CHAPTER 4

PROCESS IMPROVEMENT OF MOBILE TYPE APPROVAL

This chapter explains how the Marketing's expectation and need is collected. It is followed to the methodology of Quality Function Deployment (QFD) phase 1 that states in the chapter 2. House of Quality is created in order to develop technical responses and prioritize them as the customers' requirement. And the following of this chapter shows how the Business Process Improvement (BPI) concept is applied in this case company. New plan is created and implemented in the mobile type approval process in order to improve timing and efficiency of the process. Data is collected during the implementation also.

4.1 House of Quality and setup development team

House of Quality (HOQ) or Quality Function Deployment (QFD) phase 1 is the method that is used in this research to improve the mobile type approval process. It consists of the customer's wants and needs in the left side, the development team's technical response at the top, and other matrices joined together to show the relationship and give some information in order to make decision in developing products or services. It consists of 6 main section; A to F. Each section contains information for process development team (QFD team) to understand and plan for new product, service, or process. The figure of House of Quality (HOQ) is shown below.

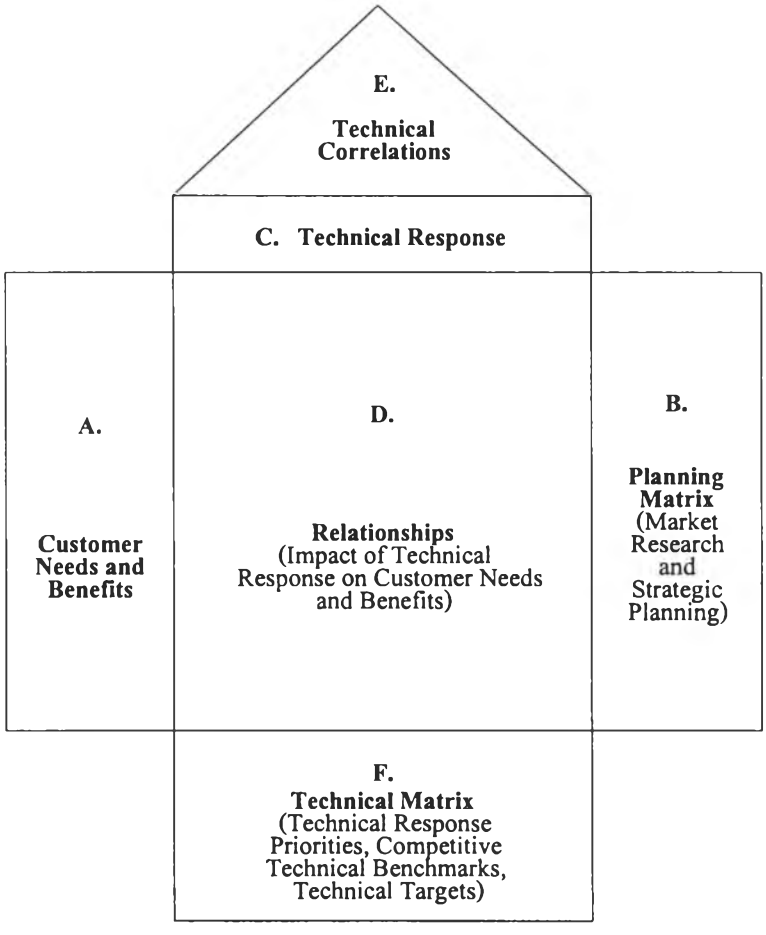

Figure 4.1 The House of Quality

Section A (Customer Needs and Benefits) contains list of customer needs and benefits that brings from market research, customer survey, and focus groups. This section aims to understand what the customer really wants and needs in the product, service, and process. Normally, this list will be in form of tree diagram.

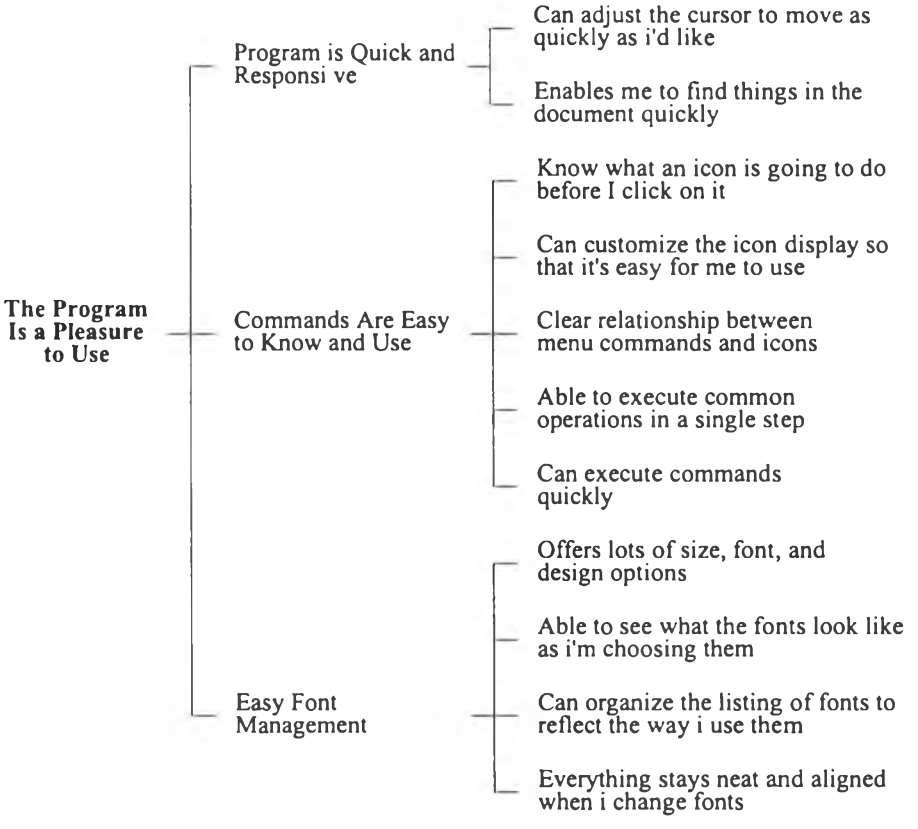

Figure 4.2 Tree diagram

Tree diagram is a hierarchical structure of ideas that is built from the top down. The development team or QFD team has to examine the information from market research, customer survey, and focus group. It starts from the highest level (or the most abstract) to the lower level (or in detail). From the example above, 'The program is a pleasure to use' is the highest level of customer wants and needs in Word Processor, then it is divided into 3 main aspects: 'Program is quick and responsive', 'Commands are easy to know and use', and 'Easy font management'. And each of these 3 main aspects is also divided into minor aspects.

Section B (Planning Matrix) contains three main types of information: Quantitative market data, Strategic goal, and Computations for rank ordering. Quantitative market data are the information about the relative importance of customer wants and needs, and the customer's satisfaction levels in the company's and competitors' product or service. Strategic goal is the company's setting goal for the new product or service. And the last one is Computations for rank ordering of the customer wants and needs. All of this information comes from doing Market Research and Strategic Planning.

Section C (Technical Response) contains the high-level technical description of how to develop the product or service as the customer wants and needs in Section A. It is translation of what the customer requires into how we (development team) measure. This technical response should be objective measurement and testable also. But it should not be the technical solution for the customer requirement (customer wants and needs).

Section D (Relationships) contains the strength of the relationship between each element of the customer wants and needs (customer requirement) and the technical response. One technical response can affect more than one customer requirement. And in one technical response, it may have affect with one customer requirement more than another customer requirement. So three symbols are used: Double Circle, Circle, and Triangle. Double Circle represents strong relationship. Circle represents medium relationship. And Triangle represents weak relationship. In addition, development team is the group who determines the strength of each relationship.

Section E (Technical Correlations) contains the interrelationships between each elements of the technical response. It is half of a square matrix and shows in the shape like the roof of a house. This matrix establishes the potential conflicts among the technical response to be found early in the planning stage. Four symbols are used in the matrix: double circle, circle, X, and double X. Double circle represents strong positive of interrelationship. Circle represents positive of interrelationship. X represents negative of interrelationship. And double X represents strong negative of interrelationship. In this section, development team has responsible for assessing interrelationship between each elements of the technical response.

Section F (Technical Matrix) contains three main types of information: Computed rank ordering of the technical responses, Comparative information on the competition's technical performance, and Technical performance targets. Computed rank ordering of the technical response is the rank order that calculate from rank order of customer requirement in Section B and the relationships in Section D. For the other two type of information, the development team has responsible for collecting the information. Then they compare the competitor's performance and set the technical performance target.

- Setup development team

However, the first step before creating House of Quality is to setup development team (QFD team) and develop training for them to understand the concept and method of QFD. This team should compose of a number of experts in each field of the process. For process improvement of Mobile Type Approval, the team members are:

1. QFD project leader
2. Import Operation staff
3. Marketing staff
4. Service Center staff
5. Network engineer
6. Handset engineer
7. SIM Operation engineer

Besides, creating House of Quality is divided into 8 steps as follow:

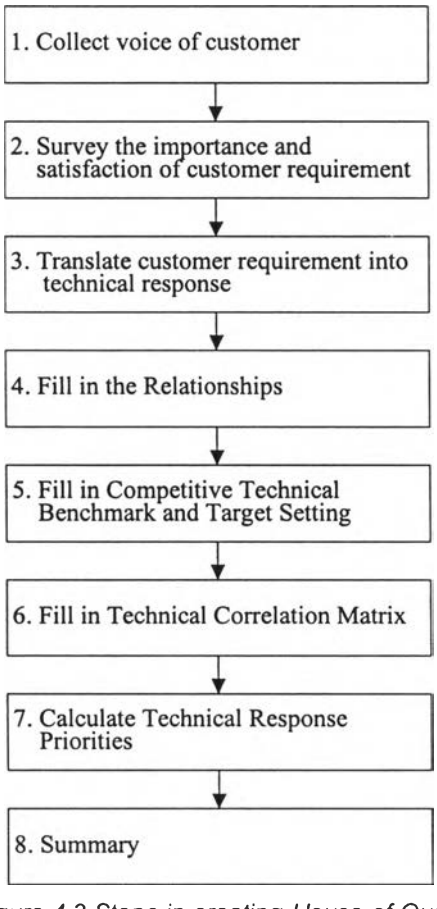

Figure 4.3 Steps in creating House of Quality

4.1.1 Collect voice of customer

Questionnaire is technique that used to collect the voice of customer. There are four questionnaires in this research. Questionnaire no.1 and no.2 are used for collecting the voice of customer. The sample of them are in the appendix J and K. Each one has different objective.

Questionnaire No. 1 has objective to survey the customer's idea about doing type approval of mobile phone before importing into the country. Target group is the officer of private company in Bangkok area. In the questionnaire, it consists of three sections: section 1 is about personal information, section 2 is about general information and doing mobile type approval before importing, and section 3 is about suggestion for improving the mobile type approval process.

Questionnaire No. 2 has objective to survey the customer wants and needs (requirement) in mobile type approval process. Target group is the marketing officers who take care about importing and planning to launch the new model of mobile phone in Thailand. This questionnaire consists of three sections: section 1 is about personal information, section 2 is about the requirement in testing mobile phone and problem occurred with mobile phone, and section 3 is about suggestion for improving the mobile type approval process.

4.1.1.1 Result from questionnaire no. 1

Totally there are 100 questionnaires distributing to the officer of private company in Bangkok area. And there are 81 questionnaires return to the researcher. This questionnaire is aimed to survey the customer's idea about doing type approval of mobile phone before importing into the country. However, the data is collected and shown in three section as follow:

Section 1 Personal Information

In this section, there are 4 questions about gender, age, education, and salary. For age, it is divided into 4 intervals: below 25 years, 26 to 30 years, 31 to 35 years, and more than 35 years. For education, it is divided into 5 levels: 2 years-diploma, 4 years-diploma, Bachelor, Master, and Ph.D. For salary, it is divided into 5 intervals: below 6,000 baht, 6,000-10,000 baht, 10,001-15,000 baht, 15,001-20,000 baht, and above 20,000 baht. All of these 4 questions aim to study the personal information of the persons who answer the questionnaire. From the questionnaire no. 1, it is found that

Question 1. Gender

Male	25	(31 %)
Female	56	(69 %)
Total	81	(100 %)

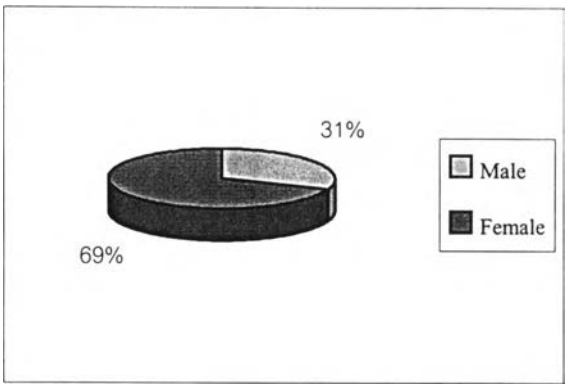

Figure 4.4 Gender of persons who answer the questionnaire no.1

Question 2. Age

Below 25 years	42	(52 %)
26 to 30 years	30	(37 %)
31 to 35 years	7	(9 %)
More than 35 years.	2	(2 %)
Total	81	(100 %)

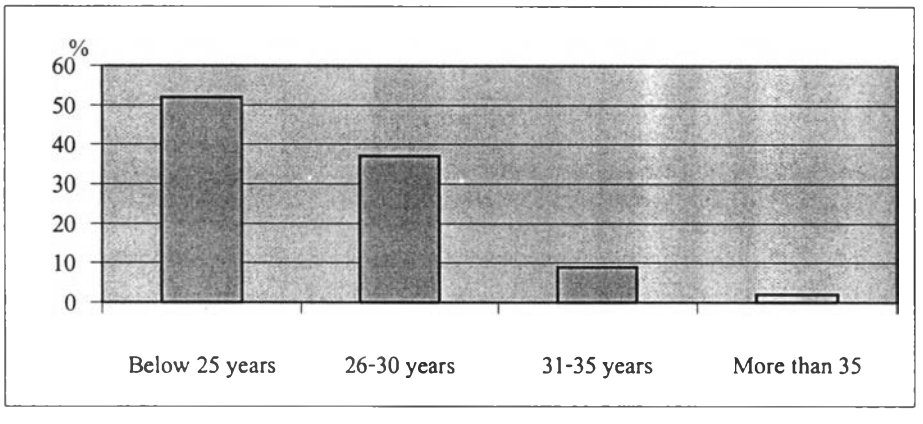

Figure 4.5 Age of persons who answer the questionnaire no.1

Question 3. Education

2 years-diploma	2	(2 %)
4 years-diploma	11	(14 %)
Bachelor	65	(81 %)
Master	2	(2 %)
Ph.D.	1	(1 %)
Total	81	(100 %)

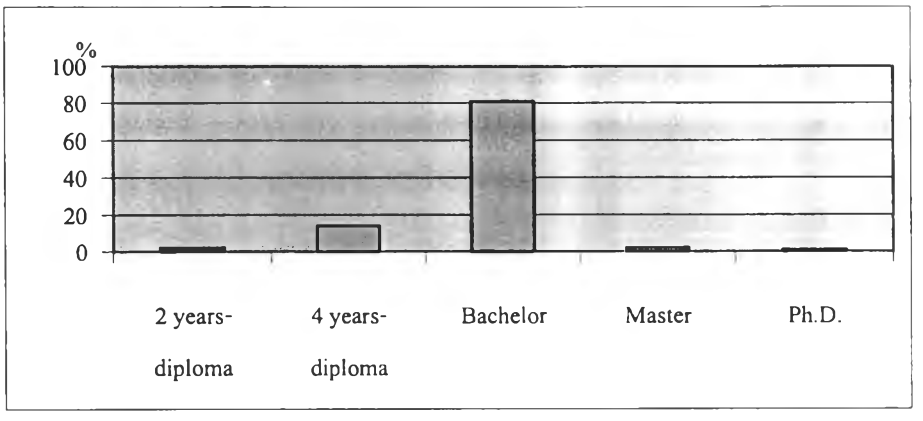

Figure 4.6 Education of persons who answer the questionnaire no.1

Question 4. Salary

Below 6,000 baht	10	(13 %)
6,000-10,000 baht	40	(49 %)
10,001-15,000 baht	20	(25 %)
15,001-20,000 baht	6	(7 %)
Above 20,000 baht	5	(6 %)
Total	81	(100 %)

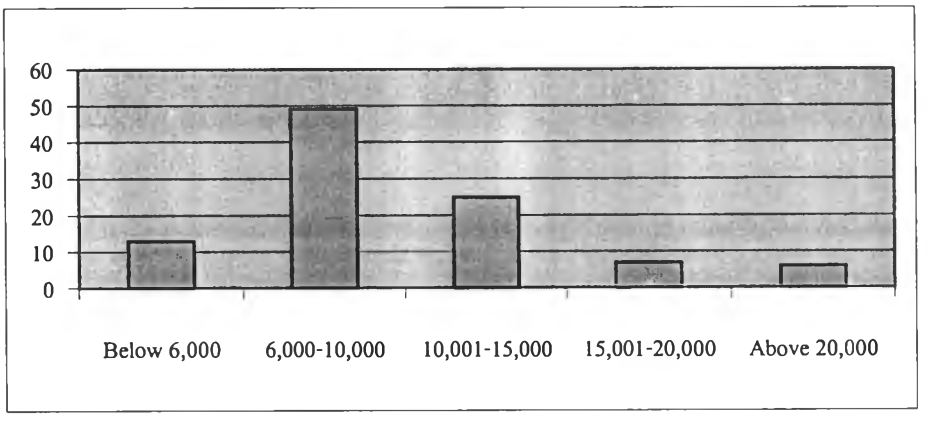

Figure 4.7 Salary of persons who answer the questionnaire no.1

Summary of Section 1 (Personal Information)

Persons who answer the questionnaire are female more than male (female 69% and male 25%). Mostly they are not more than 30 years old (Below 25 years – 52% and 26 to 30 years – 37%). Their education is mostly Bachelor degree (81%) and the salary is about 6,000-15,000 baht (6,000-10,000 baht – 49% and 10,001-15,000 baht –25%).

Section 2 General information and doing mobile type approval before importing

In this section, there are 14 questions. Mainly, the researcher aims to collect the general information about mobile phone that the customer is using, and what they think about doing type approval before importing. From the questionnaire no.1, it is found that

Question 1. Are you using mobile phone?

Yes	42	(52 %)
No	39	(48 %)
Total	81	(100 %)

Question 2. Which system do you use?

Cellular 900	1	(2 %)
Worldphone 800	3	(7 %)
Digital GSM	34	(81 %)
Worldphone 1800	4	(10 %)
Hello 1800	0	(0 %)
NMT 470	0	(0 %)
CDMA	0	(0 %)
Total	42	(100 %)

Question 3. Why do you choose that system?

Reputation	18	(15 %)
Quality of system	29	(24 %)
Quality of mobile phone	9	(7 %)
Low cost of service	2	(2 %)
Low cost of mobile phone	3	(3 %)
A lot of value added services	21	(17 %)
Large coverage area	25	(21 %)
Promotion	13	(11 %)
Total	120	(100 %)

Question 4. How much do you satisfy with each elements of mobile phone?

*** Data collecting from the questionnaires is shown in appendix N

Transmit & Receive signal	1.10
Quality	1.05
Software	0.66
Feature	0.85
Extra feature	0.66
Using with SIM Card	0.93
General usage	0.95
Durability	0.98
Using value added service	0.59
Standard	0.93

Question 5. In your opinion, how much you give important to each topic in making decision to buy mobile phone?

*** Data collecting from the questionnaires is shown in appendix N.

Promotion	1.32
Price	1.46
Reputation of operator	0.98
Brand name	1.02
Product	1.20
Quality of system	1.54
Quality of mobile phone	1.41
Feature	1.17
Standard	1.39
User friendly	1.15
Value added service	0.98
Coverage area	1.76
Durability	1.37
Convenience to buy	0.88
Advertising	0.63
Sale person	0.93
Warranty	1.44
Manufacturer	0.88
After sale service	1.83

Question 6. Who has the most influence in making decision to buy mobile phone?

Family	11	(27 %)
Folk	6	(15 %)
Friend	19	(46 %)
Sale person	1	(2 %)
Other	4	(10 %)
Total	41	(100 %)

Question 7. Have you ever found problems with your mobile phone?

Yes	30	(71 %)
No	12	(29 %)
Total	41	(100 %)

Question 8. What are the problems that you found with mobile phone?

Poor quality of signal	24	(40 %)
Problem with SIM Card	0	(0 %)
Problem with the phone	5	(8 %)
Can not make & receive call	14	(23 %)
Hang	9	(15 %)
Can not use value-added service	3	(5 %)
Easy broken	1	(2 %)
Other	4	(7 %)
Total	60	(100 %)

Question 9. In you opinion, what should the good mobile phone have?

Good in transmit & receive signal	78	(24 %)
Good in using	49	(15 %)
Durability	61	(19 %)
On standard	35	(10 %)
Can use with all value-added service	38	(12 %)
Can use with all SIM Card	33	(10 %)
Have extra features (e.g. vibrate, voice dialing)	32	(10 %)
Total	326	(100 %)

Question 10. Give the important rating to each topic. (1 = most important, 7 = least important)

*** Data collecting from the questionnaires is shown in appendix N.

Good in transmit & receive signal	1.11
Good in using	3.23
Durability	3.00
On standard	4.41
Can use with all value-added service	5.14
Can use with all SIM Card	4.92
Have extra features (e.g. vibrate, voice dialing)	6.04

Question 11. Have you ever known whether the company has done mobile type approval before importing?

Yes	61	(75 %)
No	20	(25 %)
Total	81	(100 %)

Question 12. Do you agree with doing mobile type approval before importing?

Agree	79	(98 %)
Disagree	2	(2 %)
No idea	0	(0 %)
Total	81	(100 %)

Question 13. In your opinion, how much you give important to each testing topic in doing mobile type approval?

*** Data collecting from the questionnaires is shown in appendix N.

Transmit & Receive signal	1.89
Quality of the phone	1.59
Software	1.30
Feature	1.14
Extra feature	1.01
Using with SIM Card	1.25
General usage	1.02
Durability	1.44
Using value added service	0.90
Standard	1.46

Question 14. In your opinion, are these test topics enough for doing mobile type approval?

Enough	74	(91 %)
Not enough	7	(9 %)
Total	81	(100 %)

Summary of section 2 General information and doing mobile type approval before importing

From totally 81 questionnaires that are returned, it can conclude that there are 52 % of people in the survey using mobile phone. And the systems that they use are 81% Digital GSM, 10 %World phone 1800, 7% Worldphone 800, and 2%Cellular 900. The main reason to choose that system are Quality of system 24%, Large coverage area 21%, A lot of value added service 17%, and Reputation 15%. And After sale service, Coverage area, Quality of system, Price, and Warranty are the first five things that the customer uses in making decision to buy mobile phone. It is shown that friend is the person who influence most in making decision to buy mobile phone. There are 71% of the customers have ever found the problem with mobile phone. Those problems are Poor quality of signal, Problem with the phone, and Hang. In the customer points of view, the good mobile phone should be good in transmit & receive signal, durability, good in using, can use with all value-added service, on standard, can use with all SIM Card, and have extra features (e.g. vibrate, voice dialling). Besides, the customer thinks that mobile phone should be cheaper, smaller, and have news on short message services (SMS) also.

For question 10, the objective is to survey the important rating in each topic. The result are 'Good in transmit & receive signal' is the most important. Durability, Good in using, On standard, Can use with all SIM Card, Can use with all value-added service, and Have extra features (e.g. vibrate, voice dialling) are the less important, consequently. There is 75 % of the customer known that the company has done mobile type approval before importing. And 98% of them agree with the company to do that. From question 13, it is shown that the customer give important to testing topic of 'Transmit & Receive signal' is the most important. Quality of the phone, Standard, Durability, Software, Using with SIM Card, Feature, General usage, Extra feature, and using value added service are less important, consequently.

In addition, 91% of customer thinks that these testing topic are enough for doing mobile type approval. The rest of them want the company to do more on accessory, safety of electromagnetic dispersion, and more concentrate on the real usage when comparing with the advertising, such as standby time of battery.

Section 3 Suggestion

In this section, there is one question for the customers to give their idea or suggestion in improving the mobile type approval process. The question is an open-end question. There is no choice or limitation for the customers. This section makes the customers be able to express their thinking freely. This also help the research be understand more about the customers. Although sometimes the answer is involved with the question, the researcher may get more idea about what the customers are thinking.

Summary of Section 3 (Suggestion)

There are many suggestions in this section both involve and not involve with improving mobile type approval. However, all of them are voice of customer and listed as follow:

- Checking about magnetic dispersion (Safety)
- Change from random test to be 100% test
- Agree with the existing test topic
- Standard of mobile phone is quite good, but the price is still high
- Price should be lower
- Importer should be more strict with quality control, and get the same standard with all mobile phones
- Mobile phone should be checked and tested before selling in the market
- Dealer should be trained about mobile phone and promotion
- Testing should be included in all aspects such as battery and charger
- More strict on security and tuning mobile phone
- More strict on quality control because some mobile phones can not use despite just buy it
- After sale service is not so good. Some shops have a bad service
- Value added service should be more.
- Accessory should be available in the shop at the same time as the mobile phone.
- Testing all mobile phones should have the same standard
- Checking and quality control are not 100% strict on the standard

4.1.1.2 Result from questionnaire no. 2

Owing to mobile type approval process, marketing officers of the case company are the customers of the process. They take care about importing and planning to launch the new model of mobile phone. Therefore, this questionnaire is created to survey the customer wants and needs (requirement) in mobile type approval process. There are totally 30 questionnaires distributing to the marketing officers in the case company. And there are 22 questionnaires return to the researcher. The data is collected and shown in three section as follow:

Section 1 Personal Information

In this section, there are 3 question about gender, age, and education. For age, it is divided into 4 intervals: below 25 years, 26 to 30 years, 31 to 35 years, and more than 35 years. For education, it is divided into 5 levels: 2 years-diploma, 4 years-diploma, Bachelor, Master, and Ph.D. All of these 3 questions aim to study the personal information of the persons who answer the questionnaire. From the questionnaire no. 2, it is found that

Question 1. Gender

Male	5	(23 %)
Female	17	(77 %)
Total	22	(100 %)

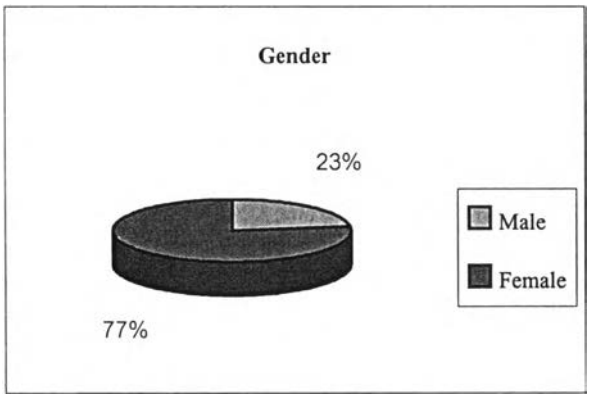

Figure 4.8 Gender of persons who answer the questionnaire no.2

Question 2. Age

Below 25 years	1	(5 %)
26 to 30 years	7	(32 %)
31 to 35 years	11	(50 %)
More than 35 years.	3	(13 %)
Total	22	(100 %)

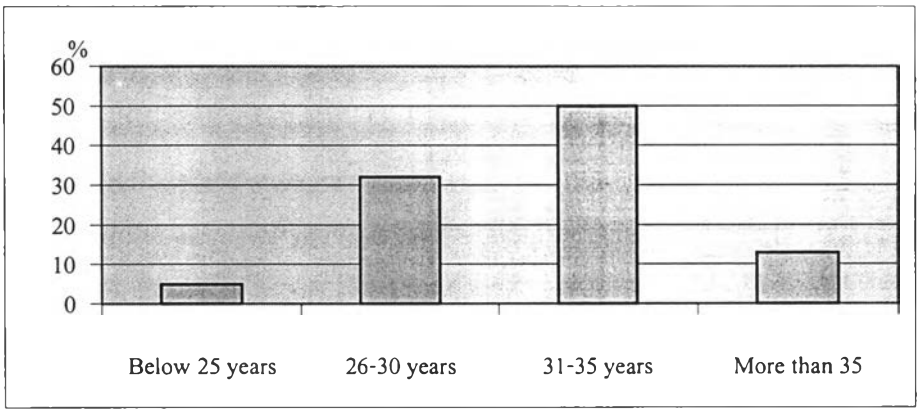

Figure 4.9 Age of persons who answer the questionnaire no.2

Question 3. Education

2 years-diploma	1	(5 %)
4 years-diploma	1	(5 %)
Bachelor	11	(50 %)
Master	9	(40 %)
Ph.D.	0	(0 %)
Total	22	(100 %)

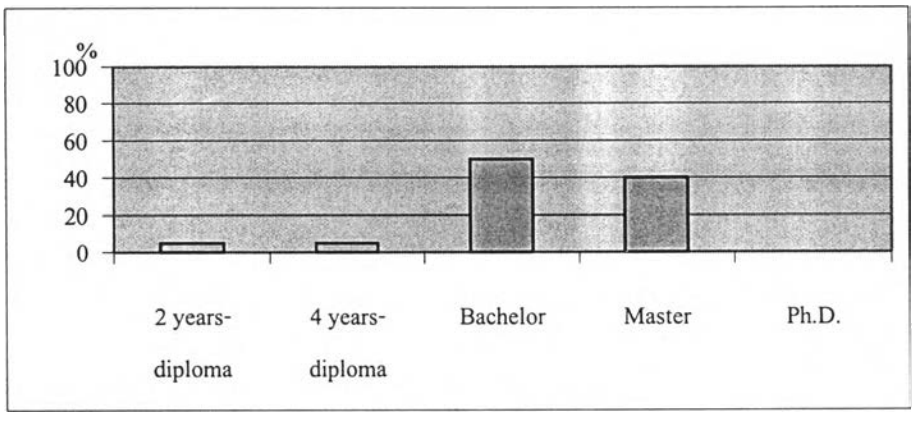

Figure 4.10 Education of persons who answer the questionnaire no.2

Summary of Section 1 (Personal Information)

From the data, the marketing officers are female more than male (female 77% and male 23%). Mostly they are 26-35 years old (26 to 30years – 32% and 31 to 35 years – 50%). Their education is mostly Bachelor degree (50%) and Master degree (40%).

