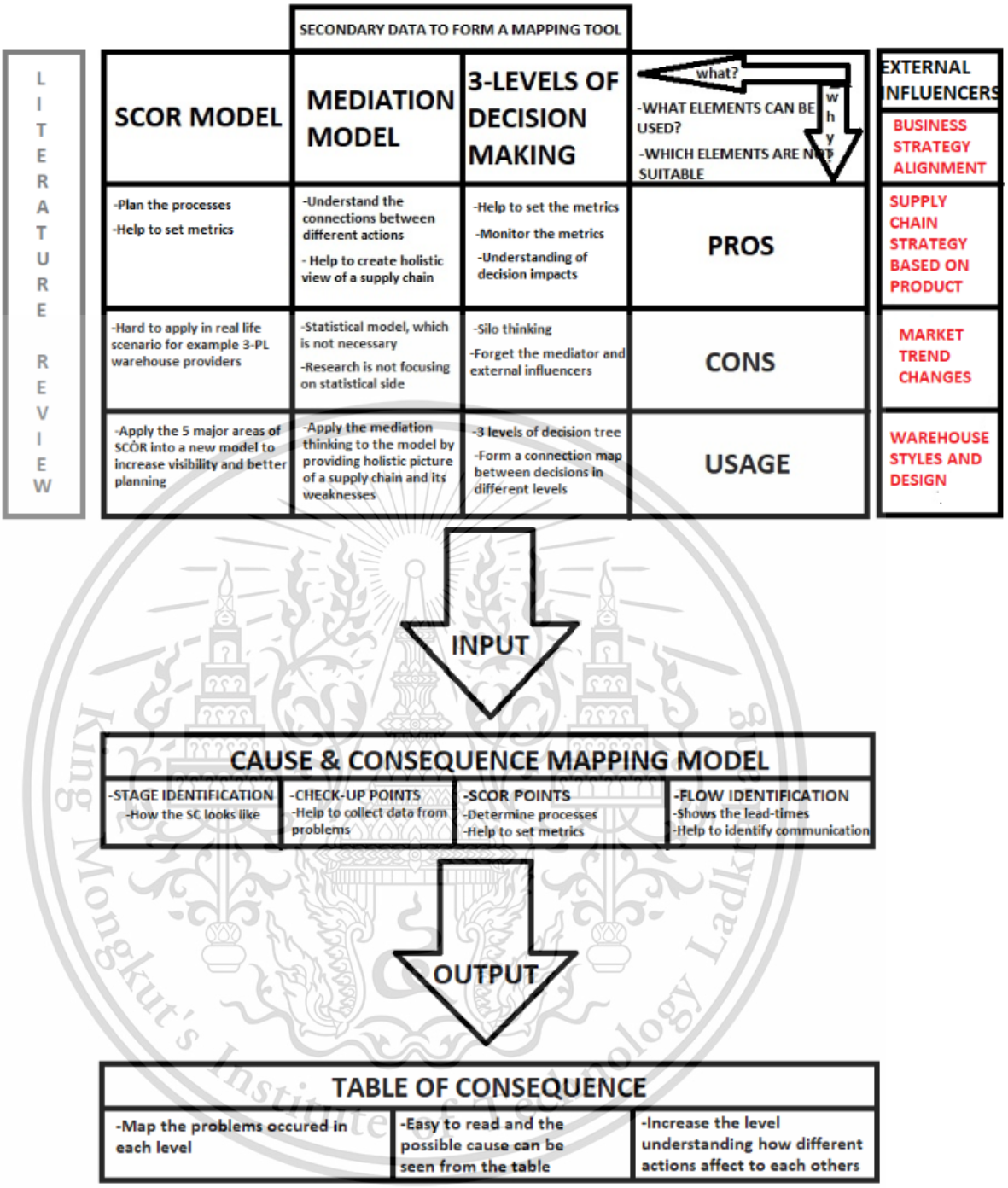

Figure 4.1. Blueprint to CCMM & Table of Consequence

4.3 Applying the Cause & Consequence Model to a warehouse

In order to create a holistic picture of a case study's supply chain, the CCMM was applied into the warehouse by following the steps which were explained in chapter 3.6.2. The wanted outcomes by applying this model to a warehouse are the following:

1. Create simple supply chain map
2. Show and plan the key processes
3. Identify the problems
4. Identify the flow of movement and communication

4.3.1 Stage control

Stages were set into the blank model and the purpose of each stage were identified based on the warehouse point of view: From the warehouse point of view each of the stages were analyzed into the table below:

- Stage 1 = Suppliers
- Stage 2 = Inventory control
- Stage 3 = Production
- Stage 4 = Order controlling
- Stage 5 = End user

Table 4.1 Stage identification

1.SUPPLIERS	2.INVENTORY	3.PRODUCTION	4.ORDERS	5.FEEDBACK
-List of suppliers	-Warehouse style	-List of factories	-AVG. number of movements per week	-Factories are the end users for the spare parts
-Item references	-Warehouse operator	-Which spare part /raw materials	-Deadlines for order placement	-OTIF
-Product information	-Warehouse purpose	-How they handle the cargo	-Correct documentation	-Transportation & securements
-Packing size and handling instructions	-Warehouse capacity & safety stock	-Special shipping requirements	-Special requirements	-Idle time in port
-Quality	-Warehouse design	-How often they place an order	-Customs formalities	-Quality

4.3.2 Flow control

Setting the flow phase by added black arrows inside the model to show flow circulation of the goods. Each stage has different type of flow and in warehousing case the flow will start from the supplier and ending to the factory. To be able to understand the real flow from suppliers to the warehouse and from warehouse to the factories the table must be form to understand the movements and the average lead-times.

Table 4.2 Flow and lead-time identification

INBOUND			OUTBOUND		
SUPPLIER 1	FROM-TO	LEAD-TIME	LEAD-TIME	FROM-TO	FACTORY 1
SUPPLIER 2	FROM-TO	LEAD-TIME	LEAD-TIME	FROM-TO	FACTORY 2
SUPPLIER 3	FROM-TO	LEAD-TIME	LEAD-TIME	FROM-TO	FACTORY 3
SUPPLIER 4	FROM-TO	LEAD-TIME	LEAD-TIME	FROM-TO	FACTORY 4
SUPPLIER 5	FROM-TO	LEAD-TIME	LEAD-TIME	FROM-TO	FACTORY 5
SUPPLIER 6	FROM-TO	LEAD-TIME	LEAD-TIME	FROM-TO	FACTORY 6

Continuing setting up the flow phase by setting up the red arrows to represent flow of data and communication between different stages. Setting the red arrows requires to identify what kind of flow is inside the supply chain and how long does it

take to receive the data. In order to understand the flow, it must be recorded into the table.

Table 4.3 Table of communication and data flow

FROM-TO	DATA TYPE	RESPONSIVNESS (from the receiving party)	DATA ACCURACY
Supplier – Customer	-Packing list	-No data available	-Supplier 5 has 3/5 times incorrect data
Customer – Freight Forwarder	-Order placement	-Typically replies in less than 1h	-Mostly correct
Freight forwarder - Warehouse	-Packing list, Invoice, cargo call-up	-Usually replies within 1-2 days	99% time correct
Warehouse – Freight Forwarder	-Actual packing data	-Typically replies in less than 1h	Most of the times includes mistakes
Warehouse – Factory	-Bill of lading	-No direct communication	-no data available
Freight forwarder – Customs clearance	-Booking order -Shipping documents	-Typically replies in less than 1h	-99% Correct
Customs clearance-factory	-PACKING DATA, BOI, TISI	-Usually replies within 1-2 days	-Mostly correct

4.3.3 Check-up control

Setting up the check-up point was the main step in sense of primary data collection. As a result of applying these steps to a warehouse, the problems were found starting from the operational level, but moving towards to tactical and strategical decisions made to see how these all levels were connected. The data collected by using these check-ups point in the CCMM was afterwards converted into a table of consequence to unify the data and see impact of any decisions. Every and each problem at any stage, at any process has always a reason behind and the reason is 100% of the times cause by a bad decision making.

