

Logistics and Supply Chain Management Approach to SMEs in Noodle Factory Industry - Lean and Six Sigma Tool

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Abstract

Supply chain management (SCM) has been a major of competitive strategy to enhance organizational profitability, technologies for effectively and productivity. This case study will be in “Noodle Factory Company: noodles made of green grams”. This Noodle Factory major issue is largely a result of the rising costs of manufacturing, shortened product life cycles, and the globalization of market. The objectives of this paper are to:

- (1) The paper provide a focused review of literature in logistics and supply chain management.
- (2) The paper will be focused of Business Process Re-engineering and Lean and Six Sigma Tool
- (3) The paper will be diagnosed of situation in that noodle factory company, for identifying which is logistical in competitive position, benchmarking process, and impact company’s competitiveness and guideline for best practices, and the best-in-class.
- (4) The paper will define a research agenda for future research in this area.

Keywords

Logistics and Supply Chain, Lean, Six Sigma Tool

1. Introduction

In the following sections, we will describe the evolution of Supply Chain Management, Business Process Re-engineering and SCOR model.

Small and Medium Enterprises (SMEs) play a significant role in the development of the any country's economy and constitute as high as around 90% of all industries in any country. Thailand’s government has declared the development of SMEs a high priority agendas. SMEs are still facing of competitive dynamics, challenges and obstacles their businesses like innovation technology, economic development of new countries, managerial and organizational growth of systems. The lack of innovation technology factors involved include low level of expert abilities and raw materials. The lack of economic development of new countries factors involved include low access in borrowing and small capital investment, low access of needed infrastructure, shortage in financing. The lack of managerial and organizational growth of systems factors involved include low expertise in management and technical knowledge, lack of managerial capabilities, shortage in human resources, lack of environment of good corporate governance, lack of human resources in SMEs pushes them to outsource to improve their organization, Limited training and skill development and Decentralized supply chain management. Logistics and Supply Chain Management are the best continuous improvement tool.

Logistics and Supply Chain Management go into ensuring that the right material reaches the right place at the right time. Logistics management is used to sourcing procurement, order fulfillment, storage of raw materials, replacement of personnel and materiel, production planning, scheduling, controlling cost effective flow, assembly, packaging, maintenance, warehousing, distribution, finished goods and customer service. Logistics management include supply and demand planning, logistics network design, inbound and outbound transportation management, inventory management, fleet management, materials handling management, and management of third-party logistics services providers (3PLs).

Supply Chain Management (SCM) is used to plans, implements, controls forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements. It is involved in all levels of planning and execution strategic, operational and tactical and related information from point of origin to point of consumption so as to meet customer requirements.

2. Small and Medium Enterprises

In today's increasingly globalized economy, small and medium enterprises (SMEs) are now considered to be the major source of dynamism, innovation and flexibility in emerging and developing countries, as well as to the economies of most industrialized nations [1]. They constitute as high as around 90% of enterprises in most countries worldwide. The table gives a global comparison of SMEs [2]. Table titles are to be centered above the tables.

Table 1. SMEs global comparison.

Table 1 : SMEs global comparison

Country	Definition	Percentage of total business
China	Defined on the basis of fixed assets and number of employees	99.0%
India	Defined on the basis of limit of historical value of investment in plant & machinery, as per the MSMED Act of 2006.	99.7%
European Union	Defined on the basis of number of people employed in the enterprise.	99.0%
Japan	Defined on the basis of capital size and number of employees	99.2%
USA	Defined by the number of employees	Not Available
Thailand	Defined by the number of employees	99.5%

Source: Government websites of SMEs of respective countries

Thailand's government has declared the development of SMEs a high priority agendas. SMEs are one of a principle driving forces in the economic development of every country's industrial production and contribute to the industrial development, exports, employment and creation of opportunities, private ownership and entrepreneurial skills. SMEs are flexible and can adapt quickly to changing market demand and supply situations, help diversify economic activity and make a significant contribution to exports and trade etc. SMEs are contribution to poverty reduction and the driving force behind a large number of innovations and contribute to the growth of the national economy [3]. Thailand's government identified the critical SMEs barriers according to manufacturers and reported in the literature review as shown in Table 2. SMEs barriers [4].

Table 2: SMEs barriers

Barriers	Type of barriers	Source
Management	<ul style="list-style-type: none"> ✚ Company polices ✚ Competitive issues ✚ Management commitment / little senior management attention ✚ Personnel resources (Training, poor level of technical knowledge) ✚ Difficulties in extended producer responsibility across countries ✚ lack of appropriate performance management system ✚ Lack of shared understanding of best practices ✚ Lack of strategic planning and structure for reverse logistics ✚ Lack of technical expertise 	Rowe and Enticott (1998); Hillary (2000); Ofori et al. (2000); Hillary (2000); Rogers and Tibben-Lembke (2001); Revell and Rutherford Bowen et al. (2001); Carter and Dresner (2001); Thompson (2002); Hemel and Kramer (2002); Perron (2005); Ravi and Ravishankar (2005); Zhou et al. (2007); PWC (2008); Chung and Zhang (2011);
Financial	<ul style="list-style-type: none"> ✚ Financial resources / Constraints / funds for training / return monitoring system / storage and handling ✚ Preferential tax policies 	Court (1996); Holland and Gibbon (1997); Barchard (1998); Wycherley (1999); Rogers and Tibben-Lembke (2001); Min and Galle (2001); Thompson (2002); Simpson et al. (2004); Ravi and Shankar (2005); Hervani et al. (2005); Ravi and Ravishankar (2005); Orsato (2006); Zhou et al. (2007); Lau and Wang (2009); AlKhidir and Zailani (2009); Paul Hoskin (2011);

