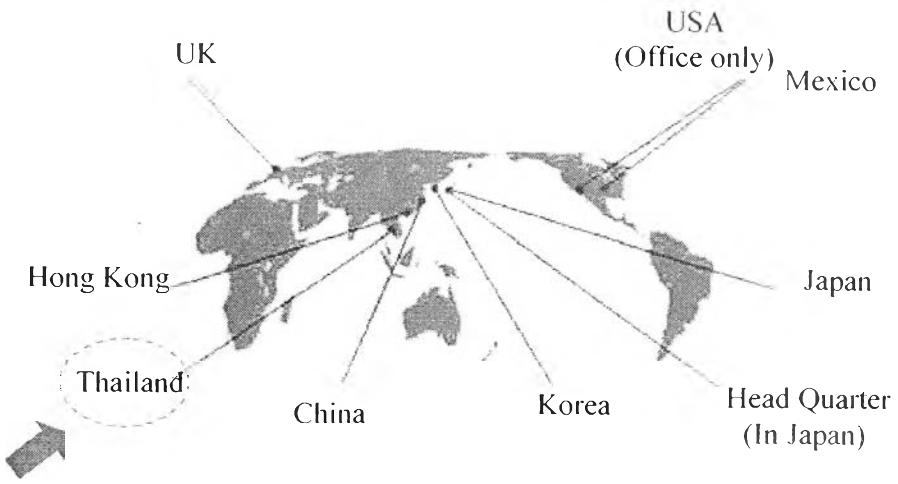
Chapter 3

Background Analysis of the Case Study

In the previous chapter the author discussed the background to Product Data Management and related some of the issues in implementation, benefits, difficulties, and success. A definition of Product Data management was offered which identified the functional areas of Product Data Management – Lifecycle product documentation; Access and control mechanisms; Engineering support – and how they need to be adapted to meet the needs of a particular organization. This chapter will look in detail at the practical implementation of Product Data Management. A focus is to analyze the need of the case study, define problem, and then develop design criteria.

3.1 Background of the Case Study



The case study of this thesis is conducted at the company's manufacturing site in Thailand.

Figure 3.1: Corporate Global Network of the Case Study

It is well-known that electronics industry is both the youngest and has most far reaching implications for the future economic evolution. The boom started since the development of transistors in the Bell Telephone Lab in 1948, which followed by the second major innovation of the integrated circuit (IC) in 1950s. Then microprocessors were invented in 1970s as the third major innovation. The increasingly pervasive application of electronics made the industry and its product data of significant.

From Figure 3.1 the company in the case study is a leading electronic components manufacturer with a worldwide network. The case study of this thesis involves the standard time estimating process for power supply units, which is responsible by the Engineering department of the company's manufacturing site in Thailand.

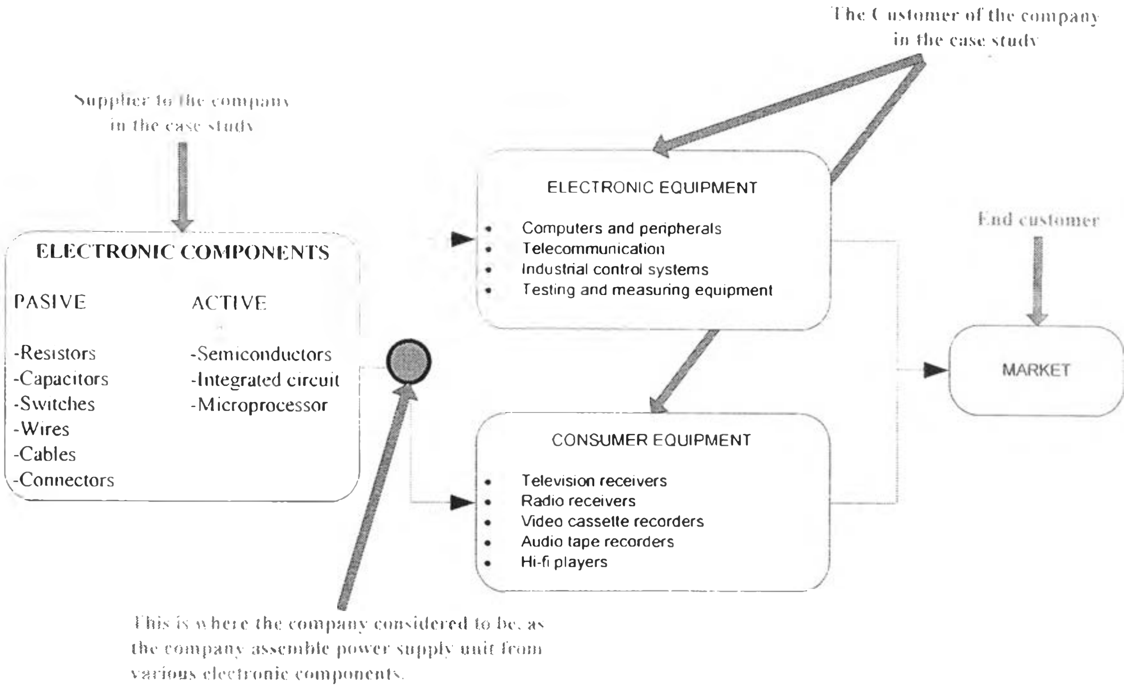


Figure 3.2: Company's Positioning in the Electronics Production Supply Chain

Source: Adapted from Lu D. (2001. *Supply Chain Management*)

From Figure 3.2 the company of the case study is considered to be the assembler of power supply unit putting together electronic components (raw materials) from various electronic sources (suppliers) to meet specific customer's design and specification, for this reason the company is operating in an assembler-to-order production system. There are two types of customers that order PSU from the company: first type customers are from the semiconductor industry, where as the other type is consumer electronic industry. The production of the latter consumer type is much more widely spread than that of the former due to the potential growth of developing countries in the East and Southeast Asia, which made Thai factory a large manufacturing site involving high capital and production capacity. Since the standard time estimated values are used in price quoting and production planning, this therefore made the study in this area of significant to the company.