Section 2 Requirement in testing mobile phone and problems occurred with mobile phone

In this section, there are 9 questions. Mainly, the researcher aims to collect the marketing officers' requirement in testing mobile phone and problems occurred with mobile phone. From the questionnaire no. 2, it is found that

Question 1. Which system do you use?

Cellular 900	1	(5 %)
Worldphone 800	0	(0 %)
Digital GSM	20	(90 %)
Worldphone 1800	0	(0 %)
Hello 1800	0	(0 %)
Other...not use	1	(5 %)
Total	22	(100 %)

Question 2. Which brand of mobile phone do you use?

Alcatel	3	(14 %)
AEG	0	(0 %)
BOSCH	0	(0 %)
DANCALL	0	(0 %)
ERICSSON	0	(0 %)
MITSUBISHI	0	(0 %)
MOBIRA	3	(14 %)
MOTOROLA	0	(0 %)
NEC	0	(0 %)
NOKIA	14	(67 %)
PANASONIC	1	(1 %)
PHILIPS	0	(0 %)
SHARP	0	(0 %)
SIEMENS	0	(0 %)
UNIDEN	0	(0 %)
Total	21	(100 %)

Question 3. Have you ever found problems with your mobile phone?

Yes	18	(86 %)
No	2	(14 %)
Total	21	(100 %)

What are the problems that you found with mobile phone?

Poor quality of signal	10	(29 %)
Hang	4	(12 %)
Unreason disconnect	6	(18 %)
Can not make & receive call	4	(12 %)
Echo	5	(14 %)
Problem with the phone	1	(3 %)
Problem with the battery	2	(6 %)
Problem with SIM Card	0	(0 %)
Be tuned	0	(0 %)
Other	2	(6 %)
Total	34	(100 %)

*Question 4*How often did you found problem with mobile phone?

Never	0	(0 %)
Seldom	9	(53 %)
Sometime	7	(41 %)
Often	1	(6 %)
Very often	0	(0 %)
Total	17	(100 %).

Question 5. Have you ever known whether the company has done mobile type approval before importing?

Yes	19	(86 %)
No	3	(14 %)
Total	22	(100 %)

Question 6. Do you agree with doing mobile type approval before importing?

Agree	22	(100 %)
Disagree	0	(0 %)
No idea	0	(0 %)
Total	22	(100 %)

Question 7. How much do you satisfy with the existing mobile type approval?

Full satisfy	3	(14 %)
Partial satisfy	9	(41 %)
Moderate satisfy	10	(45 %)
Little satisfy	0	(0 %)
Not satisfy	0	(0 %)
Total	22	(100 %)

Question 8. In your opinion, what do you want to do testing in mobile phone?

This question is an open-end question. The conclusion will be described in the summary of section 2.

Question 9. From the test topic below, do you think whether it is enough?

Enough	18	(81 %)
Add	2	(9 %)
Reduce	1	(5 %)
No answer	1	(5 %)
Total	22	(100 %)

- In this question, the marketing officers want to add two topics of test: (1) Test with SIM Card whether the mobile phone can support the old version of SIM Card, and (2) Test the menu of mobile phone that is different from other models. Besides, they want to reduce the test topic about the mobile phone function because they think that it is basic function and has already passed testing from manufacturer.

And give its priorities.

Standard of mobile phone (e.g. transmit & receive signal, power)	1.74
Network test (e.g. Sending message, fax, divert)	2.95
SIM test (e.g. 16k, 32k, SIM lock)	2.95
Value Added Service test (e.g. Web messaging, Voice mail)	4.11
New Service test (e.g. WAP, M-Commerce)	4.89
Function test (e.g. Alarm clock, Anykey answer, Speed dialing)	4.17

Summary of section 2 Requirement in testing mobile phone and problem occurred with mobile phone

From totally 22 questionnaires that are returned, it can conclude that most marketing officers in the case company using Digital GSM mobile phone system (90%). And they use Nokia 67%, Alcatel 14%, Mobira 14%, and Panasonic 5%. There are 86% of them has ever found the problem with mobile phone. Those problems are Poor quality of signal (29%), Unreason disconnect (18%), Echo (14%), Hang (12%), Can not make & receive call (12%), Problem with battery (6%), Problem with the phone (3%), and other 6% (such as can not sent short message, the person who receives call can not hear the voice). They found the problem with mobile phone: seldom (53%), sometime (41%), and often (6%). There is 86 % of them known that the company has done mobile type approval before importing. And 100% of them agree with the company to do that. Moreover, there are 14% Full satisfy with the existing mobile type approval, 41% Partial satisfy, and 45% Moderate satisfy.

In question 8, it is an open-end question about what the marketing officers really want to do testing in mobile phone. This question makes them be able to give their idea freely. The summaries of their idea are as follow:

- Test transmitting and receiving signal; especially in poor coverage area
- Test the usage of mobile phone with network
- Making and Receiving call
- Measure the strength of mobile phone signal
- Test in all technical aspect
- Test the function in mobile phone
- Test according to the standard
- Test whether it can support value added services
- Test with SIM Card whether the mobile phone can support all kinds of SIM Card
- Test feature such as sending short message
- Test hardware of mobile phone
- Test roaming between different network
- Test the quality of battery

In question 9, it aims to ask the marketing officers whether the available test topic is enough. From the survey, it is shown that 81 % of them thinks that it is enough. 9% of them think that it should add two more test topics: (1) Test with SIM Card whether the mobile phone can support the old version of SIM Card, and (2) Test the menu of mobile phone that is different from other models. Besides, 5% of them wants to reduce the test topic about function test because they think that it is basic function and has already passed testing from manufacturer. In addition, from the survey it is shown that the marketing officers give 'Standard of mobile phone' to be the first priority for testing, and 'Network test', 'SIM test', 'Value Added Service test', 'Function test', and 'New Service test' are second, third, and forth consequently (Appendix O).

Section 3 Suggestion

In this section, there is one question for the marketing officers to give their idea or suggestion in improving the mobile type approval process as same as section 3 in questionnaire no. 1. The question is an open-end question and there is no choice or limitation for the marketing officers. This section makes them be able to express their thinking freely. This also help the research be understand more about the marketing officers' want and need.

Summary of Section 3 (Suggestion)

Suggestions are from both questionnaire and interviewing with the marketing officers. All of them are listed as follow:

- Test the high priority test topic before the low priority test topic
- Test in the shortest period as much as possible
- Have quick feedback when found problem in the mobile phone
- Prepare all facility to be ready for testing such as test equipment and connector
- Have standard in testing and measuring the test result
- Work closer between Marketing and Engineering as a team
- Stress more on testing the standard of mobile phone
- Test topics should be updated continuously
- Not only testing the mobile phone, but should support information also.

4.1.1.3 Summarize the customer requirement

After collecting the voice of customer from questionnaire and interviewing, the development team (QFD team) summarizes the list of customer wants and needs (requirement) in the form of tree diagram as shown below:

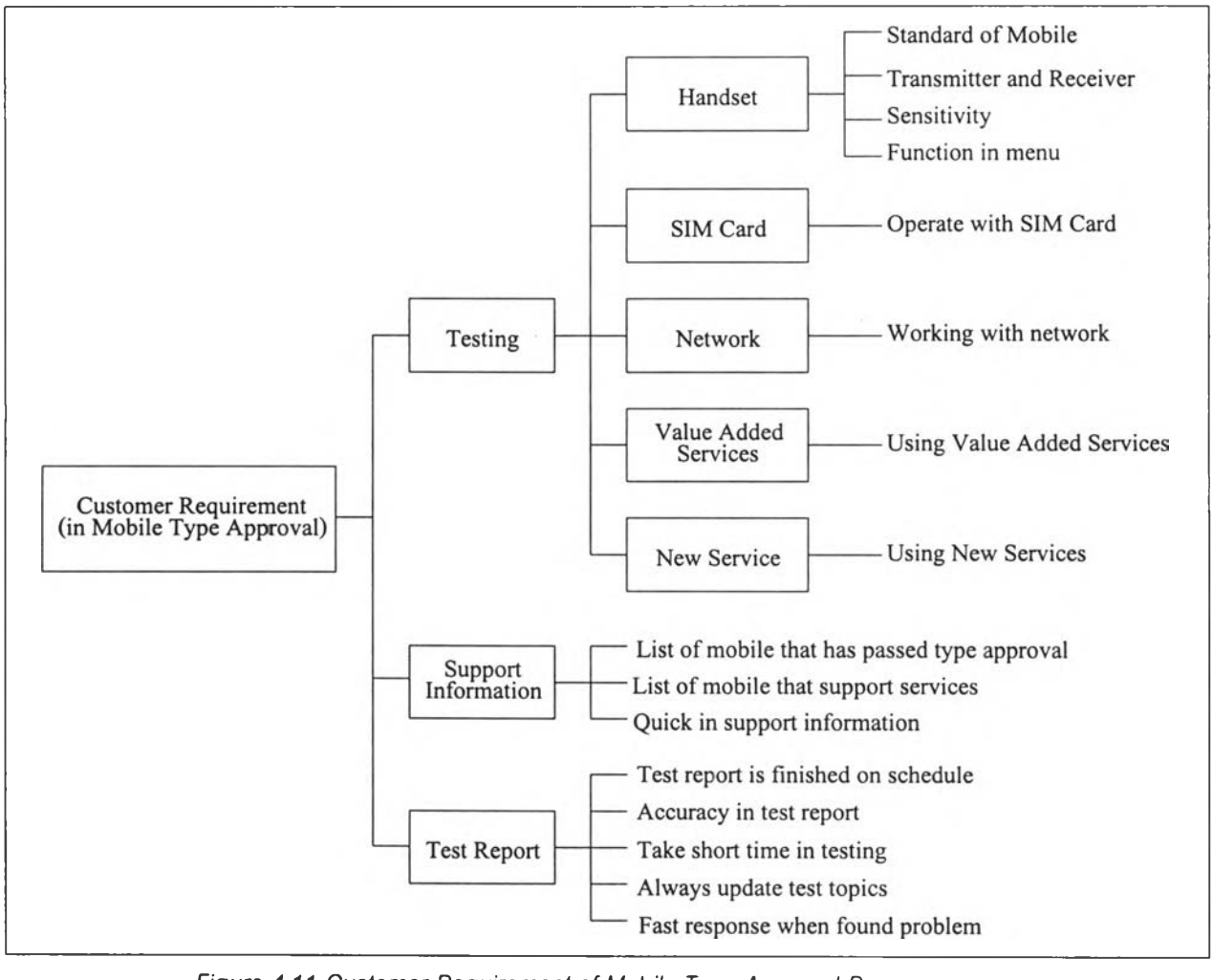

Figure 4.11 Customer Requirement of Mobile Type Approval Process

In the tree diagram above, it is shown that the customer requirement in the mobile type approval can be divided into 3 aspects: Testing, Support information, and Test report. First, Testing is divided into Handset, SIM Card, Network, Value Added Services, and New Service. Customer; marketing officers in this case, wants to test the handset (or mobile phone) in the term of its standard, transmitter and receiver, sensitivity, and its function in menu. For SIM Card, they want to know whether all kinds of SIM Card can be used or operated with the mobile phone. For Network, they want to know whether the mobile phone can work normally with the network, no effect and problem with the network. For Value Added Services, they want to know whether the mobile phone can support all the value-added services that the case company has launched to the market. For New Service, they want to test the mobile phone whether they support the new service that the company prepares for launching into the market such as Wireless Application Protocol (WAP) and SIM Toolkit (STK).

Second, Support information is divided into 'list of mobiles that has passed type approval', 'list of mobiles that support service', and 'quick in support information'. Marketing officers wants this information in order to do marketing activity such as advertising, notice in the website, and etc. Besides, they usually want this information as quickly as possible due to there is high competition in this business. Therefore, timing is very important. Third, they also require the test report to be finished on schedule, be accuracy, be tested in a short time, be always update the test topics, and be fast response when found problem. All of these requirements will be put into the section A of House of Quality (HOQ).

Next step in creating House of Quality is to survey the importance and satisfaction of customer requirement. In this research, the questionnaire no. 3 and no. 4 are used for this purpose.

4.1.2 Survey the importance and satisfaction of customer requirement

Questionnaires are used to survey the importance and satisfaction of customer requirement. Questionnaire no.3 and no.4 are created and distributing to the marketing officers. There are 30 copies of questionnaires sending to the Marketing. The sample of them are in the appendix L and M. Owing to the questionnaire no. 3 is only one page and questionnaire no. 4 is only two pages, so both of them is combined into one set of questionnaire, and then send to the marketing officers. Each one has different objective.

Questionnaire No. 3 has objective to survey the importance of the customer requirement that has been surveyed and summarized from questionnaire no.2. Target group is the same as questionnaire no.2 that is marketing officers who take care about importing and planning the new model of mobile phone for launching in Thailand. The questionnaire has only one section for the target group to give the customer importance in each element of doing mobile type approval. Customer important is divided into five levels: five is the most important, and one is the least important.

Questionnaire No. 4 has objective to survey the customer satisfaction performance of the case company and the competitors in each element of doing mobile type approval. Target group is the same as questionnaire no.2 and no. 3 that is marketing officers who take care about importing and planning the new model of mobile phone for launching in Thailand. The questionnaire also has one section for the target group to give the satisfaction performance rating for each company. However, according to the market share as shown in chapter 3, there are 3 major companies in the market. So in this questionnaire, it is to compare the customer rating between these three companies: company A (case company), company B, and company C. In addition, customer rating is divided into five levels: five is the most satisfy, and one is the least satisfy.

4.1.2.1 Result from questionnaire no. 3and no.4

Totally there are 30 questionnaires sending to the marketing officers in the case company. And there only 24 questionnaires return to the researcher. In the questionnaire no.3, the customers (or marketing officers in this case) are asked to consider each element of customer requirement and then give the customer importance for each element. Rating is divided into five-point scale: 5 for highest importance, 4 for very importance, 3 for moderate importance, 2 for low importance, and 1 for lowest importance to the customer. In the questionnaire no.4 that is combined with questionnaire no.3 into one set of questionnaire, the marketing officers are asked to consider each element of customer requirement and then give the satisfaction performance rating for each company: Company A (the case company), Company B, and Company C. Rating is divided into five-point scale: 5 for Very Good, 4 for Good, 3 for Neutral, 2 for Poor, and 1 for Very Poor. Data collection from the questionnaires is listed in the table and calculated the arithmetic mean as shown in the appendix P and Q. Customer Importance and Customer Rating can be summarized as follow:

No.	Customer Requirement	Customer Important	Customer Rating		
			A	B	C
1	Standard of Mobile	4.4	4.5	3.8	3.4
2	Transmitter and Receiver	4.6	4.7	3.3	2.6
3	Sensitivity	4.6	4.5	3.1	2.5
4	Function in menu	4.2	4.3	3.6	3.3
5	Operate with SIM Card	4.4	4.3	3.0	2.8
6	Working with network	4.6	4.4	2.9	2.6
7	Using Value Added Service	4.0	4.5	3.2	2.5
8	Using New Service	4.1	4.3	3.1	2.4
9	List of mobile that have passed Type Approval	4.2	3.9	2.8	2.4
10	List of mobile that support service	4.2	4.0	2.8	2.5
11	Quick in support information	4.0	3.9	2.7	2.5
12	Test report is finished on schedule	4.2	3.7	3.0	2.6
13	Accuracy in test report	4.5	4.0	3.0	2.7
14	Take short time in testing	3.9	3.6	2.9	2.5
15	Always update test topics	4.3	3.8	2.9	2.5
16	Fast response when found problem	4.5	4.0	3.0	2.7

Table 4.1 Customer Important and Customer Rating

Another part of section B (Planning Matrix) in House of Quality is to set the strategic goal for new product or service. In this part, the development team has responsible for deciding the target level of customer satisfaction performance that they want to aim for each customer requirement. Besides, the development team calculates the ratio for improvement also, which is called Improvement Ratio. Improvement Ratio implies the effort that will be required to change or improve the customer satisfaction performance. The larger the Improvement Ratio, the more important the customer requirement. The Improvement Ratio can be calculated from this formula:

Improvement Ratio = Goal / Current Satisfaction Performance

No.	Customer Requirement	Current Satisfaction Performance	Goal	Improvement Ratio
1	Standard of Mobile	4.5	4.5	1.00
2	Transmitter and Receiver	4.7	4.7	1.00
3	Sensitivity	4.5	4.5	1.00
4	Function in menu	4.3	4.5	1.05
5	Operate with SIM Card	4.3	4.5	1.05
6	Working with network	4.4	4.5	1.02
7	Using Value Added Service	4.5	4.5	1.00
8	Using New Service	4.3	5	1.16
9	List of mobile that have passed Type Approval	3.9	4.5	1.15
10	List of mobile that support service	4.0	4.5	1.13
11	Quick in support information	3.9	5	1.28
12	Test report is finished on schedule	3.7	5	1.35
13	Accuracy in test report	4.0	5	1.25
14	Take short time in testing	3.6	5	1.39
15	Always update test topics	3.8	5	1.32
16	Fast response when found problem	4.0	5	1.25

Table 4.2 Improvement Ratio

From the Improvement Ration in the table above, it is shown that 'Take short time in testing' is the most important of customer requirement that should be improved. 'Test report is finished on schedule', 'Always update test topics', and 'Quick in support information' are second, third, and forth priority consequently.

4.1.3 Translate customer requirement Into technical response

After collecting the Voice of Customer, Customer Importance, Customer Rating, and Strategic goal in the section A and B of House of Quality, the development team has to translate the Voice of Customer into Voice of Developer which is usually called Substitute Quality Characteristic (SQCs). Generally, SQCs is the internal, technical language of the company in providing the product or service. It is divided into two forms: qualitative and quantitative. In House of Quality, Qualitative form of SQCs is called Technical Response (Section C of HOQ). And quantitative form of SQCs consists of two things which are called Target Values and Competitive Technical Benchmarks (Section F of HOQ). Developer team has to think and brainstorm with each other in order to change the Customer Requirement into Technical Response. Customer Requirement represents 'What' is desired, while Technical Response represents 'How' the developer will respond to the 'What'. After brainstorming, the developer team concludes the Technical Response as in the table below:

No.	Technical Requirement
1	Provide samples and document
2	Provide more amount of samples
3	Prepare launch plan with Service Center and Engineering
4	Inform new service for testing
5	Inform problem and test result
6	Support in upgrading software
7	Specification Test
8	Applicability Test
9	Network Test
10	SIM Test
11	Function Test
12	Value Added Service Test
13	New Service Test
14	Send Type Approval report
15	Determine the way to do testing and measurement
16	Training the testers in doing each test topics
17	Determine a list of test requirement
18	Update new service in test requirement
19	Develop method in testing new services
20	Send list of mobiles that have passed type approval

21	Send list of mobiles that support services
22	Update technology of SIM Card and Network feature
23	Determine topic and method in testing SIM Card and network feature
24	Support equipment in testing SIM Card and set configure in testing network feature
25	Define strategy and policy in testing
26	Eliminate potential error in the process
27	Develop process document
28	Set Key Performance Indicator (KPI)
29	Remove unnecessary and non value added tasks
30	Remove identical activities and test topics
31	Reduce complexity of the process

Table 4.3 Technical Requirement

Owing to the cevelopment team composes of three main function units: Marketing, Service Center, and Engineering, the Technical Responses are defined for each functional units also. Therefore, the technical response no. 1-4 are for Marketing, no. 5-7 are for Service Center, and no. 8-24 are for Engineering. For technical response no. 25-31 are for the overall process.

4.1.4 Fill in the Relationships

Once there are Customer Requirement and Technical Response in section A and C of HOQ; consequently, it is time for the development team to make judgement for each relationships. These relationships are the strength of linkage between Technical Response and Customer Requirement. There are four possibilities of linkages: not linked, possibly, moderately, and strongly.

1. *Not linked* refers to if there is any changes in the amount or degree of Technical Response; whether large or small, there is still no change of the satisfaction performance in the customer requirement.
2. *Possibly linked* refers to if there is relatively large changes in the amount or degree of Technical Response, there is little or no change of the satisfaction performance in the customer requirement.
3. *Moderately linked* refers to if there is relatively large changes in the amount or degree of Technical Response, there is some changes; not major change; of the satisfaction performance in the customer requirement.

4. *Strongly linked* refers to if there is relatively small changes in the amount or degree of Technical Response, there is significant change of the satisfaction performance in the customer requirement.

In Quality Function Deployment (QFD), symbols are used to represent these four linkages. 'Not linked' is represented by the Blank. 'Possibly linked' is represented by the Triangle. 'Moderately linked' is represented by the Circle. And 'Strongly linked' is represented by the Double Circle. The symbols, their meanings, and their numerical equivalents are summarized as shown below:

Symbol	Meaning	Numerical Equivalent
	Not linked	0
△	Possibly linked	1
○	Moderately linked	3
◎	Strongly linked	9

Table 4.4 Symbols and its Numerical Equivalent

Customer Requirement	Technical Response																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	○	○	○		○		◎	◎						○	○	○										○	○	○			
2	○	○	○		○		◎	○						○	○	○										○	○	○			
3	○	○	○		○		◎	○						○	○	○										○	○	○			
4	○	○	○		○			△	○	○	◎	△	○	○	○	○		○								○	○	○	○	○	
5	○	○	○		○		○	△	○	◎	○	△	△	○	○	○		○				○	◎	○		○	○	○	○	○	
6	○	○	○		○		○	△	◎	○	○	○	○	○	○	○		○				○	◎	○		○	○	○	○	○	
7	○	○	○		○		△	△	○	△	○	◎	○	○	○	○		○								○	○	○	◎	◎	
8	○	○	○		○		○	△	○	△	◎	○	◎	○	○	○		○	◎							○	○	○	○	○	
9						○	○	○	○	○	○	○	○	△						◎							○				
10									○	○	○	○	○	△				◎	◎		◎						○				
11		◎		○	◎				△	△	○	◎	◎	△	△	○		◎	○	◎	◎	◎	○	○	○	△	○		◎	◎	◎
12	◎	○	◎	○		○	○	○	○	○	○	○	○	◎	○	○	◎	○	○			△	○	◎	○	△	△	○	◎	◎	◎
13							○	○	○	○	○	○	○	○	◎	◎							○		○	◎	○				
14	○	◎		○		◎		○	○	○	○	○	○	◎	○	○	◎	○	○			△	○	◎	○		△		◎	◎	◎
15				◎					○	○	○	◎	◎	○		○		◎	○	△	△	○			○		○				
16				○	◎	◎	○	○	○	○	○	○	○	○	○	○		○				○		○	○	○	○		○	○	◎

Figure 4.12 Relationship of Customer Requirement and Technical Response

Accorcing to the table above, the symbols 'Triangle', 'Circle', 'Double Circle' have numerical equivalent to 1, 3, and 9 consequently. It is shown in the table below. Full version of these relationships (Section D of HOQ) is in the appendix R.

Customer Requirement	Technical Response																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	3	3	3		3		9	9						3	3	3										3	3	3			
2	3	3	3		3		9	3						3	3	3										3	3	3			
3	3	3	3		3		9	3						3	3	3										3	3	3			
4	3	3	3		3			1	3	3	9	1	3	3	3	3		3								3	3	3	3	3	
5	3	3	3		3		3	1	3	9	3	1	1	3	3	3		3				3	9	3		3	3	3	3	3	
6	3	3	3		3		3	1	9	3	3	3	3	3	3	3		3				3	9	3		3	3	3	3	3	
7	3	3	3		3		1	1	3	1	3	9	3	3	3	3		3								3	3	3	9	9	
8	3	3	3		3		3	1	3	1	9	3	9	3	3	3		3	9							3	3	3	3	3	
9						3	3	3	3	3	3	3	3	1						9							3				
10									3	3	3	3	3	1				9	9		9						3				
11		9		3	9				1	1	3	9	9	1	1	3		9	3	9	9	9	3	3	3	1	3		9	9	9
12	9	3	9	3		3	3	3	3	3	3	3	3	9	3	3	9	3	3			1	3	9	3	1	1	3	9	9	9
13							3	3	3	3	3	3	3	3	9	9							3		3	9	3				
14	3	9		3		9		3	3	3	3	3	3	9	3	3	9	3	3			1	3	9	3		1		9	9	9
15				9					3	3	3	9	9	3		3		9	3	1	1	3			3		3				
16				3	9	9	3	3	3	3	3	3	3	3	3	3		3				3		3	3	3	3		3	3	9

Figure 4.13 Numerical Equivalent of the Relationship

4.1.5 Fill in Competitive Technical Benchmark and Target Setting

When the development team finishes filling the Relationship in section D of HOQ, they have to consider about Target Values and Competitive Assessment of each Technical Response or SQCs. Target Values can be both numerical and nonnumerical targets. It depends on SQCs. Besides, in order to understand more about the target values, it is another column to explain how good the target values should be. It is called 'Movement of Target'. In this column, there are three symbols (▲ , ○ , ▼). ▲ refers to the larger the target value is, the best it will be. ○ refers to the Target value that is already determined are the best one. And ▼ refers to the smaller the target values is, the best it will be. All the Target Values, Movement of Target, and Competitive Assessment are in the table below:

No	Technical Requirement	Target Values	Movement of Target	Competitive Assessment		
				A	B	C
1	Provide samples and document	Quick and complete set	○	3	3	3
2	Provide more amount of samples	More than 2 sets	▲	3	3	3
3	Prepare launch plan with Service Center and Engineering	3 weeks before launch	○	2	4	2
4	Inform new service for testing	2 weeks before launch	▲	3	3	2
5	Inform problem and test result	Within 2 days	▼	3	4	4

6	Support in upgrading software	As quick as possible	○	4	3	2
7	Specification Test	Within 1 days	▼	3	3	3
8	Applicability Test	Within 5 days	▼	3	3	2
9	Network Test	Within 2 days	▼	3	4	2
10	SIM Test	Within 3 days	▼	3	4	2
11	Function Test	Within 1 days	▼	3	4	2
12	Value Added Service Test	Within 2 days	▼	4	3	2
13	New Service Test	Within 3 days	▼	3	3	2
14	SendType Approval report	Within 3 weeks	▼	3	4	4
15	Determine the way to do testing and measurement	Be standardized	○	3	3	3
16	Training the testers in doing each test topics	No error in testing	○	3	3	3
17	Determine a list of test requirement	Be standardized	○	3	3	3
18	Update new service in test requirement	Within 1 week	○	3	3	3
19	Develop method in testing new services	Be standardized	○	3	3	3
20	Send list of mobiles that have passed type approval	Every month	○	3	3	2
21	Send list of mobiles that support services	Every month/as request	○	3	3	2
22	Update technology of SIM Card and Network feature	Every 2 weeks	○	4	3	2
23	Determine topic and method in testing SIM Card and network feature	Be standardized	○	3	3	2
24	Support equipment in testing SIM Card and set configure in testing network feature	As quick as possible	○	3	3	2
25	Define strategy and policy in testing	Be standardized	○	3	3	2
26	Eliminate potential error in the process	No error	▼	4	3	2
27	Develop process document	Be standardized	○	3	3	2
28	Set Key Performance Indicator (KPI)	Review every 3 months	○	3	3	2
29	Remove unnecessary and non value added tasks	As much as possible	▼	3	3	2
30	Remove identical activities and test topics	As much as possible	▼	3	3	2
31	Reduce complexity of the process	As much as possible	▼	3	3	2

Figure 4.14 Target Values and Competitive Assessment of each Technical Response

4.1.6 Fill in Technical Correlation Matrix

When the development team has determined Target Values and Competitive Assessment of each Technical Response in section F of HOQ, they have to consider about Technical Correlation. This is the interrelationship between each elements of the technical response. In this matrix, there are four symbols (double circle, circle, X, and double X). Double circle represents strong positive of interrelationship. Circle represents positive of interrelationship. X represents negative of interrelationship. And double X represents strong negative of interrelationship. This Technical Correlation matrix helps the development team in identifying the bottleneck in the planning stage. The result is shown below:

Technical Requirement	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	1				◎		◎	◎	◎	◎	◎	◎	◎	◎																	
2		2	○				◎	◎	◎	◎	◎	◎	◎	◎																	
3			3											○																	
4				4									○	○	○		◎	◎			○										
5					5	◎	○	○	○	○	○	○	○	◎																	
6						6			○	○	○	○	○	◎																	
7							7							◎																	
8								8						◎																	
9									9					◎																	
10										10				◎																	
11											11			◎																	
12												12		◎																	
13													13	◎																	
14														14	◎	○	○	○	○					○	○	◎	○	○	◎	◎	◎
15															15											◎	○	○	○	○	○
16																16										◎					
17																	17									○			○		○
18																		18	○		◎					○			○	○	
19																			19							◎			○	○	○
20																				20											
21																					21										
22																						22	○	○		◎			○	○	
23																							23			◎			○	○	○
24																								24				○			
25																									25	○	○	○	○	○	◎
26																										26		○	○		
27																											27	○	○	○	◎
28																												28			
29																													29		○
30																														30	
31																															31

Figure 4.15 Correlation matrix

4.1.7 Calculate Technical Response Priorities

Once all data in each section of HOQ are collected and its linkages are determined, the development team has to calculate Technical Response Priorities. That is the key result of QFD method. This result will show the priorities of Technical Response or SQCs. Sometime this is called 'Technical Importance'. It tells the development team which one of the Technical Response that they should develop in the new product or service first according to the Customer Requirement.

Technical Response is calculated from multiplying each numerical equivalent of relationship in each Technical Requirement to the Customer Importance of its element in the Customer Requirement, and then sum all of them to the bottom of the HOQ which is called 'Absolute'. When all absolute value of every Technical Response is calculated, then these absolute values are calculated in the percentage. So, this relative (%) will show the priorities of Technical Response. The result of calculation is shown in the table below.