Table 2: SMEs barriers

Barriers	Type of barriers	Source
Policy	<ul style="list-style-type: none"> ✚ Legal issues / lack of supportive policies ✚ Loop holes in Chinese WEEE regulations ✚ Lack of enforceable law / lack of waste management practices ✚ All-inclusive consideration and consultation and lack of inter-ministerial communication ✚ Regulations or directives to motivate manufacturers' ✚ Lack of awareness in environmental regulations ✚ Customers not informed of take back channels 	Rogers and Tibben-Lembke (2001); Ravi and Ravishankar (2005); Zhou et al.(2007) Lau and Wang (2009); Chung and Zhang (2011);
Infrastructure	<ul style="list-style-type: none"> ✚ Lack of systems / EDI standards / Underdevelopment of recycling technologies ✚ Coordination and support / collaboration / reluctance of support from members ✚ Limited forecasting and planning/ Lack of In-house facilities ✚ Lack of new technology, materials and processes 	Rogers and Tibben-Lembke (2001); Ravi and Ravishankar (2005) (Perron, 2005) ; Zhou et al. (2007); PWC(2008); Lau and Wang (2009); Chung and Zhang (2011);

SMEs are important growth in many countries and can be develop SMEs through supply chain management (SCM).

3. Review of Methodology

3.1 Supply chain management

According to Lau and Lee (2000) [5], supply chain is a formation of a value chain network consisting of individual functional entities committed to providing resources and information to achieve the objectives of efficient management of suppliers as well as the flow of parts. The supply chain includes the entities from the origin point to the final consumption such as suppliers, customers and the organization itself. In this section, The study of Supply chain management to define a framework for the Food Industry : Noodle Factory. This is shown in Figure 1: Supply chain management for the Food Industry: Noodle Factory. Noodle Factory will consist of nodes: Supplier, Manufacturing, Distributor, and Consumer.

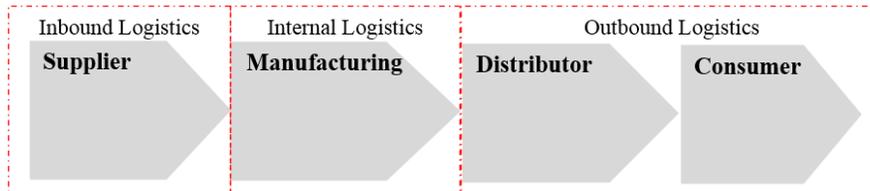


Figure 1: Supply chain management for the Food Industry: Noodle Factory.

3.2 Lean Methodology

“Lean manufacturing, lean enterprise, lean production, often simply, "lean",” originated from the concept of the Toyota Production System used by Toyota, an automobile company in Japan. The Toyota production system was used in the 1940s to improve efficiency and gain competitive advantage in this highly competitive sector. The concept of lean manufacturing became popular in the west after the publication of “The machine that changed the world by Womack, Jones, and Roos (1990). This book provide the conceptual framework for categorizing all of the tool and practices for Lean production into five basics area. The principle of Lean production can be in table 3 [6].

3.3 Six Sigma Methodology

Six Sigma is a set of techniques, and tools for process improvement. It was developed by Motorola in 1986 [7-8]. Six Sigma became famous when Jack Welch made it central to his successful business strategy at General Electric in 1995. Today, it is used in many industrial sectors. Six Sigma improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, including statistical methods, and creates a special infrastructure of people within the organization ("Champions", "Black Belts", "Green Belts", "Yellow Belts", etc.). Six Sigma project carried out value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits. The term Six Sigma originated from terminology associated with manufacturing, specifically terms associated with statistical modeling of manufacturing processes. The

maturity of a manufacturing process can be described by a sigma rating indicating its yield or the percentage of defect-free products it creates. A six sigma process is one in which 99.999998% of the products manufactured are statistically expected to be free of defects (3.4 defective parts/million), although, as discussed below, this defect level corresponds to only a 4.5 sigma level. Motorola set a goal of "six sigma" for all of its manufacturing operations, and this goal became a by-word for the management and engineering practices used to achieve it [9]. The relationship between defect rate (DPMO) and process sigma level assuming the normal distribution can be show in Table 4 [6].