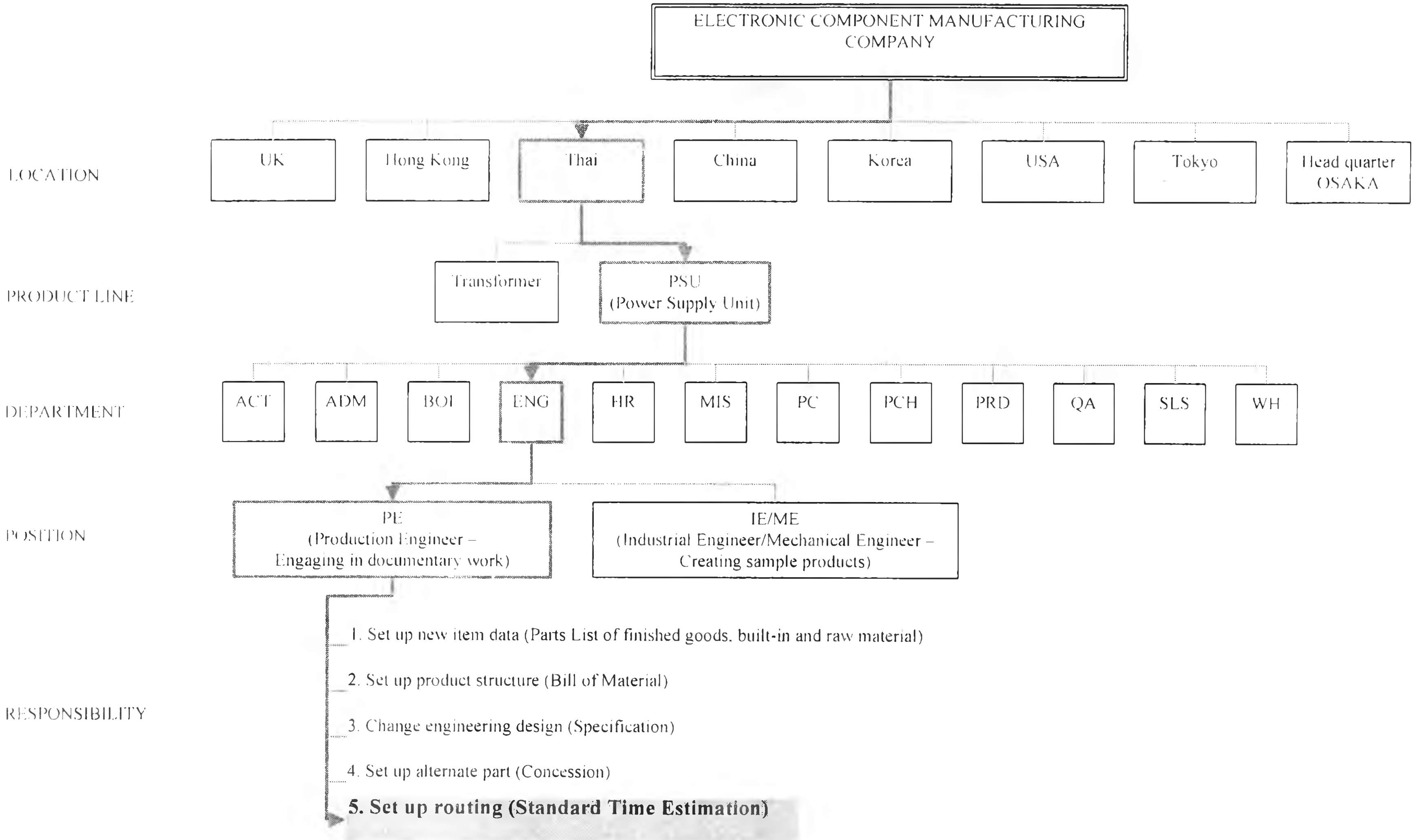


Figure 3.3: The focus area in this case study

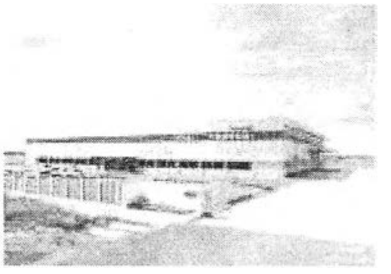
3.1.1 Corporate Level

1925	The sale of silicon lamination cores and cores for radio started.
1939	Manufacturing of cores for radio started.
1949	The company's brand of transformers was introduced to the market.
1952	Manufacturing of transformers for television started.
1966	A factory in Okayama, Japan, was established
1967	A factory in Tochigi, Japan, was established
1969	Manufacturing of transformers for microwave oven started.
1972	A factory in Korea was established.
1976	Manufacturing of power supplies started.
1981	A factory in the Yamagata, Japan was established.
1985	A factory in the United Kingdom was established.
1986	A factory in Mexico was established.
1987	***A factory in Thailand was established.***
1990	A factory in Hyogo, Japan, was established.
1995	A factory in China was established.

Figure 3.4: Corporate Milestones of the Case Study

Founded in 1925, practically starting from zero, the founder of the company in the case study has steadily expended his business with creative ideas, determined effort, and a courageous spirit. It is the cutting-to-dimension of silicon steel plating and the production of iron cores for radio manufacturers that determined the course of business in later days. With an insight into the trends of the times, the company has been successful because of the rigorous control over all aspects of its products, from quality, shape, and quantity, to delivery date. His once small sales business in Japan is now an electronic component manufacturing corporate with global network of manufacturing, service, and sales worldwide. This large corporate have its Head Quarter in Japan and manufacturing sites in Thailand, China, Korea, Japan, UK, and Mexico.