To collect the data from the check-up points, table for data collection is a must to be set in 3-levels. The data collection in different levels also includes caused by and solved sections, which could be used in many purposes. Cased by and solved steps can be used to analyze the problem-solving skills and effectiveness of the warehouse staff and the managers, but also to keep tracking if the same problem occurs more than once, the problem might be in another decision-making level.

First table shows the operational data collection result from warehouse perspective, second table shows the tactical data collection results from warehouse perspective, third table shows the strategical data collection from warehouse perspective. The tables of each levels below are the summarized results of the data collection. Full data collection tables can be found from Appendix B. From every table below, I have highlighted the rows in different colors. Each color will show the connection in Table of consequence for example yellow highlights are connected to each other's.

Table 4.4 Operational data collection results

Date	Problem	Point of notice	Check point	Execution	Cause to	Caused by	How many times occurred ?
4-28. Jan 19	Tilted pallets	Warehouse	C2	Record the handling process	125% extra work	Changing packing size	4
2017 - 2019	Bad quality	Warehouse	C2	Repacking	Extra work	Lack of inspection, bad supplier	4
2018	Mold & Termites	Warehouse	C2	Fumigation	Extra costs, delay, extra work	Bad securement material, lack of inspection	3
2017 - 2019	Dead stock	Warehouse	C2	-	Cost, Space utilization	Bad demand forecast	3

Table 4.5 Tactical data collection results

Date	Problem	Reason	Affect to stages	Suggestion	Achieved improvements	Check-up point
2019	Packing quality	Changing the packing	S1-S2	Make the packing stronger to allow stacking	Better packing	C2, C3
20017-2019	Bad packing quality	Cheap supplier	S2-S3	Change packing or supplier	-	C2-C3
2018	Bad securement materials	Lack of inspection	S1-S3	Change the operator or material	Japanese material	C2-C4
2017	Demand forecast	Bulk orders	S1-S5	Focus on purchasing	-Nothing happened	C2

Table 4.6 Strategical data collection results.

Date	Problem	Reason	Affect to stages	Suggestion	Impact	Check-up point
2017	Lack of tracking, Lack of inspection	Less inspectors needed	S1-S5	Barcoding start from supplier	Less inspection, Some suppliers follow the barcode some not.	C2
2018	Expensive producer, Lack of quality plan	Expensive supplier, Lack of quality management	S2-S5	Change supplier, Develop quality plan	Cheaper packing, bad packing	C2
2019	Purchase bulk quantities	Bought bulk quantity cheap	S1-S5	Sell,use or destroy the stock	Holding cost, Dead stock, storage cost	C2

4.3.4 SCOR point control

Applying and setting up the SCOR points is the last stage of the CCMM. In this stage the SCOR points must be set into different stages and the answers based on the user's perspective. As mentioned in the chapter 3, this research applies the SCOR points into warehouse perspective. The results of the SCOR model increase the knowledge and offers the deeper understanding to top level management, how the warehouse perspective thinks, works and looks like in actual. The table of the SCOR points below,

identifies the points managers from other levels should be considered if they want to make decisions concerned about warehouse.

Table 4.7 SCOR points applied into warehouse

PLAN	Requirements to run warehouse operations at 250-container per year level: - 4 full time warehouse workers - Trustable and long-term warehouse operator - Good connections to customs - Good connections to shipping lines& transportation providers - Warehouse manager & Supply chain coordinator - Forklift, WMS, Barcode - Continuous training and motivation
SOURCE	Requirements to run warehouse operations at 250-container per year level: -Buy enough material to build safety-stock (3-weeks) -Product quality and loading quality inspections (Increase) -Do not purchase bulk quantities if demand is not certain -Long-term suppliers to commit barcoding
MAKE	Requirements to run warehouse operations at 250-container per year level: -Define all the consignees, lead-times and special loading instructions? -How often they place orders, so the warehouse layout can be modified accordingly? -What do they order and how much? -Lead-time so the safety-stock can be built accordingly
DELIVER	Requirements to run warehouse operations at 250-container per year level:

	-How many consignees overseas and domestically -Customs process and how long it takes? -Long-term transportation service providers for domestic deliveries -Contract with most suitable shipping line
DELIVER RETURN	Requirements to run warehouse operations at 250-container per year level: -How to manage returns? -FTZ & customs rules? -Who's responsibility? -Who will absorb the costs? -How long the process takes?

4.3.5 Table of Consequence mapping

This is the last stage of model which provides the map of the problems found in collected data from checkup points. This is the output of the CCMM data collections, which shows all the problems identified. Sometimes the problem is unknown, but the cause or effect can be identified. By mapping the identified problem, cause or effect into the table of consequence the missing relationship or answer can be studied further if not explained.

Example case 1. Problem is known to be a missing item spotted at operational level. The cause is also identified to be a mistake by supplier and tracked to tactical level to be caused by lack of inspection, but the effect is unknown. The effect can be forecasted to be shortage or just backup order to replace the safety stock, based on the

information from the map control phase. Can help to make strategic decision to fix the problem

Example case 2. Problem is known but the cause and effect are unknown. If the cause and effect cannot be solved by using the flow phase and the existing data, the new entry must be recorded and added to the table of consequence. In some cases, the problem is known but the cause and effect are unknown and there are no similar cases before, the root cause analysis must be done to find the relations if it is caused by another decisions or it is affecting to other decisions or parties. As an example, there is broken items inside the package. The cause and effect are unknown, but can be clarified by using the Stage phase to identify suppliers and transportation operations. Then clarifying the flow phase and the possible problems identified there. Once the information is tracked by using the model, lack of quality inspection can be found to be a reason in tactical level to cause the problem level and the effect to increase operational costs.

Example case 3. Problem and the cause are unknown but the effect is known for example the low warehouse storage utilization percentage. Cause can be solved by going back to flow stage to see if the problem can be spotted from there. In this case it can be seen that the forecasting from customer to warehouse is not available all the time, so the warehouse space cannot be utilized perfectly and the problem can be identified to be lack of forecasting which decrease storage efficiency level. The problem can be identified and linked between Operational-Tactical-and Strategical level since at strategical level the decision not to create a long-term team caused the problem.

Table 4.8 Problem, cause & effect

PROBLEM	CAUSE	EFFECT
Known	Known	Unknown
Known	Unknown	Unknown
Known	Unknown	Known
Unknown	Known	Unknown
Unknown	Unknown	Known
Unknown	Known	Known

The data collected from the check point stage must be applied to form another table and to make the problem identifying easy. Steps and instructions for each level:

1) Operational level: This level mostly shows the effect of the problem from other decision-making levels, since there might be so many external or internal reasons affecting to operational level. Usually if the problem occurs only once or twice in operational level, it might be an individual problem caused by internal operations. These are the operational problems, which can be immediately identified and solved.

IF the problem only occurs once, it can be added to the layer but they do not need to be highlighted at any different color, since they have most likely no impact to any other party or the problem is not caused by any other decision-making level.

IF the same problem at operational level occurs more than once, the problem should be mapped, marked and highlighted into the layer. Most likely it is the effect caused by the problem in decision making at other level or other company. The effects are marked and highlighted at data collection to match the cause of the problem. Same color at different decision-making level shows the connection.

2) Tactical level: This level will include the problems made by tactical level or caused by tactical decisions. Tactical decision is most likely going to affect operational level, but it also has a strong influence to strategic decision making for example wrongly chosen location for warehouse might cause operational problems by affecting workers morale or in loss in profit and competitive advantage by not being able to satisfy customer at the lowest possible costs.