Table 3: The Lean principle (Womack et al., 1990)

Principle	Description
Value	Define value from the stand point of the customer.
The Value Stream	View you product delivery system as a continuous flow of processes that add value to the product.
Flow	The production should constantly be moving through the value steam toward the customer at the rate of demand.
Pull	Products should be pulled through the value stream at the demand of the customer rather than being pushed on the customer.
Perfection	The never-ending pursuit of eliminating waste in the system such that products can flow seamlessly through the value stream at the rate of demand

Table 4: The relationship between defect rate (DPMO) and process sigma level

Sigma level	DPMO
1	697,672
2	308,770
3	66,810
4	6,210
5	233
6	3.4

Table 5: The DMAIC project methodology has five phases:

DMAIC	Description
Define	Define the system, the voice of the customer and their requirements, and the project goals, specifically.
Measure	Measure key aspects of the current process and collect relevant data.
Analyze	Analyze the data to investigate and verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered. Seek out root cause of the defect under investigation.
Improve	Improve or optimize the current process based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to establish process capability.
Control	Control the future state process to ensure that any deviations from target are corrected before they result in defects. Implement control systems such as statistical process control, production boards, visual workplaces, and continuously monitor the process.

Six Sigma is not just about statistics. Six Sigma is widely recognized as a methodology that employs statistics and non statistics tools and Techniques to company-wide strategy for business process improvement and maximize an organization's return on Investments (ROI) Through the eliminate of defect in process. The Six sigma drive for defect reduction, process improvement and customer satisfactions are based on the "statistics think" paradigm. Organizations have included Six Sigma as a part of their business strategy and in the strategic review process to become globally competitive, increase market share and enhance satisfaction. The DMAIC project methodology can be show in Table 5[10].

3.4 Lean and Six Sigma Toolset

Lean and Six Sigma can be to understand how to implement in Manufacturing Industry, Service Sector and healthcare sector for improve process. Therefore, the project was summarized methodology as showed in Table 6. (adapted from Nave, 2002 and Antony, 2006 and Salaah al., 2011 and Ming-Tzong Wang al., 2012 and Tanaporn Panchaipetch al., 2012).

Table 6 : Lean and Six Sigma Toolset

	Lean	Six Sigma	Suggested Action Item	Suggested Application Issue	Suggested Methods & Tools
Theory	Remove waste	Reduce Variation			
Application guides :	Identify Value	Define	<ul style="list-style-type: none"> ✚ Define the requirement and expectations of the customer (McClusky, 2000 ; Pan et al.,2007 ; Abdolshah et al.,2009) ✚ Define the project goals,values, resources and boundaries (McClusky, 2000 ; Pan et al., 2007 ; Abdolshah et al., 2009 George, 2002) ✚ Design the problem-solving process (George, 2002) ✚ Develop project plans, and select appropriate projects (Hoerl, 2001) ✚ Define the process by mapping the business flow (McClusky, 2000 ; Pan et al.,2007 ; Abdolshah et al.,2009, Hoerl, 2001) 	Process	<ul style="list-style-type: none"> ~ Process ~ Process Map ~ SIPOC ~ Working Flow Analysis ~ Flow Chart
				Project	<ul style="list-style-type: none"> ~ Project Management ~ Project Charters ~ Project Evaluation
				Customer	<ul style="list-style-type: none"> ~ VOC ~ Customer Satisfaction Survey ~ Customer Relationship Model ~ Customer Data Warehouse ~ Kano Model ~ CTQ Characteristics ~ Quality Function Deployment
				Prime Analysis	<ul style="list-style-type: none"> ~ SWOT Analysis ~ Cost of Quality Analysis ~ Capacity Analysis ~ Financial Analysis ~ Human Resource ~ Distribution Analysis ~ Cause & Effect Metric ~ FMEA ~ Stakeholder Analysis
Identify Value Stream	Measure		<ul style="list-style-type: none"> ✚ Measure the process to satisfy customer's needs (McClusky, 2000 ; Pan et al., 2007 ; Abdolshah et al., 2009) ✚ Address the issue of process stability (Hoerl, 2001) ✚ Ensure data quality (Hoerl, 2001) 	Customer	<ul style="list-style-type: none"> ~ QFD ~ Kano Model ~ CTQ
				Process	<ul style="list-style-type: none"> ~ Process Mapping ~ Check Sheets ~ Process Capability Analysis ~ Statistical Process Control