3.1.1.1 The Manufacturing Site in Thailand



Business Type:	Manufacturing and sales of transformer and power supply unit
Location:	Situated on the outskirt of Bangkok, Thailand
Establishment:	25^{th} December 1987
Capital:	approximately 100 Million Baht
Employee:	approximately 2,100 employees
Plant:	Land 33.000 SQM, Building 8,380 SQM (20,655 RAI)

Figure 3.5: Profile of the Manufacturing Site in Thailand

The nature of the business is an assembler-to-order company of highly customized electronic components. The key factor to this business is to be agile (refer to Section 2.1.3) in today's electronics market provided that employee welfare and company's profits is not deteriorated.

The case study is conducted at the manufacturing site in Thailand. From Figure 3.5, this site involves in large production with over two thousand employees and having high capital investment. Appropriate standard time is hence very important to the relationship between the company's employees and employers. If the standard time is unfair, then it could create tension between labor and management. Also, if the standard time is not accurate, then the product costing could be affected. Moreover, if the company can not propose the price quotation on time for the bidding then the company could potentially lose the bid to the competitors. All in all this could impact the factory's sales and profit. Therefore, author sees the importance in providing fast and consistent standard time estimation as it contributes high profit margin to the company.

3.1.2 Business Level

The company of the case study manufactures customized electronic components within two major product lines: transformers and power supplies, as shown in Table 3.1.

Table 3.1: Principal Product of the Company in the Case Study

Division	**Principal Products**	**Use**
Transformers	• Power transformers • Switching transformers • Harmonics current noise regulated reactors • High-voltage transformers • Power factor corrective reactors	• Digital AV equipment • Information and communication equipment • Mobile equipment • Kitchen and air conditioning equipment • Amusement equipment • Environmental systems
Power Supply Units	• Switching type power supply units • Inverters for projectors • AC adapters • Chargers • Inverter units	
Other	• Assembly of various machinery • Raw materials • Etc.	

3.1.2.1 The Power Supply Unit (PSU) Division

From the division sales recorded in the table below it is clearly seen that the total sales revenue of Transformers combined is 36.4 millions US dollars, which is approximately 3 times less sales than the Power Supply Units (PSU) at 115.1 millions US dollars. The total sales of power supply units can be broken down into two parts: the consumer power supply units and industrial. With respect to consumer power supply units, sales of power supply units for LCD projectors, solar power generators, and game machines increased, and as a whole, sale of consumer power supply units increased 50.7% (150.7) when compared to the previous year. On the other hand regarding the industrial power supply units, sales of power supply units for office automation equipments increased, but sales of power supply units for communication equipment decreased. As a result, industrial power supply units as a whole decreased 2.8% (97.2) compared to the previous year. The total sales revenues of both consumer and industrial power supply units have increased by 35.4% in respect to the previous year. Above all transformers constitutes 22.3% of the total revenue, where 70.5% came from power supply units and the other 7.2% came from sales of other products.

Table 3.2: Division Sales in 2003, at the end of March

Product	Sale Revenue (in millions of US$)	Comparison with previous year (%)	Composition Ratio (%)
TRANSFORMERS:			
Consumer	26.1	94.5	16
Industrial	10.3	105.8	6.3
Total	**36.4**	**97.5**	**22.3**
POWER SUPPLY UNITS:			
Consumer	102.6	150.7	62.8
Industrial	12.5	97.2	7.7
Total	**115.1**	**142.2**	**70.5**

The nature of a PSU, the focused products in this thesis, is an electronic component required high engineering content and rather complex to manufacture and also have short product life cycle. Despite that, the main source of company's profit is considered to have come from the increase in the sales of power supply units. Therefore, if there should be an investment at all, it is to be in the area of PSU in order to maximize efficiency of production output. So improvement in the standard time estimation process for this thesis is prioritized at PSU.