IF problem occur only once, it should be mapped to see if it has effect or cause at any other level in future.

IF the problem at tactical level occurs more than once, most likely the problem is caused by the decision making or the lack of decision making in strategical level, or the tactical decision is not aligned well with operations.

3) Strategical level: This level is the top management level, which get most easily influenced by external factors such as market fluctuations, changing in trends. Decisions made in strategical level will affect to the creation for tactical and operational decisions. If the decision made in strategical level is not well thought, it will most likely have a negative impact at tactical and operational level and it might cause the collapse of the whole company.

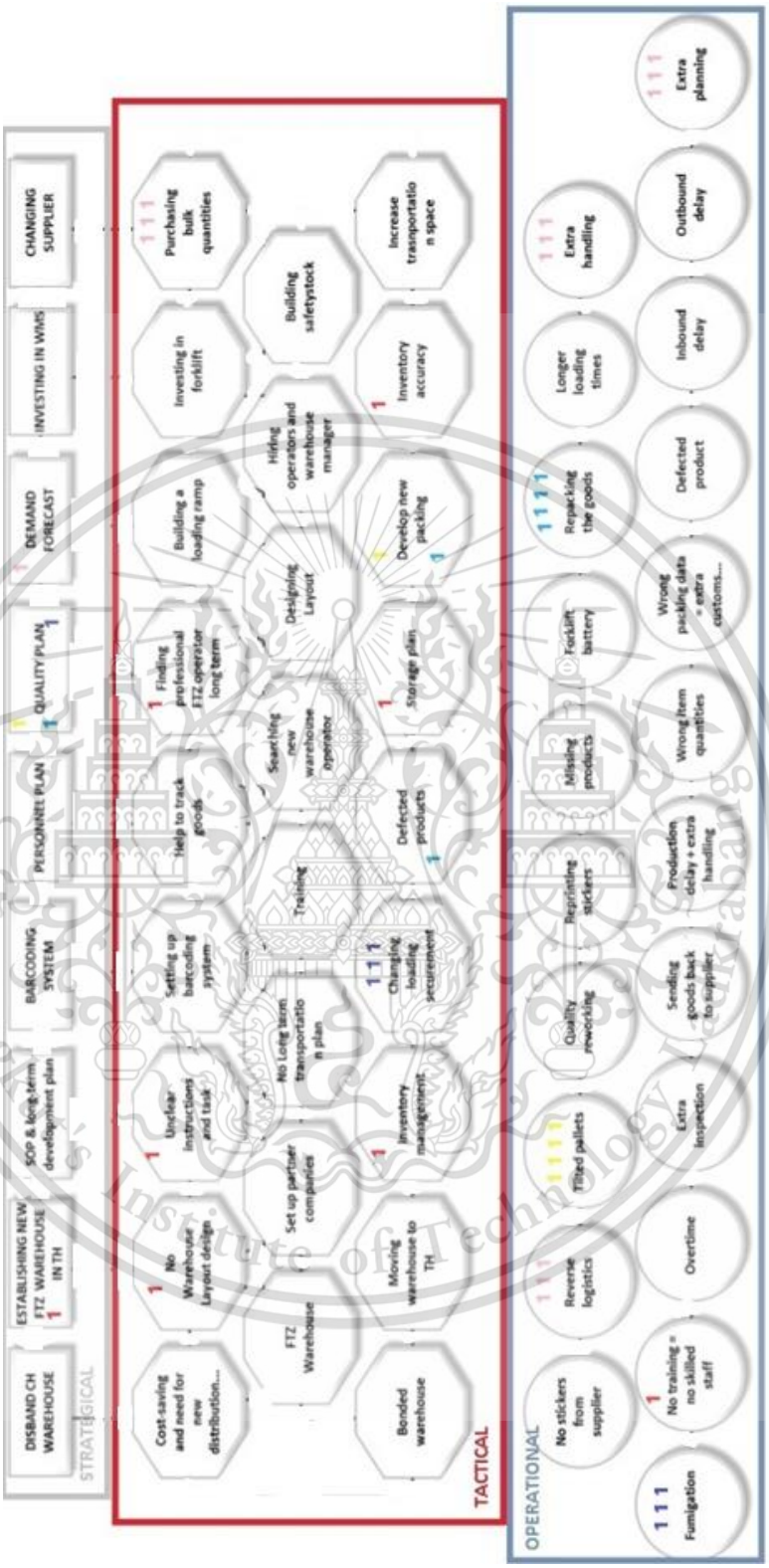

Figure 4.2 Table of Consequence

4.3.6 Table of Consequence calculation

Problems identified and collected by using CCMM are mapped into the table of consequence. Sometimes the problems cannot be connected directly to each levels. On that case the problems should be marked for example using a black color and overtime if the problem occurs more often, the cause and effect can be identified.

As an example: Warehouse and customs clearance have found problems to match the actual stock with customs stock. By collecting the data and mapping it into the Table of Consequence, the author was able to identify the cause of the problem. The cause of the problem was warehouse workers who did not pick according to the shipping packing data, but the customs clearance company deducted the stocks according to the packing data.

All the problems which are affecting to any level directly or indirectly to each other, are marked with same number. If the same number 1 is added many times, it means there has been same problem spotted as many times as the number 1 is added. To read the results the colors and times occurred at any level should be marked down. The most alarming problems has more numbers and it goes through each and every decision-making level.

Example results: (O=Operational level, T=Tactical level, S=Strategical level) x (Affected circles) The weight of the problem should be considered from the level where the same problem occurs most of the times, by analyzing the main problem and the model can find the answer to the problem and show the cause and effect.

1) YELLOW NUMBERS (**O= 4x1**) + (T=1x1) + (S=1x1) total: 6points
    - **Level O** = the effect are tilted pallets and they have cause warehouse to use extra space and effort to handle the pallets.

- Level T = the problem can be found from the new packing development, which has caused the problems at operational level.
- Level S = the cause can be found from the quality plan circle, and the decision made or the lack of decision made in Quality planning is affecting at every level

2) LIGHT BLUE NUMBERS (**O=4x1**) + (T=1x2) + (S=1x1) total: 7 points
   - **Level O** = the effects are repacking the goods, which increase the costs and create waste.
   - Level T = the cause can be found from the new packing development, which has caused the problems at operational level. Also defected products caused by the material supplier has used.
   - Level S = the problem can be found from the quality plan circle, and the decision made or the lack of decision made in Quality planning is affecting at every level
3) DARK BLUE NUMBERS (**O= 3x1**) + (**T= 3x1**) + (S=1x1) = 7 points
   - **Level O** = Fumigation of the containers has been an issue and it have occurred 3 times. This is the effect of other decision making and it delays the unloading and delivery process.
   - **Level T** = the problem can be found from the loading securement, which has caused the problems at operational level. Also defected products cause by the material the supplier has used.
   - Level S = the cause can be found from the quality plan circle, and the decision made or the lack of decision made in Quality planning is affecting at every level
4) RED NUMBERS (O=1x1) + (**T= 1x6**) + (S=1x1) = total 8points

- Level O = Problem seems to be in lack of training at operational level, which can be connected to the decisions in tactical level.
- **Level T** = The most of the problems occurs at this level and they are connected to each other. The main problem causing all problems is the lack of professional long-term FTZ operator, which means there is no effective inventory management nor layout design, storage plan nor controlling plan, and it also affect to the operational level. How to train the staff at operational level, if tactical level has so many problems?
- Level S = The effect can be found from the warehouse establishing plan, maybe the strategic decision of establishing a new warehouse into TH was not suitable, but due to most of the problems occurs and are connected at tactical level, the problem might is suggested to be found from there

5) PINK NUMBERS (O= **3x2**) + (T=3x1) + (S=1x1) total: 10
   - **Level O** = Effect seems to be the increased handling and planning and it has happened often, which means the problem should be found from the tactical or strategical level.
   - Level T = The problem seems to be the purchased bulk quantities which has occurred 3 times at this level. Since it has occurred more than once, the cause might be in strategical level.
   - Level S = The cause can be found from strategical level, which seems to be demand forecast. It might be lack of professional forecasting personnel, lack of suitable tools, lack of long-term planning or anything else. This is suggested to be studied further.

