

# FOOD VALUE CHAIN PRODUCTION IMPROVEMENT USING QUALITY FUNCTION DEPLOYMENT TECHNIQUE

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## **Introduction**

Due to the increasing demands of consumers who are constantly on the rise, the present food industry has gone through a dynamic change through technology and competition. In order to respond to the need of consumers in the current competitive food industry, while maintaining a competitive price, improvement of product and production management is crucial. The competition in this industry includes competing in the design, development, and production of various diversified products. The needs of the consumer and the manufacturing process are no more than a repetition of the process. To reduce the time in production processes and reduce the waiting of time that occurs in production, constant amendments in processes are necessary, while maintaining the production cost.

The Porn-Sawan Factory in San Kamphaeng, Chiang Mai is a small and medium sized enterprise (SME) which produces meatball related products. The company has been established for the past 12 years and currently facing difficulties in responding to customers' demand in volume and quality. In order to remain profitable in the current business environment, capacity and quality improvement are required in order to keep pace with competitors. The goal is to reduce process costs while responding to the needs of consumers. The researchers selected this factory as case study due to its clarification of problem and accessibility to information. For the reasons mentioned above and academic interest, the researchers have embraced the principle of value chain (Value Chain) for the analysis activities to acquire whether the operations can be improved by reducing the duplication of production activities and analysis of robust activity throughout the process by Value Stream Mapping (VSM). It is expected that this research will improve the whole chain to be more effective and reduce costs throughout the chain resulting in increasing competitiveness. Based on these tools, researchers can specify the root cause of the problem. Using the principle of Quality Function Deployment (QFD) as qualitative techniques to analyse and design the improvement of product or services that focus on responding to the needs of the consumer, consumers' need can be transformed into technical data. This technical requirement is communicated to manufacturing process to develop product prototype that can be used for comparing with the original products.

## **Theory and Related Research**

### *Value Chain*

According to Porter (1995), the strategy to create a competitive advantage by positioning the product with competitive advantage requires both price and differentiation. In order to understand and create a distinctive product, understanding questions associated with the product such as, supporting activities performed by internal and external of the organization that affects the design, manufacture, marketing and distribution of products to consumers are essential. In order to analyse activities involved in the production processes, identification of activities are important to analyse the current product differentiations in order to gain competitive advantages throughout the value chain (Figure 1).

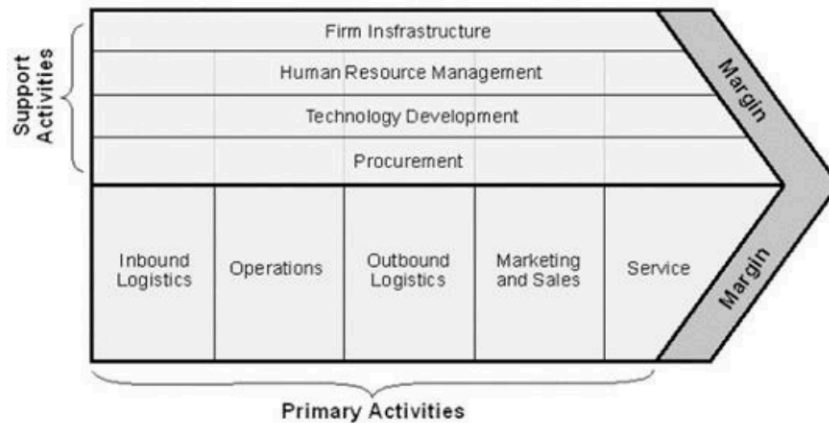


Figure 1: Michael E. Porter's (1998) Concept of Value Chain.

The concept of Porter (1998) has helped us understand the how each particular business activities contribute in creating value for customers. Value created by the company can be measured by the price that the consumer agrees to pay for that product or services. Under this concept, there are two main types of activities, Primary Activities and Support Activities. Primary activities are operational activities which has direct impact on the supplies and demands of the product. Supporting activities are facilitating activities which have direct influence on the production capacity and product quality. Both activities are inseparable and contribute to the overall well-being of the firm (Chao, 2011).