Table 6 : Lean and Six Sigma Toolset

	Lean	Six Sigma	Suggested Action Item	Suggested Application Issue	Suggested Methods & Tools
			<ul style="list-style-type: none"> ✚ Develop a data collection plan and system (McClusky, 2000 ; Pan et al., 2007 ; Abdolshah et al., 2009, George, 2002) ✚ Collect and compare data to determine issues and short falls (McClusky, 2000 ; Pan et al., 2007) 	Data Collection	<ul style="list-style-type: none"> ~ Brainstorming ~ Pareto Charts ~ C&E Analysis ~ Fishbone ~ Run charts ~ Control Charts ~ Gage R&R ~ Inter-relationship Diagram ~ Frequency Distribution ~ Stratification ~ Histogram ~ Arrow Diagram Method
	Flow	Analyze	<ul style="list-style-type: none"> ✚ Identify ways to decrease the gap between the current performance level and the desired goals (Pan et al.,2007) 	Prioritization	<ul style="list-style-type: none"> ~ C&E Matrices ~ FMEA ~ Fuzzy Method
<ul style="list-style-type: none"> ✚ Analyze the causes of defects and sources of variation (McClusky, 2000 ; Pan et al., 2007 ; Abdolshah et al.,2009, George, 2002 ; Hoerl,2001) 			Variations in the Process	<ul style="list-style-type: none"> ~ Process Capability Analysis ~ Regression ~ ANOVA ~ MSA ~ Correlation Analysis ~ Multivariate Statistical Analysis ~ Factor Analysis ~ Reliability Analysis 	
<ul style="list-style-type: none"> ✚ Determine the variations in the process (McClusky, 2000 ; Pan et al., 2007 ; Abdolshah et al., 2009, Hoerl, 2001) ✚ Prioritize opportunities for future improvement (McClusky, 2000 ; Abdolshah et al., 2009, George, 2002) 			Cause of Defects and Sources of Variation	<ul style="list-style-type: none"> ~ Fishbone Diagram ~ Inter-relationship Diagram ~ QI Story ~ Pareto Chart ~ QFD ~ Run Chart ~ Scatter Diagram ~ Histogram ~ Hypothesis Test ~ Earned Value Analysis ~ Line Chart ~ Root Cause Analysis 	

Table 6 : Lean and Six Sigma Toolset

	Lean	Six Sigma	Suggested Action Item	Suggested Application Issue	Suggested Methods & Tools
				Optimization	<ul style="list-style-type: none"> ~ Design of Experiments (DOE) ~ Simulation ~ Taguchi ~ Artificial Neural Network
	Pull	Improve	<ul style="list-style-type: none"> + Identify, evaluate, and select the right improvement solution (Pan et al., 2007) + Improve the process to eliminate variations (McClusky, 2000 ; Abdolshah et al., 2009 ; George, 2002) + Develop creative alternatives and implement enhanced plan (McClusky, 2000 ; Abdolshah et al., 2009) 	Process	<ul style="list-style-type: none"> ~ Process Decision Program Chart (PDPC) ~ Process Map ~ Process Redesign ~ Statistical Process Control
				Optimization	<ul style="list-style-type: none"> ~ Design of Experiments (DOE) ~ RSM ~ Artificial Neural Network ~ Genetic Algorithm ~ Numerical Analysis ~ Process Capability Analysis
				Measurement	<ul style="list-style-type: none"> ~ Regression ~ Grey Relational Analysis ~ Correlation Coefficient
				Assay	<ul style="list-style-type: none"> ~ Fishbone Diagram ~ Scatter Chart ~ Financial Analysis ~ Payoff Matrix ~ C & E Diagram ~ Cost Benefit Analysis ~ Force Field Analysis ~ Stakeholder Analysis ~ 5S's Method and Kaizen ~ Benchmarking ~ Tree Diagrams ~ Systematic Diagram
				Prevention	<ul style="list-style-type: none"> ~ FMEA ~ Poka Yoke ~ Pilots Test

Table 6 : Lean and Six Sigma Toolset

	Lean	Six Sigma	Suggested Action Item	Suggested Application Issue	Suggested Methods & Tools
	Perfection	Control	<ul style="list-style-type: none"> ✚ Control process variations to meet customer requirements (McClusky, 2000 ; Abdolshah et al., 2009) ✚ Develop a strategy to monitor and control the improved process (McClusky, 2000 ; Pan et al., 2007 ; Abdolshah et al., 2009 ; George, 2002 ; Hoerl, 2001) ✚ Implement the improvements of systems and structures (McClusky, 2000 ; Abdolshah et al., 2009 ; Hoerl, 2001) 	<ul style="list-style-type: none"> Assay Development Prevention 	<ul style="list-style-type: none"> ~ Control Charts ~ Pareto Charts ~ Statistical Process Control ~ Process Capability Analysis ~ MSA ~ Project Assessment ~ Project Summary ~ Flow Diagram ~ Charts to Compare Before and After ~ Standardization ~ Knowledge Management ~ PDCA Cycle ~ Daily Management ~ Visual Management ~ Process Management ~ SOP ~ Training Plan ~ Control Plans ~ Poka Yoke ~ FMEA
Focus :	Flow focused	Problem focused			
Assumption :	<ul style="list-style-type: none"> • Waste removal will improve business performance • Many small improvement are better than system analysis 	<ul style="list-style-type: none"> • A problem exists • Figures and numbers are valued • System output improves if variation in all processes is reduces 			
Primary effect :	Reduce flow time	Uniform Process out			
Secondary effect :	<ul style="list-style-type: none"> • Less variation • Uniform inventory • Less inventory • New accounting system 	<ul style="list-style-type: none"> • Less waste • Fast throughput • Less inventory • Fluctuation-performance measures for managers • Improve Quality 			
Criticisms :	<ul style="list-style-type: none"> • Statistics or system analysis not value 	<ul style="list-style-type: none"> • System interaction not considers process improved independently 			

4. Case Study

Noodle Factory Industry use case study in this academic service with The Federation of Thai Industries Nakhonsawan Province, for example: noodles made of green grams, rice noodles. The research focused on the flow of using resource and Process Waste : noodles made of green grams. Today's manufacturing and business environments are reaching a point that competition for survival and market share. Global economy will show to be good is not enough, and each organization must strive for success if want to stay in the market. Six Sigma Method consist of five-step approach. The five steps in DMAIC are Define, Measure, Analyze, Improve, and Control. The methodology is learn and apply to process improvement framework known in industry today.