4.4 Overall results

Results collected by using a Cause & Consequence Mapping model and the suggestions based on them will be discussed in this sub chapter. The data can be found from the Appendix A where the model was applied into a case study. The results from the CCMM tables are indicating the same problems what can be found from the collected and applied data in Table of Consequences. The results explained before are suggested to be studied further by the decision-making company.

4.4.1 Stage setting results

From the stage setting of the mapping process, the results show that the quality of supplier S6 & S11 is marked bad. Problem with S6 is the packing quality and with S11 the problem is Defected product.

The warehouse stage 2, the problem seems to be marked as a 3-pl warehouse provider is not experienced to run FTZ warehouse. Also, the warehouse quality indicators show bad in the following sectors: Cleanliness, Warehouse Management & Monthly inventory checkups. Results also indicates the lack of WMS and warehouse layout.

The production stage 3, indicates that factories F1, F2, which are domestic producers have communication problems. F6 & F7 have problems with their last-minute order or late order changes.

Order handling in stage 4 indicates the customs have problems in stock deduction, but also that customs works when ever they feel like working.

Stage 5 indicates only that customer has not set or shared instructions for possible return policy.

4.4.2 Flow control results

The results in flow control looks good except, the communication between warehouse and freight forwarder. The problem with the warehouse management was shown in the warehouse stage setting table, which could be the reason for bad communication.

4.4.3 Check-up control results

This phase was used to collect the primary data from the actual work inside the warehouse. The data was collected and set into three levels, and applied into three different tables. The tables 4.3.3.1 – 4.3.3.3 are the highlights of the problems found during the data collection. Operational level table indicates problems in forecasting, quality inspection and supplier management. Tactical level table indicates same problems with operational level and strategical table indicates the lack of tracking system development, lack of forecasting and supplier changes.

4.4.4 Table of consequences results

After the data was collected and applied to the table of consequence per the highest number of same problems occurred in data collection, the table indicates the following:

Yellow 6 points = the problem occurs 4x in operational level in unloading phase. The effect seems to be from the tactical level in changing packaging but the main cause is the lack of inspection or quality assurance.

Light Blue 7 points = Repacking occurs 4x in operational level and is the effect of the problem in tactical level. The problem is the packing development and defected products caused by the quality plan in strategic level.

Dark Blue 7 points = indicates the problem or/and effect is either in tactical or operational level since both of them got 3 points. The cause is in tactical level effected by lack of quality plan and creating the problem in operational level.

Red 8 points = indicates strongly that the problems are occurring in tactical level which are the effects of the operational level and completely caused by strategical decision.

Pink 10 points = indicates that effect of the possible problem is affecting strongly in operational level. The problem can be found from the tactical level and the cause of the problem from the strategical level.

The results indicate the cause of the problems to be found from demand forecasting strategy, warehouse establishment planning and quality strategy planning. The decisions from strategic level are causing the problems in tactical level which can be seen in the operational level. Based on the model, each person what ever level can use this map to add the problem there and try to identify why it is occurring.

4.5 Model Validation

The author created the Cause and Consequence Mapping Model to help in controlling the warehouse management objectives by stating the problems about communication and actions of the other parties. In wider perspective using the warehouse management system will only show the operations and actions inside the warehouse, without focusing on the cause and effects of the other level decisions to warehouse. By applying the model into a warehouse, especially into 3-pl warehouse where the subcontracting party has no influence to change the processes can increase level of understanding between different parties.

4.5.1 Model testing

One step of the model validation was to valuate if the model is actually working and valuable in practice. The model was tested in practice, whether this methodology could provide practical help in supply chain from the warehouse perspective. The following questions were set to test the model designed by Adesola & Baines, 2000.

1) Could the methodology be used in practice?
2) Are there any problems or difficulties with the method?
3) Are the results worth the effort and are they useful to the host organization?

After the author created the model based on the problems found throughout the empirical investigation in different warehouses and especially the problems in 3PL warehouse management, the model proved itself useful and was able to answer to the questions above.

By using the model, the author was able to locate the problems in communication between different parties as well the problems in operations and

warehouse management, which could not be seen by using any warehouse management system.

The results can be used to suggest and educate 3PL service provider to change their processes or focus on their weakest processes, in which they would not waste resources normally. Results of the model can be used as well to improve communication between different parties and to track the problems caused by any party at any level.

4.5.2 External analysis

Model was not only tested and reviewed by the author of this research, but also by the external parties. Before the model was able to be tested by the external personnel, the author prepared the introduction, information and structured walk-through to the test personnel. Explaining the model to another person can make the modeler focus on different aspects of the model and the structured walkthrough was suggested to be done as a part of validation process by Hillston, 2003. *"Even if the listeners do not understand the details of the model, or the system, the developer may become aware of bugs simply by studying the model carefully and trying to explain how it works."* (J. Hillston, 2003).

The model testing and validation based on the review from the external party, and the feedback can be found from the Appendix B. The model testing and review was done by a person from the supply chain of a case study. The other person who tested and reviewed the model was completely external person who applied it for different industry. The appendix B will only show the written answers to the model testing questions set by the author of this research. Few of the answers can be seen below, and the rest from the Appendix B.

1. Do you consider the Cause& Consequence mapping model was useful to create and understand wider picture of the supply chain processes and if yes, please explain how?

   "A bit difficult question but in overall cause & consequence mapping is useful, not only in Supply Chain but in all other functions and business as well. Cause & consequence mapping helps to find out real root causes that helps to solve the real problems and/or weaknesses."

2. Do you think this model could help different parties to understand each other's and set S&OP and metrics to work more efficiently together and if yes, please explain why?

   "Sure, it helps. Clear process and same way of working helps all parties to estimate, execute and plan the end 2 end processes. Future S&OP process should focus also for financial issues, not only material-based issues and this cause & consequence mapping help the take steps for that direction."

3. How do you think this model could help in understanding and identifying the flow of the communication and data?

   "The model is continuously collecting data, checking what are the problems in each level and provide the traceability data for making logical decisions and solution simple."

4. Do you consider this tool could be helpful to solve problems and understand the relationship between different actions?

"Yes, the core concept of the model provides a strong foundation for users to understand the overall picture from the communication between each channel."

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

In this chapter the discussion will be in the summary of findings, conclusion and recommendations and also suggestions for the future research based on the data presented in previous chapters.

5.1 Summary

This study is a Qualitative study using an exploratory research method and was designed to investigate the problem in communication and operations from the warehouse management perspective. Understanding and identifying supply chain as strong as its weakest link is, help companies to get motivated to understand each other's actions. By forming a mapping model to help companies to understand the supply chain from the wider perspective by decreasing the silo thinking can be a huge increasement for the total supply chain or logistic efficiency.

Lack of motivation and the fear of wasting resources are one of the stepping stones for the third-party logistics service providers. By creating and applying a simple tool based on their daily operations, valuable data can be collected. This data can be used to enlighten the 3PL companies and help them to improve their processes and communication between the contractor and other parties, without consuming their resources and time.

Understanding the external factors and supply chain drivers together with strategies will help managers to form a holistic and anticipatory view of the supply chain operations. Applying Cause & Consequence Mapping Model tool into target improvement in supply chain, can easily be used to identify key problems and help to find solutions for them.

5.2 Conclusion

Based on the results: suppliers #6 and #11 are performing weakest. The results also indicate that the factories #1 and #2 have problems in communication. Other findings suggest that 3PL warehouse service provider is not enough experienced to manage their FTZ warehousing operations based on their bad performance in many categories.