Customer Requirement	Customer Importance	Technical Response																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	4.4	3	3	3		3		9	9						3	3	3										3	3	3			
2	4.6	3	3	3		3		9	3						3	3	3										3	3	3			
3	4.6	3	3	3		3		9	3						3	3	3										3	3	3			
4	4.2	3	3	3		3			1	3	3	9	1	3	3	3	3		3								3	3	3	3	3	
5	4.4	3	3	3		3		3	1	3	9	3	1	1	3	3	3		3				3	9	3		3	3	3	3	3	
6	4.6	3	3	3		3		3	1	9	3	3	3	3	3	3	3		3				3	9	3		3	3	3	3	3	
7	4.0	3	3	3		3		1	1	3	1	3	9	3	3	3	3		3								3	3	3	9	9	
8	4.1	3	3	3		3		3	1	3	1	9	3	9	3	3	3		3	9							3	3	3	3	3	
9	4.2						3	3	3	3	3	3	3	3	1						9							3				
10	4.2									3	3	3	3	3	1				9	9		9						3				
11	4.0		9		3	9				1	1	3	9	9	1	1	3		9	3	9	9	9	3	3	3	1	3		9	9	9
12	4.2	9	3	9	3		3	3	3	3	3	3	3	3	9	3	3	9	3	3			1	3	9	3	1	1	3	9	9	9
13	4.5							3	3	3	3	3	3	3	3	9	9							3		3	9	3				
14	3.9	3	9		3		9		3	3	3	3	3	3	9	3	3	9	3	3			1	3	9	3		1		9	9	9
15	4.3				9					3	3	3	9	9	3		3		9	3	1	1	3			3		3				
16	4.5				3	9	9	3	3	3	3	3	3	3	3	3	3		3				3		3	3	3	3		3	3	9
Absolute		154.2	188.4	142.5	88.5	181.2	100.8	205.3	152.4	184.9	167.5	215.1	221.9	230.9	229.9	187.0	207.9	72.9	214.2	123.9	78.1	74.8	97.5	130.8	125.4	76.2	166.9	189.9	117.3	210.3	210.3	149.4
Relative%		3.1	3.8	2.9	1.8	3.7	2.1	4.2	3.1	3.8	3.4	4.4	4.5	4.7	4.7	3.8	4.2	1.5	4.4	2.5	1.6	1.5	2.0	2.7	2.6	1.6	3.4	3.9	2.4	4.3	4.3	3.1

Figure 4.16 Calculate Technical Response Priorities

4.1.8 Summary

From the figure 4.16, it shows the priorities of each Technical Response (Technical Requirement) or Substitute Quality Characteristics (SQCs). This helps and guides the development team in planning to develop product further. The highest percentage is the most important Technical Response that the development should realize on. The list of Technical Requirement, which is reordered according to its percentage, is show in the figure 4.17 below.

No.	Technical Requirement	%
1	New Service Test	4.7
2	Determine the way to do testing and measurement	4.7
3	Value Added Service Test	4.5
4	Function Test	4.4
5	Develop method in testing new services	4.4
6	Remove identical activities and test topics	4.3
7	Reduce complexity of the process	4.3
8	Specification Test	4.2
9	Determine a list of test requirement	4.2
10	Set Key Performance Indicator (KPI)	3.9
11	Provide more amount of samples	3.8
12	Network Test	3.8
13	Training the testers in doing each test topics	3.8
14	Inform problem and test result	3.7
15	SIM Test	3.4
16	Develop process document	3.4
17	Provide samples and document	3.1
18	Applicability Test	3.1
19	Send Type Approval report	3.1
20	Prepare launch plan with Service Center and Engineering	2.8
21	Support equipment in testing SIM Card and set configure in testing network feature	2.7
22	Define strategy and policy in testing	2.6
23	Send list of type approval mobile	2.5
24	Remove unnecessary and no value added tasks	2.4
25	Support in upgrading software	2.1
26	Determine topic and method in testing SIM Card and network feature	2.0
27	Inform new services for testing	1.8
28	Send list of mobile that support services	1.6
29	Eliminate potential error in the process	1.6
30	Update new services in test topic	1.5
31	Update technology of SIM Card and network feature	1.5

Figure 4.17 Priorities of Technical Response

After the development team has brainstorming, they decide to mainly focus on the technical requirements that have their percentages more than 4 to implement in the new process. So those are 'New Service Test', 'Determine the way to do testing and measurement', 'Value Added Service Test', 'Function Test', 'Develop method in testing new services', 'Remove identical activities and test topics', 'Specification Test', and 'Determine a list of test requirement'. However, according to the methodology of this research, all of these technical requirements are used with BPI approach in order to improve the Mobile Type Approval process. In addition, the completed House of Quality is created and shown in the figure 4.18 as follow.

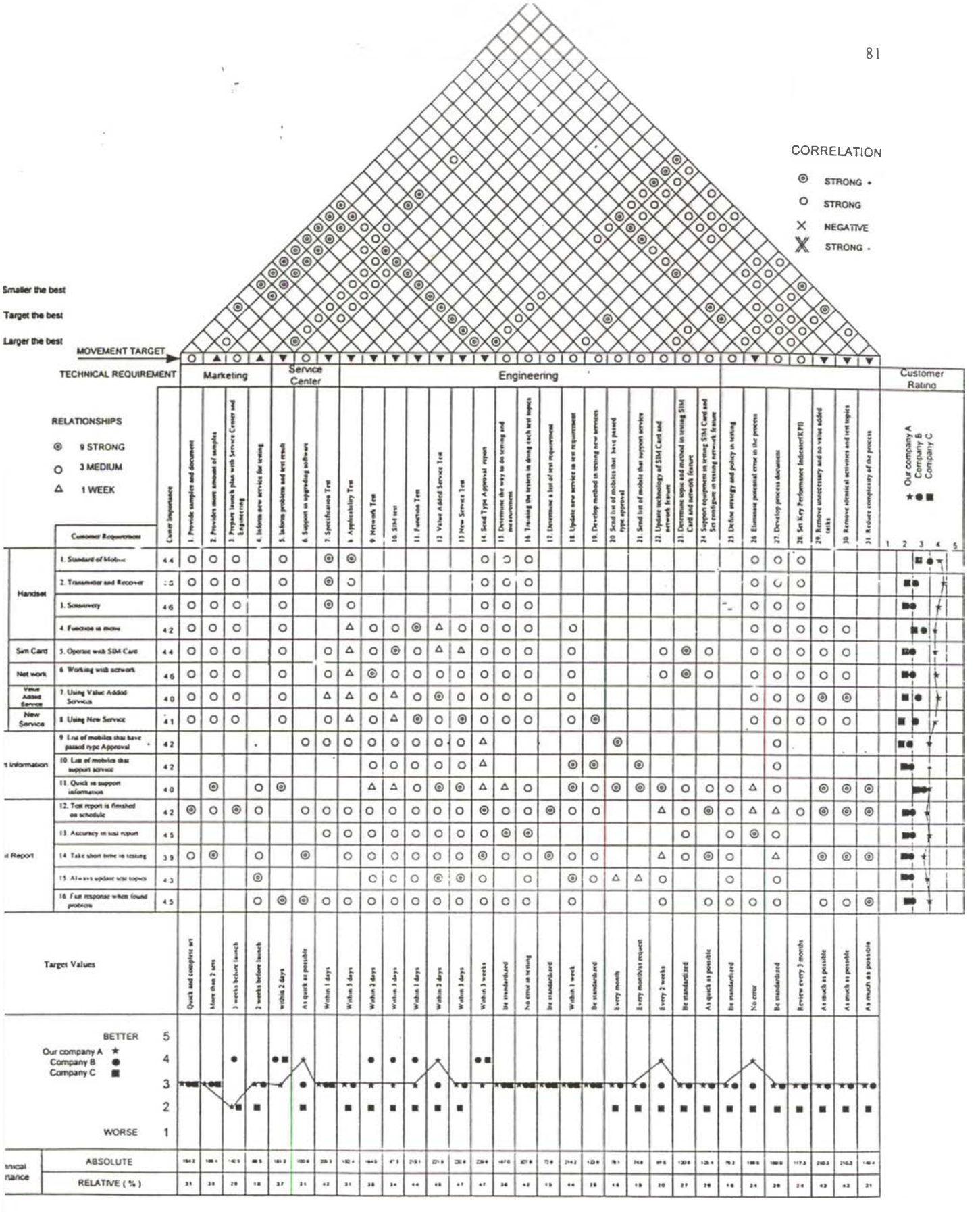

Figure 4.18 Completed House of Quality

4.2 BPI Approach

After surveying the customer requirement and creating the completed House of Quality, the researcher aims to implement the BPI approach into the Mobile Type Approval process. Business Process Improvement (BPI) consists of 5 phases as the figure 4.19

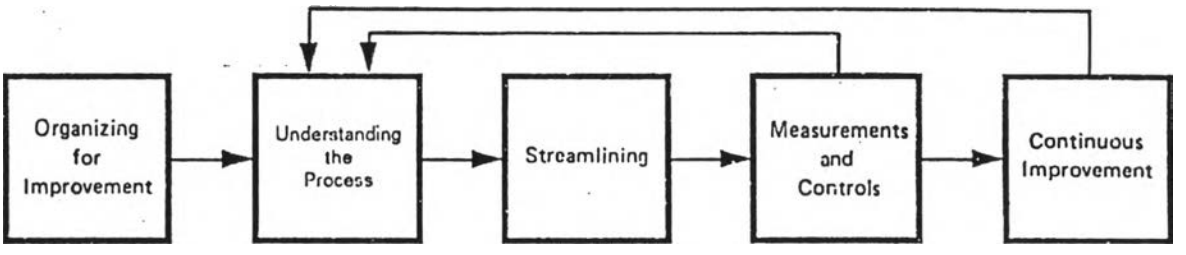

Figure 4.19 Five phases of BPI

- Phase 1: Organizing for improvement
- Phase 2: Understanding the process
- Phase 3: Streamlining
- Phase 4: Measurement and Controls
- Phase 5: Continuous Improvement

In this research, the researcher tries to do step by step of each activity in each phase of BPI. Phase 1 (Organizing for improvement) has totally 9 activities. Phase 2 (Understanding the process) has 10 activities. Phase 3 (Streamlining) has 13 activities. Phase 4 (Measurement and Controls) has 4 activities. And Phase 5 (Continuous Improvement) has 6 activities. All of them are described as follow.

4.2.1 Organizing for improvement (BPI phase 1)

Organizing for improvement is the first phase of improvement. It consists of 9 activities to ensure success in improving process. Mainly, it aims to build leadership, understanding, and commitment. The activities in this phase are stepped as follow:

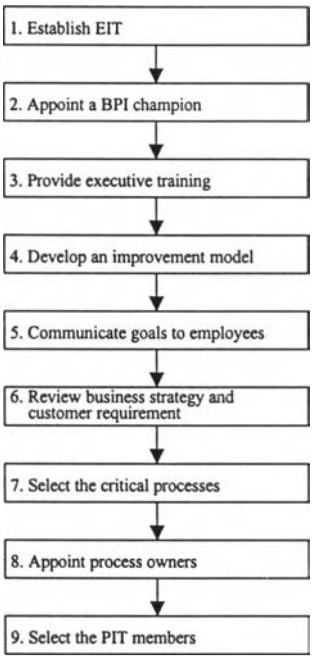

Figure 4.20 Nine activities in BPI phase 1

4.2.1.1 Establish EIT

Doing the BPI approach, the Executive Improvement Team (EIT) has to be established first. In improving Mobile Type Approval process, EIT is established from the involved functional unit head of the case company. Owing to this process involves with three functional units: Marketing, Service Center, and Engineering, so EIT consists of three managers from each functional units. They are

(1) Terminal Product Marketing Manager (Marketing department)

(2) Headquarter Service Manager (Service department)

(3) Technical Service Support Manager (Engineering department)

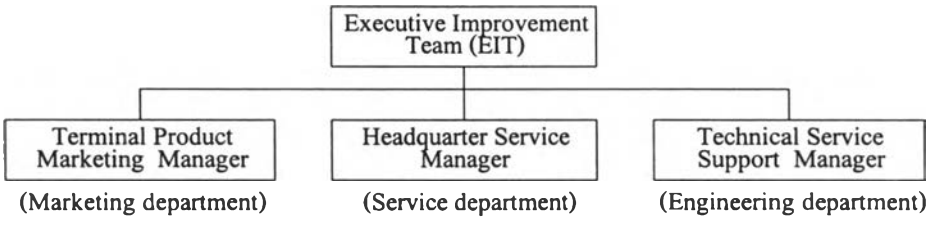

Figure 4.21 Executive Improvement Team (EIT)

4.2.1.2 Appoint a BPI champion

For Mobile Type Approval process, EIT has appointed the researcher to be as BPI champion. And they assign the researcher to develop and customize the process improvement effort to the business process and introduce the BPI approach into the case company. Then the researcher has to prepare the business process directive and general job description for process owners and PIT members. Besides, the researcher has to continuously review the individual teams' progress in order to determine when the process is ready to be qualified at the next higher level. The first task of BPI champion is to determine the scope of BPI activities that will be related with the case company. Therefore, the researcher defines the scope of improving Mobile Type Approval process as follow:

'It covers the activities of Mobile Type Approval process in the case company to check the quality of mobile phone in standard specification, network and SIM card compatibility. This improvement is not including the activities outside the company such as PTD and TOT activities. Besides, the improvement emphasizes on reducing timing of the overall process, but still maintaining the quality of works.'

Moreover, the researcher as BPI champion also develop procedures in order to implement BPI concept in the case company. These procedures should be released under the EIT's agreement.

4.2.1.3 Provide executive training

In this step, the researcher has responsible for training the EIT about BPI concept so that they can understand the concept and apply it with the process. In addition, they can familiar with the purposes and activities of BPI effort. These will build and reinforce the EIT's commitment to the process improvement. In the training, it is divided into 2 phases. *First phase* is about explaining the schedule, objectives, overview of BPI major steps, review of the process of launching a BPI effort, and other major steps such as goals, methods, challenges, and the support and contribution expected from the EIT at each step. *Second phase* is about open group discussion. This phase aims to measure the EIT's reaction to BPI concept such as their hope, reservation, and feelings of resistance.

4.2.1.4 Develop an improvement model

Once the EIT understands about BPI concept, they should develop an improvement model. The improvement model or BPI model is a detailed plan of the steps that the company will take through the BPI cycle. It helps them visualize the process, identify the sequence of events and activities, and determine the resources necessary to implement the improvement. Improvement model is divided into five-phase according to the phase of BPI as followed:

(1) Organizing for improvement

(1.1) Review the business strategy

(1.2) Identify the problem in the Mobile Type Approval process

(1.3) Make questionnaire in order to survey the customers' requirement

(1.4) Brainstorming in order to translate the customers' requirement into technical response

(1.5) Create House of Quality (QFD phase 1) and calculate the technical response priorities

(1.6) Brainstorming and select the critical process that should be improved

(1.7) Appoint process owners and select the PIT members

EIT sets the improvement model for this phase as 7 steps. In the beginning, they decide to review the business strategy of the case company in order to plan for improvement the Mobile Type Approval process. Then, they try to identify the problem that currently be in the process. Moreover, the researcher proposes the methodology of creating House of Quality (HOQ) to survey the customer requirement and develop technical response. So the questionnaires are made and distributed to the customer of the process. After collecting and summarizing the customer requirement, EIT and involved people are meeting for brainstorming. HOQ will be created to find the priority of technical response. Moreover, in the brainstorming they should select the critical process for improvement. And at the end of this phase, process owners should be appointed and PIT members should be selected.

(2) Understanding the process

(2.1) Overview the Mobile Type Approval process; e.g. flow diagram and workflow between each functional units

(2.2) Explain how to measure the process and what is expected from the process

(2.3) Show data that is collected from the process before improvement

EIT sets the improvement model for this second phase as 3 steps. First, owing to this phase aims to make people understanding the process, then they make an overview of the Mobile Type Approval process: what is type approval, why it should have to do type approval, its objectives and benefits, and method & procedure to do mobile type approval. All of these will show in form of flow diagram. Second, they aim to explain how to measure the process and its expectation. Third, they show the data that is collected from the process before improvement; especially time used in the process.

(3) Streamlining

(3.1) Brainstorming in order to identify improvement opportunities

(3.2) Simplify the process and find the way to reduce processing time

(3.3) Eliminate the potential error in the process

(3.4) Develop new model of the process include flowchart and work instruction

(3.5) Train the people that involve in the process

According to data collection in the phase 2 and technical response priorities in the phase 1, EIT sets the improvement model for this third phase as 5 steps. First, they will brainstorm with PIT member in order to identify improvement opportunities. And then they will simplify the process as much as possible and find the way in order to reduce the processing time. Besides, they try to eliminate the potential error in the process as much as possible according to the objective of this research 'To improve efficiency and reduce timing in Type Approval process'. Moreover, new model of the process will be developed. And the people who involve in the process will be trained for the new system also.

(4) Measurement and control

(4.1) Determine how to measure the new model of process

(4.2) Define the targets of the process

(4.3) Establish feedback system in each activity

(4.4) Determine the period to audit the process

(4.5) Establish a poor-quality cost system

In this phase, EIT intend to implement the new system in this phase. At the beginning, they try to determine how to measure the new model of process, define its targets, establish feedback system in each activity, determine the period to audit the process, and establish a poor quality cost system. After all of these are defined, new system is implemented in the workplace.

(5) Continuous improvement

(5.1) Review the process and its problems periodically

(5.2) Identify improvement opportunities and create improvement model

(5.3) Evaluate the change impact on the business and customer

(5.4) Advanced training the people that involve in the process

After the period that is set in the phase 4 is reached, EIT defines it as phase 5 (Continuous Improvement). They set the activity in this phase roughly into 4 steps. First, they will review the process and its problems. Second, they will identify the improvement opportunities and create new improvement model. Third, they will evaluate the change impact on the business and customer. And fourth, they will arrange course or meeting to train people about new model of the process.

4.2.1.5 Communicate goals to employees

In this step, EIT communicates goals to all people that involve in the process about the reason that the process will be changed or improved. This is because no one wants the change. And how the process is efficiency and effective depends on the people in the process also. Therefore, if the people do not understand the goal of the new process and EIT's objective, they will not perform it well as it should be. EIT sets the goal of new process as 'To improve efficiency and reduce timing in the Mobile Type Approval process'.

4.2.1.6 Review business strategy and customer requirement

According to the case company's policy 'To retain the existing customer and seek for new customer simultaneously, and improve the quality of network continuously', the case company's business strategy focuses on 5 aspects as follow:

1. *Retaining the existing customers*

According to table 3.3 (Number of customer), the case company has approximately 2 million customers at the end cf year 2000. The case company foresees this market that it is not easy to get customers in this competitive market. In addition, when we get them, we should retain them to be our customer as long as possible. So the way to do this is to satisfy them as much as possible. Then the case company has set one strategy to retain the existing customer with efficiency services. Many new services have been developed as follow:

- SIS (Subscriber Identification Security)

  SIS is the system to protect tuning the mobile phone signal; especially in Analog system. Normally, Analog mobile phone is easy to be tuned, so someone can detect your signal and copy into another phone. Then he can use that phone as if being your phone, and then you have to pay for his expend also. Therefore, the case company has implemented SIS system to make the customer be more satisfied and convinced in the company's system.

- CLI (Calling Line Identification)

  CLI is new service for analog system to show the incoming call number. Normally, Analog mobile phone can not show the incoming call number as same as Digital mobile phone. Owing to the case company wants to retain the existing customer, the case company invests some budget to develop the software in order to implement CLI in the system.

- WAP (Wireless Application Protocol)

  WAP is a new standard that brings Internet content and advanced value added services to mobile phones and other wireless devices. It offers new innovative services to the consumer market and a wireless channel for the existing services. Owing to growing demand of mobility, when WAP is implemented, the customers can access the information resources and company's services wherever they are and whenever they want. The information resources and services are stock prices, directory, news, flight schedule, wireless banking, buying movie tickets, and etc.

- GSM MobileLife

  GSM MobileLife is new service that uses technology of SIM Tool Kit (STK). Nowadays, mobile phone is not used for making and receiving call only; which is called Voice Application. But the trend of using it is growing into more and more Non-Voice Application. At present, the company provides Non-Voice Application such as Short Message Service (SMS), Voice Bill, and Voice Info. However, trend of Non-Voice Application is growing into Enhanced SMS, STK, WAP Solution, and Multimedia Messaging. GSM MobileLife can provides many services to the customer with high security. Those services are mINFO, mENTERTAIN, mSHOPPING, and mBANKING. Besides, more services can be added later on.

- Priority Call Center

  Priority Call Center is a project in retaining existing customer. It aims to establish the center of information for customers. Customer can contact and ask for some suggestion about services throughout 24 hours a day. This can make customers be feel that the company always cares them.

- Priority Care Center

  Priority Care Center is a project in retaining existing customer. It aims to provide the customer with extra services. For example, Replacing Service (Replace the new mobile phone if the customer's phone is lost). New phone with the old number Service (Customer can buy new mobile phone with special price). And Migration Service (This is for NMT customer who wants to change his mobile phone to be GSM mobile phone).

- Customer Segmentation

  Customer Segmentation is a project in retaining existing customer. It aims to classify the customer into groups: Very high, High, Medium, and Low value customer. This project makes the company be able to develop marketing activity in each period in order to satisfy more on the existing customers.

- Extra activity

  Extra activity is the activity to give some return to the customer. For example, Minute Plus project is the project for giving discount and gift to the customer by collecting points from monthly service charge. Discount may be 10% in next month service charge or hotel service, restaurant, and hospital service. Sometimes there is free movie ticket for special group of customer such as pre-paid customer.

2. *Expanding the market base to get new customer*

Apart from retaining the existing customer, the case company also gives the importance on expanding the market base to get new customer. The case company has divided this strategy according to the system: NMT, GSM, and Pre-paid system.

- NMT system

  In NMT system, most customers are the persons who use mobile phone for voice communication only and no need in using value added services. This customer group wants to use the system that has wide coverage area of service. However, the case company has already implemented the network throughout the country. So the company has no need to implement more. But the case company will expand the market base into the customer who has lower average income. The company will bring the old mobile phone that is already refurbished to sell to this customer group with special price.

- GSM system

  GSM system is the system that has higher technology than NMT system. It can give services to the customer more than voice communication. Therefore, the case company aims to expand the market base by launching new value-added services. Two new services (GSM MobileLife and Wireless Application Protocol) has been launched in August and December 2000, consequently. GSM MobileLife is the Non-voice application service that uses technology of SIM Toolkit. In the beginning, there are four services in GSM MobileLife: mBanking, mInfo, mShopping, and mMessaging. mBanking is the service that customer can do transaction with the bank such as transferring money by using mobile phone. mInfo is the service that customer can search or get the desire information such as news, stock price, and traffic report by using mobile phone. mShopping is the service that customer can shop or buy things such as booking movie ticket, ordering flower, and pay bills by using mobile phone. mMessaging is the service that the customer can send or receive email by using mobile phone. For WAP, it is to link the mobile phone to Internet that supports WAP. All

of these make the company be able to develop new value-added services to respond the customers' need. Therefore, the case company has a lot of opportunity to expand the market base in this system.

- Pre-paid system

  Pre-paid system is one service that company has developed since July 1999. This system aims to respond the customer who wants some convenience because this system has not to do registration. It has not to pay for monthly fee also. The target customers are teenagers, person who wants to control his expend, and person who mostly receives call only. Therefore, the case company aims to expand the market base by setting the representative dealer throughout the country and supply the Scratch card be available in more distribution channel; not only in the mobile phone shop but in other convenience store also.

3. *Developing new services*

   The case company aims to develop more services and understanding in each service to the customer. This will increase the income of the company. In GSM system, the case company has developed many services to respond the customer need. Customer need is also classified into many groups. For example, the case company has developed GSM Internet Integration for the customer group that needs Data communication such as connecting to Internet, and send-receive email. Besides, the company also develops Voice Bill for customer to ask for his bill, Horoscope for foretelling the fortune, and etc. For NMT system, new services are also developed continuously such as CLI, SIS and Infotainment services.

4. *Expanding and improving the network system*

   Owing to the quality and coverage area of the network is the major important factor in this telecommunication business, the case company aims to expand and improve the network system in Coverage, Capacity and Quality. For GSM system, the company plans to implement base station throughout 795 amphur of Thailand. Besides, the company also increases the capacity of network to support more customer and improve the quality of service continuously; especially In-door Coverage.

5. *Concerning more on after sale service*

After sale service is another aspect that the case company has given important in the business strategy. The company aims to develop more effective and efficiency in after sale service in order to satisfy the customer. Many activities and projects has been developed as follow:

- Training Service Dealer

  Owing to the Service Dealers are distributed in every province of Thailand, the case company develops training course for them be able to check and repair customer's mobile phone. This makes the customer be more convenience in receiving better services and satisfaction.

- Developing Temp-O-Phone

  In the case that the service center can not repair the customer's mobile phone within 24 hours, the case company has developed service that is called Temp-O-Phone. This service is to give temporary replacement of mobile phone to the customer in order to make them not lose for contacting.

- Setting Service Caravan

  Owing to the case company has given more important on after sale service, so service caravan has been set. Service caravan will travel the major province in order to check and repair mobile phone in each local area.

- Improving registration system

  Registration system has been improved in order to make customer be more satisfied. New registration has to be completed as soon as possible and customer should be able to use the mobile phone service within 3 hours. For reconnecting the service in the case of barring service, it should be completed within 1 hours. Besides, the customer can request for edit the personal information or record in the system by mail in the case of not convenience to contact at service center. Moreover, the customer can receive service about registration not only the company's shop, but in the major shop also.

- Facilitating in payment

  In order to facilitate customer in payment, the case company has expanded counter service and increases the payment method. So customers can choose the place to pay service charge and the method of payment as they want and get most convenience.

For the customer requirement, the researcher has made questionnaires and distributed them to the customer according to QFD phase 1 methodology. Therefore, the customer requirement in the process can be summarized as follow:

(1) Testing the standard of handset

(2) Testing the transmitter and receiver of handset

(3) Testing the sensitivity of handset

(4) Testing function in menu of handset

(5) Testing handset when operating with SIM card

(6) Testing handset when working with network

(7) Testing handset when using value added services

(8) Testing handset when using new service

(9) Support list of mobiles that have passed type approval

(10) Support list of mobiles that support service

(11) Quick in support information

(12) Test report is finished on schedule

(13) Accuracy in test report

(14) Take short time in testing

(15) Always update test topics

(16) Fast response when found problem

4.2.1.7 Select the critical processes

According to this research, the critical process has already been selected. That is Mobile Type Approval process. Then, the next step is to do process analysis. Process analysis begins with breaking the complex process down into subprocess. Refer to figure3.7 (Functional units in the Mobile Type Approval Process), the subprocess of 'Mobile Type Approval' consists of:

1. Coordinating to do type approval by Marketing
2. Requesting and testing at The Post and Telegraph Department (PTD)
3. Requesting and testing at Telephone Organization of Thailand (TOT)
4. Testing at Service Center
5. Testing at Engineering

According to the scope of this research, the activities that are outside the company (e.g. PTD and TOT) are excluded in analyzing and developing improvement for this research. Other reasons are: (1) It would need the organization's policy; especially PTD and TOT, to agree on improvement of process, (2) It would need support in order to access information to develop the new workflow, (3) It would need cooperation of the personnel to identify the problems, (4) It would need resource support in order to brainstorm the problems to find possible streamlining, (5) It would need management support to get process implement with reduction of steps with additional effort and resource, and (6) It would need monitoring capability tc measure results. So the subprocess no.2 and no.3 is cut off. The remaining subprocesses are listed as follow:

1. Coordinating to do type approval by Marketing
2. Testing at Service Center
3. Testing at Engineering

After considering problems and cycle time of each subprocess, EIT has selected the subprocess no.3 above to be critical subprocess to be improved. This is because there are some weak points and spend most of the cycle time in the overall process. However, the other two subprocesses are brought into consideration for improvement also because the objective of this research is to improve efficiency and reduce timing for the overall process; not only in the subprocess.

4.2.1.8 Appoint process owners

In BPI approach, process owner has an important role to develop business process improvement. Executive Improvement Team (EIT) has responsibility for selecting the process owner. Objective of setting the process owner is to ensure that the total process is going to be both effective and efficient. However, process owner should be person who is at high level enough to identify the impact of improvement, have influence in changing policies and procedures of the process, commit to a plan and implement changes, and be able to monitor the effectiveness and efficiency of the process. Moreover, the process owner's responsibility is to improve a specific process or subprocess and ensure that the effectiveness and efficiency of the entire process are improved.

In this research, EIT has selected one process owner for each subprocess of Mobile Type Approval process. Those are:

- Import & Type Approval Manager - to be process owner of 'Coordinating to do type approval by Marketing'
- Service Development Manager - to be process owner of 'Testing at Service Center'
- Senior Handset Engineer – to be process owner of 'Testing at Engineering'

After EIT has selected the process owners already, the researcher as BPI champion explains the scope of the job and prepares the list of their major responsibilities. List of their major responsibilities is shown as follow:

- Determine how to measure the subprocess, and set targets for improvement in effectiveness, efficiency, and adaptability
- Manage and control the improvement to reach the goal, and not to be effect with other process in the company.
- Form and select the Process Improvement Team (PIT)
- Train the PIT member about BPI concept
- Identify the critical success factors of each subprocess
- Define subprocesses and their owners
- Monitor the subprocess
- Identify and implement process changes

4.2.1.9 Select the PIT members

As selecting the PIT members is the responsibility of process owners, the process owners should consider which section play key roles in their process. And then process owners should select at least one appropriate person in that section to be PIT member. Besides, the researcher as BPI champion keeps supporting the process owners to explain the scope of the job and prepares the list of major responsibilities to PIT members. Major responsibilities of PIT members are listed as follow:

- Participate in all PIT activities (e.g., train in BPI concept, attend meetings, and walk through activities)
- Conduct BPI activities required by PIT (e.g., develop flowchart and documentation, measure efficiency, and implement the changes)
- Support change (e.g., inform, encourage, provide feedback, and listen to complaints)

For Mobile Type Approval process, there are three process owners from Marketing department, Service department, and Engineering department. Process owners are Import & Type Approval manager, Senior Service Engineer, and Senior Handset Engineer; consequently. Each process owner considers his or her process and selects PIT members who play key roles in his or her process as follow:

(1) For 'Coordinating to do type approval by Marketing' process

After Import & Type Approval Manager as process owner has considered the persons who involve in the process, she invites three persons who play key roles to be PIT member. Those are

- Handset Marketing Manager
- SIM & Numbering Manager
- Channel Marketing Manager

Handset marketing manager plays key role in contacting all mobile phone suppliers to sell the handset in the market. SIM & Numbering manager plays key role in loading IMEI in the system. And Channel marketing manager plays key role of being contact point of agent and dealer in distributing mobile phone into each market channel.