DMAIC Step 1 – Define

The “D” Define focuses on selecting high-impact projects, Process critical, Measurable Impact, Potential for Improvement, Resource support within the organization and Feasibility. In some cases the leadership focuses on poor performance on Critical to Quality (CTQ) factor. The Lean Tool can implement four aspect: Philosophy, Process People and Partner and problem solving. This is shown in Figure 2: 4P Model of Lean Production System [11]. In some cases the leadership can implement 5 Principles of Lean Leadership: Improvement Culture, Self Development, Qualification, Gemba and HoShin Kanri. This is shown in Figure 3: Five Principles of Lean Leadership [11].

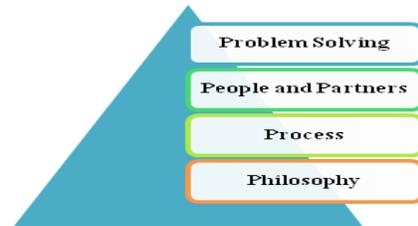


Figure 2: 4P Model of Lean Production System

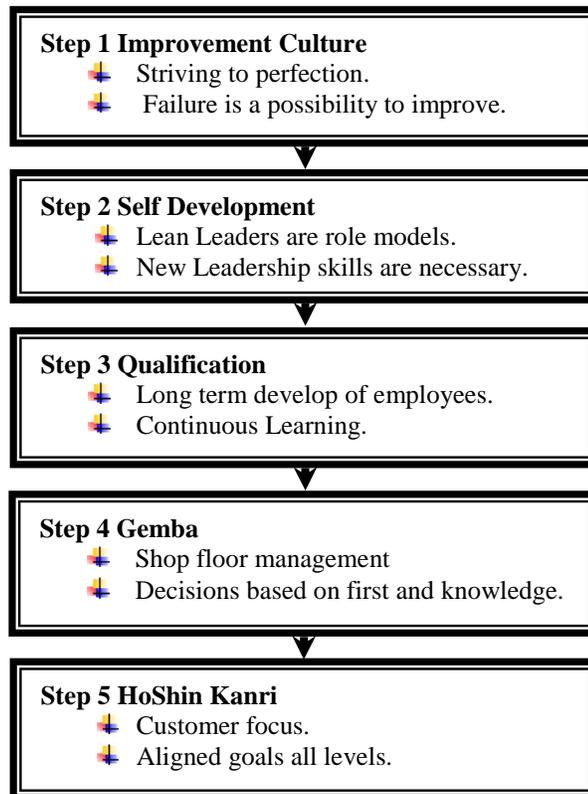


Figure 3: Five Principles of Lean Leadership

The research focused on Gemba KaiZen that when various problem in factory, you should go to the place, In another tool is the Questionnaire. The Questionnaire was sent to 20 Food Factory in Nakhonsawan Province. The research selected 2 case study: noodles made of green grams because of compliant from customers and community around factory about environment. This is shown in table 7: Result Questionnaire of clean technology (CT) in 2 year ago.

Table 7: Result Questionnaire of Clean Technology (CT) in 2 year ago.

ข้อคำถาม	Frequency	
	Yes	NO
1. Check sheet for Raw Material	85 (17)	15 (3)
2. Raw Material loss	85 (17)	15 (3)
3. Water Use for process	70 (14)	30 (6)
4. Electrical Consumption	100 (20)	-
5. Heat Consumption	100 (20)	-
6. Water Waste	95 (19)	5 (1)
7. Solid Waste	100 (20)	-
8. bad smell of water waste	85 (17)	15 (3)
9. bad smell of solid waste	10 (2)	90 (18)
10. Waste water Treatment System	85 (17)	15 (3)
11. Water Reuse	10 (2)	90 (18)
12. Solid Reuse	15 (3)	85 (17)
13. Select equipment for save energy	25 (5)	75 (15)
14. Maintenance : CBM	100 (20)	-
15. Install water meter	45 (9)	55 (11)
16. Training course	20 (4)	80 (16)
17. Clean Technology	30 (6)	70 (14)

DMAIC Step 2 – Measurement

The “M” Measurement focuses on four main objective: 1) More specifically define the scope of the project and delineate the required improvement activities 2) Gather data to qualify the opportunities for improvement and quantify their potential for improvement 3) Gather data to quantify the current state performance and create a baseline from which improvement can be measured 4) Based on the data analysis provide into what the root causes are for the problems and define the scope of current state process such as operation process, material and information flow.