3.1.3 Functional Level

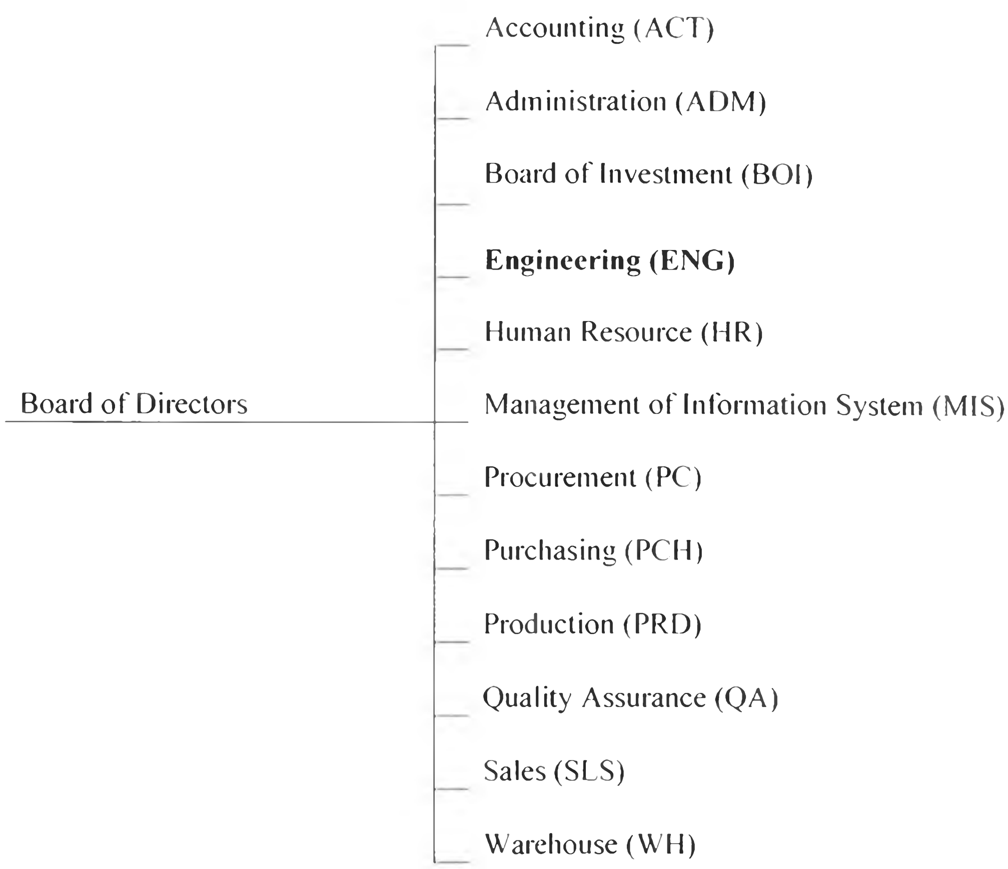


Figure 3.6: Organizational Chart of the Thai Factory in the Case Study

Under the PSU Division, there are many departments in the factory as shown in Figure 3.6. The Engineering department is the essence of the advancement in technology and innovation. It engages in process planning activities such as inspecting of local raw materials, controlling of documentary work, creating sample products, and estimating manufacturing standard time. Standard time is the end result of process planning.

The company in the case study quotes manufacturing costs based on manufacturing standard time estimation before actual production is begun. The manufacturing standard time estimation is therefore significantly important to this assemble-to-order company's profit and sales. The case study of this Thesis concerns the engineering's function of estimating standard times.

3.1.3.1 Manufacturing Standard Time Estimation

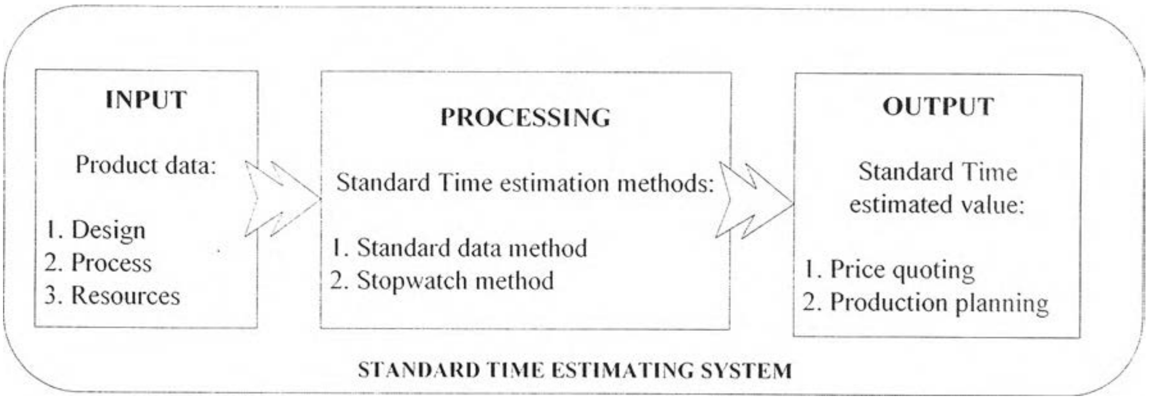


Figure 3.7: Standard Time Estimation Model

Manufacturing standard time estimation is one of many subsystems in the whole corporate system. As illustrated in Figure 3.7, before the standard time can be estimated complete product data are needed: first, the technical description of how to make the product must be clear; secondly, the necessary knowledge about the manufacturing systems and technologies available at the factory; and finally, the ability to realize the market regarding applicable raw materials and semi-finished goods. All of these contribute to the estimation of standard time, which there are two methods in finding: first, the engineers make use of the pre-defined value that are found through the table of reference and if still the value cannot be found they are required to carryout a much more complicated method, which is to get down on the shop floor and measure the time through the use of stopwatch. Once the standard time values are found they can be used in the price quotation process, to propose fast and accurate processing time as well as to allow the production engineers to plan ahead the production.

3.2 Current Situation in the Case Study (System)

Despite great capabilities and the technologies presence within the engineering department, there exist problems that are currently working against the engineers limiting the efficient to perform usual tasks, thus long standard time estimation process (usually 3-4 days). Further analysis on the current situation would help gain better understanding of the current situation and the problem the persisting problems.

Regarding the standard time estimation process, currently, the engineers have their own ways of estimating the standard time for the product model, which is somewhat disorganized since the standard estimation procedure has not ever been established to which can be followed as the standard approach. Instead the engineers often estimate new product model by scanning and recalling through the memories of the past products data of similar specification and design that they once came across. This approach imposes inconsistent estimation of the standard time for the product. There are hundreds and thousands of products data going by engineers everyday and it would take a lot of thinking to recall all the numbers from the back of their head, which is why the engineers do rely on the another source of data. Often the engineers cannot memorize all the little details, which is why they do also refer on the documents that are kept in the cabinets and going through a pile of documents certainly not an easy job. Beside the file cabinets if the design data remains unknown, the next best approach that they do is to browse through suppliers' website for exact or similar design. Above all these three approaches if the product data still unknown then there is a need to contact engineers at the head-quarter in Japan for reference.

It is a long process that most engineers have to go through once, twice or as many times as such a procedure remains. The current procedure is hardly efficient and very little chance that it would be effective. Further concern as the consequence of the current procedure is that the knowledge do often leave the company with the engineers had they resigned. Since there are no written procedures engineers often discover ways and techniques through experience, which is risky when they leave the company because that would mean all of the knowledge and expertise also gone out of the company, hence extra learning time must be given to the newly recruit engineers. Therefore it is important to reorganise the way things presently are done in order to improve both efficiency and the effectiveness of the time estimation.

3.2.1 Analysis of Business Requirement (Output)

1) Case Study Need: faster estimation and more consistent estimated value

Due to the electronics industry nature of the case study, what the company need is to be able to access data more quickly, which shall have a consequent benefit upon the standard time estimation as it can be done more quickly and yet result in a consistent standard time estimated value. Fast and accurate standard time estimation can benefit price quoting and production planning purposes before the actual production is begun.