(2) For 'Testing at Service Center' process

After Service Development Manager as process owner has considered the persons who involve in the process, he invites a person who plays key roles to be PIT member. These is

- Senior Service Engineer

Senior Service Engineer plays key role in testing the specification of mobile phone at Service Center, and supporting marketing department in testing at PTD.

(3) For 'Testing at Engineering' process

After Senior Handset Engineer as process owner has considered the persons who involve in the process, he invites five persons who play key roles to be PIT member. Those are

- Network Optimization manager
- Senior SIM Operation engineer
- Handset Technology engineers (3 persons)

Network Optimization manager plays key role in supporting and setting parameter in the network in order to do type approval. Senior SIM Operation engineer plays key role in supporting SIM test and test equipment in order to do type approval. And three handset technology engineers play key role in being the testers of type approval process.

In conclusion of BPI phase 1 (Organizing for improvement), Mobile Type Approval Process has divided into three subprocesses: 'Coordinating to do type approval by Marketing', 'Testing at Service Center', and 'Testing at Engineering'. Process owner and PIT members are assigned in each subprocess as shown in the figure 4.22 below.

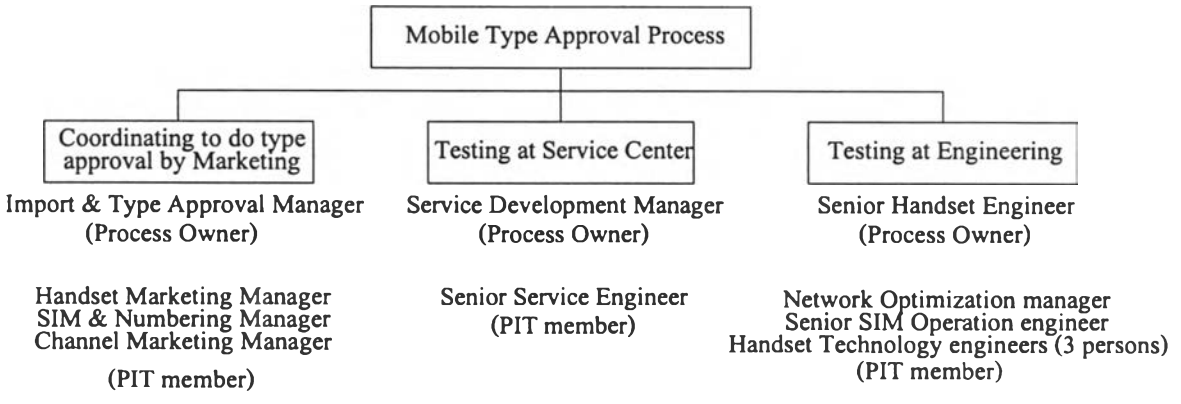

Figure 4.22 Process Owner and PIT members

4.2.2 Understanding the process (BPI phase 2)

Understanding the process is the second phase of improvement. It consists of 10 activities to make everyone understand the current process; especially EIT, process owners and PIT members. The activities in this phase are stepped as follow:

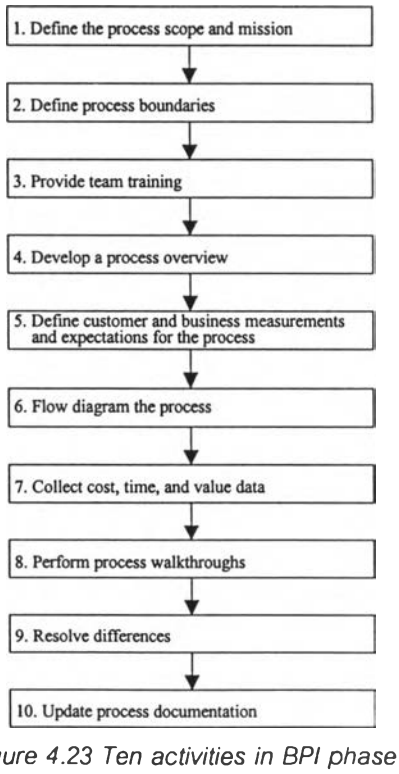

Figure 4.23 Ten activities in BPI phase 2

4.2.2.1 Define the process scope and mission

In the first step of BPI phase 2, it is required the PIT to define the process scope and mission. Firstly, the researcher recommends PIT to develop the process's goals and objectives before developing the mission statement. In addition, the good mission statement should be short, define the scope of the activities, state what will be accomplished, and include performance improvement targets and completion dates (in some cases). Owing to the Mobile Type Approval process is divided into 3 subprocesses, the process scope and mission are divided according to the subprocess also as follow:

- Coordinating to do type approval by Marketing

  Goal: Spending 35 working days in overall type approval process for each model.

  Objective: To reduce total cycle time and improve the efficiency of coordination in the process.

  Mission: To implement BPI approach in order to improve the existing process in both efficiency and effectiveness, and shorten the timing as much as possible.

- Testing at Service Center

  Goal: Spending 2 working days in testing at Service Center for each model

  Objective: To reduce the cycle time of testing, but still maintain the quality of work.

  Mission: To implement BPI approach in order to shorten the timing in the process, and maintain the efficiency.

- Testing at Engineering

  Goal: Spending 15 working days in testing at Engineering for each model.

  Objective: To eliminate no-value-added activities in order to reduce the cycle time of the process.

  Mission: To implement BPI approach in order to improve the efficiency, effectiveness, and adaptability of the process, and shorten the timing as much as possible.

4.2.2.2 Define process boundaries

In this step, it is the responsibility of *process owner* to define preliminary process boundaries (where the process begins and ends) of each subprocess. This is because most processes are not clearly defined the beginning and end points, so someone may not understand the process in the same way. Besides, some processes may be complex and have many points that the process should begin and end. To define the process boundaries is also represent the activities that are outside the scope of the core process also. In addition, the process boundaries are shown in the block diagram as below:

- Coordinating to do type approval by Marketing

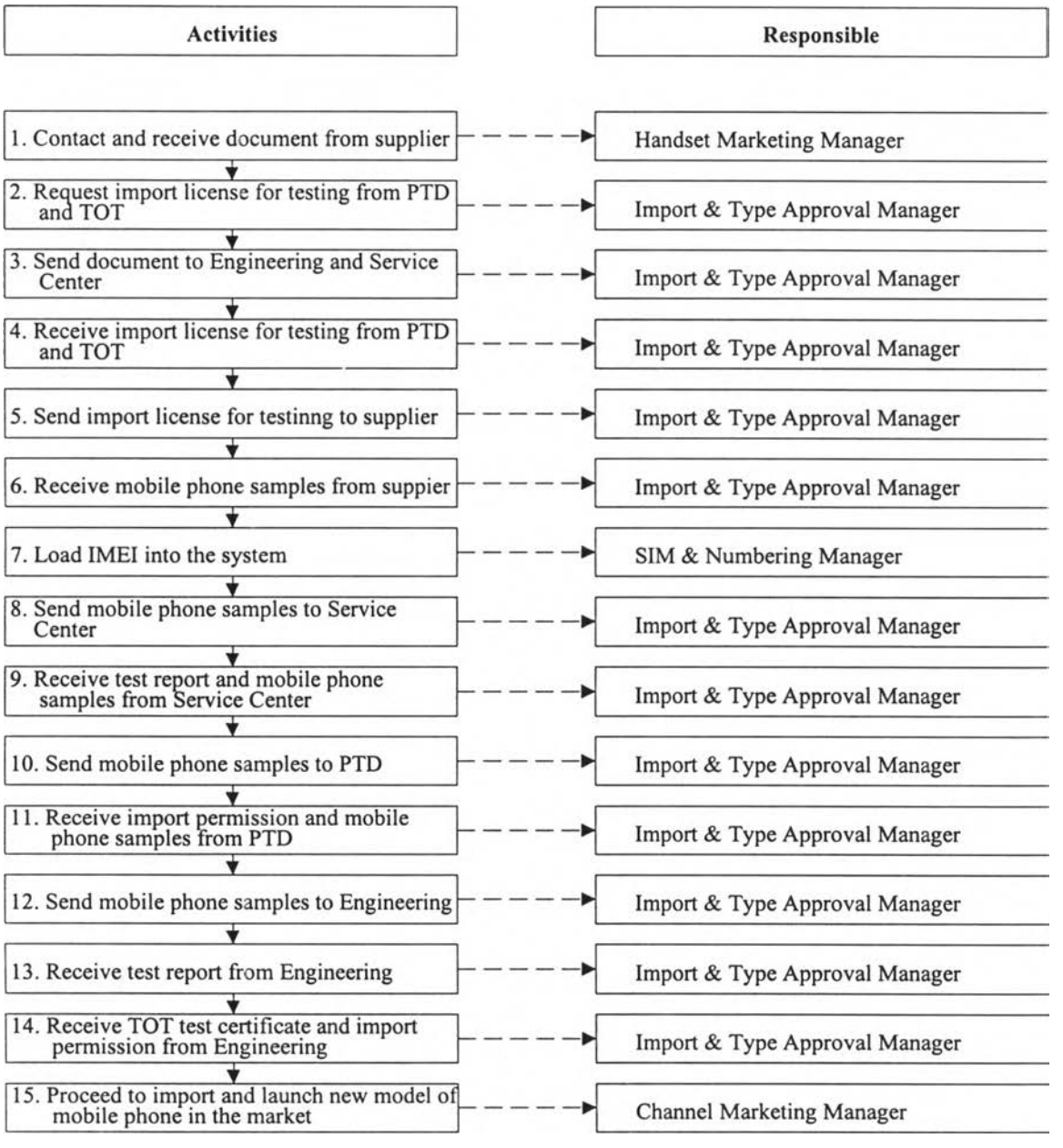

Figure 4.24 Block diagram of 'Coordinating to do type approval by Marketing' process

- Testing at Service Center

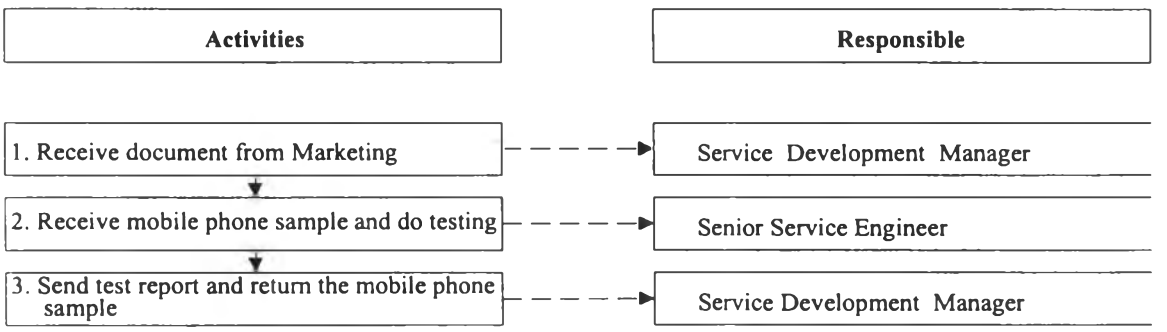

Figure 4.25 Block diagram of 'Testing at Service Center' process

- Testing at Engineering

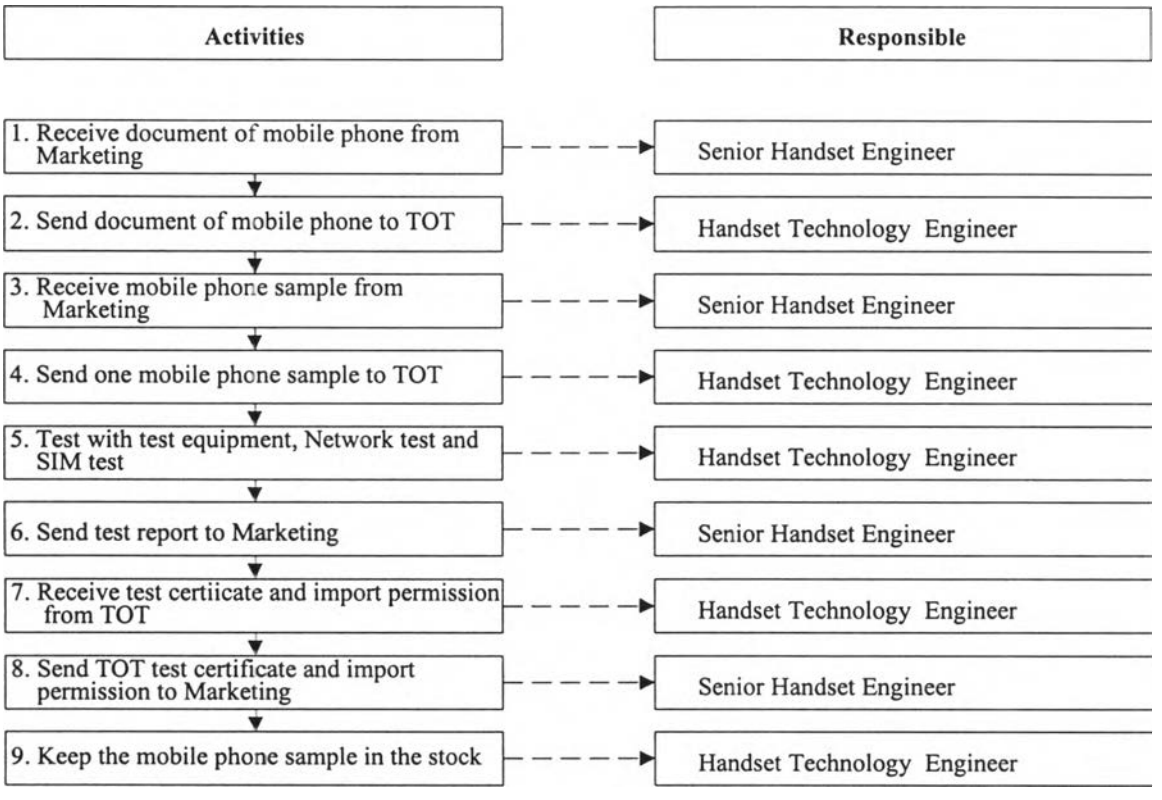

Figure 4.26 Block diagram of 'Testing at Engineering' process

4.2.2.3 Provide team training

Training is very important; especially for PIT member. Normally, it should have a training class about basic teamwork and problem-solving tools; such as team process, brainstorming, check sheets, and etc. But in the practical for this research, the researcher as BPI champion has chosen the important topics to explain to the PIT members and persons who involve in the process. Those topics are related to the process improvement as list below:

- *Team process*

  Team process is the process that people from different functional departments working together to develop the process as a team. Generally, most companies organize themselves into vertically functional groups or department. But most processes do not flow vertically. They flow horizontally. So every functional department in the process has impact on the efficiency and effectiveness of the process. The workflow of team process is shown below:

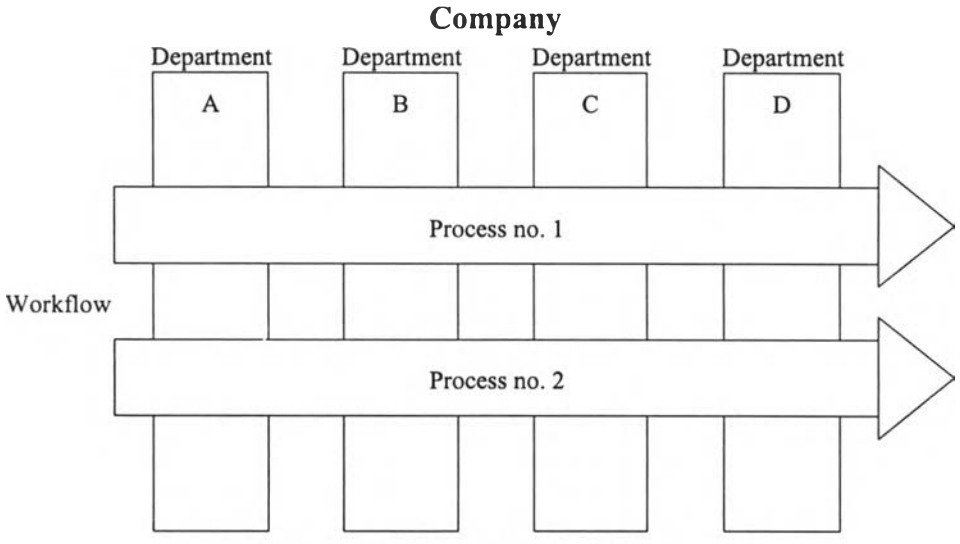

Figure 4.27 Workflow of team process

Owing to process is logic series of related transactions that converts input to output, each process its own supplier and customer. Supplier and customer can be both internal and external of the company. Supplier is person or functional department that sends input to the process. And customer is person or functional department that receives output from the process. This concept can be illustrated as figure shown below:

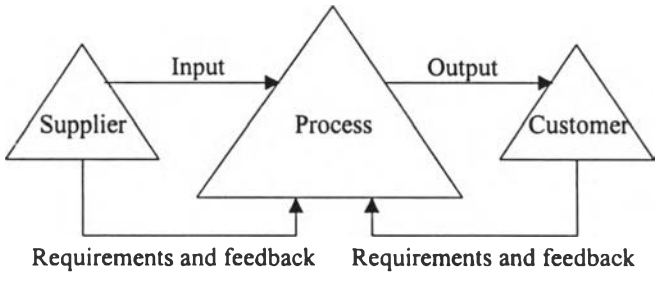

Figure 4.28 Process with supplier and customer

- *Brainstorming*

Brainstorming is a technique for idea generation to find solutions as many as possible. This technique has many advantages in generating creative idea, encouraging joint problem-solving, making possibility for people to build on one another's ideas, minimizing the tendency to prematurely evaluate ideas, and appreciating the thinking that expands the traditional boundaries of the solution space. Besides, there are two different ways of brainstorming: Structured and Unstructured brainstorming. Structured brainstorming is technique to let the individual person launch

one idea in turn. This approach is most structured one and to ensure equal participation, but is less spontaneous and may limit the possibility for building on one another's idea. Unstructured brainstorming is technique to let everyone feel free in launching ideas all the time. This approach is very spontaneous, but is often more confusing and be able to lead one or a few persons ending up dominating the activity. The procedure is as follows:

- Define clearly topic of brainstorming
- Let the participants launch ideas according to the approach used, structured or unstructured. Encourage everyone to launch ideas, no matter how silly they might seem.
- Write down every single idea launched.
- It is not allowed to discuss, criticize, or evaluate ideas during the brainstorming.
- When the ideas seem to become only reformulation of previously launched ideas or when the frequency of new ideas is decreasing for the second time, close the process.
- Evaluate the idea by picking the obviously good ideas. Sort the rest into groups.

However, there are rules that everyone should remember in mind for brainstorming. Those are:

- No criticism or discussion of ideas is permitted during the brainstorming.
- Laugh with crazy ideas, not at them.
- Be loose and spontaneous; there are no stupid ideas.
- Keep all ideas.
- Combine ideas. The ideas are not mine or yours; they are the group's.

- *QFD*

QFD or Quality Function Deployment is a tool for process improvement. It is utilized to identify improvement actions for a business process. In QFD model, there are totally four phases. Phase I is Product Planning (House of Quality). Phase II is Design Deployment (Part Deployment). Phase III is Manufacturing Planning (Process Planning). And Phase IV is Production Planning (Production Operations Planning). According to the scope of this research, we will cover and apply only Phase I of QFD. The general house of quality is shown below:

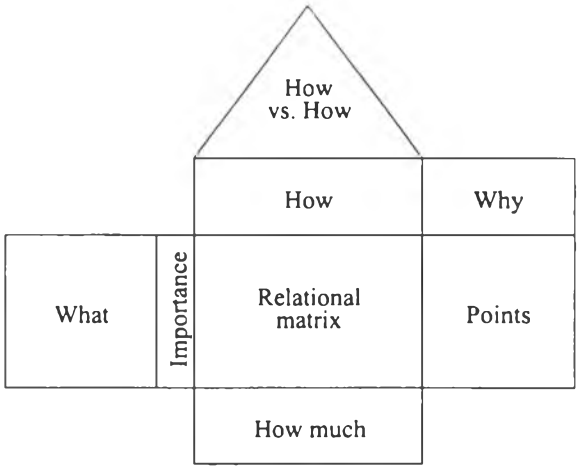

Figure 4.29 General House of Quality

The general house of quality is divided into 8 sections. Each section has its own meaning as described below:

- 'What' section shows the requirement of customer in product or process.
- ' Importance' section shows the importance of each customer's requirement.
- 'How' section shows the means used to satisfy the customer's requirement.
- 'Relational matrix' section shows the relation between the requirements and the means.
- 'How vs. How' section shows the connections between the different means.
- 'Why' and 'Points' section shows the benchmarking of requirement against other companies.
- 'How much' section shows the target of technical requirement and results of the analysis.

However, in order to create House of Quality, there are seven steps to follow:

(1) Collecting the customer requirement

(2) Translating the customer requirement into technical requirement

(3) Developing relationship between each customer requirement and each technical response

(4) Determining the target of each technical requirement in measurable figure

(5) Creating the correlation matrix

(6) Creating the competitive assessment graph

(7) Creating the relative importance rating

- *BPI*

BPI or Business Process Improvement is a methodology for simplifying and streamlining the company's operation. It focuses on eliminating waste and bureaucracy. For BPI methodology, there are totally five phases. Phase I is 'Organizing for improvement'. Phase II is 'Understanding the process'. Phase III is 'Streamlining'. Phase IV is 'Measurements and Controls'. And Phase V is 'Continuous Improvement'. The five phases of BPI can be shown in figure below:

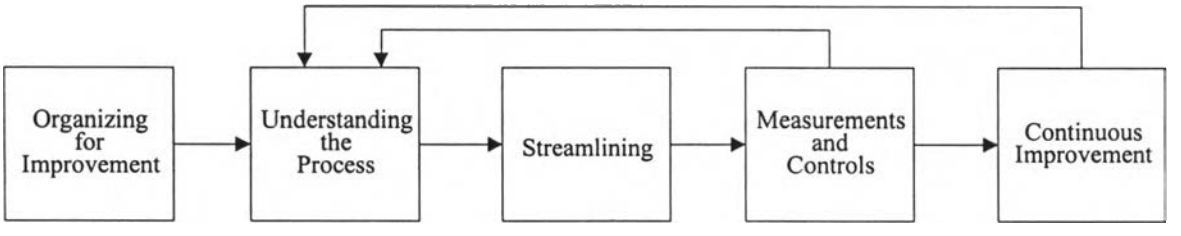

Figure 4.30 Five phases of BPI

However, in each phase of BPI, there are activities that should be followed as described.

Phase I. Organizing for improvement

Activities
1. Establish EIT
2. Appoint a BPI champion
3. Provide executive training
4. Develop an improvement model
5. Communicate goals to employees
6. Review business strategy and customer requirement
7. Select the critical processes
8. Appoint process owners
9. Select the PIT members

Phase II. Understanding the process

Activities
1. Define the process scope and mission
2. Define process boundaries
3. Provide team training
4. Develop a process overview
5. Define customer and business measurements and expectations for the process.
6. Flow diagram the process
7. Collect cost, time, and value data
8. Perform process walkthroughs
9. Resolve differences
10. Update process documentation

Phase III. Streamlining

Activities
1. Provide team training
2. Identify improvement opportunities: Errors and rework, High cost, Poor quality, Long time delays, and Backlog
3. Eliminate bureaucracy
4. Eliminate no-value-added activities
5. Simplify the process
6. Reduce process time
7. Errorproof the process
8. Upgrade equipment
9. Standardize
10. Automate
11. Document the process
12. Select the employees
13. Train the employees

Phase IV. Measurements and Controls

Activities
1. Develop in-process measurements and targets
2. Establish a feedback system
3. Audit the process periodically
4. Establish a poor-quality cost system

Phase V. Continuous Improvement

Activities
1. Qualify the process
2. Perform periodic qualification reviews
3. Define and eliminate process problems
4. Evaluate the change impact on the business and on customers
5. Benchmark the process
6. Provide advanced team training

- *Flowcharting*

Flowcharting is a method for describing the existing process or the proposed new process graphically by using simple symbols, lines, and words. It displays the activities and the sequence in the process. There are many types of flowcharts. But for process improvement, there are basically four types of flowcharts: Block diagrams, The American National Standards Institute (ANSI) standard flowchart, Functional flowcharts, and Geographic flowcharts. Block diagram provides a quick, uncomplicated view of the process. ANSI standard flowchart provides more detailed understanding of a process than Block diagram. It is used to expand the activities within each block to the desired level of detail. Functional flowchart shows the movement between different work units, using either block or standard flowchart symbols. It identifies how vertically

oriented functional departments affect a process flowing horizontally across the company. Geographic flowchart or physical layout flowchart provides the physical flow analysis of activities in the process. It is useful for evaluating department layout and paperwork flow, analyzing product flow, and identifying excessive travel and storage delays

However, there are 12 common symbols that should be understood.

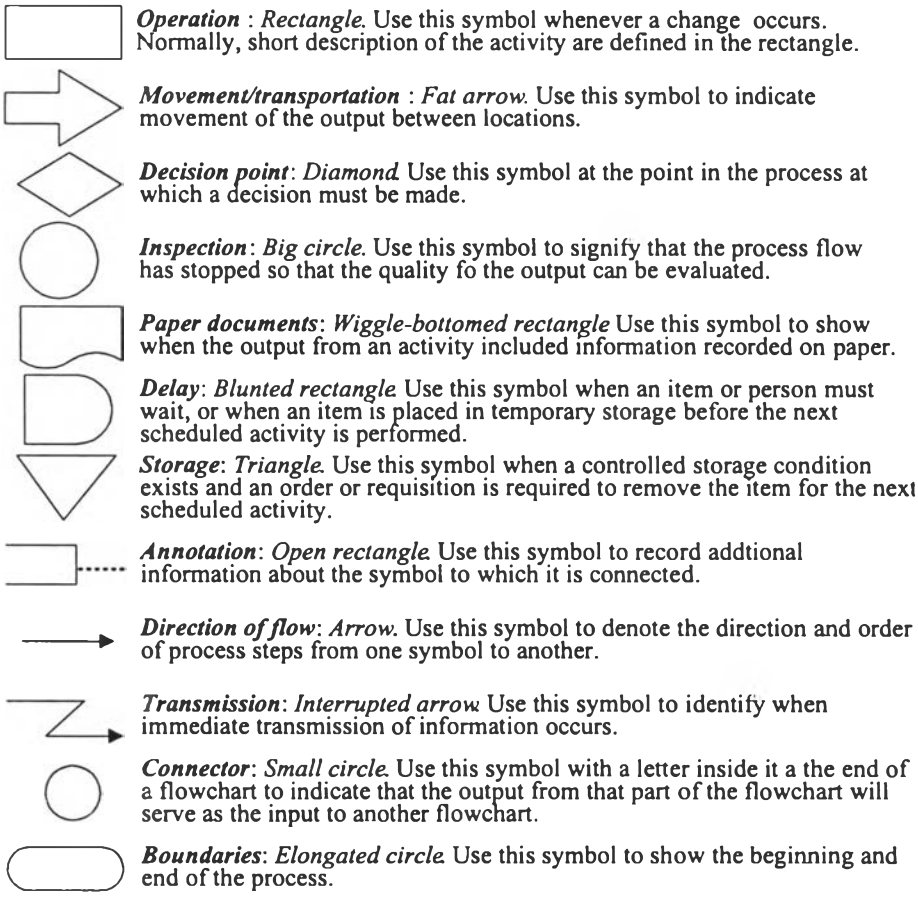

Figure 4.31 Standard flowchart symbols

- *Benchmarking*

Benchmarking is the process of continuously measuring and comparing one's business process against comparable processes in leading organizations to obtain information that will help the organization identify and implement improvement. Generally, Benchmarking is used for four main purposes: measurement, comparison, learning, and improvement. In addition, there are four types of Benchmarking: Internal Benchmarking, Competitive Benchmarking, Functional Benchmarking, and Generic Benchmarking. Internal Benchmarking is the comparison against the best within the

company or organization. Competitive Benchmarking is the comparison against the best competitors. Functional Benchmarking is the comparison against the companies or organizations that are not necessary competitors, but they perform related tasks within the same area. And Generic Benchmarking is the comparison against the best, regardless of industry or markets. For all types of Benchmarking as describe above, the comparison begins from our own company to competitors, and then to other industries. This can be illustrated as figure 4.32.

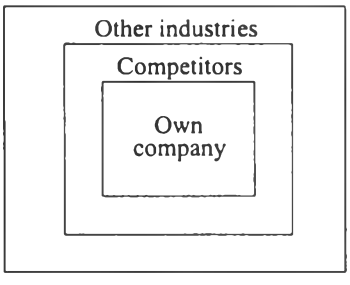

Figure 4.32 Benchmarking

4.2.2.4 Develop a process overview

Before further analyzing the process for improvement, it is necessary to develop an overview in order to identify the suppliers of the inputs to the process, the customers of the outputs of the process, and other processes it interacts with. Typically, a process may have several inputs and outputs. One or two of them may be considered as primary inputs. In the same way, one or two of them may be considered as primary outputs. And the rest are considered as secondary inputs and outputs. All of them are reviewed in order to ensure that there is no inconsistency and gross omission. In some processes, the supplier and customer may be the same person or department. Generally, suppliers are other companies or departments that provide the input. Customers are other companies or departments that receives or benefits from the output of the process.