#### Value Stream Mapping (VSM)

Value stream map (VSM) is one of the lean concepts that uses diagram to show the production of the product. It shows the flow of raw materials and information needed to produce the product. It is useful in the identification, or indicates, the process steps that are "Value Added" and "Non-Value Added" to the product. A non-value added steps are known as "Waste" that we need to find ways to eliminate. Value stream map is a simple tool to visualise the flow of products (Product Movement), from raw materials to the final consumer. Lean organisations often begins with Value stream map to identify waste prior to using other Lean tools.

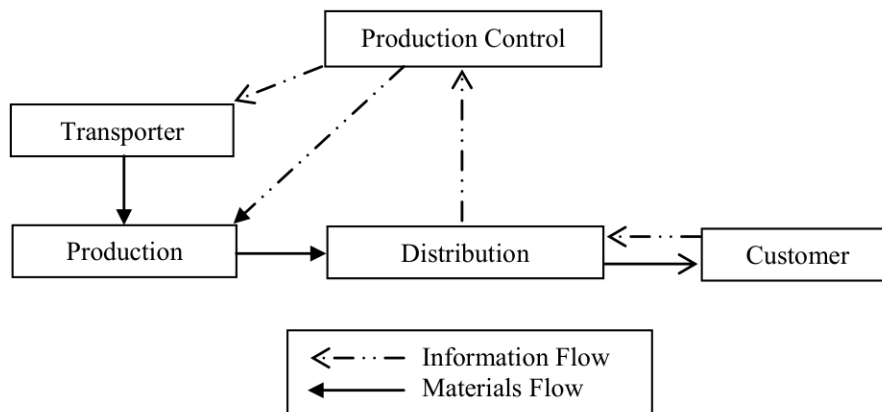


Figure 2: Product Flow Diagrams

#### Quality Function Deployment Techniques (QFD)

This technique helps to plan, design and developing products to meet the needs of consumers (Consumer Oriented Product Development) Instead of focusing on the development of technological aspects alone. The goal of this technique is to ensure that the products developed responds to customer expectation based on available resource and capabilities. The principle of the technique is to link the information of customer needs, based on market research and technical specifications of the product, together with production data to assist in developing a customer-orientated products through a data matrix. It can also be used as a communication tool to create a systematic link between Marketing, Product Development, Quality Control Manager, and Production Departments.