2) Case Study Problem: long estimation time and subjective estimated value

As has already elaborated in the previous section, currently the product data in the case study is too complex and lacking of discipline which has an impact on the efficiency of outcome namely long lead time at finding data and subjective values, on standard time estimation process. From this information author has carried out a Cause and Effect analysis in search for root cause, which was conducted together with engineers listing all the possible causes to the effect, this is illustrated in the following page Figure 3.8. The root cause was found and came down to one factor, which is Procedure since it is at present carried out manually and data are recorded in the old media form (paper) this can be very tiring when there are thousands and thousands of data documented in the file cabinet. The entire situation is summarized below please refer to Table 3.3.

3) Solution Criteria for the Case Study: more simple and standard estimation process

The requirement analysis indicates that to meet the case study need, the solution for the case study should make standard time estimation simpler and more standard.

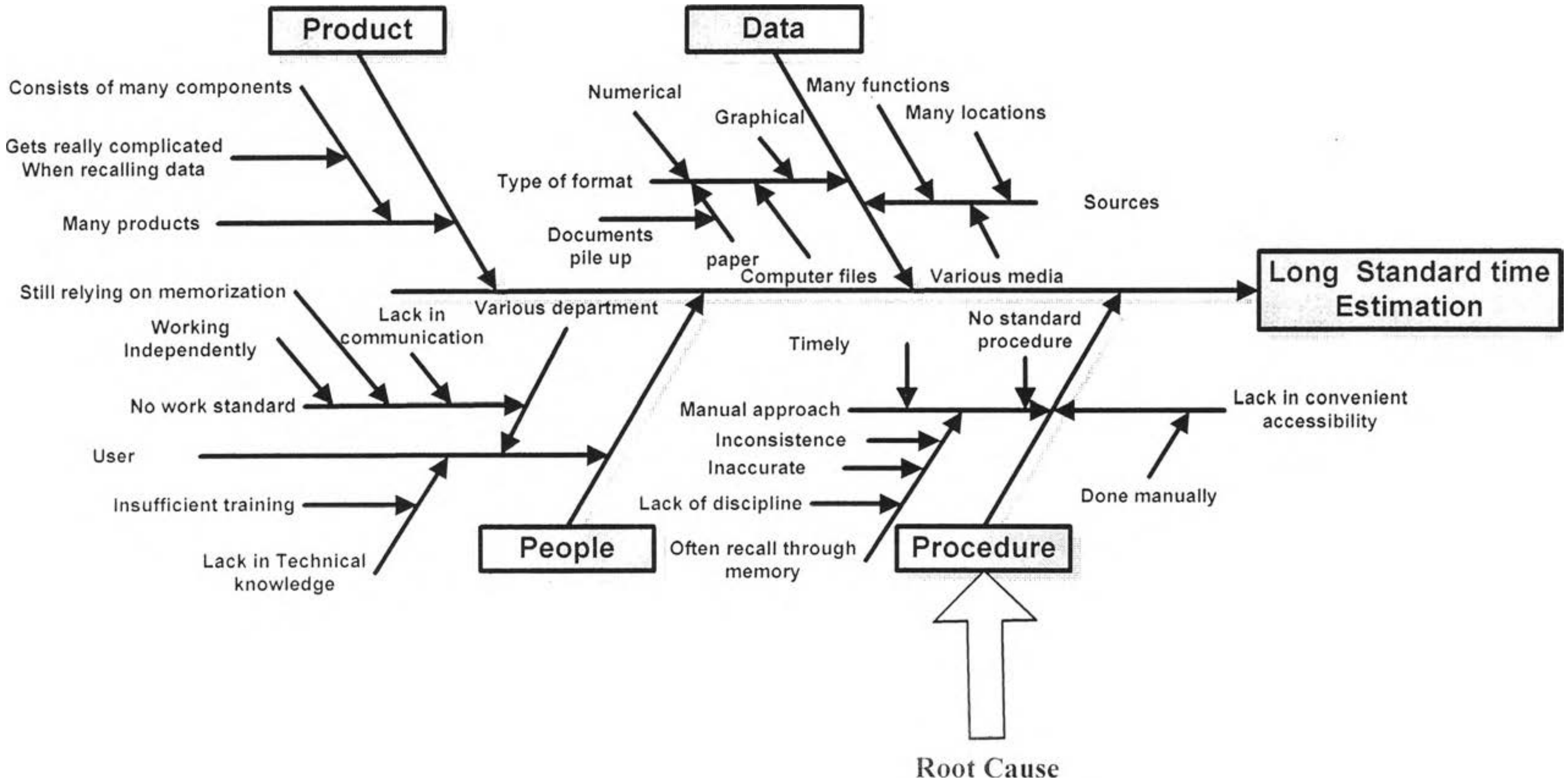


Figure 3.8 Cause and Effect diagram revealing current situation

Table 3.3: Business Requirement Analysis

Current Working Practice and Procedure	1. Memorizing	2. Cruising Documents	3. Searching through Internet	4. Head Quarter
• Confidentiality issue • Integrity issue • Availability issue	• Memorization although gives fast data but data can also be lost if the engineer in the future quit or forget N.B. there is no record of data on paper but in brain	• Although may take longer time to find data than memory but documented data may stay with the company longer than data recorded in memory of the engineers. The data may exist but can not be found or possibly the data may not had been documented at first. • But as data amount increase and changes is inevitable. some data may lose control using the manual document control approach – lose lifecycle & access control easy N.B. data is on paper	• Take longer time searching net compared to cabinets but data may be or may not be available through the supplier's web site N.B. do not have necessary data within the company so look outside the company e.g. internet	• Take longest time due to distance and language barrier N.B. data is at the Engineering department Head quarter in Japan