The results also indicate, that the weakest communication was identified to be from the 3PL warehouse end with other parties together with their incapability in order handling and the customs export/import entry documentation.

Table of consequence suggest the biggest cause for the problems and their effects can be found from both strategical and tactical level. In strategical level the Quality Strategy, Warehouse implementation and Forecast strategy are suggested to be studied further. In tactical level storage plan, warehouse layout and service provider are suggested to be studied further.

Model was tested by 2 external personnel and the feedback was mainly positive and they would recommend the model to be used, but also studied further.

5.3 Delimitation of the study

The present study is limited to focus on communications in the supply chain process improvement from the warehouse management perspective. It focuses on Cause-Effect relationship in 3-decision making levels based on warehouse operations and it was designed to help 3PL logistic service providers and overseas agents to understand the importance of their own and the other actions.

Primary data collection was done inside the 3PL warehouse on daily basis and the supportive data collection was done throughout the several different warehouses and their problems as well as the problems mentioned in literature review.

The study does not reveal any real-life connections such as names of the different companies in a presented supply chain. Collected data will neither expose any of the parties in supply chain where the model was applied.

5.4 Suggestions for the future research

Based on model building process, background research and implementation, the author can validate the model to be 100% working for the company where it was applied. Nonetheless, the feedback from the test users indicates the model can be successfully used in different situations, positions and companies. To consider future research, the CCMM can be helpful in solving supply chain and communication-based problems from warehouse perspective, but it could be helpful in other fields of business.

The author of this study recommends to apply and study this model further to find out its maximum potential as a confirmed and validated tool for management level. It can be used to collect big data, by applying it into many companies in a company's supply chain or internal supply chain between the departments to improve internal or external processes.

It is highly suggested to study deeper into internal and external influencers when applying the model to perceive the level of knowledge of what can happen even the model would show the correct information or how is there any intermediator, which the model cannot identify. Also, once the model is applied and data collected, the results are only the trendsetters, which implicates the companies should discuss and study the problem points deeper without making a permanent decision based on the results. The

research and its statements shall be inspected and studied further before making any decisions based only on the data presented on this study.

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APPENDIX A

1.APPLYING THE MODEL INTO CASE STUDY

1.1 SET STAGES AND FILL UP THE TABLE

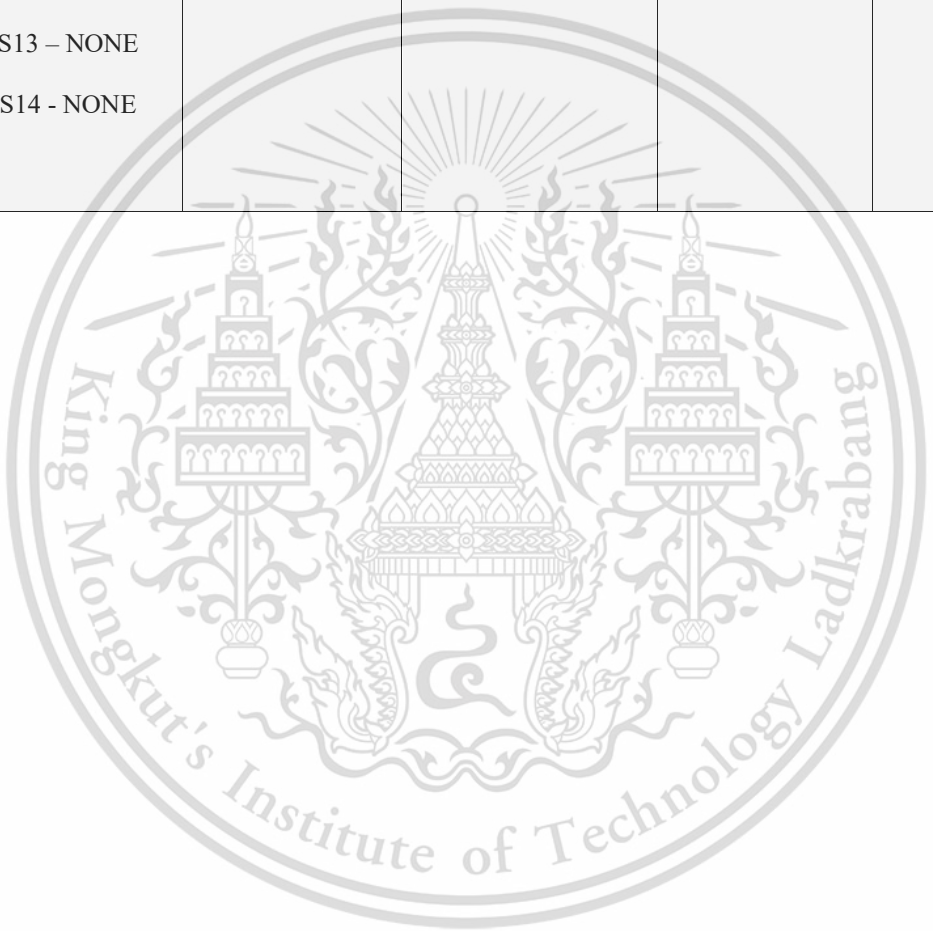
- Stage 1 = Suppliers
- Stage 2 = Warehouse
- Stage 3 = Production
- Stage 4 = Order control
- Stage 5 = End user

STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5
SUPPLIER INFO: CHINA: S1 - ANODE S2 - HEATER S3 - CABLE S4 - CABLE S5 - METER S6 - THERMOMETER S7 - THERMOSTAT S8 - COMPRESSOR S9 – ELECTRONICS	WAREHOUSE STYLE: -FREE TRADE ZONE WAREHOUSE -3-PL OPERATOR: NOT EXPERIENCED -BUILD SAFETY STOCK: BASED ON LEAD TIME -FEEDER UNIT:	FACTORY INFORMATION: THAILAND: F1 – S3, S8, S9 F2 - S13, S10, S11, S14 F3 – NONE FRANCE: F4 – ALL F5 – ALL UKRAINE: F6 – ALL	ORDER HANDLING: -AVG # of movements per week IN: 3x 20’ 2x 40’ -AVG# of movements per week OUT: 1-3x 6wheel truck 1-2x 10wheel truck 1-3x 20’ 1-2x 40’	CUSTOMER: - RETURNING POLICY: NO -ORDER PLACEMENT: DECENT - MOVEMENT FORECAST: DECENT

VIETNAM: S10 - STEELPIPES S11 – ELECTRONICS MALAYSIA: S12 - COMPRESSOR S13 – STEELPIPES HONGKONG: S14 - COVERS	LOCAL FACTORIES -CAPACITY 1500sqm (1200plts)	EGYPT: F7 – ALL GEORGIA: F8 – ALL SLOVENIA: F9 – S10, S5		
QUALITY: S1 - EXCELLENT S2 - GOOD S3 - GOOD S4 - GOOD S5 - OK S6 - BAD S7 - EXCELLENT S8 - OK S9 - OK S10 - GOOD S11 - BAD S12 - OK	WAREHOUSE QUALITY: -PICKING: GOOD -SAFETY: OK -CLEANLINESS: BAD -SKILLED LABOR: OK	FACTORY QUALITY: F1 – BAD COMMUNICATION F2 – BAD COMMUNICATION F3 – NONE F4 – OK F5 – OK F6 – LAST MINUTE ORDERS	ORDER QUALITY: -CUSTOMS CLEARANCE: 2DAYS -CARGO PREPARATION : 2DAYS -DOCUMENT AMENDMENT BEFORE: 1DAY	