In this research, the researcher as BPI champion asks the PIT to develop a list of inputs and outputs of their process. Moreover, each input and output are classified into primary and secondary. So the inputs and outputs are listed as follow:

- *'Coordinating to do type approval by Marketing' process*

  Primary input: Requesting for doing type approval

  Secondary input: Documents and test samples

  Primary output: Proceeding to import and launching new model of mobile phone in the market

  Secondary output: Test report from PTD, TOT, Service Center, and Engineering

- *'Testing at Service Center' process*

  Primary input: Requesting for testing

  Secondary input: Documents and test sample

  Primary output: Test report

  Secondary output: Support PTD in testing

- *'Testing at Engineering' process*

  Primary input: Requesting for testing

  Secondary input: Documents and test sample

  Primary output: Test report

  Secondary output: Support information such as list of mobile that supports services.

4.2.2.5 Define customer and business measurements and expectations for the process

In this step, there are three things that should be listed. Those are list of customer, business measurements and expectations for the process. In a process, customers are divided into five types: Primary, Secondary, Indirect, External customer, and consumer. The relationship of each customer to the process can be shown in the figure.

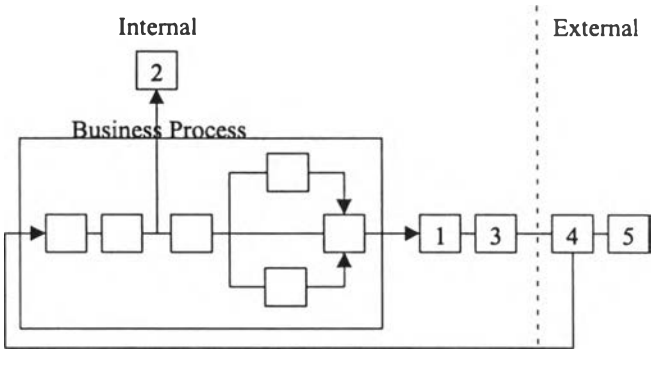

Figure 4.33 Types of customer

(1) Primary customer – customers who directly receive the output from the process

(2) Secondary customers – customer who is outside the process boundaries that receives output from the process.

(3) Indirect customer – customer who do not directly receive the output from the process but are affected if the output from the process is wrong or late.

(4) External customer – customer who outside the company who receive the end product or service.

(5) Consumers – customer who consume the product or service.

For business measurement, there are three major process measurements: effectiveness, efficiency, and adaptability. Effectiveness is something that meets the needs and expectation of the customer. Efficiency is something that the company focuses on when minimizing resources and eliminating waste. And adaptability is something that the company focuses on in order to flexible the process to meet future customer expectations. These typical measurements are listed as below:

- Effective measurement

  Appearance, Timeliness, Accuracy, Performance, Reliability, Usability, Serviceability, Durability, Costs, Responsiveness, Adaptability, and Dependability
- Efficiency measurement

  Processing time, Resources expended per unit, Value-added cost per unit, Percentage of value-added time, Poor-quality cost, and Wait time per unit
- Adaptability measurement

  Average time to get a special customer request process, Percentage of special requests that are turned down, and percentage of time special requests are escalated

- *'Coordinating to do type approval by Marketing' process*

  List of customer

Primary customer:	Terminal Product Marketing Department
Secondary customer:	Order processing Department
Indirect customer:	Top management
External customer:	Dealer and franchised shop
Consumer:	Customer who buys and uses mobile phone

  List of business measurement

Effectiveness:	Total cycle time of the process
Efficiency:	Processing time
Adaptability:	Average time to get special customer request

  Expectation of the process

  On-time schedule

- *'Testing at Service Center' process*

  List of customer

  Primary customer: Import & Type Approval Department

  Secondary customer: Headquarter Service Center

  Indirect customer: Terminal Product Marketing Department

  External customer: The Post and Telegraphs Department (PTD)

  Consumer: -

  List of business measurement

  Effectiveness: Accuracy, Timeliness

  Efficiency: Processing time

  Adaptability: Average time to test special customer request

  Expectation of the process

  Take short time and have accuracy in testing

- *'Testing at Engineering' process*

  List of customer

  Primary customer: Import & Type Approval Department

  Secondary customer: Value Added Service Department and Channel Marketing Department

  Indirect customer: Terminal Product Marketing Department

  External customer: -

  Consumer: -

  List of business measurement

  Effectiveness: Accuracy, Timeliness

  Efficiency: Processing time

  Adaptability: Average time to test special customer request

  Expectation of the process

  Take short time and have accuracy in testing

4.2.2.6 Flow diagram the process

Flowchart is a key factor in improving business process. In this research, Mobile Type Approval process is flowcharting in high-level and down to the task level of each subprocess. As mention in section 3.2.1 (High-level flow diagram), the process is shown in the block diagram as figure below:

Figure 4.34 High-level flow diagram

In high-level flow diagram, it provides a quick overview of the process. The process is divided into 6 activities: activity 1'Plan to launch new model', activity 2 'Import samples for type approval', activity 3 'Test at PTD and Service Center', activity 4 'Test at TOT and Engineering', activity 5 'Send test report', and activity 6 'Prepare for launching'.

Activity 1 'Plan to launch new model'. The process starts when marketing department has planned to launch new model of mobile phone in the market. Marketing will contact and request the supplier some document and test sample. According to the law, Marketing will also request The Post and Telegraph Department (PTD) and Telephone Organization of Thailand (TOT) for testing import permission.

Activity 2 'Import samples for type approval'. After receiving import permission for testing, Marketing will contact the supplier in order to import samples for type approval. Normally, doing type approval or testing mobile phone is developed at 4 functional units: PTD, Service Center, TOT, and Engineering. Each functional unit has its own objective in testing. PTD develops testing for inspecting and monitoring the uses of radio frequency according too radiocommunications laws and regulations. Service Center develops testing for technically supporting PTD, improving the quality of product and training the dealers. TOT develops testing for checking the specification of mobile phone according to the concession. And Engineering develops testing for technically supporting TOT, checking the compatibility of mobile phone with network and services.

Activity 3 'Testing at PTD and Service Center'. Marketing will send the samples to Service Center to pre-test about the specification. When Service Center confirms the specification of the sample, then Marketing will send the sample to PTD. Besides, Service Center technically supports PTD in testing also. After finishing tests, PTD will give import permission to Marketing. In addition, Service Center develops some training for dealer.

Activity 4 'Testing at TOT and Engineering'. After finishing test at PTD and Service Center, Marketing will send the samples to Engineering. Engineering responsible for contacting TOT to do type approval according to the concession, and developing tests with the network and company's services. After TOT finishes testing, TOT will give test certificate in order to import and sell in the country. At the same time, Engineering develops testing and sends test report to Marketing.

Activity 5 'Send test report'. After finishing all tests, the test report will send to Marketing in order to confirm that the samples are passed the specification and requirement.

Activity 6 'Prepare for launching'. At this step, Marketing has to prepare everything ready before launching the new model in the market such as amount of product in the warehouse, spare part and equipment in each service shop, price, promotion, and etc.

According to the scope of this research, Mobile Type Approval process is divided into 3 subprocesses: (1) Coordinating to do type approval by Marketing, (2) Testing at Service Center, and (3) Testing at Engineering. Process owners and PIT members are responsible for developing their own processes. All of them are shown in the task level as follow:

(1) 'Coordinating to do type approval by Marketing' process

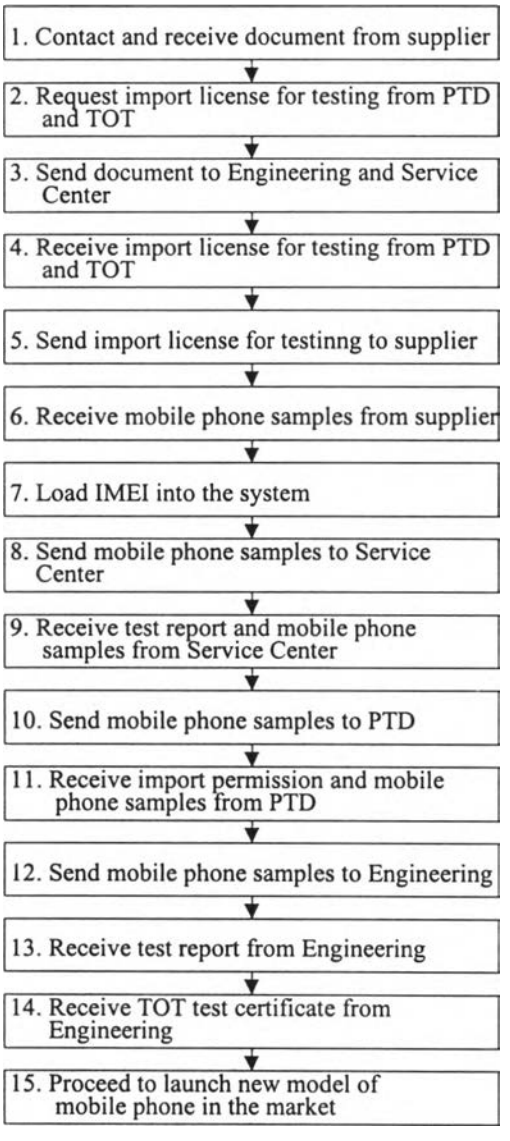

Figure 4.35 Coordinating to do type approval by Marketing process

In this subprocess, there are 15 activities as follow:

Activity 1 'Contact and receive document from supplier'.

Handset Marketing Manager contacts suppliers for planning to launch new model of mobile phone into the market. Before launching new model, the suppliers have to send some document and samples in order to do type approval. In addition, Import & Type Approval Manager is responsible for doing type approval.

Activity 2 'Request import license for testing from PTD and TOT'.

Handset Marketing Manager will inform Import & Type Approval Manager which model of mobile phone is planned to launch in the market. Supplier will also contact and send document to Import & Type Approval Manager. Then Import & Type Approval Manager will make an official letter to PTD and TOT in order to request import license for testing.

Activity 3 'Send document to Engineering and Service Center'.

When Import & Type Approval Manager receives document from suppliers, she sends it to Engineering and Service Center for preparing to do type approval.

Activity 4 'Receive import license for testing from PTD and TOT'.

After PTD and TOT have considered the company's official letter, they will return the import license for testing to Marketing.

Activity 5 'Send import license for testing to supplier'.

When Import & Type Approval Manager receive import license for testing from TOT and PTD, she will send it to the suppliers. Supplier will bring it to take the samples out of the customs, and then send the samples to Marketing.

Activity 6 'Receive mobile phone samples from supplier'.

According to the import license for testing, 2 units of sample are brought into the country. Then they send it to Marketing in order to do type approval with PTD, TOT, Service Center and Engineering.

Activity 7 'Load IMEI into the system'.

When Import & Type Approval Manager receives mobile phone samples for testing, she requests SIM & Numbering department to load IMEI into the system. IMEI is the serial number of mobile phone. Each one has its own serial number (15 digits). If IMEI is not in the system, the mobile phone can not be used.

Activity 8 'Send mobile phone samples to Service Center'.

Import & Type Approval Manager sends the samples to Service Development Manager in order to pre-test its specification. She requests for test report and technical support when she goes to test at PTD also.

Activity 9 'Receive test report and mobile phone samples from Service Center'.

After Service Center finishes testing, Service Development Manager sends test report and the sample to Import & Type Approval Manager. If there is some problem with the samples, Import & Type Approval Manager will contact the supplier to solve problem before testing at PTD.

Activity 10 'Send mobile phone samples to PTD'.

When everything is ready for testing, Import & Type Approval Manager brings the samples to test at PTD. Owing to the manager has only some technical knowledge with the mobile phone, she needs some support from Service Center. Usually, senior service engineer goes with her for testing at PTD.

Activity 11 'Receive import permission and mobile phone samples from PTD'.

When testing is finished and all tests are passed, PTD will issue the import permission to the company. Then Import & Type Approval Manager brings the samples back and proceed to send it to test at TOT and Engineering.

Activity 12 'Send mobile phone samples to Engineering'.

After Import & Type Approval Manager brings the samples back from PTD, she sends them to Senior Handset Engineer at Engineering department in order to do type approval at TOT and testing with the company's network, SIM card and services.

Activity 13 'Receive test report from Engineering'.

After finishing test with network, SIM card and services, Senior Handset Engineer will conclude the test result and send the test report back to the Import & Type Approval Manager.

Activity 14 'Receive TOT test certificate from Engineering'.

Engineering department has responsible for doing type approval with TOT. After finish testing, TOT will send the test certificate to Engineering department. And then Senior Handset Engineer will send it to Import & Type Approval Manager.

Activity 15 'Proceed to launch new model of mobile phone in the market'.

After type approval process is done, Import & Type Approval Manager will inform the Channel Marketing Manager in order to proceed launch new model of mobile phone in the market.

(2) 'Testing at Service Center' process

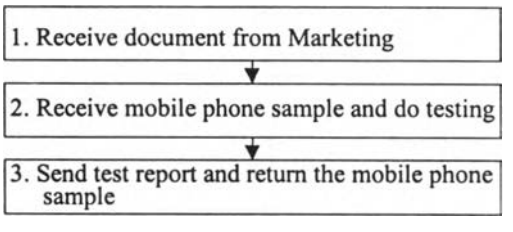

Figure 4.36 Testing at Service Center process

In this subprocess, there are 3 activities as follow:

Activity 1 'Receive document from Marketing'.

This process starts when Service Development Manager receives the document such as user manual and service manual from Import & Type Approval Manager.

Activity 2 'Receive mobile phone sample and do testing'.

When the sample is imported and sent to Marketing, Import & Type Approval Manager will send the sample to Service Center. Senior Service Engineer does pre-test the specification of the samples.

Activity 3 'Send test report and return the mobile phone sample'.

After finishing testing, the Service Development Manager will send the test report and return the mobile phone sample to Import & Type Approval Manager. Besides, Senior Service Engineer will go to PTD in order to support testing with Import & Type Approval Manager.

(3) 'Testing at Engineering' process

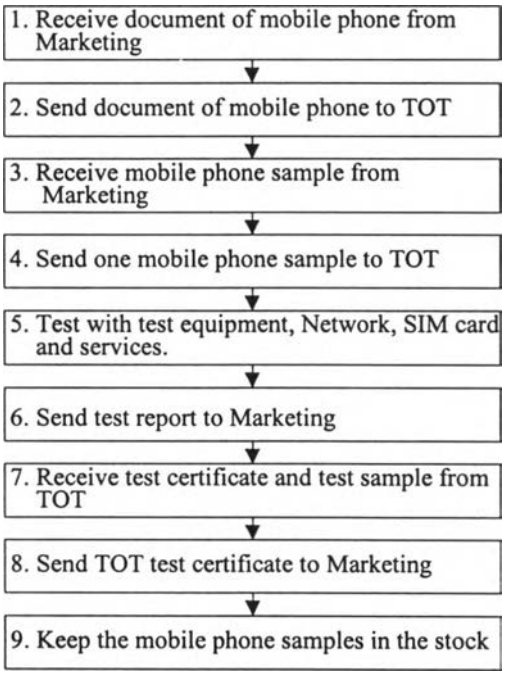

Figure 4.37 Testing at Engineering process

In this subprocess, there are 9 activities as follow:

Activity 1 'Receive document of mobile phone from Marketing'.

This process starts when Senior Handset Engineer receives the document such as user manual and technical specification from Import & Type Approval Manager.

Activity 2 'Send document of mobile phone to TOT'.

According to the concession, the company has to request to do type approval with TOT for each new model of mobile phone. Then, Handset Technology Engineer makes the official letter and sends the document to TOT.

Activity 3 'Receive mobile phone sample from Marketing'.

When finishing test at PTD and Service Center, Import & Type Approval Manager sends 2 units of sample to Senior Handset Engineer. One sample is for testing at TOT, and another one is for testing with network, SIM card and services.

Activity 4 'Send one mobile phone sample to TOT'.

After paying the fee for testing at TOT, Handset Technology Engineer brings the mobile phone sample to TOT and support testing if it is required.

Activity 5 'Test with test equipment, Network, SIM card and services'.

In this activity, it is internal testing within the company. There are a lot of topics to be tested. Testing with test equipment is almost same as testing at Service Center because it aims to check the samples' specification. For testing Network, Handset Technology Engineer has to corporate with Network Engineer in order to develop testing. For testing SIM card, Handset Technology Engineer has to corporate with SIM Operation Engineer in order to update test topic and SIM technology. For testing services, Handset Technology Engineer has to corporate with Application staff in order to testing and updating test topics.

Activity 6 'Send test report to Marketing'.

After finishing testing, Senior Handset Engineer will send the test report to Import & Type Approval Manager.

Activity 7 'Receive test certificate and test sample from TOT'.

When finishing all the test and all tests are passed, TOT will send the test certificate and test sample to Engineering department.

Activity 8 'Send TOT test certificate to Marketing'.

When Senior Handset Engineer receives the TOT test certificate, he will send it to Import & Type Approval Manager.

Activity 9 'Keep the mobile phone samples in the stock'.

After finishing all tests, Handset Technology Engineer will keep the 2 units of sample in the stock at Engineering department. This is for testing new software of mobile phone and new services of the company.

4.2.2.7 Collect cost, time, and value data

According to the scope of this research, timing is the important factor of the Mobile Type Approval process. So the time of each subprocess is collected since September 1999 to January 2000. As mention before, the Mobile Type Approval process is divided into 3 subprocesses. Therefore, the timing for these subprocesses is shown in table below.

(1) 'Coordinating to do type approval by Marketing' process

Timing of this process starts when Import & Type Approval Manager receives the document from the suppliers and finishes when Import & Type Approval Manager receives test report from all functional units: PTD, TOT, Service Center and Engineering.

No.	Mobile phone	Start date	Finish date	Time used (working days)
1	Model A	13/9/99	26/11/99	55
2	Model B	30/9/99	21/12/99	58
3	Model C	1/10/99	4/1/00	66
4	Model D	11/10/99	28/12/99	56
5	Model E	11/10/99	28/12/99	56
6	Model F	1/11/99	3/2/00	67
7	Model G	9/11/99	21/1/00	52
8	Model H	24/11/99	10/2/00	55
9	Model I	7/12/99	18/2/00	52
10	Model J	21/12/99	28/2/00	49
11	Model K	29/12/99	17/4/00	74
12	Model L	7/1/00	24/3/00	56
			Average	*58*

Table 4.5 Time collection in 'Coordinating to do type approval by Marketing' process

From the table above, it is shown that the average timing for this process is 58 working days. The timing is longer than that Marketing has ever expected. Expected timing for this process is 35 working days. However, nowadays there is delay time about 23 working days.

(2) 'Testing at Service Center' process

Timing of this process starts when Service Development Manager receives the document from Import & Type Approval Manager and finishes when Service Development Manager sends test report to Import & Type Approval Manager.

No.	Mobile phone	Start date	Finish date	Time used (working days)
1	Model A	30/9/99	4/10/99	3
2	Model B	27/10/99	29/10/99	3
3	Model C	29/10/99	29/10/99	3
4	Model D	1/11/99	4/11/99	4
5	Model E	1/11/99	3/11/99	3
6	Model F	30/11/99	3/12/99	4
7	Model G	30/11/99	1/12/99	2
8	Model H	17/12/99	21/12/99	3
9	Model I	29/12/99	3/1/00	3
10	Model J	11/1/00	14/1/00	4
11	Model K	27/1/00	1/2/00	4
12	Model L	2/2/00	4/2/00	3
			Average	***3.3***

Table 4.6 Time collection in 'Testing at Service Center' process

From the table above, it is shown that the average timing for this process is 3.3 or 4 working days. The timing is longer than that Marketing has ever expected. Expected timing for this process is 2 working days. However, nowadays there is delay time about 2 working days.

(3) 'Testing at Engineering' process

Timing of this process starts when Senior Handset Engineer receives the document from Import & Type Approval Manager and finishes when Senior Handset Engineer sends test report to Import & Type Approval Manager.

No.	Mobile phone	Start date	Finish date	Time used (working days)
1	Model A	8/10/99	29/10/99	16
2	Model B	4/11/99	1/12/99	20
3	Model C	8/11/99	4/1/00	40
4	Model D	9/11/99	25/11/99	13
5	Model E	10/11/99	17/12/99	27
6	Model F	8/12/99	3/2/00	40
7	Model G	8/12/99	20/1/00	30
8	Model H	27/12/99	24/1/00	20
9	Model I	6/1/00	31/1/00	18
10	Model J	20/1/00	28/2/00	28
11	Model K	8/2/00	17/4/00	46
12	Model L	10/2/00	1/3/00	15
			Average	***26.1***

Table 4.7 Time collection in 'Testing at Engineering' process

From the table above, it is shown that the average timing for this process is 26.1 or 27 working days. The timing is longer than that Marketing has ever expected. Expected timing for this process is 15 working days. However, nowadays there is delay time about 12 working days.

4.2.2.8 Perform process walkthroughs

Process walkthrough is the method to follow the workflow that is written in the document, discuss and observe what is going on in the practical. Mostly, the process that is documented is not what is really happening in the company. According to the time is limited, the researcher is assigned in doing this process walkthrough. The purpose is to gather additional information about existing problems and roadblocks to change and to make suggestions for improvements. This is to review and verify the process flow diagram.

Owing to performing process walkthrough, the Mobile Type Approval process can be shown in the ANSI standard flowchart as figure below:

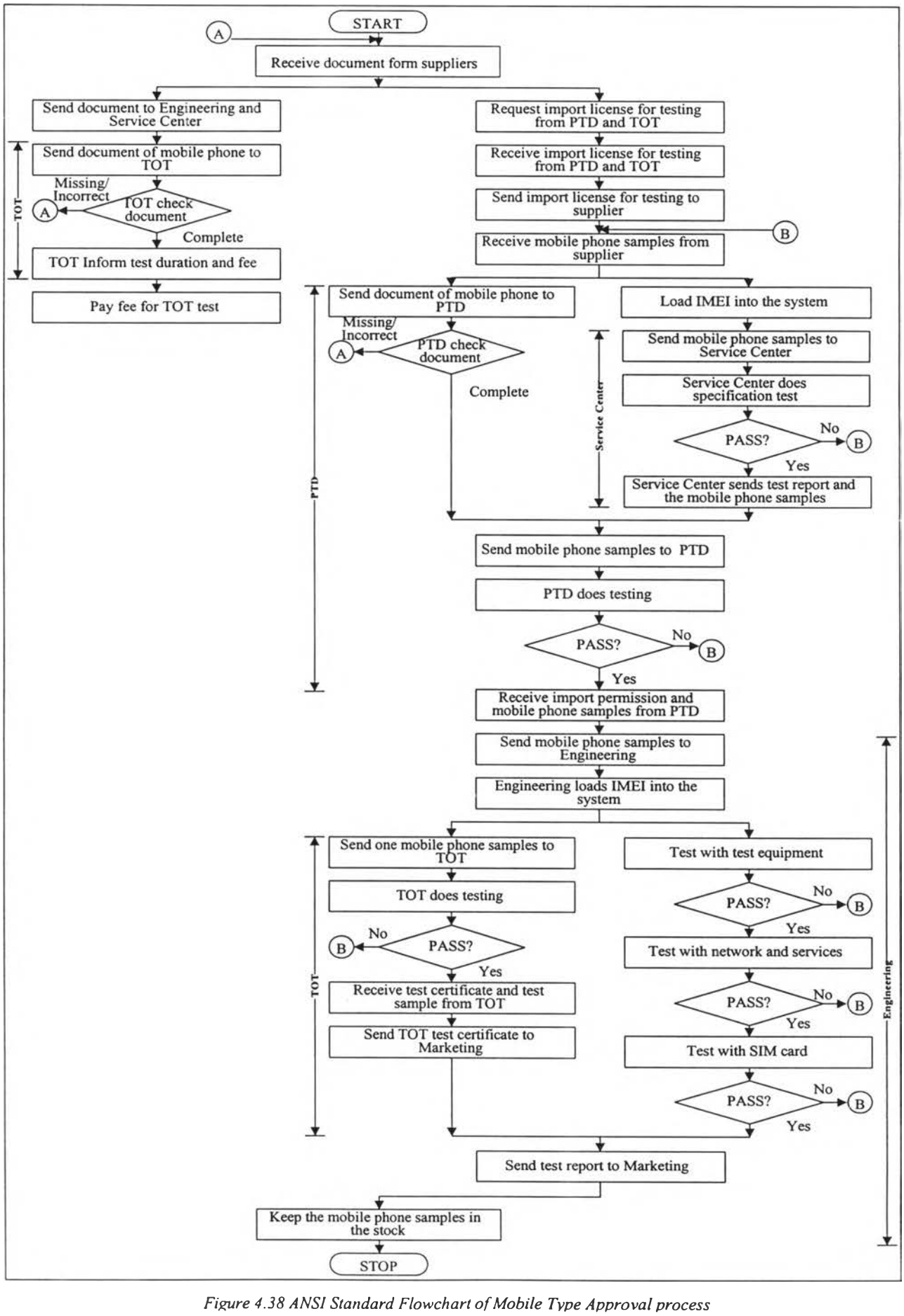

Figure 4.38 ANSI Standard Flowchart of Mobile Type Approval process

From the process walkthrough, the researcher recognizes that there are some activities are working in parallel; not in the sequence as the PIT member shows in the flow diagram. And there are some differences between the documented process and the actual practice. Those are:

- Activity 'Send document of mobile phone to PTD' for Marketing subprocess is missing
- Activity 'Load IMEI into the system' for Engineering subprocess is missing

Besides, the researcher has found that some activities are redundancy. Those are:

- Activity 'Load IMEI into the system'

  From the process walkthrough, the researcher found that both Marketing and Engineering has this activity in their subprocess. Sometimes the samples that are sent to Engineering have not yet load IMEI in the system, the Engineering has to proceed to perform this activity.
- Activity 'Does specification test'

  From the process walkthrough, the researcher found that the activity 'Does specification test' in Service Center subprocess and activity 'Test with test equipment' in Engineering subprocess have the same objective. That is to check whether the sample is within its specification. However, both departments use different test equipment to check the specification.

Suggestion for improvement:

- Ask the suppliers for more amounts of test samples.
- Timing in the Engineering subprocess should be improved.
- Activity 'Load IMEI into the system' should be reviewed.
- Test topics of company's services should be always update and clear defined.
- Each activity in Engineering subprocess should be analyzed in more detail.

4.2.2.9 Resolve differences

After performing process walkthrough, the researcher has identified some missing activities that are not drawing in the process document. So it should be corrected as shown in the figure below.

(1) Activity 'Send document of mobile phone to PTD' for Marketing subprocess is missing

This activity should be added between activity 6 and activity 7 of Marketing subprocess in the figure 4.35. Therefore, the new flow diagram of 'Coordinating to do type approval by Marketing' will have totally 16 activities as shown below:

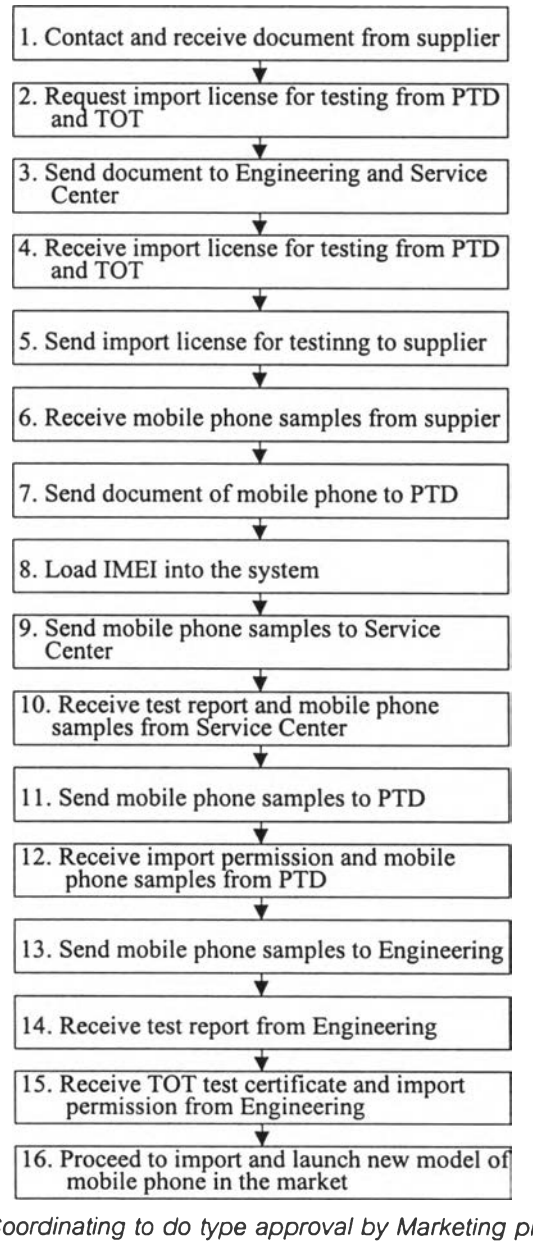

Figure 4.39 Coordinating to do type approval by Marketing process (New)

(2) Activity 'Load IMEI into the system' for Engineering subprocess is missing

This activity should be added between activity 3 and activity 4 of Engineering subprocess in the figure 4.37. Therefore, the new flow diagram of 'Testing at Engineering' will have totally 10 activities as shown below:

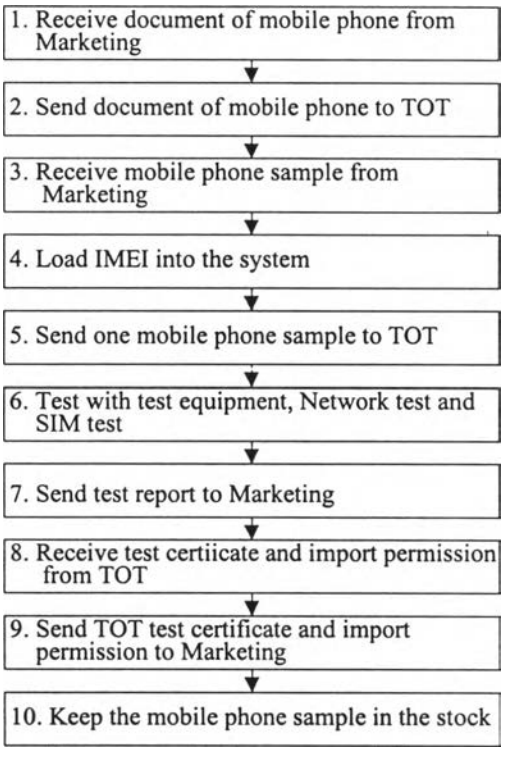

Figure 4.40 Testing at Engineering process (New)

4.2.2.10 Update process documentation

In this activity, the researcher gathers all information (process scope, mission, process boundaries, customer of each subprocess, business measurement and expectation for the process, flow diagram, and time collection) that receives from this phase in form of process documentation. This is for understanding the existing business process, and finding the improvement in the next phase of BPI.