Step 1. Analyze Need (see Fig 3.7) To increase sales and profits, standard time estimation process should be fast & gives consistent standard time estimated value The problem lies in that complete product data is needed (which are design data, process data, resource data, time data) before the estimation can begin	**1. Design Data** Need the description of the product about the technical system to be made	**2. Process Data** Need knowledge about the manufacturing systems and technologies available in the particular factory	**3. Resource Data** Need recognition of the markets regarding raw materials and semi-finish goods	**4. Standard Time Data** Need application of standard time estimation method
Step 2. Define Problem From the analysis of Current Situation (also refer to Fig 3.8 Cause and Effect diagram) the root	**1. Lack of manufacturing knowledge**	**2. Lack of work experience at this particular factory therefore dependent on detailed design description**	**3. lack of structured mapping between design and production**	**4. Lack of contextual integrity**

cause lies in the Procedure factor, as it is manually done and it is starting to become ineffective and standard time estimate becomes too subjective.				
Step 3: Develop Design Criteria From Current Situation the company realizes the problem and therefore needed to solve and prevent future occurrence. Importantly, the solution should make the standard time estimation process more simple and standard.	**1. Capable of Managing Knowledge** The solution must be able to support other engineers so that the knowledge and expertise remains within the company in case one day the only person who knows how to calculate standard time leave the company	**2. Capable of Managing Data** The solution must reduces data complexity and able to handle future increasing amount of data.	**3. Simple Procedure** The solution must be simple (not to increase work load)	**4. Standard System** The solution must provide standardized method