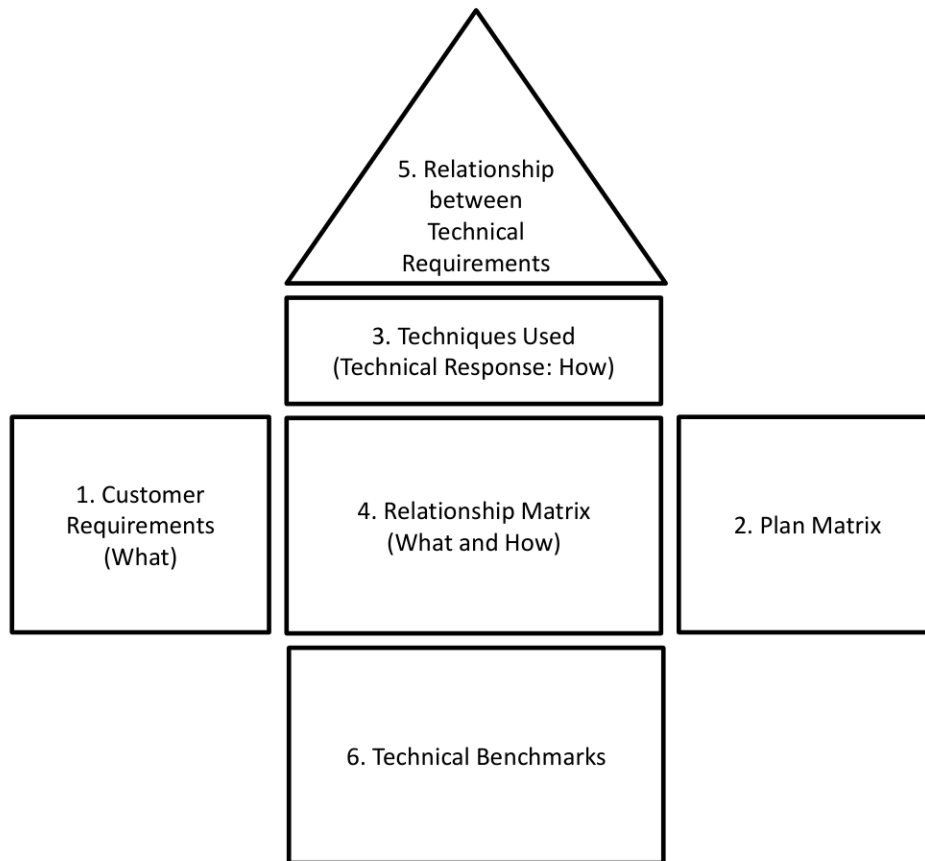


Figure 3: The House of Quality (QFD)

## Methods

### *Overview of Manufacturing Process and Case study*

As the preliminary data for the analysis, the product characteristics and its manufacturing processes are to be identified.

### *Value Chain Analysis*

As case study, we will perform Value Chain analysis on activities and process steps to produce meatball, starting from incoming raw materials to the final product and distribution.

### *Value Stream Analysis (Value Stream Mapping: VSM)*

To analyse the nature of works in the production line, Works are divided into 3 types (Hines and Rich, 1997) as follows

- Works that add value to products and customers (Value Added). Activities that are valuable to the operation and products. Starting from the raw material stage, components used in the production until to last process of product, we want to identify labor requirements, machinery in the manufacturing, etc. Including all the information and require decisions to make product.
- Works that do not create value but are necessary (Necessary but Non-Value Added). Activities that consider as wasted but it may be necessary to the operating. Characteristics of these wastes may not be able to eliminate but can be minimized.
- Works that do not added value to products and customers (Non Value Added). An unnecessary activities that consider as wasted, such as, waiting time, the same activity repeatedly (Double Handling), etc. These activities should be eliminated from operations.

### The Market Survey

Structured interview technique is used to collect information regarding to customers' need. A total 200 interviews was conducted in the local traditional markets of San Kamphaeng.

### Building House of Quality for Product Planning Matrix

The process of converting voice of consumers (VOC) or the needs of the consumer (Customer's Requirements) from a questionnaire survey on the product. This was done by converting them into technical features (Technical Characteristics). This is the product's requirements under a matrix called the House of Quality (HOQ).

### Develop Prototypes

Create a product prototype base on House of Quality. By transferring the needs of consumer to the manufacture requirements, the developed product is producible and meets the needs of customers.