4.2.3 Streamlining (BPI phase 3)

Streamlining is the third phase of improvement. It consists of 13 activities to improve the efficiency, effectiveness, and adaptability of the business process. The activities in this phase are stepped as follow:

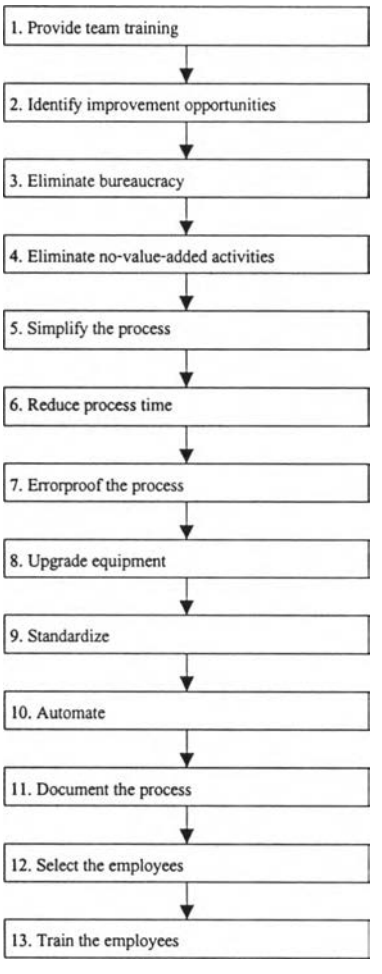

Figure 4.41 Thirteen activities in BPI phase 3

4.2.3.1 Provide team training

First of all in this phase to streamline the Mobile Type Approval process, everyone in the improvement team should be trained to understand the basic tools to streamline the process. There are 12 basic tools for streamlining the business process. The researcher as BPI champion has responsible for explain these twelve basic tools to EIT, process owner, PIT member, and other persons who involve in the process. They are explained as follow:

- Bureaucracy elimination

It aims to remove unnecessary administrative tasks, approvals, and paperwork. Bureaucracy refers to useless tasks that take long delays in processing such as multi-level of review and signatures in the documents.

- Duplication elimination

It aims to remove identical activities that are performed at different parts of the process. Not only these identical activities add the cost and time in the process, it may provide some conflict data in the process also.

- Value-added assessment (VAA)

It aims to evaluate the activities in the process whether they contribute to meet customer requirement. The activities that provide the output as customer's expecting are call Real-value-added (RVA) activities. There are activities performed that are required by business, but adding no value to the customer are called Business-value-added (BVA) activities. In addition, the example for BVA is the storage. Another type of activities that are not provided output as customer expecting and business requirement is called No-value-added (NVA) activities. The objective of Value-added assessment is to optimize BVA activities and minimize or eliminate no-value-added activities. In streamlining the process, PIT member should consider every activity whether it contributes real value to the entire process. The evaluation of each activity can be shown as figure below:

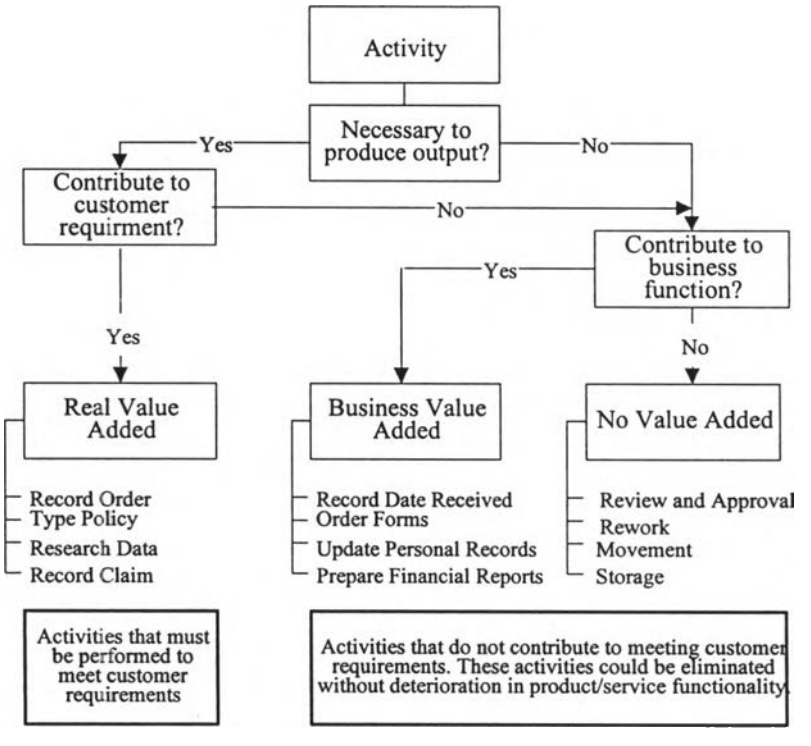

Figure 4.42 Value-added assessment

- Simplification

It aims to reduce the complexity of the process and lead to fewer stages, fewer tasks, fewer interdependencies, and etc. This refers to make everything easier: easier to learn, easier to do, easier to understand. Example of simplification is to manage the complex flows and bottlenecks by changing order of tasks, combining or separating tasks, and balancing the workload.

- Process cycle-time reduction

It aims to determine ways to compress cycle time to meet or exceed customer expectations and minimize storage cost. There are typical ways to reduce cycle time such as rearranging serial activity to be done in parallel, changing activity sequence, reducing interruption, reducing output movement, set the priorities of activities, and etc.

- Error proofing

It aims to make it difficult to do the activity incorrectly. Owing to there are a lot of chances to make errors, and they are so easy to make it. The thing that we should do is to make it difficult to create errors. There are typical methods to do error proofing such as using different color paper for different jobs, using computer programs to check spelling, writing down the directions to employees for their future reference, and etc. Suggestion for doing error proofing is to make a list of the things that you could do them wrong, and then use error-proofing methods to eliminate or minimize the possibility of making an error.

- Upgrading

It aims to make effective use of equipment and working environment to improve overall performance. This is because equipment and tools helps the individual in increasing efficiency and effectiveness. Upgrading does not just refer to upgrade equipment only, but refer to upgrade people also.

- Simple language

It aims to reduce the complexity of the way we write and talk; making our documents easy to comprehend by all who use them. In this tool, PIT is suggested to evaluate the present documents used in the process whether they are written for the user. Key factors that should be considered are the reading and comprehension level of the person who gets the output or document, and how familiar the user in the terms and abbreviations.

- Standardization

It aims to select a single way of doing an activity and have all people do the activity in the same way all the time. Work procedure should be standardized in order to ensure that all current and future people use the best ways to perform the activity. The things that should be standardized are blueprints of product, step-by-step test procedure, inspection or test instruction, and training plan.

- Supplier partnerships

It aims to improve the supplier's input of the process. Each PIT member in the subprocess should provide his own suppliers with documented input specifications that define needs and expectations. Then suppliers should carefully review them and feedback whether they can be met. If they can not, PIT member needs to work with the supplier to understand what can be supplied and help the supplier develop plan to upgrade their output.

- Big picture improvement

It aims to create ways to drastically change the process. This technique is used when the first 10 streamlining tools have not provided the desired results. In this technique, PIT should step out the today's process, and define what the perfect process should be without the constraints of the present organization or process.

- Automation and/or mechanization

It aims to apply tools, equipment, and computers to boring and routine activities to free up employees to do more creative activities. For BPI, PIT should identify the operation in the flowchart that might be automated; especially for repetitive operation. However, effective automation of operation requires the teamwork of people also.

4.2.3.2 Identify improvement opportunities

Generally, there are many opportunities to improve the process in many aspects such as errors, rework, high cost, poor quality, back log and long time delay. In this research, PIT members consider the process in all aspects; especially for long time delay. Refer to the data collection in table 3.6, it is shown that the average delay time of overall process is 23 working days when comparing to setting target (35 working days). So we should apply the 12 basic tools of streamlining as providing for team training to improve the timing of Mobile Type Approval process. Besides, PIT members take the Technical Response and its priorities, which is the outcome of QFD phase 1, to consider in identifying the improvement opportunities of the process.

According to the scope of this research, we do not include the activity outside the company, so we look at the subprocess of 'Testing at Service Center' and 'Testing at Engineering'. Refer to table 3.7 and 3.8, it is shown that the average delay time of 'Testing at Service Center' is 2 working days when comparing to setting target (2 working days). And the average delay time of 'Testing at Engineering' is 12 working days when comparing to setting target (15 working days). Owing to the delay time of 'Testing at Engineering' is very long, so we think that it may have opportunities for improvement.

After process owners and PIT member has brainstorming, they have identified and proposed the method in order to improve the process as follow:

- Request more samples for testing

Usually, the supplier will send 2 mobile samples to Marketing for doing type approval. These samples will send to Service Center, PTD, Engineering, and TOT. When they are sent to Engineering, one sample is sent to TOT and another one is left at Engineering for testing. According to Engineering has tested a lot of test topics: network, SIM card, specification, and value-added services; so PIT member thinks that one unit is not enough. This makes the process be slower than we expect. Therefore, if it is possible, we should ask the supplier to send more test samples.

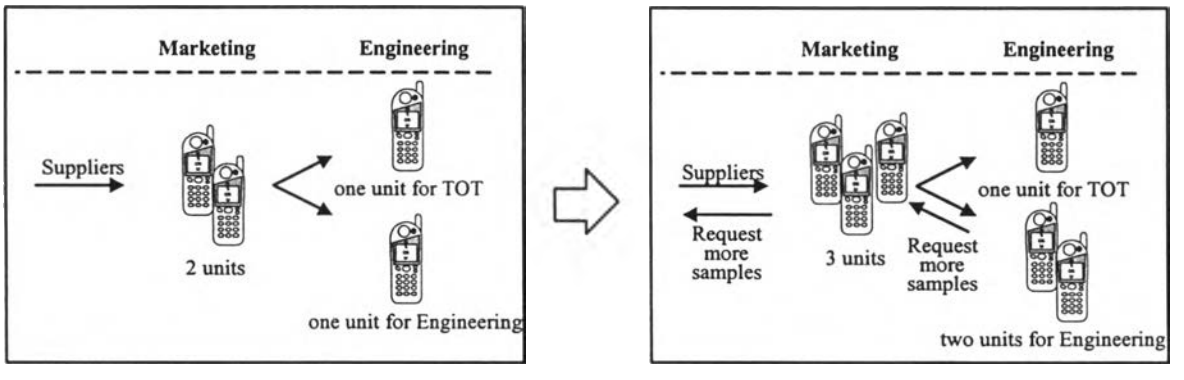

Figure 4.43 Request more samples for testing

- Change the method of Applicability test

Refer to the figure 3.6 (Functional flowchart and average processing time & cycle time), it is shown that the activity no. 41 (Testing with test equipment) is the activity that use much processing time in testing (5 days). Moreover, the cycle time of testing with equipment is very long (10 days). Therefore, PIT member realizes that this activity should be improved. As described in chapter 3, testing with test equipment is to measure the value in the mobile phone whether it is in the specification. And there are two main testing; GSM specification and Applicability of tests. It contains 18 test topics in testing GSM specification, and 620 test topics in testing applicability of tests.

After consider the test topics, the PIT member agrees to cut all test topic in applicability of tests off and change it to be checking the test report about applicability of test from supplier or manufacturer instead. Then the list of samples and document for doing Mobile Type Approval is developed as shown in appendix S. In addition, the testing about GSM specification is remained. However, Testing with test equipment is not the first priority as before. This is because when the mobile phone samples are sent to Engineering, they have passed testing the specification at PTD and Service Center already. So it has low priority in testing. However, it is still important for testing; should not be cut off.

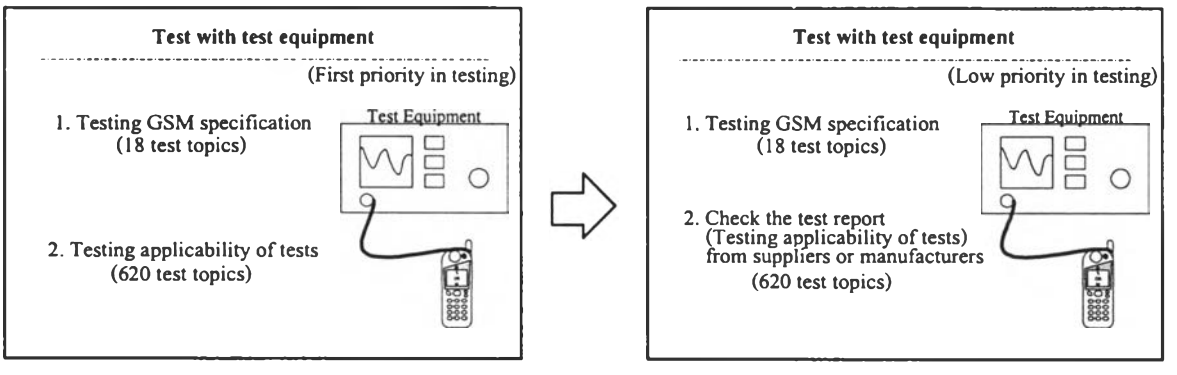

Figure 4.44 Change the method of Applicability test

- Create procedure in updating test topics of new services

New services can be developed from many sections and departments in the company. For example, MobileLife service is developed from SIM operation section. Wireless Application Protocol (WAP) is developed from System Development section. Therefore, in order to update the test topics of new service, it needs to corporate with other section also. However, the flowchart of updating test topics is created as figure 4.45 below:

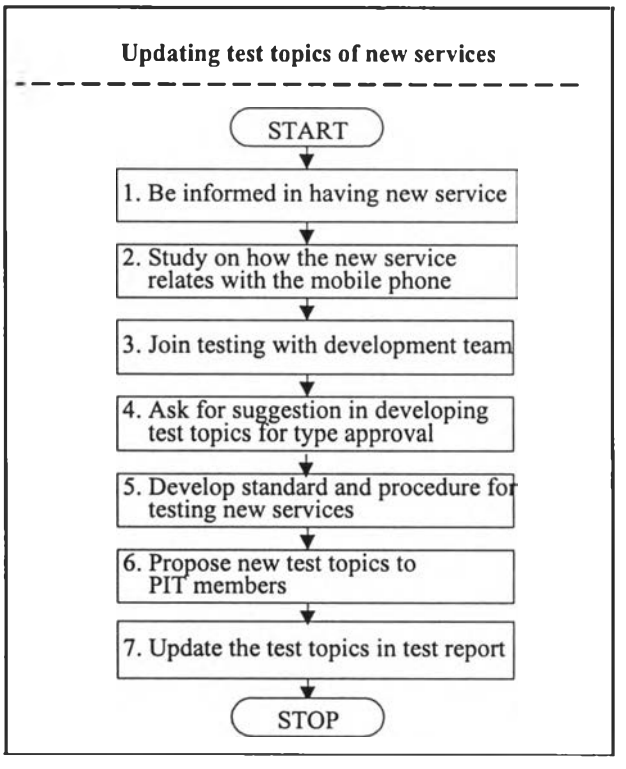

Figure 4.45 Flowchart of updating test topic

From the flowchart above, the process of 'Updating test topics of new services' is started when other sections which develop new services such as SIM operation, or System Development, and etc inform to Handset Technology section that there is new service developing for the customer (Activity no. 1). Then Senior Handset Engineer, who is the process owner of testing in Engineering, will assign one engineer to study how the new service relates with the mobile phone (Activity no. 2). Then when there is testing the new service for User Acceptance Test or other purposes, Senior Handset Engineer will assign that engineer to join testing with the development team (Activity no. 3). After testing is finished, the development team will be asked for some suggestion in developing test topics for type approval (Activity no. 4). Then that engineer will be responsible for developing standard and procedure for testing new services within one week (Activity no. 5). And then PIT members will be called for meeting. That engineer will present the new service, test topics, test standard, and test procedure to PIT members (Activity no. 6). After PIT members have considered the new test topics, then they will be updated in the test report (Activity no. 7). All of these are procedure to update the test topic in Mobile Type Approval process.

- Assign the owner for each test

Owing to arranging the test topics into group, PIT members have suggested to assign the owner for each group. The reason is that PIT member can provide the training course for that owner when the training topic is related to the test topics in that group. Besides, the owner of each group will be the contact point of doing type approval. It is not necessary that one engineer will be the owner of a group. He can be the owner of one, two, or more groups. Moreover, when new services are created a new group, the owner should be assigned also.

For Handset Technology section, there are one senior engineer and four engineers (Engineer A, B, C, and D). Senior engineer is responsible for being the owner of overall process. Engineer A is assigned to be owner of 'Test with test equipment', 'Test with network feature', 'Test with existing services', and 'Test with new service (WAP)'. Engineer B is assigned to be owner of 'Test with SIM card'. Engineer C is assigned to be owner of 'Test with new service (MobileLife)'. And Engineer D is assigned to be owner of 'Test with new service (Bluetooth and GPRS). In addition, this is not meaning that engineer A has to do all the test topics in the group that he is the owner, but every engineer has to work as a team.

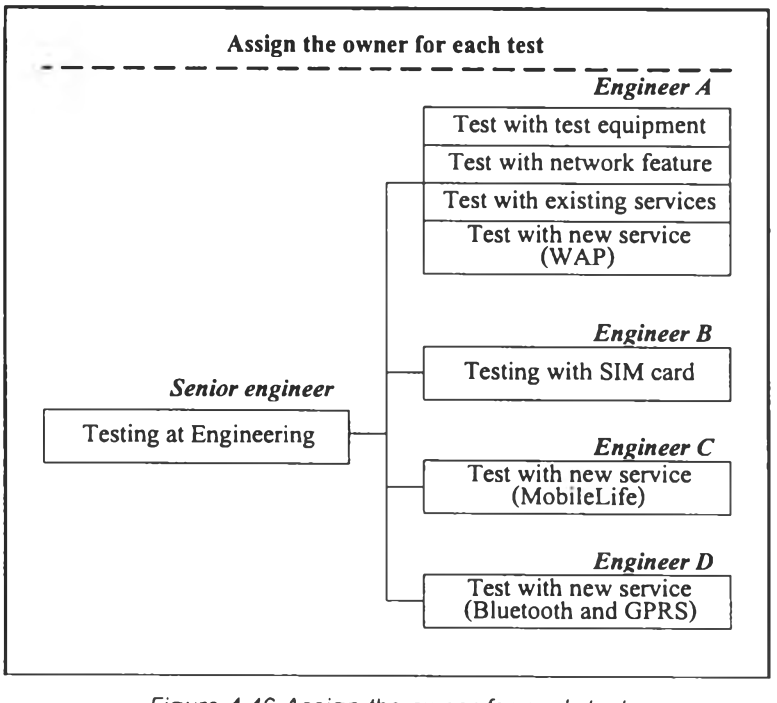

Figure 4.46 Assign the owner for each test

- Develop new form of test report

Interviewing with Marketing staffs, the researcher has found that they can not read test report because they do not understand the technical term. So the researcher recommend the owner of each test to develop new form of test report that is easy for non-technical person to understand. After the meeting, PIT members recommend Senior Handset Engineer to have the testing summary at the first page of test report as table 4.8 below:

Test topics	Result
1. Test with test equipment	
2. Test with network feature	
3. Test with SIM card	
4. Test with existing services	
5. Test with new services	

Table 4.8 Summary of test report

4.2.3.3 Eliminate bureaucracy

After brainstorming, PIT members have found that the activity of 'Load IMEI into the system' has some bureaucracy and redundancy. In order to load IMEI into the system, it needs the top management to approve the request. If the top management is busy and does not sign the request, then loading IMEI into the system is postponed. So this activity should be reviewed. Therefore, PIT members create the subprocess for emergency case as shown in the figure 4.47 below. Emergency case means to ask for loading IMEI into the system before having approval from top management. When the samples are not registered in the system and we needs to test them now, then we just call to SIM & Numbering department and inform the IMEI number to load into the system for emergency case. And after the top management has approved the request, we will send that approved request to the SIM & Numbering department. This will make the process be more flexible and reduce the timing in the Mobile Type Approval process.

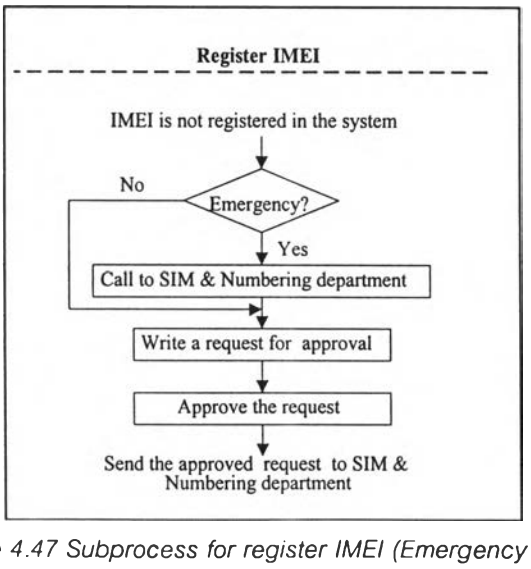

Figure 4.47 Subprocess for register IMEI (Emergency case)

Besides, Activity of 'Register IMEI' is also redundancy. Refer to the figure 1.2 (Time-scale in Mobile Type Approval Process), it is shown that activity no. 9 and no. 14 about registering IMEI are the same. After meeting, PIT member has decided to change the activity no. 14 in the Engineering to be 'Checking whether IMEI is in the system' activity, and create 'Register IMEI' process instead for the one that has not register as shown in figure 4.48 below:

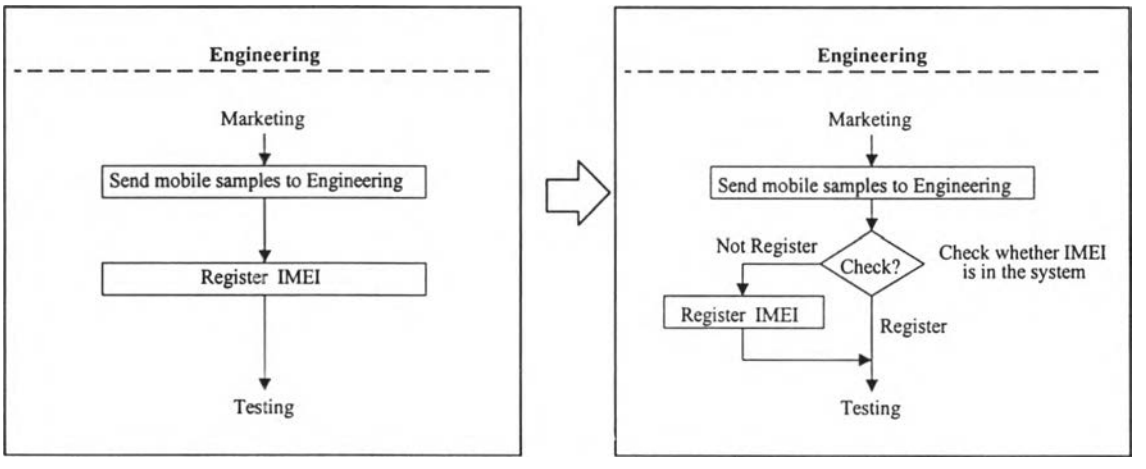

Figure 4.48 Change 'Load IMEI into the system' activity

4.2.3.4 Eliminate no-value-added activities

No-value-added activities should not be existed in the process. In the meeting, PIT members recommend us to review test topics in testing. They think that it may have some no-value-added activities in the test that we should eliminate it. Moreover, we may found some test topics that we should add it in the testing also. Firstly, we lists all test topics and divided into groups as follow:

(1) Test with test equipment

- Standard specification: TX power, Peak Phase Error, RMS Phase Error, Freq. Error, BER, and Sensitivity. (In 3 Channel: 1, 63, and 124)
- Applicability test: 620 test topics as shown in appendix E.

(2) Test with network feature

- Location Update
- 13 and 17 Calling, Emergency Call with DTMF, DTMF sending.
- Short Message Service (SMS): Send, Receive, Send (active call), Receive (active call)
- Call Line Identification
- Call Waiting/Call Hold
- Call Conference
- Call Forwarding: All call, Not answer, Not reachable, If busy.
- Call Barring: Outgoing call, International call, Incoming call.
- Show Time Duration

- Advice of Charge
- Data/Fax transmission
- Handover: Intracell, Intercell
- Frequency Hopping
- Discontinuous Transmission (DTX)
- Short Message Cell Broadcast (SMSCB)
- Assignment to worse cell

(3) Test with SIM card

- Language Preference
- Ciphering Key Kc
- PLMN selector
- Broadcast control channels
- Forbidden PLMNs
- Location Information
- Accumulated Call Meter
- Accumulated Call Meter (max. value)
- Price per unit and currency table
- Cell broadcast message identifier selection
- Abbreviated dealing numbers
- Fixed dialling numbers
- Short messages
- Short messages parameter
- MSISDN
- Last number dilled
- Service dialling numbers
- Extension 1
- Extension 2
- SIM Lock

(4) Test with existing services

- *Voice Mail Service*: Voice Mail, Voice Mail Plus, Voice and Fax Mail, Voice and Fax Mail Plus, GSM Call Back, Express Link, Voice Message, 152 to GSM, International Voice Mail.
- *International Roaming (IR)*
- *Special Service Info*: Voice Bill, Voice Info, Horoscope, Local Line Service, Music Phone Vote, Movie Preview, Call Charge Check Up, Mchat, Stock Tracking, Fax Bill, Fax on Demand, Lottery Info, Joke, Music Phone Chart, Thailand Travel Guide, Matching Check.
- *Internet Integration*: Mobile Office, Internet Mail Note, Internet Short Mail, GSM Web Messaging, GSM Internet on Demand.
- *Value Added Service for Nokia*: My Logo Service, My Ring Tone Service, Caller Group Logo, GSM Graphic Net Designer, GSM Melodies.

(5) Test with new services

- *MobileLife*: mBanking, mInfo, mShopping, mMessaging, Extra Services, My Services, AIS Service No.
- *Wireless Application Protocol (WAP):* mMail, mInfotainment, mSearch, My Service, Support Thai language.
- *Bluetooth*
- *General Packet Radio Service (GPRS)*

After considering test topics in each group, PIT members have found that some test topics are not necessary and should be cut off. Some of them should be changed the method of testing for reducing the cycle timing, some should be cut off due to nearly the same as another test topic, and some are topics that the company does not provide to the customer. Besides, PIT members have realized that the subprocess for updating new services should be created. Test procedure and testing standard for each test topic should be created also. The conclusion for reviewing the test topics is followed:

- Standard specification test topics are still remained, but change its priority to be lower because PTD and Service Center have already checked them before sending to Engineering. For Applicability test (620 test topics), it takes long time in testing. These tests are eliminated and changed to do checking the test report from suppliers or manufacturers instead. This is because the suppliers have to send the sample to be tested before manufacturing.

- For testing with network feature, the test topics of Send and Receive SMS (active call) is eliminated because PIT members think that it is not necessary. Another test topic that is eliminated is 'Advice of Charge' because the company does not provide this topic or service to the customer.

- For testing with SIM card, PIT members have agreed to transfer testing SIM card from SIM operation section to Handset Technology section, and let the SIM operation section support and update the technology of SIM card to Handset Technology. For test topics, PIT members think that all of them are necessary, but the subprocess for updating new test topics or new services should be created such as testing SIM Lock.

I 20556159

- Nowadays the competition is very high in the market. So the company provides not only voice communication, but try to provide more value-added services also. According to the list of services, PIT members choose 'Voice Mail' test topic from Voice Mail Service, and 'Mobile Office' and 'GSM Web Messaging' test topic from Internet Integration. The other test topics can be neglected in the term of doing type approval. Besides, PIT members recommend that we choose test whether the mobile phone samples support Thai language; especially for GSM Web Messaging service. This can be information providing to Marketing in supporting to launch new product and service into the market.

- At the time that we list the test topics for testing, there are new services developing and preparing for launching into the market. This is because technology is continuously innovated. These services are coming and will be launched into the market soon. After PIT members have meeting, they recommend creating subprocess for updating the test topics of new service.

4.2.3.5 Simplify the process

Simplifying the process is to reduce the complexity of the process and lead to fewer stages, fewer tasks, and fewer interdependencies. In the meeting, PIT members suggest to simplify the process of testing SIM card. Normally, testing with SIM card has to be done at SIM operation section only. So the mobile phone sample has to be sent from Handset Technology section to SIM operation section.