3.2.2 Analysis of Standard Time Estimation Method (Process)

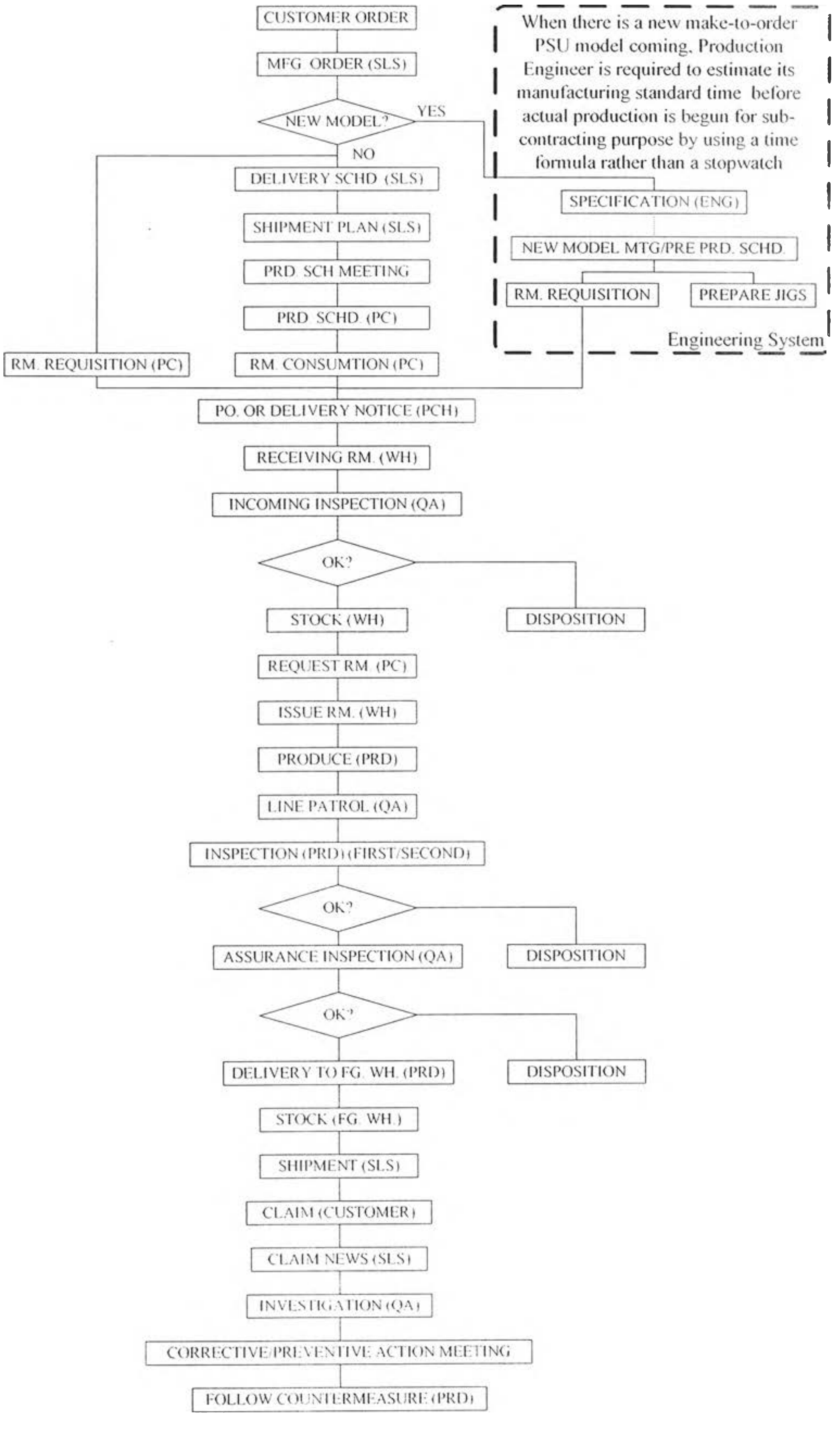


Figure 3.9: Business Process of the Case Study

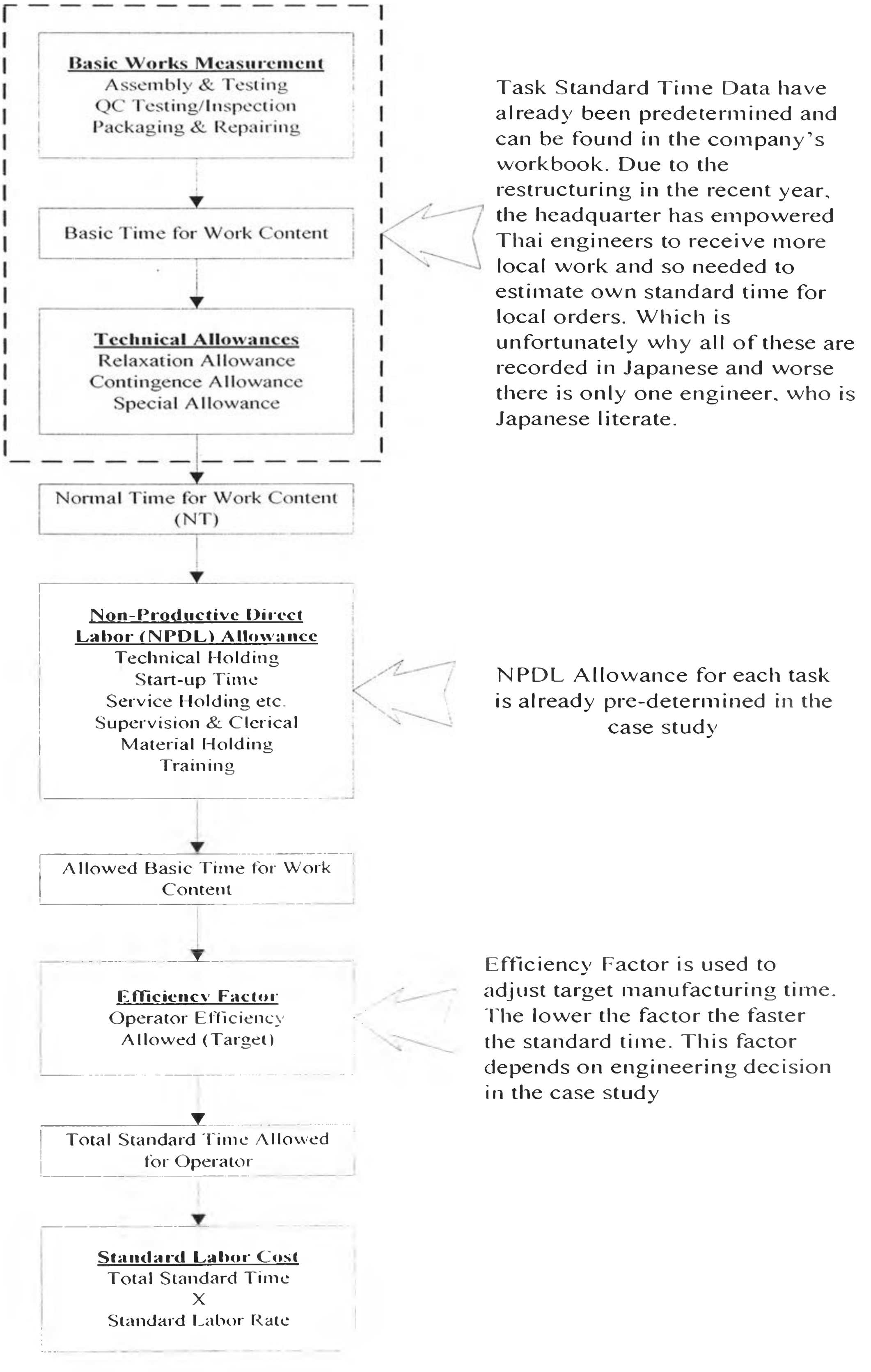


Figure 3.10: Standard Time Estimation Process in the case study

The Figure 3.9 illustrates the business process of the case study to give the overview of how the business is run and show major functional units that are involved with the manufacturing side of the business. Since the beginning, customer places order with the Sales department, who will check against the company past records whether or not the specific product model already exist on the company's data. If not exist, Sales department then past on the order to Engineering department who shall interpret technical aspects such as: design, process, resource, and time, all of which are relevant to determine manufacturing cost in order to pass back the cost information to the Sales department, who shall calculate the overall product cost then quote back in response to customer order. Product cost is given by:

PRODUCT COST = MATERIAL COST + MANUFACTURING COST + OVERHEAD COST
MFG STANDARD COST = MANUFACTURING STANDARD TIME x LABOR RATE
MANUFACTURING STANDARD TIME = (NORMAL TIME x EFFICIENCY) x (1 + ALLOWANCE)

As shown in Figure 3.10, the manufacturing cost needed to find is based on a manufacturing standard time. This manufacturing cost may also be referred to as direct labor cost; the case study is using these terms interchangeably. During the sub-contracting phrase, as mentioned in Chapter 2 Section 2.2, there are two ways in going about capturing time, which are categorized as:

1) Stopwatch time-study method based on the use of timing device
2) Standard time data method base on historical production data

Given the nature of the company in the case study is customization and so there should be no production forward until the deal was agreed with the customer, which is why the first method is inapplicable since there is no actual production in progress for such stopwatch to be used. Although, the company could insist on a trial production but producing electronic component is complex to produce and time is a key competitive factor in electronics industry. This implies, it is rather not physical, economical, and financial feasible for the case study to employ the stopwatch method during the early sub-contracting phrase. The focus of the thesis therefore should aim at better utilizing the task standard time data to predetermine standard times, because the method is currently being employed and already appropriate to the case study's nature.