1. Energy Balance of production area

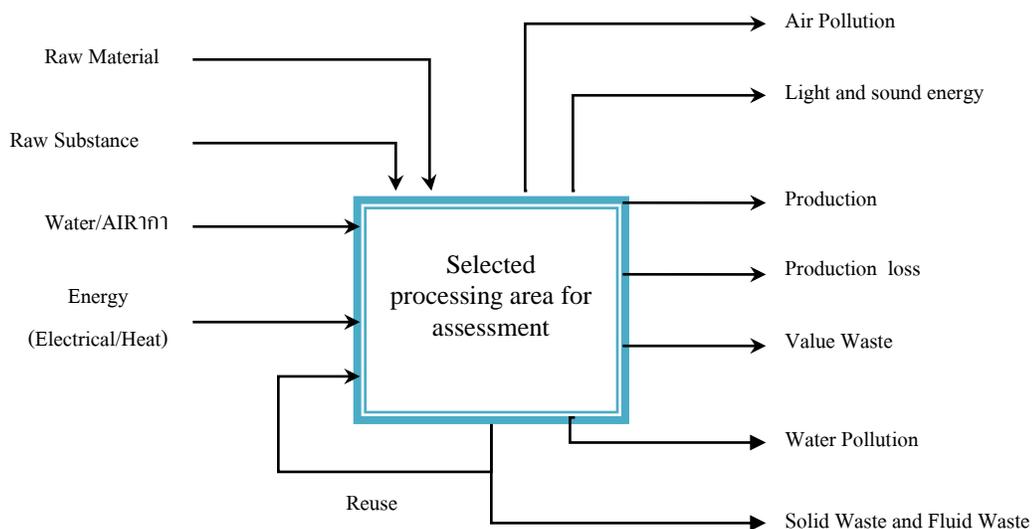
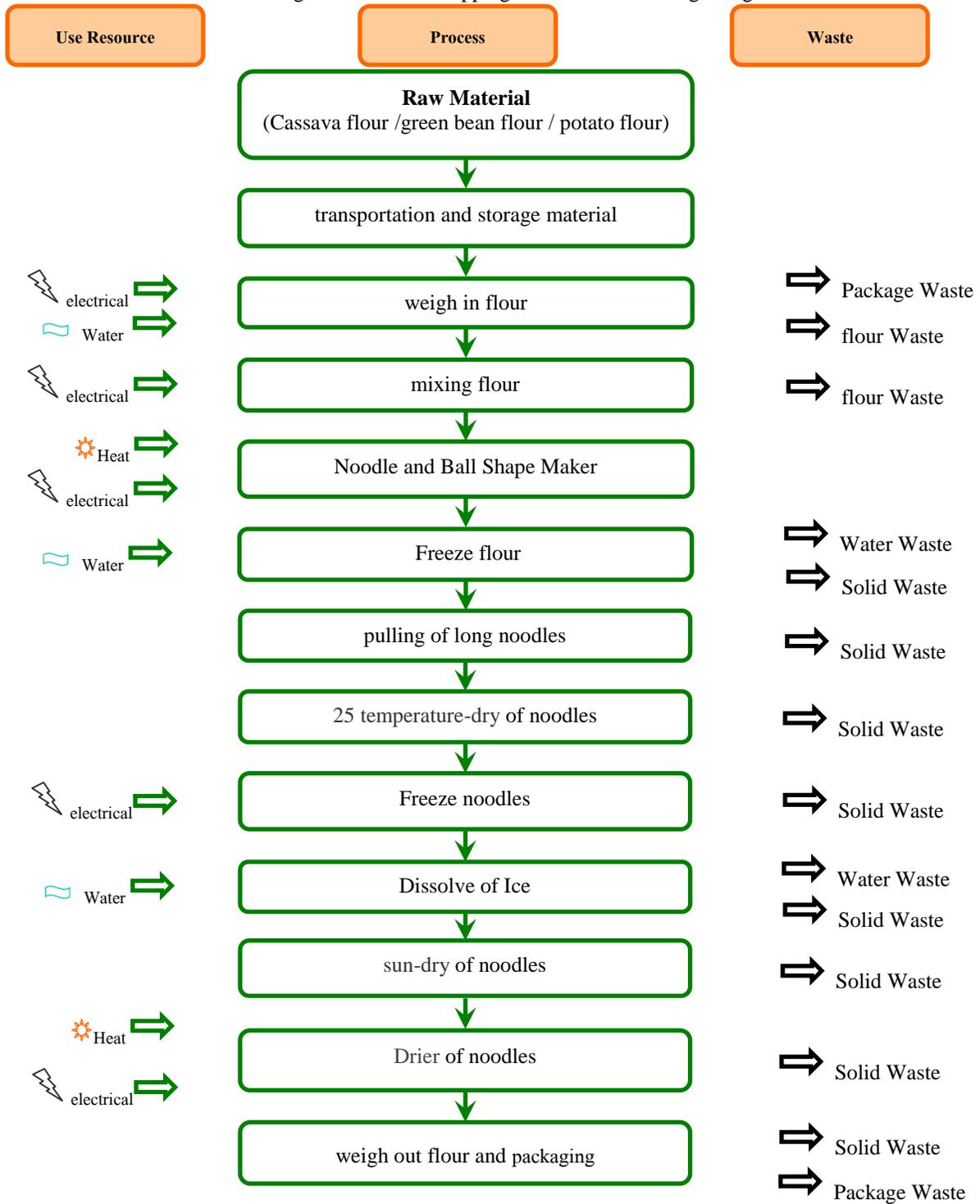