S13 - GOOD S14 – GOOD	-MGMT: BAD -FORKLIFT : GOOD -MONTHLY CHECKUPS: BAD -LOADING: EXCELLENT -UNLOADING EXCELLENT	F7 – CHANGING ORDER QUANTITIES F8 – OK F9 – AIRFREIGHT	-DOCUMENT AMENDMENT AFTER: 1+ MONTH -FINAL PACKING DATA AND ORDER PLACEMENT: 2DAYS BEFORE DELIVERY	
PROBLEMATIC ITEMS: S1- NONE S2 - NONE S3 - NONE S4 - NONE S5 – wrong item refs S6 – BAD PACKING S7- NONE S8 – low packing quality	WAREHOUSE DEFICIENCY: -NO WMS -NO CONTINOUS STOCK CHECKUP -LACK OF PROFESSIONA L LAYOUT	HOW OFTEN PLACE ORDER: F1 – WEEKLY F2 – WEEKLY F3 – NONE F4 – 2x month F5 – 2x month F6 – 3x month F7 – 2x month F8 – 2x month F9 – 1x 2months	ORDER PROBLEMS: -LATE ORDERING: RUSH PREPARATION -CUSTOMS: PROBLEM TO DEDUCT STOCK	

S9 – Low packing quality S10 - NONE S11- defected products, wrong barcodes, wrong PO# S12 – NONE S13 – NONE S14 - NONE			-CUSTOMS: WORK WHENEVER THEY FEEL LIKE	



1.2 SET FLOW CONTROL

To keep building holistic view, the flow must be identified and mapped. It might be helpful in future when solving a problems or communication efficiency.

INBOUND			OUTBOUND		
S1	NINGBO - LCB	3weeks	2HOURS	LCB - RAYONG	F1
S2	NINGBO - LCB	3weeks	2HOURS	LCB - RAYONG	F2
S3	SHEKOU - LCB	2weeks	2HOURS	LCB - RAYONG	F3
S4	SHEKOU - LCB	2weeks	4WEEKS	LCB – MONTOIR	F4
S5	SHEKOU - LCB	2weeks	5WEEKS	LCB – LE HAVRE	F5
S6	SHANGHAI - LCB	4weeks	5WEEKS	LCB - ODESSA	F6
S7	SHANGHAI - LCB	4weeks	5WEEKS	LCB - ALEXANDRIA	F7
S8	NIGNBO - LCB	3weeks	5WEEKS	LCB - POTI	F8
S9	SHEKOU - LCB	2weeks	3 DAYS	LCB - LJUBJLANA	F9
S10	Hai Phong - LCB	3weeks			
S11	Hai Phong - LCB	3weeks			
S12	KLM -LCB	2weeks			
S13	KLM -LCB	2weeks			
S14	HNKG - LCB	2weeks			

FROM-TO	DATA TYPE	RESPONSIVNESS (from the receiving party)	DATA ACCURACY	AVG RATE OF COMMUNICATION

Supplier - Customer	-Packing list	-No data available	-Supplier 5 has 3/5 times incorrect data	-NO DATA AVAILABLE
Customer – Freight forwarder	-Order placement	-Typically replies in less than 1h	-Mostly correct	-GOOD
Freight forwarder - Warehouse	-Packing list, Invoice, cargo call-up	-Usually replies within 1-2 days	99% time correct	-GOOD
Warehouse – Freight forwarder	-Actual packing data	-Takes long time to reply	Most of the times includes mistakes	-BAD
Warehouse - Factory	-Bill of lading	-No direct communication	-no data available	-NO DIRECT COMMUNICATION
Freight forwarder – Customs clearance	-Booking order -Shipping documents	-Typically replies in less than 1h	-90% Correct	- GOOD
Customs clearance- factory	-PACKING DATA, BOI, TISI	-Usually replies within 1-2 days	-Mostly correct	-GOOD

1.3 Check-up control

Setting up the check-up point was the main step in sense of primary data collection. As a result of applying these steps to a warehouse, the problems were found starting from the operational level, but moving towards to tactical and strategical decisions made to see how these all levels were connected. Full tables of data collection by using CCMM

Date	Problem	Point of notice	CHECK POINT	Execution	Cause to	Caused by
15.6.2017	7pcs of anodes	Distribution center	C2	Send back to supplier	Shortage	Supplier production mistake
2017-2019	Dead stock	Distribution center	C2	-	Space utilization	Bulk order quantities
28.6.2017	Missing stickers	Distribution center	C2	Print new stickers	Waste of time	Supplier forgot to label pallets
28.6.2017	3500pcs of Steel pipes	Distribution center	C2	Insurance inspector	Must deliver low quality products	Bad transportation/ lack of lashing
11.11.2017	Whole warehouse	Distribution center	C2	New layout	Lack of storage space	Bad warehouse layout
15.10.2017	200pcs of cables	Distribution center	C2	Repacking	increased workload	Lack of inspection, lack of management, bulk order quantity
3.12.2017	600pcs of cables	Distribution center	C2	Repacking	increased workload	
3.2.2018	600pcs of cables	Distribution center	C2	Repacking	increased workload	
10.4.2018	Missing items	Distribution center	C2	Redoing customs clearance	Extra costs, delay in shipping	Lack of inspection, Careless loading from supplier's end
14.4.2018	Wrong item quantities	Distribution center	C2	Redoing customs clearance	Extra costs, delay in shipping	Mistake's in documentation
6.5.2018	320pcs of compressor	Distribution center	C2	Reverse logistics	Extra handling, storage, shipping costs +	Suppliers

					Production delay	
27.5.2018	10 pallets	Order placement	C2	No execution	Useless barcoding	Lack of information in barcoding
8.6.2018	13pcs ceramics	Distribution center	C2	Send Q inspector	Replacement, extra packing and handling	Bad production from supplier's end
19.6.18	10ctns	TH FACTORY	C3	Double transportation	Missing ctns	Careless cargo handling and loading at warehouse
10.7.2018	FULL CONTAINER of Anode	Distribution center	C2	FUMIGATION/ JAPANESE WOOD	increased workload/ Costs / Delay in delivery	Using molded packing material / securements
11.7.2018	2 CONTAINERS of Anode	Distribution center	C2	FUMIGATION/ JAPANESE WOOD	increased workload/ Costs / Delay in delivery	Using molded packing material / securements
12.7.18	10pcs ceramics	Distribution center	C2	Repacking / sneaking	Problems with customs	Bad quality inspection, handling at supplier's end
6.9.2018	Thousands of PCB	EU factory	C5	Reverse logistics	Extra handling, storage, shipping costs + Production delay	Suppliers bad quality
20.9.2018	Thousands of PCB	Distribution center	C2	Rework at FTZ	Items cannot be used	Suppliers supplier bad quality

1.10.2018	1 container of compressor	Distribution center	C2	FUMIGATION	Delay in delivery, extra costs, extra handling	Wet container securement
3.12.2018	20plts of PCB	TH FACTORY	C6	REPRINTING	REPRINTING BARCODES	WRONG STICKERS PRINTED BY SUPPLIER
4.1.2019	24/26plts of ceramics	Distribution center	C2	Photo report	125% increased workload	New packing material and size, not strong enough, tilted pallets
16.1.2019	23/26plts of ceramics	Distribution center	C2	Photo report	125% increased workload	New packing material and size, not strong enough, tilted pallets
22.1.2019	18/26plts of ceramics	Distribution center	C2	Photo report	125% increased workload	New packing material and size, not strong enough, tilted pallets
28.1.2019	25/26plts of ceramics	Distribution center	C2	Photo report	125% increased workload	New packing material and size, not strong enough, tilted pallets

Date of planning	**Problem**	**Reason**	**Effect to**	**Timeline for**	**Suggestion**	**Improvement**	**Checkup**	**Stage**

			different levels	**implementation**			**point**	
5.2017	Lack of cargo tracking	No tracking for the goods	S1, S2, S3, S4, S5	6months	Barcode scanning system	Increase visibility and decrease the workload	C1-C6	S1-S5
7.2017	Lack of cargo handling tools	No forklift available all the time	S2, S3	1month	Buy another forklift	Increase the loading efficiency and deliver time accuracy	C3	S2-S3
9.2017	Lack of communication	Lack of clear instructions, whose job is what	S2-S5	Immediate	Development meetings/ mapping the problems/SOP	Talking	C2-C5	S2-S5