3.2.3 Analysis of Product Data (Input)

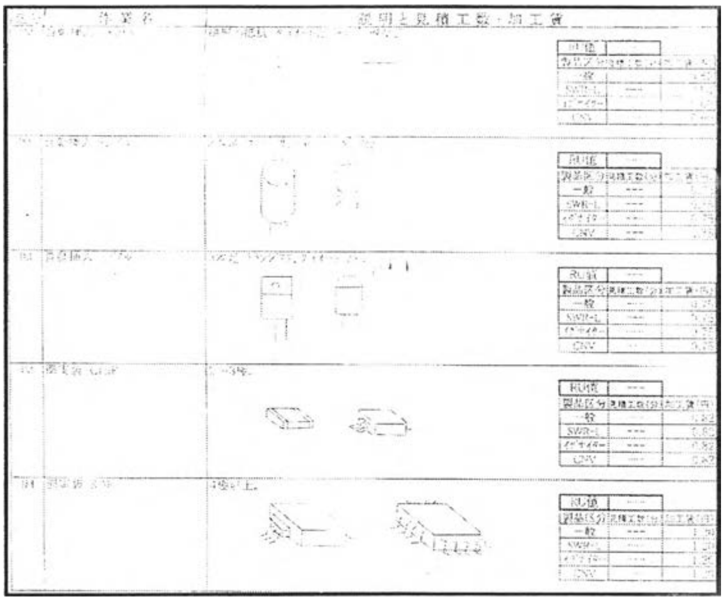


Figure 3.11: A Sample of Standard Time Data Table

As based on Figure 3.10, once the analyst summarizes all tasks required to perform PSU assembly properly. Then, the rated times in RU (1RU = 0.001 minute) for each task are determined from the methods-time data tables as shown above in Figure 3.11 which is a Sample of Standard Time Data Table. Then the analyst sum up times in RU of each task in order to arrive at the overall Normal Time (NT) for work content. The outcome is then multiply with the Target Efficiency Factor to arrive at Allowed Basic Time for Work Content, however, since there shall be break time it is then to be multiplied with the Non-Productive Direct Labour allowance, NPDL.

Using the standard time data method for sub-contracting purposes, without clear defined of manufacturing standard time, manufacturing cost cannot be estimated and subsequently manufacturing standard time cannot be established prior the process plan is established, and process plan cannot be completed without product data. Therefore, the ability to establish standard time during the sub-contracting phrase, other factors must also be found before an actual production. The current problem lies in that such complete product design information and process plan must be available before an estimate can be computed during such phrase. This is where the historical product data, both in a tangible or intangible form, should come into play.

3.3 Proposal of Solution

It is proposed that, firstly, individual know-how in standard time estimation be documented and, secondly, standardized in the form of a database so that the whole group can share information. By doing so, all people involve in standard time estimation can improve their operational efficiency. An enable is needed to convert individual knowledge to group and organizational knowledge. Professor Ikujiro Nonaka, who developed the original concept of Knowledge Management, called it "Externalization." There are 4 enablers which are leadership, the learning organization, information technology, and the measurement system. According to Asian Productivity Organization (2002, *Knowledge Management: a Key for Corporate Competitiveness*), Professor Ikujiro Nonaka suggested that the enabler required to promote the horizontal deployment of knowledge is Information Technology.

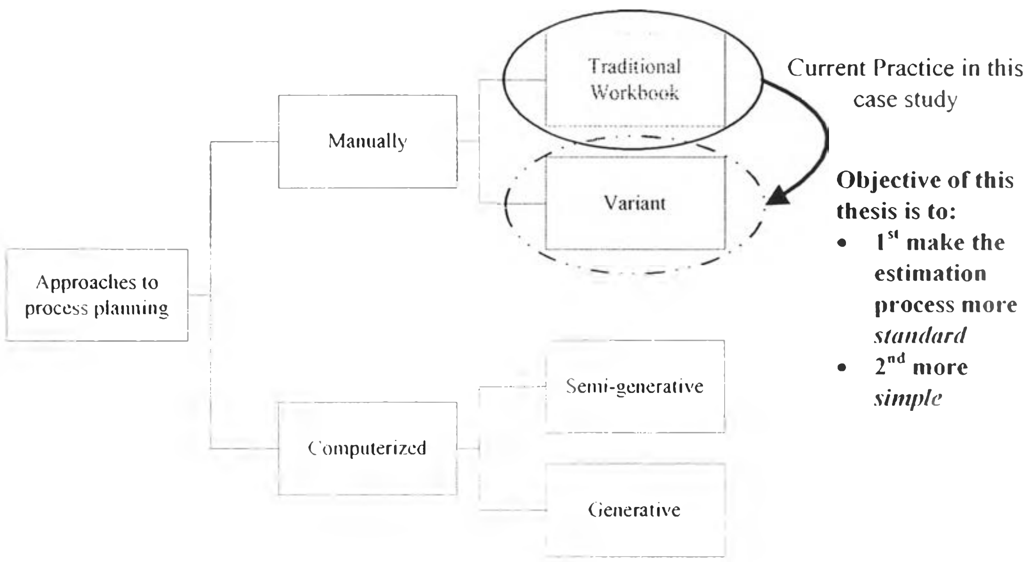


Figure 3.12: Alternatives and Selection of a Process Planning Approach for the Case Study

Since standard time calculation is often the end result of a process planning activity, it is important to first evaluate the process planning approaches and select the best one for the standard time estimation in the case study. Due to in the nature of the business and product of the case study is as follows:

- Product design is relatively stable
- Lot size is medium to high
- Part size variations within a family are minimal
- Material type is the same for all the family

As a result and also refer back to Section 2.4, among the four alternatives shown in Figure 3.12, the variant process planning approach (VPP) is selected. It is the more feasible solution to the case study than doing nothing or employing the generative process planning (GPP).

Stage 1: Preparation of Product Data to Facilitate the Estimation of Manufacturing Standard Time (Further Detail in Chapter 4)

1) **Standard Process Plan Preparation** – transfer manufacturing knowledge onto a formal document by providing more detailed description of the technical system to produce a PSU.

2) **Part Family Formation** – reduce dependence on design description every time a new PSU model comes in by providing a quick part routing guideline developed based on knowledge about the manufacturing systems and technologies.

3) **Part Coding** – create structured mapping between component design and production by providing a key to supplier information to fasten recognition of the markets regarding raw materials and semi-finished goods.

4) **Management of Product Data** – increase speed and consistency in standard time estimation process by providing simple and standard application.

Stage 2: Development of Database Management System to Support the Estimation of Manufacturing Standard Time (Further Detail in Chapter 5)