Refer to the figure 1.2 (Time-scale in Mobile Type Approval Process), it is shown that 'Test with SIM card' activity (activity no. 22) is the last testing activity in Engineering. This is because when Marketing sends the samples to Handset Technology section. Handset Technology section will develop testing with test equipment and network feature. Then Handset Technology section will send the samples to SIM operation section in order to develop testing with SIM card. Usually, SIM operation section is responsible for checking and testing the SIM card that will be sold in the market; not for type approval. Besides, Handset Technology has no test equipment and knowledge for testing SIM card. In addition, when looking at the timing for testing SIM card, it is shown that the cycle time for testing the SIM card is the highest one (15 days). But the processing time for testing SIM card is only 2 days. It is found that to send the sample for testing SIM card (for type approval) is to load more work to the SIM operation section. Normally, engineers in the SIM operation section are busy with their work. They do type approval for SIM card as second priority, so it makes some delay and long cycle time.

Then, PIT members have decided to transfer testing SIM Card (for type approval) from SIM operation section to Handset Technology section. And SIM operation section will support and update the technology of SIM card to Handset Technology section instead such as providing test equipment, training for testing, and updating test topic. So the new process of testing SIM card is created and shown as figure 4.49 below.

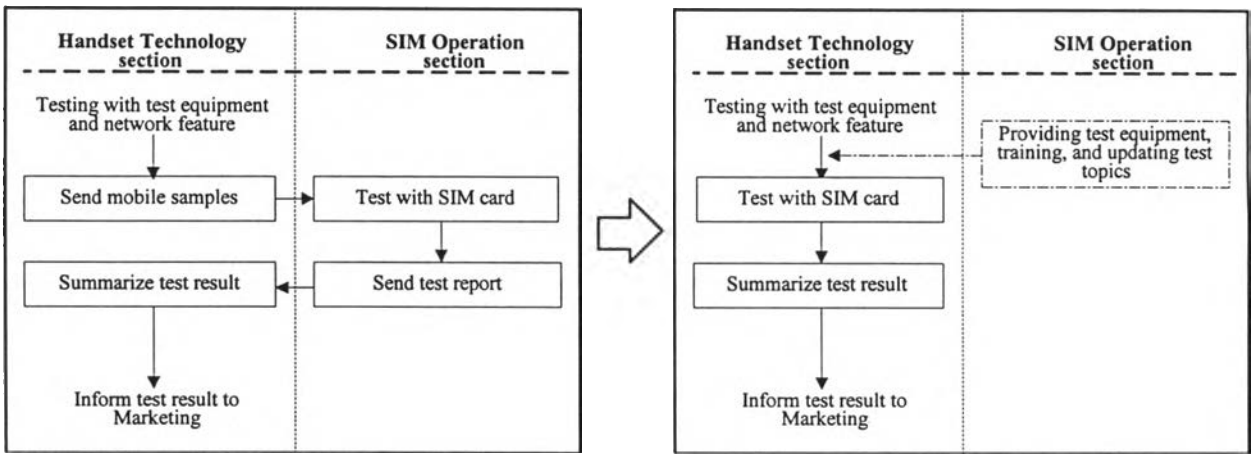

Figure 4.49 New process for testing SIM card

4.2.3.6 Reduce process time

In order to reduce process time, PIT members propose to rearrange the existing process into parallel. Refer to the figure 1.2 (Time-scale in Mobile Type Approval Process), it is shown that all testing at Engineering are in sequence. The first one is testing with test equipment, then testing with network feature, and then testing with SIM card. This is because there is only one sample sending to be tested. But after we request more samples, we can rearrange the process into parallel. This can reduce the total cycle time of testing also. Therefore, the flowchart of process is changed as figure 4.50 below.

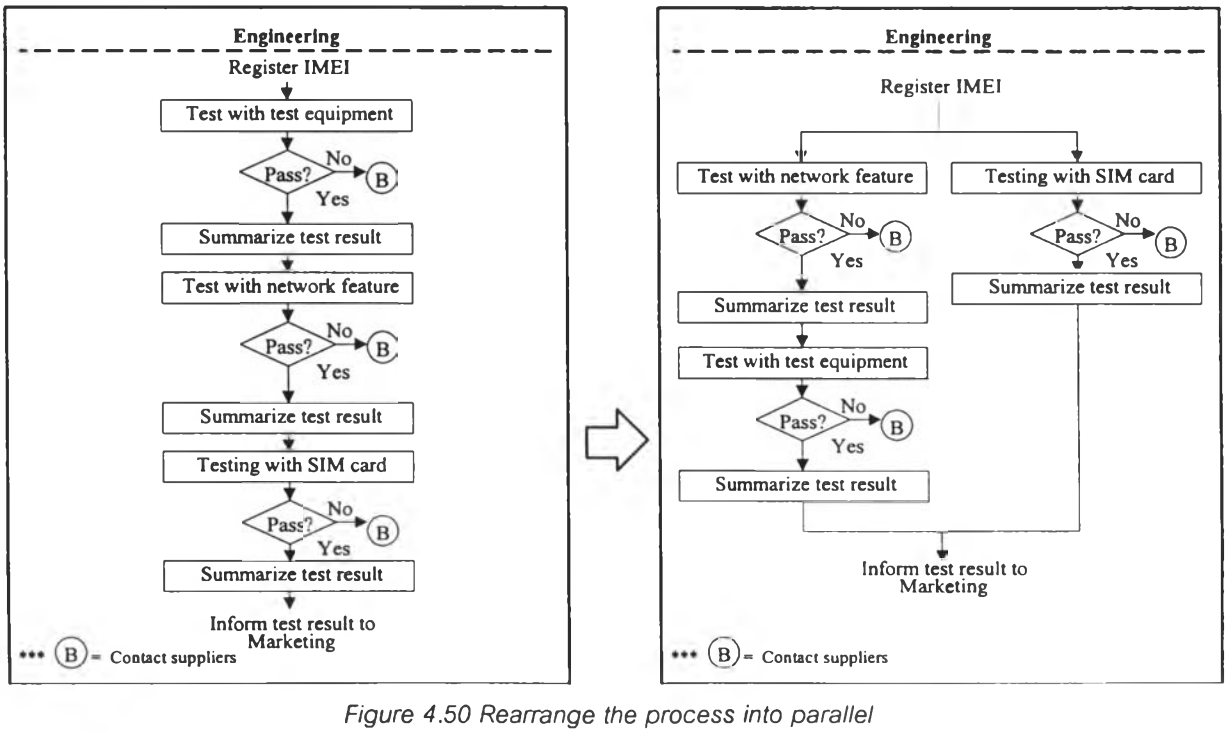

Figure 4.50 Rearrange the process into parallel

4.2.3.7 Errorproof the process

For process improvement, there are many error-proofing methods to develop in order to eliminate or minimize the possibility of making an error. PIT members has agreed to develop something to errorproof the Mobile Type Approval process. Owing to Mobile Type Approval process is about testing the mobile phone, so the testing method is very important. Nowadays, each tester do the test according to the existing test form which has only test topics, but has no procedure to do testing. Each tester does the test from their experience and background knowledge, so sometimes they do the same test topic in different way. Besides, expect result from testing is not clearly defined. Then PIT members have assigned the owners of each test to develop test procedure and expect result. Test procedure is the step that we should follow in order to do testing. Expect result is the result that we expect the mobile phone to respond. This aims to make the tester do the right thing at the first time. Moreover, the standard of the process should be developed further. The guideline for developing test procedure and expect result is shown as figure 4.51 below.

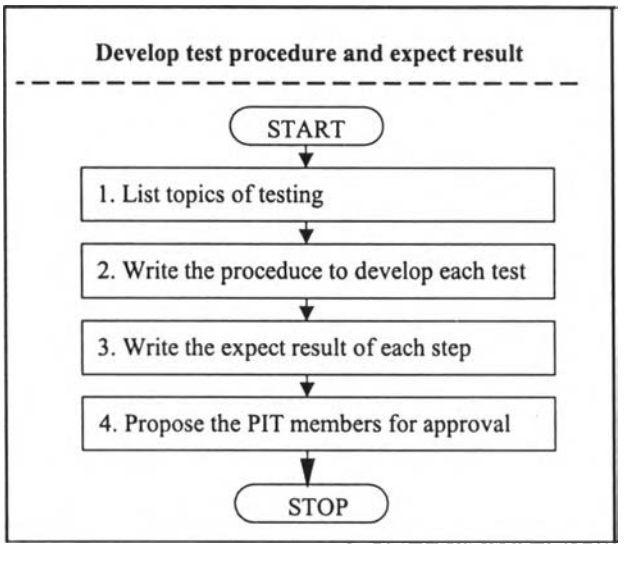

Figure 4.51 Guideline for developing test procedure and expect result

First, each owner should review and list the test topics. Then he should write the procedure to do each test. In the meanwhile, expect result is also defined for each step. After all of them are developed, the owner of each test should propose them to the PIT members for approval before using it in the process.

4.2.3.8 Upgrade equipment

For testing the mobile phone samples, equipment is one important factor to make the overall process be effective and efficient. So upgrading the equipment for testing should be done when it is necessary. In order to improve the Mobile Type Approval process, PIT members let the owners of each test check the equipment in their responsibility whether it should be upgraded. If they think that some equipment should be upgraded, they can propose it to senior handset engineer as process owner of 'Testing at Engineering' subprocess. After process owner approves the request, he should send the request to the manager for approval also. However, the flowchart of upgrading equipment is created as figure 4.52 below.

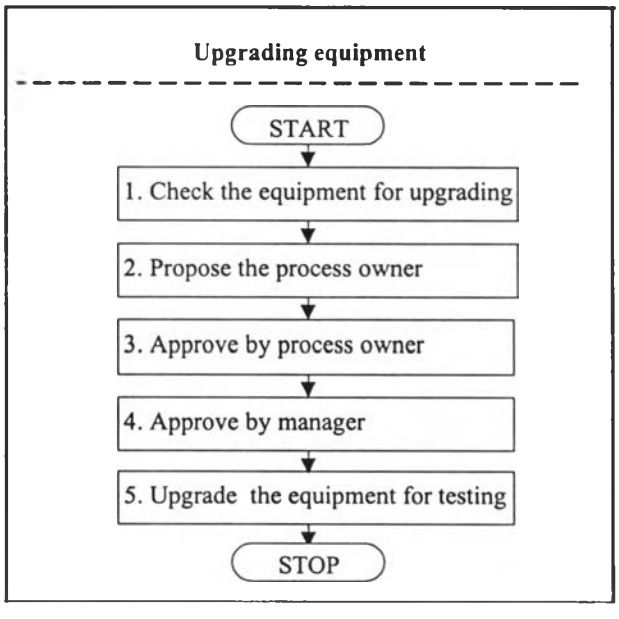

Figure 4.52 Flowchart of upgrading equipment

Besides upgrading the equipment, we should not forget to upgrade people also. It means that we should train the person to have knowledge in order to do the test correctly. PIT members assign the senior handset engineer to draw a roadmap of training course and basic knowledge that each tester should have. In addition the roadmap is classified according to group of test topics: test with test equipment, test with network feature, test with SIM card, test with existing services, and test with new services. The process owner has listed the training course and basic knowledge as figure 4.53 below:

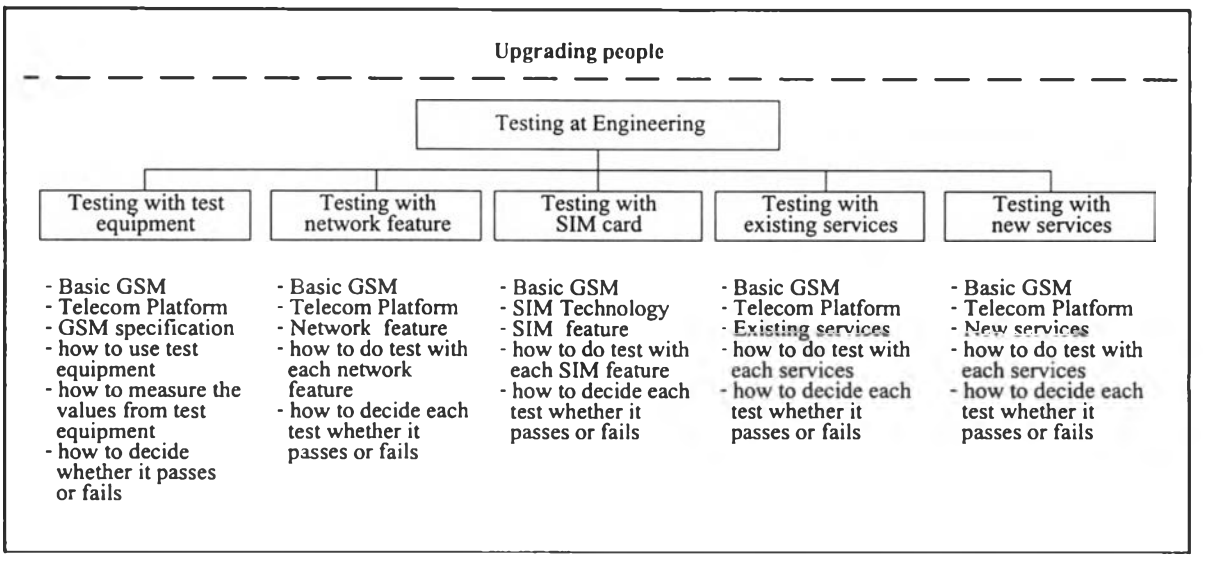

Figure 4.53 Roadmap for upgrading people

4.2.3.9 Standardize

Standardization is the way to make people do the activity in the same way all the time. For improving the Mobile Type Approval process, all of the things that are created in the phase of streamlining should be concluded and standardize. After the meeting, PIT members have considered all the improvement opportunities, bureaucracy and no-value-added activities elimination, process simplification, process time reduction, process errorproof, and equipment upgrading. They conclude the new way of doing the Mobile Type Approval process as follow:

- Request 3 mobile phone samples from suppliers.
- Change the method of testing applicability to be checking the test report from test house.
- Create procedure in updating the test topics; especially new services.
- Assign the owner for each test.
- Develop new form of test report.
- Eliminate bureaucracy in registering IMEI and create subprocess for register IMEI (emergency case).
- Eliminate no-value-added activities; especially the test topics.
- Simplify the process of testing SIM Card by transferring the activity to Handset Technology section.
- Reduce the process time by rearranging the process into parallel.
- Errorproof the process by developing the test procedure and expect result of each test (Appendix T).
- Review equipment in order to upgrade it.
- Create roadmap for upgrading people.

4.2.3.10 Automate

Actually, automate refers to apply tools, equipment and computers to boring and routine activities to free up employees to do more creative activities. However, for Mobile Type Approval process, the routine activity is to inform information about list of mobiles that have passed type approval and list of mobile that support services. In order to automate this routine activity, PIT members has recommended updating this information to Marketing every 2 weeks. Intranet mail can be used in this purpose. The information can be sent from the source directly through the destination, or from the Handset Technology section to the Value Added Services Marketing section.

4.2.3.11 Document the process

After PIT members have meeting and brainstorming for improving the Mobile Type Approval process, they assign the researcher as BPI champion to collect the data and develop document for presenting to other people in the process. It is included the flowchart of the new process, the procedure in updating the test topics, new form of test report, subprocess for registering IMEI, test procedure and expect result. All of them will be presented and distributed to everyone in the next meeting.

4.2.3.12 Select the employees

Owing to this improvement process is not large, so the step of selecting the employees in this case refers to the existing employees. Therefore, we select all existing employees to be the employees in the new process. Besides, PIT members have assigned each person to be the owner of each group. In addition, he will be provided the training course when the training topic is related to the test topics in that group. Moreover, the owner of each group will be the contact point of doing type approval. In Engineering department of Mobile Type Approval process, there are seven groups of testing: Test with test equipment, Test with network feature, Test with existing services, Test with new service (WAP), Test with SIM card, Test with new service (MobileLife), and Test with new service (Bluetooth and GPRS). Then Engineer A is assigned to be owner of 4 test groups: 'Test with test equipment', 'Test with network feature', 'Test with existing services', and 'Test with new service (WAP)'. Engineer B is assigned to be owner of 'Test with SIM card'. Engineer C is assigned to be owner of 'Test with new service (MobileLife)'. And Engineer D is assigned to be owner of 'Test with new service (Bluetooth and GPRS).

4.2.3.13 Train the employees

When the document of the process is developed, the researcher makes an appointment to everyone in the process; including PIT members. This meeting has purposed to present all information about the new process: what is changed and how to develop each step in the process. Besides, the problem and target of the process is presented also. Moreover, each owner of the test group presents his own information about his responsibility in the process. Test procedure and expect results of each test topic are explained to everybody. This gives a chance to everybody to understand in the same way, and ask some questions when he does not understand.

4.2.4 Measurements and Controls (BPI phase 4)

Measurements and Controls is the forth phase of improvement. It consists of 4 activities to implement new process and control the improvement. The activities in this phase are stepped as follow:

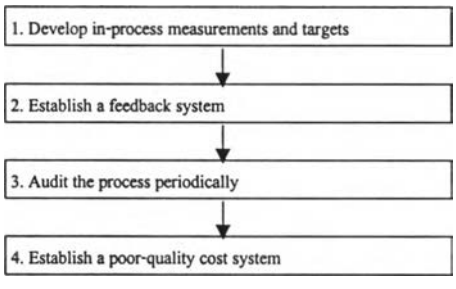

Figure 4.54 Four activities in BPI phase 4

4.2.4.1 Develop in-process measurements and targets

Refer to Engineering department (activity no. 33 to no. 51) in the figure 3.8 (Functional Flowchart and average processing time & cycle time), it is shown that there is no step to record the timing of each test. In order to improve the Mobile Type Approval process, PIT members recommend the Senior Handset Engineer to create step to record the amount of sample & document that are sent from Marketing, start date and finish date of testing. Moreover, when finishing each test, the testers have to record in the book that the test is finished. So we can measure the improvement of the process and compare with the target that we have set as Key Performance Indicator (KPI). Therefore, the steps are created as figure below:

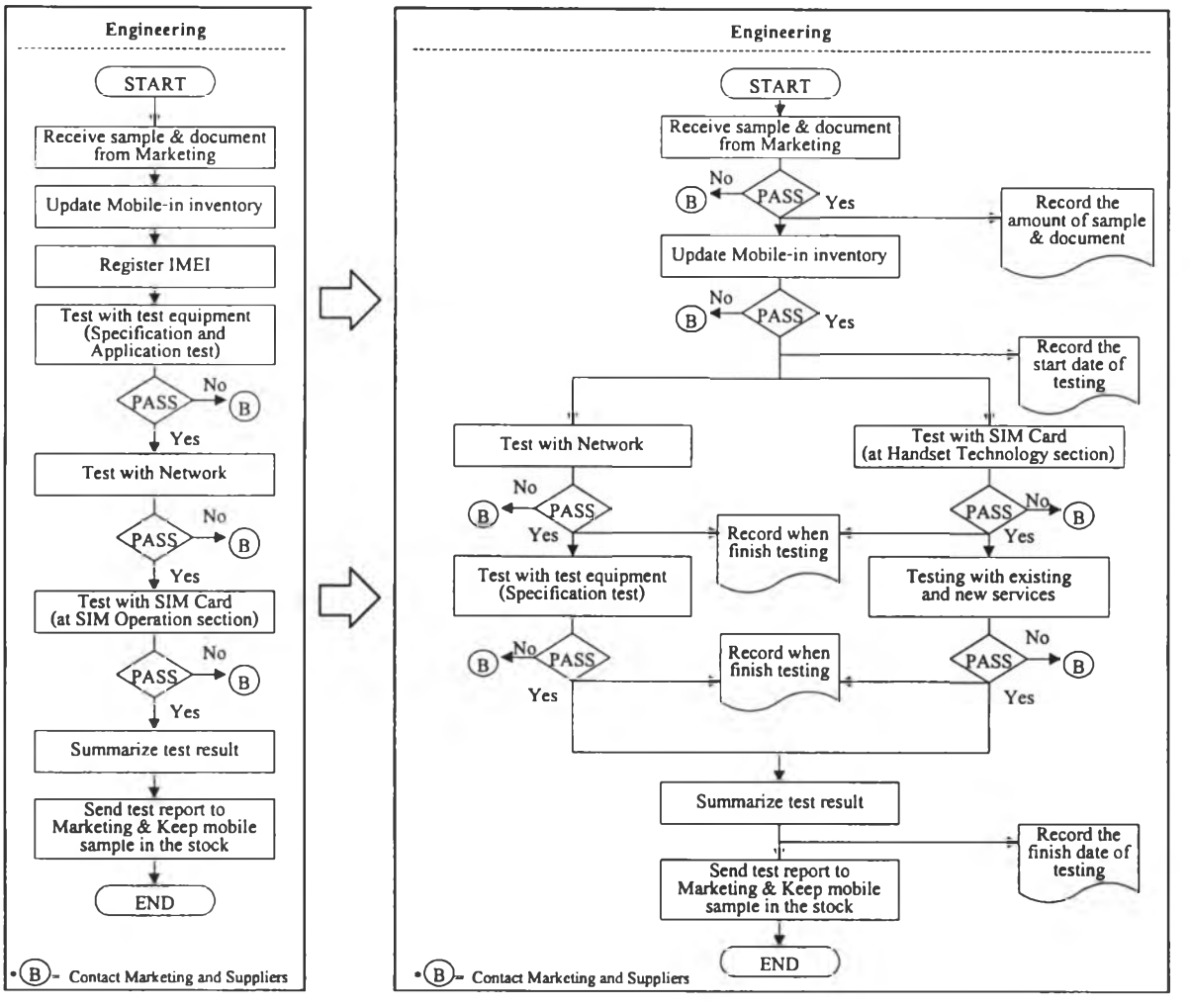

Figure 4.55 Adding step for recording the received date and finished date in each test

From the figure 4.55 above, we add the steps for recording the amount of sample & document when we receive document and mobile phone samples from Marketing, start date and finish date of testing. This step is useful not only to identify the starting and finishing date of the process, but it is useful for other purposes also. In addition, when we record the receive date of receiving document and mobile phone, we can also record the missed document and mobile phone samples. For example, sometimes Marketing does not send the complete set of document as requirement, so we can record the missed document in order to request it later. And when Marketing sends the missed document, we can check it with this record. For recording that the test is finished, we can check the progress of each test whether the test has been finished and which test is not finished yet, so we can proceed the test.

4.2.4.2 Establish a feedback system

Feedback is very important for improving the process. Besides developing the in-process measurements and targets, it is necessary to establish the feedback loops for the new process also. So PIT members have assigned the researcher as BPI champion to develop feedback system for the new process. Firstly, the researcher explains the important of feedback to everyone in the process. And he can give any suggestion for improving the process anything. Feedback can be the timing that is measured in each test when comparing with the setting target. The researcher will be the contact point for this purpose. If there is any problem, the researcher will collect and propose it to the PIT members in the next meeting. The meeting will be done every month. The feedback system can be illustrated as figure 4.56 below:

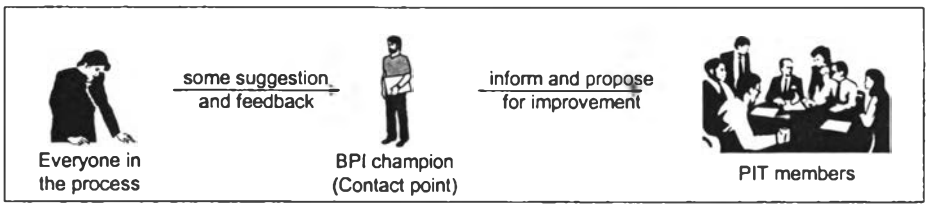

Figure 4.56 Feedback system

4.2.4.3 Audit the process periodically

According to the BPI approach, the new process will be measured and feedback will be developed. Then PIT members should set the period for audit the new process. Auditing the process is to go back to the phase 2 'Understanding the process', and then streamlining the process again. However, PIT members have concluded to audit the process every 6 month. In addition, the test topics of new services should be reviewed and updated to the PIT members every month.

4.2.4.4 Establish a poor-quality cost system

According to the Business Process Improvement (BPI) concept, poor-quality cost refers to the cost incurred to help the employees do the job right every time, the cost to determine whether the output is acceptable, and the cost incurred by the company and the customer because the output did not meet specifications and/or customer expectation. Generally, PQC can classify into 2 groups: direct and indirect. Direct PQC consists of controllable PQC (prevention cost and appraisal cost), resultant PQC (internal error cost and external error cost), and equipment PQC. Indirect PQC consists of customer-incurred cost, customer-dissatisfaction cost, and loss-of-reputation cost.

In Mobile Type Approval process, it is not easy to calculated the poor quality cost. Owing to the process is about testing the mobile phone sample, the cost is mainly on maintenance and calibration of test equipment. However, the cost in delay launching the mobile phone in the competitive market can not be estimated.

4.2.5 Continuous improvement (BPI phase 5)

Continuous improvement is the fifth phase of improvement. It consists of 6 activities to implement a continuous improvement process. The activities in this phase are stepped as follow:

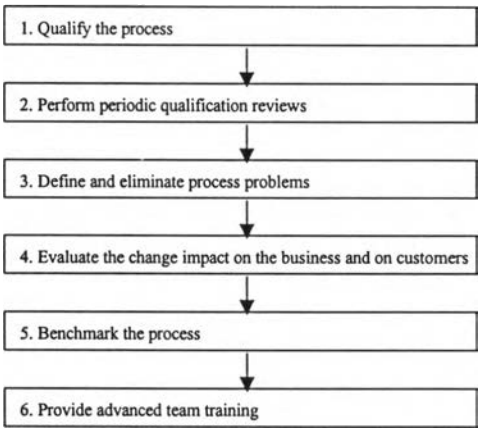

Figure 4.57 Six activities in BPI phase 5

4.2.5.1 Qualify the process

Qualifying the process is involved in evaluating the process whether it can perform at the appropriate level when the activities are linked together. After implementing BPI concept for 6 months since June 2000 until November 2000, EIT and PIT members has qualified the improved process on the timing of the process.

The timing of the Mobile Type Approval process is shown as tables below. Timing of the Mobile Type Approval process is classified into 3 kinds: (1) Total time used in the process, (2) Time used in testing at Service Center, and (3) Time used in testing at Engineering.

Mobile phone	Marketing receives document (starting date)	Marketing receive all test report (finishing date)	Time used (working days)
Model AG	13/07/2000	22/09/2000	52
Model AH	14/07/2000	22/09/2000	51
Model AI	12/07/2000	25/09/2000	54
Model AJ	13/07/2000	25/09/2000	53
Model AK	25/07/2000	13/10/2000	59
Model AL	10/08/2000	13/10/2000	47
Model AM	15/08/2000	02/11/2000	57
Model AN	17/08/2000	07/11/2000	58
Model AO	21/08/2000	07/11/2000	56
Model AP	25/08/2000	10/11/2000	55
Model AQ	01/09/2000	10/11/2000	50
Model AR	22/09/2000	29/11/2000	48
Model AS	26/09/2000	06/12/2000	50
Model AT	04/10/2000	08/12/2000	46
Model AU	04/10/2000	08/12/2000	46
Model AV	19/10/2000	26/12/2000	47
Model AW	19/10/2000	28/12/2000	49
Model AX	01/11/2000	10/01/2001	49
Model AY	09/11/2000	10/01/2001	43
Model AZ	17/11/2000	19/01/2001	44
Model BA	17/11/2000	25/01/2001	48
Model BB	20/11/2000	01/02/2001	52
Model BC	24/11/2000	07/02/2001	52
		Average	*48.65*

Table 4.9 Total time used in the process since June'00 to Nov'00

From table 4.9, there are 23 model of mobile phones sending to do type approval in the period of implementing the BPI approach (June 2000 to November 2000). Their brand and model are represented as Model AG to BC. It is shown that the average time is 49 working days decreasing from 58 working days (before implementing BPI approach). However, the total time used in the Mobile Type Approval process can not meet the setting target (35 working days). This is because the overall process

consists of controllable and uncontrollable subprocess. Controllable subprocesses are the processes of testing within the company (at Service Center and Engineering). And uncontrollable subprocesses are the processes of testing outside the company (at PTD and TOT). Therefore, in order to qualify the process, we should look at the timing of controllable subprocesses as shown in the table below.

Mobile phone	Service Center receives mobile phone (starting date)	Service Center sends test report (finishing date)	Time used (working days)
Model AG	03/08/2000	07/08/2000	3
Model AH	03/08/2000	07/08/2000	3
Model AI	03/08/2000	07/08/2000	3
Model AJ	03/08/2000	08/08/2000	4
Model AK	18/08/2000	22/08/2000	3
Model AL	31/08/2000	01/09/2000	2
Model AM	06/09/2000	07/09/2000	2
Model AN	08/09/2000	12/09/2000	3
Model AO	15/09/2000	18/09/2000	2
Model AP	18/09/2000	19/09/2000	2
Model AQ	20/09/2000	21/09/2000	2
Model AR	17/10/2000	19/10/2000	3
Model AS	17/10/2000	18/10/2000	2
Model AT	24/10/2000	26/10/2000	3
Model AU	27/10/2000	01/11/2000	4
Model AV	13/11/2000	15/11/2000	3
Model AW	13/11/2000	15/11/2000	3
Model AX	23/11/2000	24/11/2000	2
Model AY	27/11/2000	29/11/2000	3
Model AZ	08/12/2000	11/12/2000	2
Model BA	12/12/2000	14/12/2000	3
Model BB	12/12/2000	14/12/2000	3
Model BC	19/12/2000	20/12/2000	2
		Average	*2.61*

Table 4.10 Time used in testing at Service Center since June'00 to Nov'00

From table 4.10, it is shown that the average time for testing at Service Center of Model AG to BC is 2.61 or 3 working days that reduce from 4 working days before implementing BPI approach. Therefore, there is a little bit improvement in testing at Service Center. Besides, the timing of another controllable subprocess, which is testing at Engineering, is shown in the table below.