9.2017	Loading trucks by not using the maximum capacity, because the loading takes 10minutes longer if the space is maximized.	Wasting transportation space + increasing costs for domestic deliveries	Affect to S2,S3,S4,S5 by increasing costs	before next domestic delivery	Enhance transportation planning	Cutting haulage costs by 30%	C2 & C3	S2 - S3
11.2017	Warehouse operator's financial problem	Unknown	S1,S2,S3,S4,S5	Immediate change	Search new operator immediately	Reliability	C1-C6	S5
11.2017	Warehouse layout design	Lack of communication	S1-S5	2 months	Calculate and find optimal warehouse capacity	Increased storage space	C2-C3	S1 - S5
1.2018	Lack of operators	Increased workload	Affect to S3,S4 by increasing lead	Hiring more operators asap	Hiring interns hips for 3-	decrease the workload	C2-C3	S2

			times due to too much workload		6months			
4.2018	Lack of operators	Increased workload	Affect to S3, S4 by increasing lead times due to too much workload	Hiring more operators asap	Hiring 2 warehouse operators	decrease the workload	C2-C3	S2
2017-2018	Lack of inspection	Bad quality products, packing	S1-S3	-	Hire regional quality manager	-	C2-C4	
4.2018	Need for container lift on/off	Expensive cargo loading costs	S2, S5	within 2 months	Building a loading ramp	decreasing costs	C1 & C2	S2

5.2018	Lack of inventory control	Discrepancies, shortage	Affecting to S3, S4, S5, S	1month	Hire warehouse manager or establish WMS	No improvement	C2 & C3	S2
6.2018	Lack of management	Lack of planning	Affect to S1, S2, S3, S4, S5 by increasing costs,	Immediate	hiring warehouse manager	decrease the workload	C2 & C3	S2
7.2018	Loading material problem	Bad securement	Affect to S1, S2, S3, S4	Immediate	Finding new securement vendor	No need for fumigation	C1, C2, C3	S1, S2, S3
8.2018	WMS Discrepancies	Lack of motivation & skilled worker	Affect to S2-S4	1month	Change workers, change warehouse operator	No improvement	C2 & C5	S2

9.2018	Bad Supplier's supplier selection	Bad quality pcb / defected products	Affect to S1-S5	12.2018-3.2019	Rework in FTZ Thailand	Cheapest option	C1 &C3	S1 - S3
11.2018	Transportation company's change	Lack of 10wheeler trucks for domestic delivery	Affect so S2, S3, S4	1month	Make a contract with transportation service provider	No improvement	C3	S2 , S3 ,S4
1.2019	Bad implementation of new packing size	Unstable pallet stacks / tilted pallets	S2-S3	No timeframe	Stronger packing	Saving 50% in shipping costs	C1-C3	S2 - S3

Time frame	**What**	**Purpose**	**Requirement**	**Implementation**	**Input**	**Output**	**Impact**	**Evaluation (after implementation)**	**Affect to level**

Planning: Summer 2016 - Spring 2017	Establish new distribution center	**1)**Build safety stock **2)** Support domestic factors **3)** Consolidating of goods **4)** Support overseas factories 5) Closing CH warehouse	**1)** Suitable location **2)** Suitable warehouse style **3)** Suitable logistics service providers	Spring 2017	**1)** Sourcing and searching suitable partners & 3pl-warehousing **2)** Implementation costs **3)** Hiring new workers **4)** Set the instructions based on the needs	**1)** FTZ warehouse **2)** Enough storage space but not highly utilized space **3)** 3-Pl warehouse provider **4)** No warehouse management system	**1)** Allow to build safe stocks based on the lead times **2)** Support domestic factories and cutting their inventory holding and storage costs **3)** Consolidate goods	**1)** Safety stock building **2)** Ability to support factories **3)** Bad 3-pl warehouse provider **4)** FTZ warehouse style was suitable	S1-S4

							4) Import tax exemption **5)** Improved production scheduling and reliability		
Planning: Summer 2016 - Spring 2017	Barcoding system	**1)** Track cargo **2)** Increase visibility **3)** Keep track what is inside the warehouse **4)** Quality & quantity tracking	**1)** Suitable barcoding style **2)** Suitable barcoding equipment **3)** Training staff	Spring 2017	**1)** Hours of training **2)** Sticker formation and quality inspection **3)** Studying barcoding **4)**	**1)** Workable barcoding system **2)** Each product has to be labelled and scanned **3)**	**1)** Improved tracking system **2)** Need 1 person to scan + 1 to print stickers due to silo	**1)** Barcode does not provide enough data **2)** It is not connected to any WMS or ERP system **3)** It cannot be	S1-S4

					Choosing the most suitable barcoding style **5)** Negotiate supplier s start the barcoding chain	Each product number and workweek recorded into system **4)** All movements in/out recorded	thinking	tracked via any app **4)** Input-Output = negative impact	
Summer 2017	Demand forecasting	1) Forecasting demand 2) Bulk purchase	1) Negotiation of long-term supplier contract	Summer 2017	1) Negotiations 2) Contract with supplier	1) Bulk production and bulk order placements	1) Burden to warehouse capacity	1) Deadstock	S2, S4

Autumn 2017	Closing CH warehouse	**1)** Move the cargo to TH warehouse **2)** Save in costs **3)** Closer to factory and big port facility	**1)**FTZ **2)** Overseas agent **3)** Freight forwarder **4)** Customs clearance **5)** 3-Pl warehouse operator	Autumn 2017	**1)** Waive the contract **2)** Move the goods out to another FTZ **3)** Clear with customs **4)** Arrange the transportation	**1)** Moving to FTZ warehouse overseas	**1)** Increased transportation and costs **2)** Closer safety stocks for factories **3)** Allowed consolidation **4)** Lower inventory holding costs at factories **5)** Faster distrib	**1)** Cost saving **2)** Centralized warehouse and consolidation operations in future	S1-S3

							ution and consolidation		
Autumn 2017	Moving to another FTZ Warehouse	**1)** To minimize possible upcoming problems **2)** Warehouse service provider had financial problems	**1)** Searching new provider **2)** FTZ warehouse **3)** Arrange customs clearance and permission to move the goods to another FTZ **4)**	Autumn 2017	**1)** Movement of goods **2)** Movement of staff **3)** Customs formalities **4)** Contract creation **5)** New Layout design	**1)** Goods moved **2)** Operations running **3)** Customs stock fixed **4)** Long-term contract	**1)** Layout design problems **2)** WMS development	**1)** Long-term warehousing **2)** Warehouse Layout design fail **3)** WMS fail	S2, S3, S4

			Transportation						
2018	New supplier	**1)** Cheaper **2)** Better quality **3)** Better packing quality **4)** On time in full **5)** Increased demand	**1)** Negotiation and terms **2)** QA **3)** Product testing **4)** Background checking	Autumn 2018	**1)** Hours of Negotiation **2)** Hiring new QA/QC **3)** Help in design process	**1)** Efficient packing **2)** Saving in transportation costs	**1)** Warehouse complains because of the bad packing quality **2)** Dangerous tilted and stacked pallets to handle	**1)** Cost-effective **2)** Bad implementation **3)** Bad packing might cause accidents or broken items	S2, S3

2018	Investing in WMS	**1)** Accurate inventory **2)** Effective planning **3)** On time **4)** Long term convertibility to SAP	**1)** Capital investment **2)** Training **3)** Searching, testing and developing **4)** Man hours	Summer 2018	**1)** Money **2)** Data **3)** Time **4)** Consultation	**1)** Half developed system **2)** Inaccurate data **3)** Cannot be connected with barcode	**1)** Time saving tool **2)** Accurate data **3)** Helping to plan and calculate **4)** Efficient layout	**1)** Waste of time **2)** Decreasing working moral **3)** Bad communication **4)** Waste of money and energy	S2, S4

1.4 SCOR point control

Applying and setting up the SCOR points is the last stage of the CCMM. In this stage the SCOR points must be set into different stages and the answers based on the user's perspective. Once the SCOR points are set, the questions will be asked and used to form S&OP.