Figure 4: Energy Balance of production area

2. Process Chat

Figure 5: Process Mapping of noodles made of green grams



3. Measurement System Analysis

Clean Technology Concept consist of 4 Key Performance Index (KPI). This is shown in table 8 : Critical Factor of Production

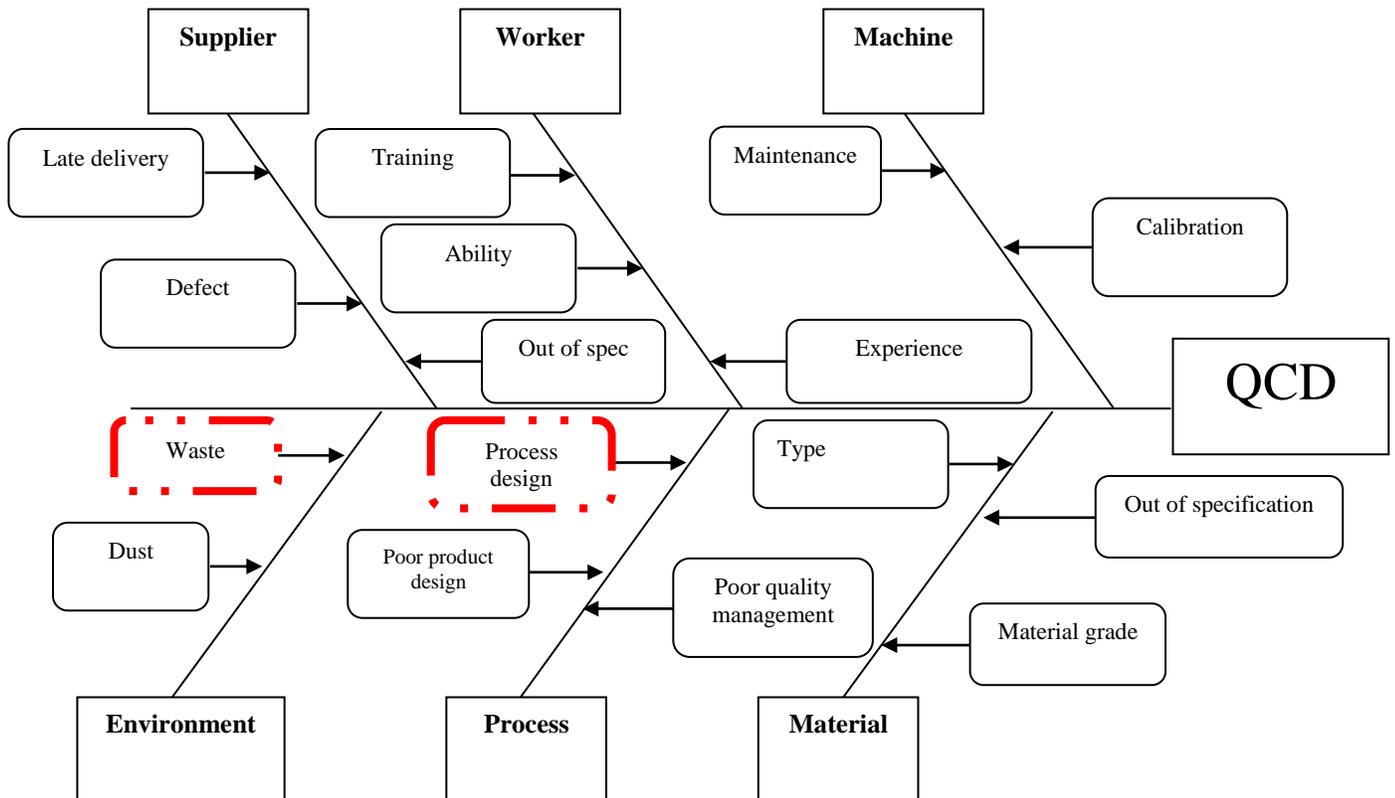
Table 8: Critical Factor of Production

Critical Factor	Unit loss	Money Loss
Raw Material	1.56 Ton/Ton Product	22,759.2 kg/month
Energy Consumption	98,506.07 - 196,533.89 Mj/Ton Product	5,849,173.79 baht per year
Electrical Consumption	6,755.39 - 12,239.18 kWh/Ton Production	9,977,081.04 baht per year
Product loss	22,759.2 kg/month	7,100,870 baht per year