## Research Findings

### Overview of the operation analysis

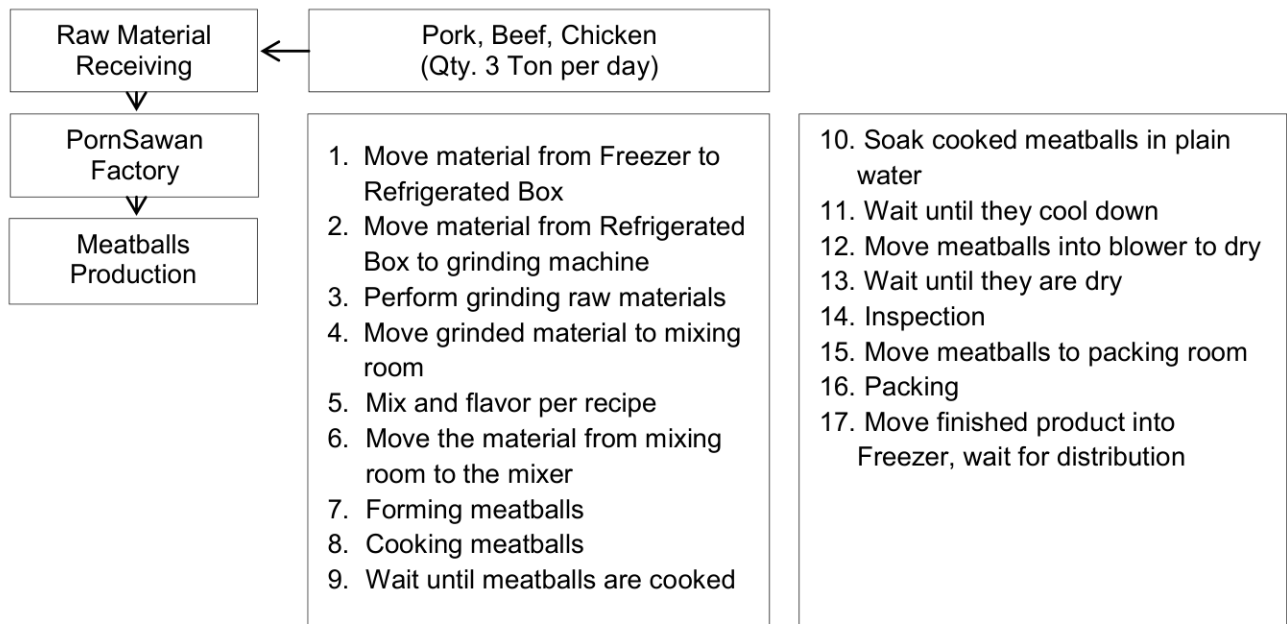


Figure 4: The flow of Information in the case study plant

*Value Chain Analysis*

Activity	Average Time (min)	Symbol	Activity Type
Move material from Freezer to Refrigerated Box	30		NNVA
Move material from Refrigerated Box to grinding machine	5		NNVA
Perform grinding raw materials	35		VA
Move grinded material to mixing room	8		NNVA
Mix and flavor per recipe	40		VA
Move the material from mixing room to the mixer	12		NNVA
Forming meatballs	45		VA
Cooking meatballs	38		VA
Wait until meatballs are cooked	25		NNVA
Soak cooked meatballs in plain water	25		NNVA
Wait until they cool down	10		NNVA
Move meatballs into blower to dry	15		NNVA
Wait until they are dry	20		NNVA
Inspection	45		VA
Move meatballs to packing room	15		NNVA
Packing	45		VA
Move finished product into Freezer, wait for distribution	20		NNVA
Total	433		

Table 1: Analysis of the Value Chain

From the case study of typical meatballs plant (before improvement) above, the study found that the time it takes to produce meatballs product is 433 minutes (or 7 hours and 22 minutes) with a total of 17 production steps and/or activities.

The market survey, using a questionnaire

Needed	Average	Original Product (A)	Competitor (B)	Competitor (C)	Competitor (D)
Soft crispness when chewing	4.23	3.40	4.35	3.86	2.41
Silky Taste	3.88	3.35	4.30	3.81	2.36
Not too salty	4.08	3.32	4.27	3.78	2.33
Feel bouncy when chewing	4.41	3.35	4.30	3.81	2.37
Fine grain texture	4.40	3.35	4.30	3.81	2.36
No Odor Small	4.42	3.34	4.29	3.80	2.35
No fishy smell of meat	4.56	3.30	4.25	3.76	2.31
Smooth Surface	4.60	3.29	4.24	3.75	2.30
Right Size	4.63	3.31	4.26	3.77	2.33
Variety	4.89	3.33	4.28	3.79	2.34

Table 2: The Results of Market Survey on Senses

Creating Quality Function Deployment (QFD)

**Customer Requirements (What)**

- Soft crispness when chewing
- Silky Taste
- Not too salty
- Feel bouncy when chewing
- Fine grain texture
- No Odor Small
- No fishy smell of meat
- Smooth Surface
- Right Size
- Variety

Table 3: Customer Requirements (What)