PLAN	Requirements to run warehouse operations at 250-container per year level: - 4 full time warehouse workers - Trustable and long-term warehouse operator - Good connections to customs - Good connections to shipping lines& transportation providers - Warehouse manager & Supply chain coordinator - Forklift, WMS, Barcode

	- Continuous training and motivation
SOURCE	Requirements to run warehouse operations at 250-container per year level: -Buy enough material to build safety-stock (3-weeks) = Normally works -Product quality and loading quality inspections (Increase) = Lack of quality inspection -Do not purchase bulk quantities if demand is not certain = deadstock -Long-term suppliers to commit barcoding = Some
MAKE	Requirements to run warehouse operations at 250-container per year level: -Define all the consignees, lead-times and special loading instructions? = F2 everything with lashing, F5 height 1.4max -How often they place orders, so the warehouse layout can be modified accordingly? = Layout modified by item stacking -What do they order and how much? = depends -Lead-time so the safety-stock can be built accordingly = done
DELIVER	Requirements to run warehouse operations at 250-container per year level: -How many consignees overseas and domestically = 3+6 -Customs process and how long it takes? = 2-3 days -Long-term transportation service providers for domestic deliveries = 1 company -Contract with most suitable shipping line = Freight forwarder Negotiated

DELIVER **RETURN**	Requirements to run warehouse operations at 250-container per year level: -How to manage returns? = No feedback -FTZ & customs rules? = Everything through customs -Who's responsibility? = Record & report -Who will absorb the costs? = Insurance & depends on the case -How long the process takes? = 1-6months

APPENDIX B

MODEL TESTING QUESTIONS (personnel A)

1. What is your name and academical background?

   Name: S. Kwok
   Academic background:
   - **Bachelor's degree in Animation**
   - **Professional Diploma in Business Logistics Management**

2. In which level are you working at or most familiar with (Operational, Tactical or Strategical)?
   Operation

3. How do you consider the importance of understanding other parties in supply chain and the effect of their actions to each other's?
   Today's supply chain becomes more and more about collaboration between each party according to Christophe Roussel (Executive Vice President of International Sourcing and Production for Gap Inc).

   To collaborate meaning integration, which cannot be done well without understanding. In my opinion, knowing each party's role in the supply chain is definitely one of the most important elements and also the foundation of a good SCM, if we understand each other fairly, there must also be chances to enhance the efficiency in communication and procedure substantially.

4. Do you consider the Cause& Consequence mapping model was useful to create and understand wider picture of the supply chain processes and if yes, please explain how?
   Yes. The value of the Cause & Consequence mapping model is keeping efficient communication which gives you information. And the data through these connections in the Cause& Consequence mapping can not only be reviewed for every each of the next move for now, but ultimately it will be the knowledge for machine learning that helps us to improve demand forecasting accuracy in the smart supply chain.

   Lastly a good reminder from Sam, "Information is power, and the gain you get from empowering your associates more than offsets the risk of informing your competitor."

5. How do you think this model could help in understanding and identifying the flow of the communication and data?
   The model is continuously collecting data, checking what are the problems in each level and provide the traceability data for making logical decisions and solution simple.

6. Do you think this model could help different parties to understand each other's and set S&OP and metrics to work more efficiently together and if yes, please explain why?
   Yes, I'm fascinated and loving the simplicity of the model. As mention previously, information gives us the power and chances to improve. The design of understanding each party with a seamless communication channel (which provides checking points and data collection) enable the value-based management to optimize the overall business result.

7. Do you think this model could be useful to gather big data from the different parties in supply chain and use it to design operations and processes more efficiently?
   The idea and base are definitely there; however, there should be supportive software to assist and organize the data.

8. How do you consider the importance of the data collection and identifying the problem, cause and effect?
   Data collection is definitely one of the hottest and most valuable commodities for modern businesses; however, it is also very tricky. Data is what the information can be provided, but only knowing how to use it can allow us to identify the problems and gain more profound insights from it.

   In business, we humans tend to use data to understand the correlation, whereas it is known, "correlation does not mean causation." The reason is we live in a world based on humanity, which is far more complicated and the dependency between A and B does not imply that A causes B or that B causes A.

   I agree cause and effect are working for today, but it is not what will help us moving forward. And maybe with the help from technological phenomenon like artificial intelligence (AI), it could assist us in digging deeper into the data, considering other evidence, and in adapting, adjust and agile.

9. Do you consider this tool could be helpful to solve problems and understand the relationship between different actions?
   Yes, the core concept of the model provides a strong foundation for users to understand the overall picture from the communication between each channel.

10. How hard understanding and using the tool is and is it worth to be studied further?
    Medium, and yes, it's worth to be studied further.

11. Would you use or recommend the model to be used as a daily operation as a data collection method?
    Yes.

12. Do you think the model is working and you can validate it?

I believe in the design but what defines the workability will be the users.

MODEL TESTING QUESTIONS (personnel B)

1. **What is your name and academical background?**

My name is T. Tuukkanen. I am working as a Facility & Security Engineer. I have BBA education.

2. **In which level are you working at or most familiar with (Operational, Tactical or Strategical)?**

I am mainly working in operational activities.

3. **How do you consider the importance of understanding other parties in supply chain and the effect of their actions to each other's?**

Common and overall understanding of all supply chain functions is the key for success. In the world the trend is to move from local supply chain to international end to end supply chain.

4. **Do you consider the Cause& Consequence mapping model was useful to create and understand wider picture of the supply chain processes and if yes, please explain how?**

A bit difficult question but in overall cause & consequence mapping is useful, not only in Supply Chain but in all other functions and business as well. Cause & consequence mapping helps to find out real root causes that helps to solve the real problems and/or weaknesses.

5. **How do you think this model could help in understanding and identifying the flow of the communication and data?**

It is clear that better and deeper understanding of cause & consequences helps communication and data flow mainly because of larger and more specific understanding strengths and weaknesses.

6. **Do you think this model could help different parties to understand each other's and set S&OP and metrics to work more efficiently together and if yes, please explain why?**

Sure, it helps. Clear process and same way of working helps all parties to estimate, execute and plan the end 2 end processes. Future S&OP process should focus also for financial issues, not only material-based issues and this cause & consequence mapping help the take steps for that direction.

7. **Do you think this model could be useful to gather big data from the different parties in supply chain and use it to design operations and processes more efficiently?**

I would say that the main idea of this is just to collect the data from the different parties and use the data for better, precise and efficient planning of the operational activities.

8. **How do you consider the importance of the data collection and identifying the problem, cause and effect?**

Data collection is the key for planning. Too many times planning is not accurate because of different numbers in different part of function or chain. One set of numbers and data is the key for success.

9. **Do you consider this tool could be helpful to solve problems and understand the relationship between different actions?**

As I understand this is the main idea of creating this tool so definitely it will be helpful.

10. **How hard understanding and using the tool is and is it worth to be studied further?**

Not the easiest one to understand but has anyway a lot of potential and need good facilitator to be able to implement it to the organization.

11. **Would you use or recommend the model to be used as a daily operation as a data collection method?**

I am very interested in to learn more and make trial.

12. **Do you think the model is working and you can validate it?**

I am sure this model is very useful. Might need some tuning on the way of implementation but really worth of trying and testing.

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