DMAIC Step 3 – Analyze

The Analyze phase in DMAIC are Identify ways to decrease the gap between the current performance level and the goals level, Analyze the causes of defects and sources of variation, Determine the variations in the process, Prioritize opportunities for future improvement. The most commonly used of these are Pareto Chart, Fishbone Diagram, 5-Why, Hypothesis Testing, Regression Analysis, Time Series Plots, Multivariate Analysis, Histograms, Scatter Diagrams, Tree Diagrams, PFMEA. In this research used Seven Waste to Indentify operation process waste: Defects (repair, rework, scrap), Overproduction (inventory), Transportation (conveyance), Waiting (queue time), Inspection (reliance on mass inspection/ verification), Motion (parts, paper, people), Process, itself (over-processing, long cycles). Other causes of waste may include: poor maintenance, lack of training, poor supervisory skills, ineffective production planning/ scheduling, lack of workplace organization, Supplier quality/ reliability. This is shown in Figure 6: Fishbone Diagram

Figure 6: Fishbone Diagram



DMAIC Step 4 – Improve

The Improve phase focuses on understand the causes form identified in the Analyze phase, Identify, evaluate, and select the right improvement solution, Improve the process to eliminate variations, Develop creative alternatives and implement enhanced plan and selected methods to solve problem or improve process. Improve phase is process redesign and the following Six Sigma tools are commonly used in this phase are four main objective : Process (Process Decision Program Chart (PDPC), Process Map, Process Redesign, Statistical Process Control), Optimization (Design of Experiments (DOE), RSM, Artificial Neural Network, Genetic Algorithm, Numerical Analysis, Process Capability Analysis), Measurement (Regression, Grey Relational Analysis, Correlation Coefficient), Assay (Fishbone Diagram, Scatter Chart, Financial Analysis, Payoff Matrix, C & E Diagram, Cost Benefit Analysis, Force Field Analysis, Stakeholder Analysis, 5S's Method and Kaizen, Benchmarking, Tree Diagrams, Systematic Diagram, and Prevention (FMEA, Poka Yoke, Pilots Test)

Table 9: Summary of cause

Critical Factor	Cause	Clean Technology
Raw Material	Low Raw Material	- High SO ₂ - High moisture
Energy Consumption	Boiler over heat load of production	- new design boiler for energy saving money
Electrical Consumption	Freeze over load of production	- Improvement for energy saving
Product loss	Quality of Product	- Process redesign
Waste Water	Not Water treatment system for waste water Mixing waste water type of each step Solid Waste	- Design for Waste Water Treatment System - Separate solid Waste

DMAIC Step 5- Control

DMAIC's Control phase focused on Control process variations to meet customer requirements, Develop a strategy to monitor and control the improved process, Implement the improvements of systems and structures. Sigma tools are commonly used in this phase are three main objective : Assay (Control Charts, Pareto Charts, Statistical Process Control, Process Capability Analysis, MSA, Project Assessment, Project Summary, Flow Diagram, Charts to Compare Before and After, Development (Standardization, Knowledge Management, PDCA Cycle, Daily Management, Visual Management, Process Management, SOP, Training Plan, Control Plans), Prevention (Poka Yoke, FMEA).

Table 10: Summary of Clean Technology

Critical Factor	Cause	Clean Technology	Economic Return (year)
Raw Material	Low Raw Material	- High SO ₂ - High moisture	Find new supplier
Energy Consumption	Boiler over heat load of production	- new design boiler for energy saving money	1. Investment fund : 420,000 baht 2. Saving Money : 406,879.88 baht 3. Payback period : 1.11 year
Electrical Consumption	Freeze over load of production	- Improvement for energy saving	1. Investment fund : no 2. Saving Money : 203,107.5 baht 3. Payback period : now
Product loss	Quality of Product	- Process redesign	1. Investment fund : no 2. Saving Money : reduce 30 minute 3. Payback period :now
Waste Water	Not Water treatment system for waste water Mixing waste water type of each step Solid Waste	- Design for Waste Water Treatment System - Separate solid Waste	1. Investment fund : 10,000 baht 2. Saving Money : 7,254,499.2 baht 3. Payback period : 0.78 year

5. Conclusions

Logistic and Supply Chain Management are key competition factors for the organizations. Factory are using regarding the SCM and Logistic. Logistic and Supply Chain Management affects all the processes, decreases their profitability and affects the quality of the service given by the University. The people have the opportunity to assess the Perception of the core competences of the organization. The customer take measures by Logistic and Supply Chain Management. The level of information has a direct effect in the customer. SCM will contribute to their perception and increases the employment efficiency of the business to other businesses. The SCM and Logistic will make advantaged by developing skills. The logistic will providing them with the opportunity to achieve leadership ability and maintain it effectively. The logistic will also make be successful in the production of information for logistic purpose and in the human resources. Six Sigma Method can apply thought the organization for solving problem and decrease defect and control of variation. Lean Method can identify problem and current state process, eliminate delay, and reduce waste such as reduce delay, reduce defect and reduce of deviation. Finally, Academics or Research Institutes in Thailand should studies from this case study and will apply to other case study for sustainable in future.

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