**Plan Matrix**

Original Product Ratings (A)	Champ Meatballs (B)	Papee Meatball (C)	Wanna Meatball (D)	Planned Rating	Improvement	Improvement Weight Ratio
3.40	4.35	3.86	2.41	4.35	1.19	5.03
3.35	4.30	3.81	2.36	4.30	1.19	4.62
3.32	4.27	3.78	2.33	4.27	1.19	4.86
3.35	4.30	3.81	2.37	4.30	1.19	5.25
3.35	4.30	3.81	2.36	4.30	1.19	5.24
3.34	4.29	3.80	2.35	4.29	1.19	5.26
3.30	4.25	3.76	2.31	4.25	1.19	5.43
3.29	4.24	3.75	2.30	4.24	1.19	5.47
3.31	4.26	3.77	2.33	4.26	1.19	5.51
3.33	4.28	3.79	2.34	4.28	1.19	5.82

Table 4: Plan Matrix

**Techniques used (Technical Response: Hows)**

▲	▼	◆	▲	◆	▲	▲	▲	▲	▲
Crispy	Good Taste	No more than 3% Salt	Bounce	Fine Grain	No Odor	No fishy smell of meat	Meat and flour Mixture	0.8-1.0 inch	Round or Oval Shape

Table 5: Techniques used (Technical Response: Hows)

**Relationship Matrix (What & How)**

▽	▽	▽	▽	▽				▽	▽
▽	○	○	○	○	○	○	○	▽	○
○		○						○	○
○	○	○	○	○	○	○	○	○	○
○	○	○	○	○	○	○	○	○	○
	▽	▽		○	○	○	○	○	○
	○	○		○	○	○	○	○	○
				○				○	○
○	○	○	○	○	○	○	○	○	○
○	○	▽	○	○	○	○	○	▽	▽

**Relationship between Technical Requirements**

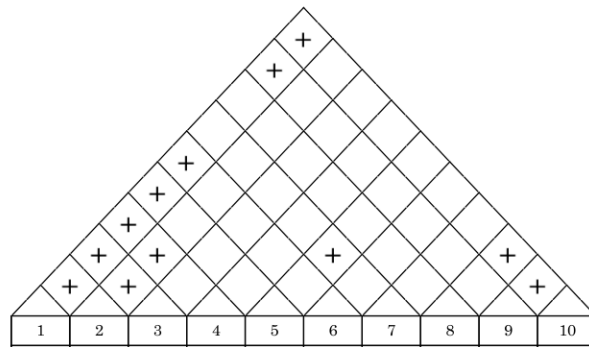


Table 6: Relationship Matrix (What & How)      Table 7: Relationship between Technical Requirements

Objectives	Technical Benchmarks									
	Crispy	Good taste	Among of Salt	Bouncy Feeling	Fine Grain	No Odor	No fishy smell of meat	Surface Texture	Not more than 1 inch. In Size	Variety
Absolute IMP*	89.69	100.6	108.84	84.35	84.35	111.39	111.39	111.39	126.53	62.55
Relative IMP (%)	9.05	10.15	10.98	8.51	8.51	11.24	11.24	11.24	12.77	6.31

\*IMP: Important Rating

Table 8: Benchmark Technical (Technical Benchmarks)

**Experimental for Product Improvement by Quality Department**



Figure 5: Experiments for Product Improvement



Figure 6: Prototypes Product

**Summary findings**

From this research, unnecessary processes are identified in the case study factory which appeared to be a major cause of long production cycle time. Improvement was implemented base on competitor benchmarking by modification and elimination of activities that does not provide value to the product. Before improvement activities, the production cycle time was 433 minutes and after improvement it was dramatically reduced to 375 minutes, or 13.40 percent in improvement. This allows the firm to reduce production lead time and to gain opportunity to increase the production capacity. This not only responds to the voice of the customers but also improve product delivery lead-time. The level of satisfaction in products was quantitatively determined. Base competitors' information, the plant has improved their product to respond to customers' suggestions on taste and quality. This has resulted in gaining a larger share in the local market and more competitive in terms of quality. An average customer satisfaction index has shown an improvement according to the needs of the customer.

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