Mobile phone	Engineering receives mobile phone (starting date)	Engineering sends test report (finishing date)	Time used (working days)
Model AG	10/08/2000	25/08/2000	12
Model AH	10/08/2000	29/08/2000	14
Model AI	10/08/2000	04/09/2000	18
Model AJ	10/08/2000	04/09/2000	18
Model AK	28/08/2000	14/09/2000	14
Model AL	07/09/2000	22/09/2000	12
Model AM	14/09/2000	29/09/2000	12
Model AN	15/09/2000	05/10/2000	15
Model AO	25/09/2000	10/10/2000	12
Model AP	25/09/2000	16/10/2000	16
Model AQ	26/09/2000	19/10/2000	18
Model AR	25/10/2000	09/11/2000	12
Model AS	26/10/2000	13/11/2000	13
Model AT	01/11/2000	20/11/2000	14
Model AU	06/11/2000	23/11/2000	14
Model AV	20/11/2000	11/12/2000	15
Model AW	20/11/2000	14/12/2000	18
Model AX	01/12/2000	19/12/2000	12
Model AY	01/12/2000	19/12/2000	12
Model AZ	19/12/2000	08/01/2001	14
Model BA	19/12/2000	09/01/2001	15
Model BB	19/12/2000	09/01/2001	15
Model BC	27/12/2000	12/01/2001	12
		Average	*13.70*

Table 4.11 Time used in testing at Engineering since June'00 to Nov'00

From table 4.11, it is shown that the average time for testing at Engineering of Model AG to BC is 13.70 or 14 working days. As the Marketing has set target for Engineering to test within 15 working days (or 3 weeks), this is shown that this subprocess has been improved. In addition, this subprocess has considered to be more efficiency than before.

Besides; the timing of the process during implementing is collected and shown in the appendix U. From timing of the process in appendix U, it is shown that the average cycle time for Testing with network is 4.61 or 5 working days. Testing with SIM card is 4.91 or 5 working days. Test with test equipment is 4.43 or 5 working days. Testing with existing services is 2.57 or 3 working days. Testing with new services (MobileLife) is 3.17 or 4 working days. And Testing with new services (WAP) is 3.14 or 4 working days.

4.2.5.2 Perform periodic qualification reviews

In this step, in order to continuous improve the process, the schedule for next meeting to qualify and review the process should be determined. After meeting with EIT and PIT member, it is concluded that the qualification review will be done every 6 month. Moreover, in order to qualify and review the process, the activity of improvement has been review and compare with the requirement.

- Change the method of Applicability test

Owing to PIT members has considered that to do applicability of tests takes long time then they decide to cut all test topics in applicability of tests off and change it to be checking the test report from the supplier or manufacturer instead.

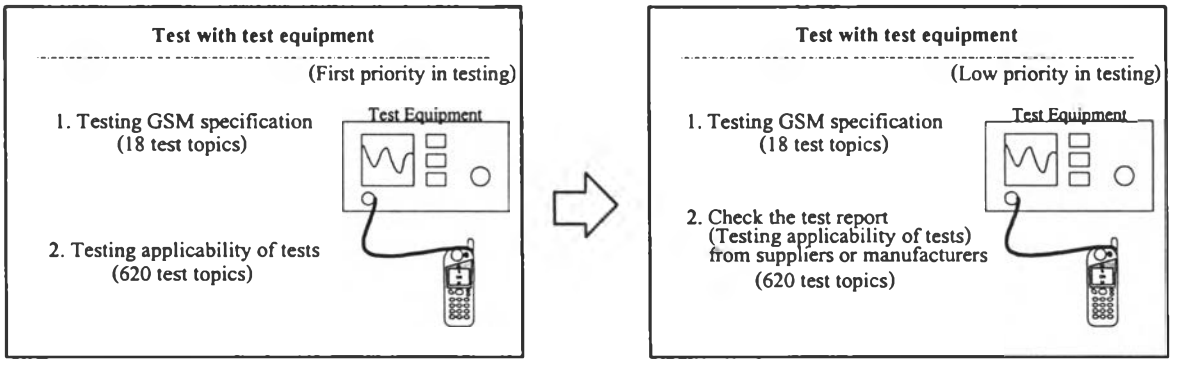

Figure 4.58 Change the method of Applicability test

After implementing this change in the process, there are some problems at the beginning because the suppliers have to prepare and request this test report from the manufacturer. However, the

processing time of testing with test equipment is reduced from 10 days to 5 days. And the quality of work is still qualified. Therefore, EIT has considered this step to be effective one.

- Create procedure in updating test topics of new services

Owing to many new services are developing for customers, so in order to do Mobile Type Approval it is necessary to update test topics also. The flowchart of this activity is created as figure below

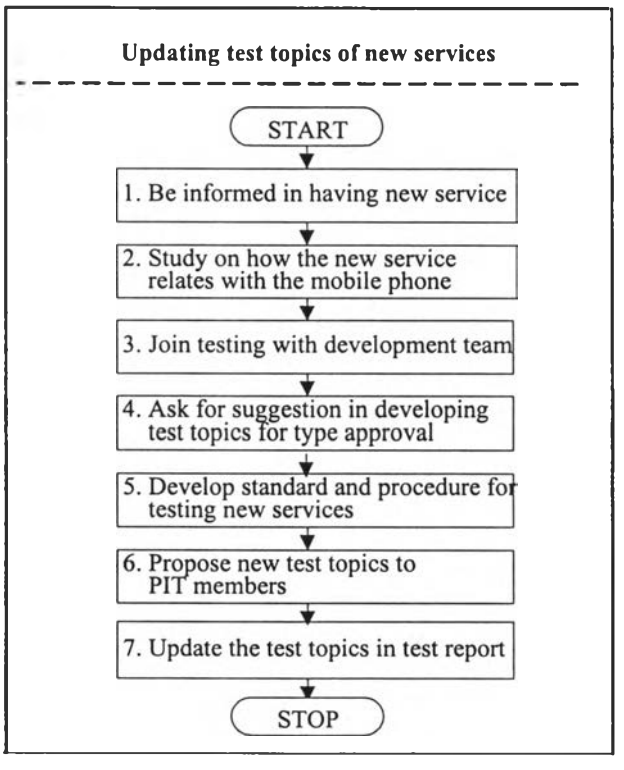

Figure 4.59 Flowchart of updating test topic

According to this flowchart, there are three sections (SIM Operation, System Development, and Wireless Internet) inform the new service to Handset Technology. SIM Operation section informs about new technology of SIM card which will provide new service to the customer. It is called 'GSM MobileLife'. It uses the technology of SIM Toolkit (STK) which the operator can create special menu in the mobile phone and the customers can request the information and services as they want. Services in GSM MobileLife are mBanking, mInfo, mShopping, and etc. System Development section informs about new technology of Wireless Application Protocol (WAP). WAP is technology to provide new service like Internet in the mobile phone. The services are mMail, mSearch, mInfotainment, and etc. And Wireless Internet section has just established to develop the new services in both GSM MobileLife and WAP. Many services are innovated and prepared for launching in the future such as MissLilly for ordering the flower passing through GSM MobileLife, NearByMe Service for searching the location of important place and give suggestion for its direction.

However, PIT members has qualified this flowchart being effective as a guideline to update test topics of new services for doing Mobile Type Approval.

- Assign the owner for each test

After senior engineer has assigned the owner for each test ; Engineer A for 'Test with test equipment', 'Test with network feature', 'Test with existing service' and 'Test with new service (WAP)', Engineer B for 'Test with SIM card', Engineer C for 'Test with new service (MobileLife), and Engineer D for 'Test with new service (Bluetooth and GPRS). Each engineer can understand more clear scope of his responsibility. Besides, he will be the contact point of the test when the Marketing asks for the progress of the test. Therefore, PIT member has qualified this step to be effective one.

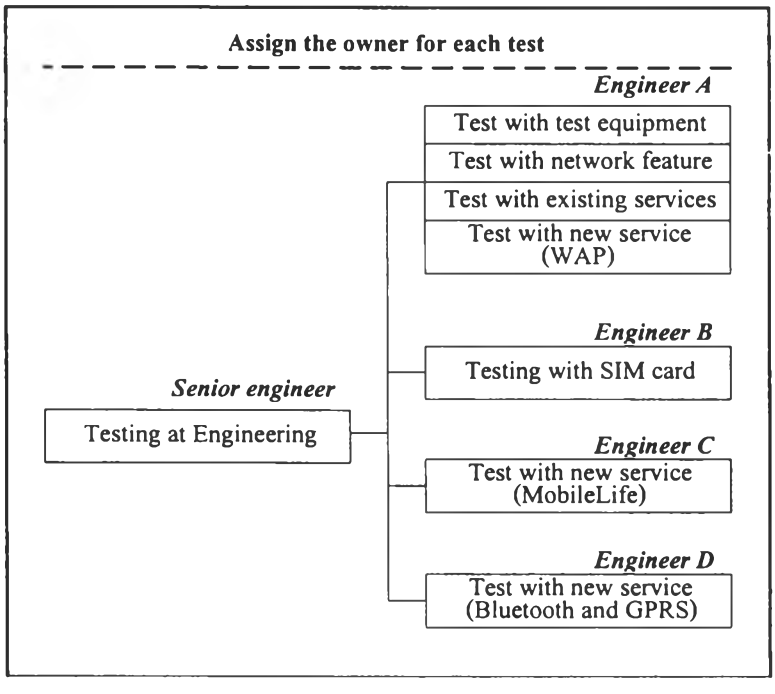

Figure 4.60 Assign the owner for each test

- Develop new form of test report

After developing new form of test report to be easy for non-technical person; especially Marketing staff to be understand, the respond from Marketing staffs how that this new form is acceptable. Moreover, they recommend that the new test topics should be updated and informed continuously. Therefore, EIT has considered this step to be effective one.

Test topics	Result
1. Test with test equipment	
2. Test with network feature	
3. Test with SIM card	
4. Test with existing services	
5. Test with new services	

Table 4.12 Summary of test report

- Eliminate no-value-added activities

For Mobile Type Approval process, no-value-added activities refers to the test topics that are not necessary and should be cut off. After PIT member and Handset team has reviewed the test topics, it is found that some topics can be reduced because there is no service to the customer for that topic and some are nearly the same. In conclusion, after eliminating no-value-added and implementing in the new process, EIT has found that it is still effective for the overall Mobile Type Approval. However, EIT recommend to review the test topic every 6 month. Some test topics may be changed to be no-value-added activities.

- Process for testing SIM card

In order to improve and simplify the Mobile Type Approval process, the step for sending the sample to SIM operation section is eliminated, and transfer testing SIM card (for type approval) from SIM operation to Handset Technology section. Then an engineer has assigned to be the owner of testing SIM card at Handset Technology section.

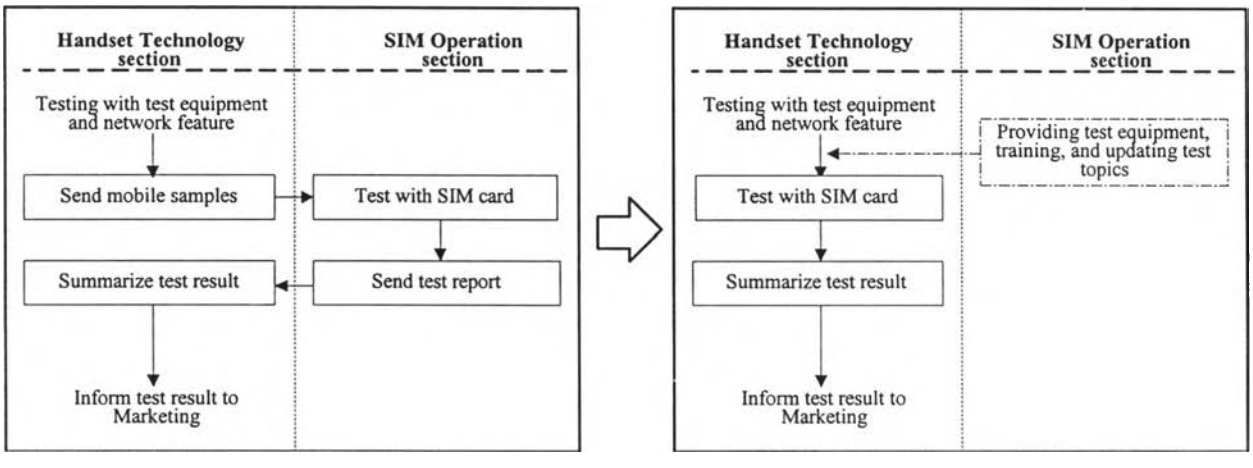

Figure 4.61 New process for testing SIM card

After implementing the new process for testing SIM card for 6 months, it is shown that the process is more effective due to reduce the processing time of testing SIM card from 15 working days to 5 working days. This will also not load the work of SIM operation engineer. SIM operation has provided test equipment, training for testing, and updating test topic for doing type approval. Besides, changing the process of testing SIM card makes the overall process to be more flexible. This is because we can develop the testing in parallel with testing network and with test equipment. Therefore, this new process for testing SIM card is qualified.

Besides, the activities of 'Errorproof the process by developing the test procedure and expect result of each test', 'Review equipment in order to upgrade it', and 'Create roadmap for upgrading people' are considered to be effective also.

4.2.5.3 Define and eliminate process problems

After EIT and PIT member has meeting, they identify the improvement opportunity to implement in the process. There are many problems occurred as follow:

- Some suppliers do not support 3 samples as request

According to PIT members recommend to request more samples for testing, then the Marketing proceeds to request the suppliers 3 samples (one for TOT, and two for Engineering) as shown in the figure below.

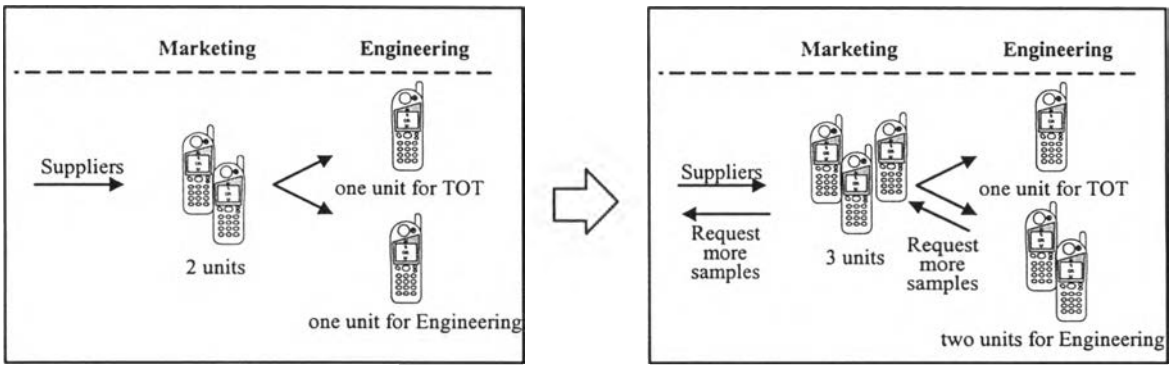

Figure 4.62 Request more samples for testing

After Marketing has informed to the suppliers about requesting more samples for testing, some suppliers can support only two samples. In the timing of the process during implementing as shown in the appendix U, 13 models of mobile phone samples (Model AJ-AL, AN-AQ, AW, AX, and AZ) are sending with 3 samples. So these models are tested with parallel process with other tests. However, the supplier has requested to send the third sample back when the testing is finished. In conclusion, EIT has considered this step not be effective and suggest determining the new requirement for new suppliers to send 3 samples.

- Policy of register IMEI is more strict

According to registering the IMEI in the system, it is needs the top management to approve the request. PIT members has tried to eliminate this bureaucracy to improve the timing of the process by creating subprocess for emergency case as shown in the figure below.

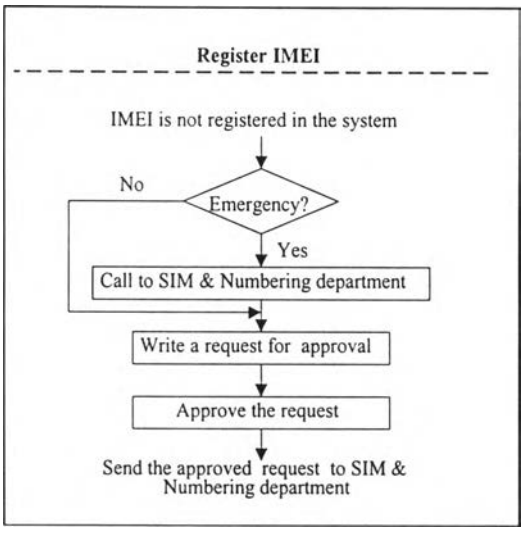

Figure 4.63 Subprocess for register IMEI (Emergency case)

When implementing this subprocess in the process, it is accepted only in the beginning of the period. Due to the policy in the SIM & Numbering department is stricter, so this subprocess is not effective anymore. SIM & Numbering manager has developed form of requesting for loading IMEI in the system. After filling in this form, this form should be approval by someone who is in manager position. This is not effected the new process so much, but the flowchart is already changed as figure below.

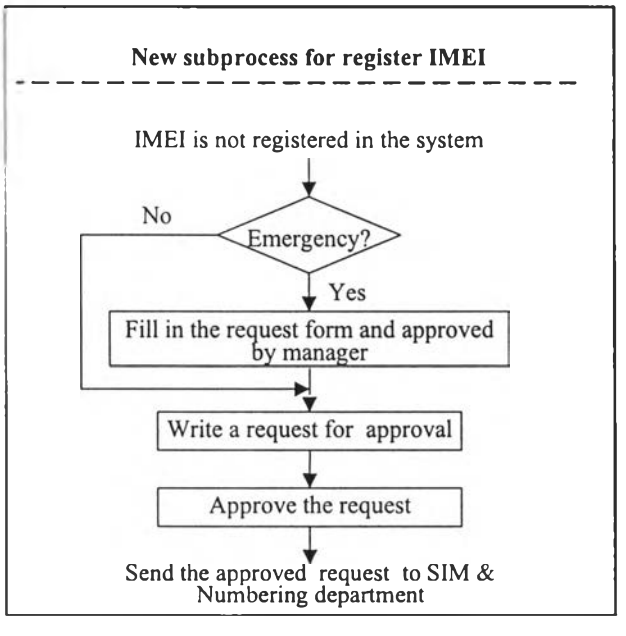

Figure 4.64 New subprocess for register IMEI (Emergency case)

For eliminating the redundancy of activity of 'Register IMEI' in Engineering, it is shown that 'checking whether IMEI is in the system' is effective for the new process. Engineering has not to mainly responsible for registering IMEI in the system, but do it only for the emergency case.

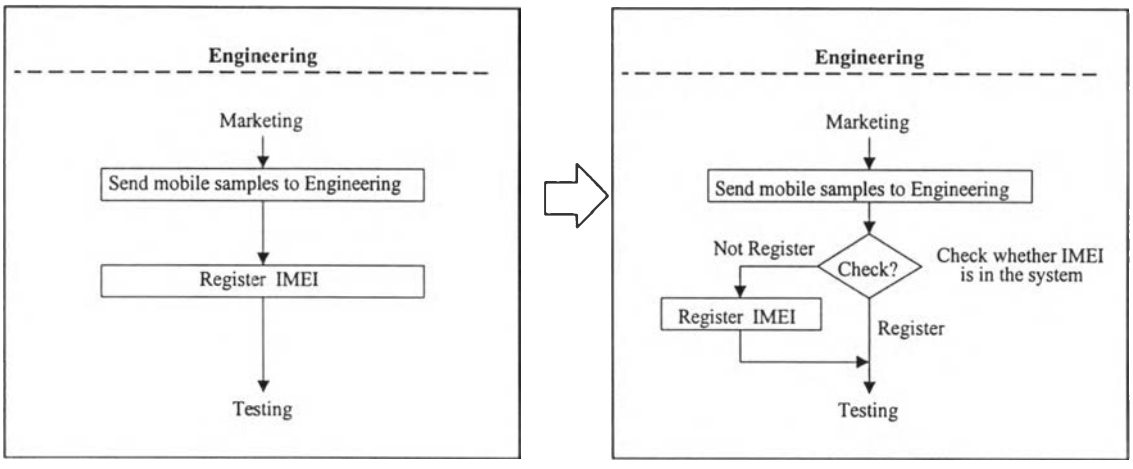

Figure 4.65 Change 'Load IMEI into the system' activity

- In practical the process is not developed in parallel

According to PIT members propose to rearrange the process into parallel as shown in the figure below, but in the practical the tester does not follow to this flowchart. One main cause is that some suppliers do not supply more samples as request, so the tester can not develop the process into parallel.

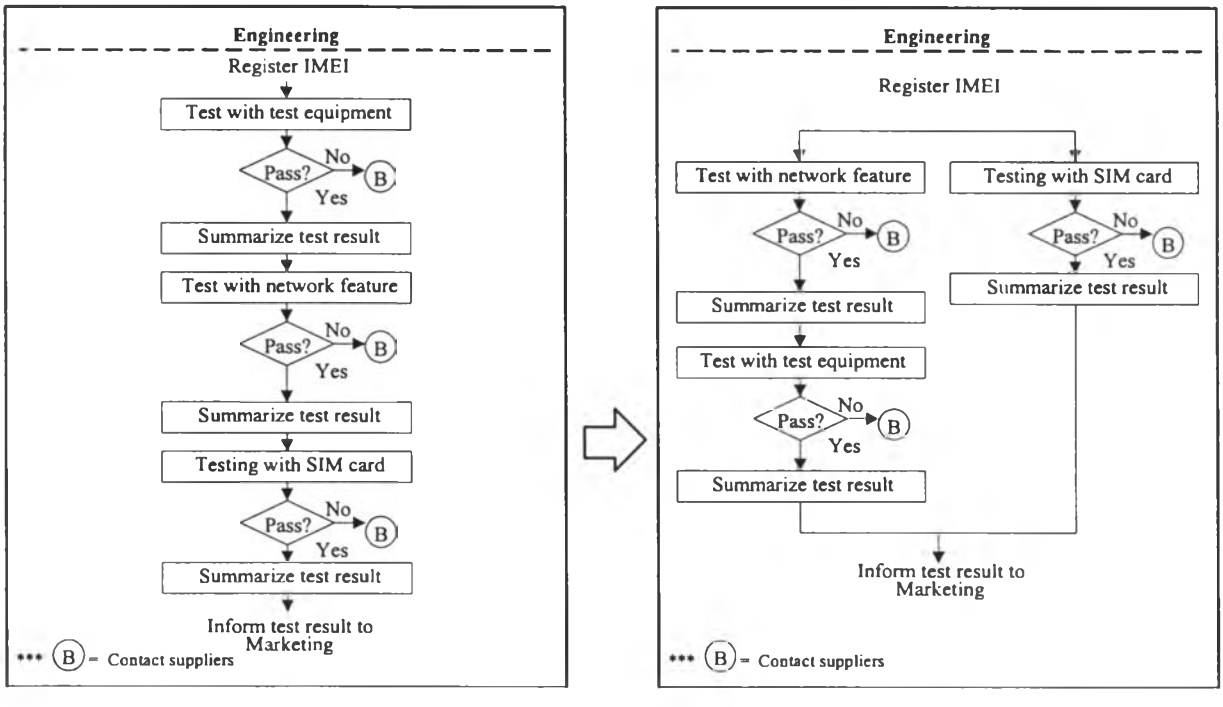

Figure 4.66 Rearrange the process into parallel

In order to qualify the process, EIT and PIT members have considered this flowchart be not effective. Then they define the new one and way of testing as figure below.

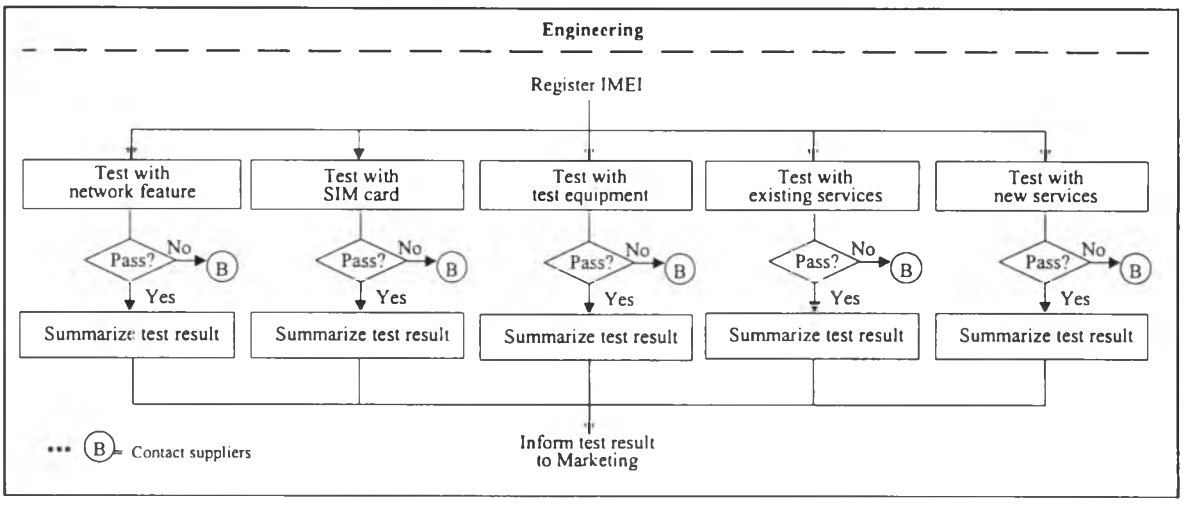

Figure 4.67 New flowchart of testing at Engineering

In the new flowchart of testing at Engineering, all the tests are seems to be developed in parallel. But, indeed, it is not in parallel. This is because the suppliers can not support with many samples as requirement. Some suppliers support only two of them. Some suppliers can support with more than two samples. In the new flowchart, the tester can start testing the sample with any test topics if he is ready. But he should give the priority to 'Testing with new service' first, and then 'Testing with existing service', 'Test with test equipment, 'Test with network feature', and 'Testing with SIM card'; consequently. However, this step is flexible. If owner of 'Testing with new service' is not free, the owner of 'Testing with existing service' can do testing first. However, every owner of test topic has to work together as a team in order to meet the setting target (finish testing within 15 working days).

4.2.5.4 Evaluate the change impact on the business and on customers

In this improvement, the change impact is mainly on the timing of the process. Timing of overall process is decreased, so this make the Marketing department be able to launch the new model of mobile phone into the market faster. Moreover, owing to there is survey of customer requirement in doing type approval, so Engineering can develop the test following to the Marketing also. This makes the process be more effective. According to in this research, two methodologies (QFD and BPI) are brought into the Mobile Type Approval process. Team is setup. No-value-added activities are eliminated. Test procedure and test standards are created. All of these improve the quality of work in testing the mobile phone also. Besides, this make the Engineering department can respond to the Marketing requirement more efficiency.

4.2.5.5 Benchmark the process

Owing to this process is internal process between Marketing and Engineering department, it is difficult to benchmark with other companies. Moreover, nowadays the telecommunication market is very competitive. So every company tries to reduce the processing time of doing Mobile Type Approval process as much as possible. Therefore, in this research the timing of new process is benchmark with the timing of the process before improvement.

Topic	Target	Before Improvement (working days)	After improvement (working days)
1. Total time of overall process	35	58	49
2. Time used at Service Center	2	4	3
3. Time used at Engineering	15	27	14
4. Register IMEI	1	4	1
5. Test with test equipment	2	10	5
6. Test with network feature	3	5	5
7. Test with SIM card	3	15	5

Table 4.13 Benchmark timing of the process

From table 4.13 above, all of the numbers are in the unit of working days. There are seven topics of timing that are going to benchmark. All of them will be compared with the target that both Marketing and Engineering have been set in the second column (Target). The first topic is the total time of overall process. Its target is 35 working days. The time for this before improvement is 58 working days, and after improvement is 49 working days (improved 16%). This is shown that it is decreased but not meets the target. The main cause is that it depends on the timing of testing at TOT which is uncontrollable and out of the scope of improvement in this research. Normally, the subprocess of testing at TOT and subprocess of testing at Engineering are parallel. Although we have improved the timing of testing at Engineering to be 14 working days, the timing of testing at TOT (External activity – uncontrollable) is still 27 working days. Therefore, the timing after improvement is not much reduced (from 58 to 49 working days). However, when considering only internal activity (controllable); excluding testing at TOT, the time after improvement is 35 working days as target (improved 40%).

Second topic is time used at Service Center. Its target is 2 working days. The time for this before improvement is 4 working days, and after improvement is 3 working days (improved 25%). This is shown that there is some improvement in Service Center, but there is still something that should be improved further in order to meet the target. Third topic is time used at Engineering. This topic is the main point that we have identified improvement opportunities and developed the change in the process. Time used before improvement is 27 working days and after improvement is 14 working days (improved 48%). It is shown that after improvement the timing of the process is met the target (15 working days).

Besides, the subprocess in the Engineering has measured the timing also. In topic 4 (Register IMEI), it spends about 4 working days before improvement. But after improvement, this step has reviewed and redesigned its flowchart. Then after improvement it spends only 1 working days (improved 75%). The rest topics are about the timing of each test topic: Test with test equipment, Test with network feature, and Test with SIM card. Time used in testing with test equipment is reduced from 10 working days to 5 working days (improved 50%). Time used in testing with network feature is still the same as before improvement. And time used in testing with SIM card is decreased a lot from 15 working days to 5 working days (improved 67%). Besides, two main test topics (testing with existing services and new services: MobileLife and WAP) have just been created, so it has no measurement before improvement. However, testing with existing services takes 3 working days and testing with new services (MobileLife and WAP) take about 4 working days each.

In summary, the timing of the overall process is improved. Some are met the target, but some are nearly the target. However, there is some limitation in improving the timing of overall process such as subprocess of testing at TOT that is outside the company. Although the total time of overall process is not much reduced (from 58 to 49 working days), there are extra resource increasing such as timing for the testers to do other works (testing with existing services and testing with new services). This is shown that the process is improved not only for decreasing in the timing, but increasing in the extra resources also. However, the workflow of before and after improvement is shown in the appendix V.

4.2.5.6 Provide advanced team training

This step is the last step in phase 5 of BPI approach (Continuous improvement). But it is not the last activity to do in improving the process. Improving the process should be continuously developed. This step is to review all the information that has developed in this phase to everyone in the process. Everyone will know what is improved, what should be improved next, and problems that is occurred in the process. However, everyone should understand the process clearly in order to improve the process further.