CHAPTER 3

MOBILE TYPE APPROVAL BEFORE IMPROVEMENT

This chapter will explain about the company background, product, market, and process of mobile type approval that develops before making improvement. It will show each activity in the process in form of flowchart. And there also have timing and problems that are collected from the process.

3.1 Company Background

The case company is a telecommunication organization in Thailand. Upon the government regulation, any company which give mobile phone services in the country have to be given a permission or concession from The Telephone Organization of Thailand (TOT) or The Communications Authority of Thailand (CAT). In this case, the case company has granted a 20-year concession since 1986 by The Telephone Organization of Thailand (TOT) to run business in giving Cellular Mobile Telephone services in 900 MHz frequency band. In 1996, the period of concession was extended to be 25 years (due on September 30, 2015) on the condition that TOT was able to bring a new mobile phone service provider. According to the concession, the company has to invest, implement and transfer the entire network to be the ownership of TOT before operating them. This is called Build-Transfer-Operate system (BTO). And the company has permission to operate and maintain them in the concession period. Besides mobile phone network, the company also takes care of importing, selling, and servicing the mobile phone.

Therefore, the company has divided into 3 main business units: Marketing, Engineering and Service Center. All of them are running as Service Company, not manufacturing company. Marketing responsible for contact mobile phone suppliers in order to import and sell the mobile phone in the country. Engineering responsible for contact the suppliers in order to import, implement, and maintain the mobile phone network throughout the country. And Service Center responsible for contact mobile phone suppliers in order to service the customer in checking and repairing the mobile phone.

3.1.1 Company product

Company's product is classified into 2 types. First type of product is mobile phone service. It is service for customers to connect the mobile station to the base station and mobile telephone exchange. Customer pays the money for the airtime in using the mobile phone services. Engineering unit has responsible for contact suppliers in order to install and implement the network throughout the country. Moreover, Engineering has to do operation and maintenance all the equipment in order to provide the mobile phone services to the customer. Nowadays, the company has two mobile phone services in 900 MHz frequency band: Analog (NMT) and Digital (GSM) system. In the beginning, the company implemented Analog network throughout the country. Later on, the technology of Digital is innovated. Then, the company also implemented Digital network. Many services are developed not only voice transmission but also fax and data transmission. Moreover, new value-added services are created

in order to respond the customers' need. In addition, the company has assigned each region for suppliers to take care of installing base station, mobile telephone exchange and transmission as follow:

- *Base station and mobile telephone exchange in NMT system*

  Nokia – Base station throughout the country, and mobile telephone exchange mostly in Bangkok area

  Ericsson – Base station throughout the country, and mobile telephone exchange mostly in upcountry area

- *Base station and mobile telephone exchange in GSM system*

  Nokia – North, South, and West region

  Siemens – East and North-east region

  Ericsson – Bangkok and circumference, and upper central region

- *Transmission*

  NEC – North, North-east region and Bangkok

  Siemens – South, East and West region

3.1.1.1 NMT system

Nordic Mobile Telephone (NMT) is analog cellular system that consists of three main parts: Mobile Telephone Exchange (MTX), Base Station (BS), and Mobile Station (MS). This system sends signal in the same form as sending general radio wave such as radio broadcasting. Due to this form of sending signal, it makes one channel to serve only one conversation. One conversation uses a pair of frequency. And a pair of frequency composes of 2 kinds of frequency: receive (RX) and transmit (TX). Both of them are in Ultra High Frequency (UHF) band. RX frequency is 905-915 MHz and TX frequency is 950-960 MHz.

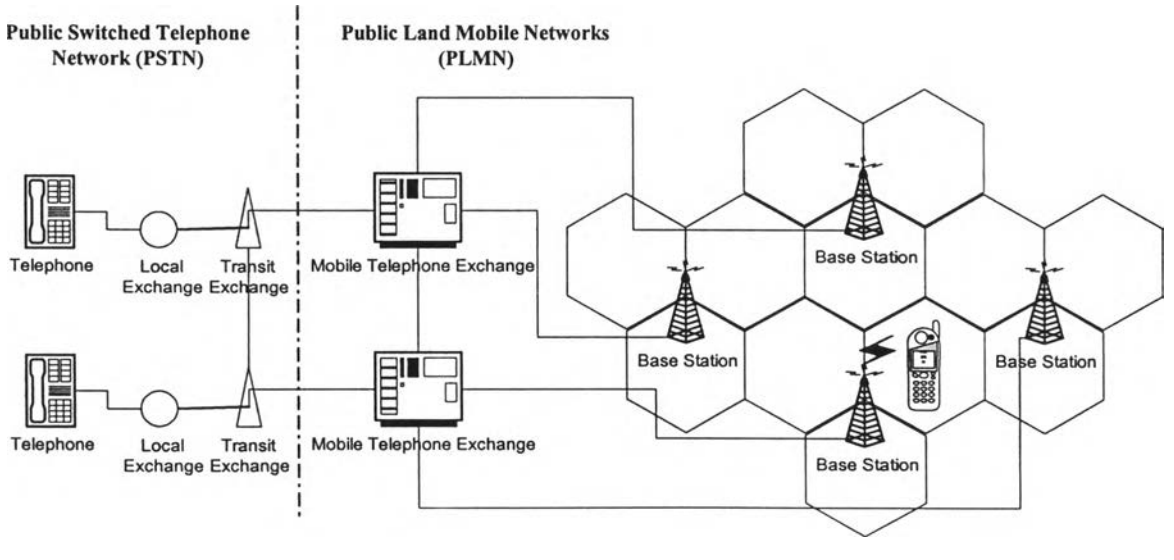


Figure 3.1 NMT system

- *Mobile Telephone Exchange(MTX)*

  This part is the controlled and interfaced unit of cellular network to other networks especially Public Switched Telephone Network (PSTN). It is mainly responsible for handling calls to and from mobile stations (MS), keeping track of MS location, switching calls between Base Stations as MS move, charging call, operating network.

- *Base Station (BS)*

  This part is the connecting unit between MTX and MS. It is mainly responsible for supervising the radio transmission quality during a call. The speech and signals from MS will be sent to MTX by passing through BS. Generally, one base station has three directional coverage area or 'Cell' as shown in figure above. One hexagon represents the coverage area of a 'Cell'.

- *Mobile Station (MS)*

  This part is the equipment that makes the users connect to the system. It mainly consists of transceiver unit, logic unit, control unit, loudspeaker and microphone, duplex filter, and antenna. And it can be divided into two types: handheld and portable. Handheld mobile phone is a small one that users can carry out. And Portable mobile phone has the same functional unit as handheld but the size is bigger. And it can send the signal and speech out more power output (6- watt).

3.1.1.2 GSM system

Global System for Mobile communication (GSM) is digital cellular system that consists of three main systems: Switching System (SS), Base Station System (BSS), and Operation and Support System (OSS); and Mobile Station (MS). This system sends signal in the way of mix signal using Time Division Multiple Access (TDMA). It is the special technique to serve eight conversations in one channel at the same time. This makes GSM system have 8 times capacity more than NMT system. Moreover, GSM system is standard digital telephone system and there are many countries having implemented it. For the case company, RX frequency is 897.5-905 MHz and TX frequency is 942.5-950 MHz. In the future, mobile phone is developing into Third generation that is high speed of sending data and voice at the same time. In addition, this system supports in upgrading to be Third generation also.

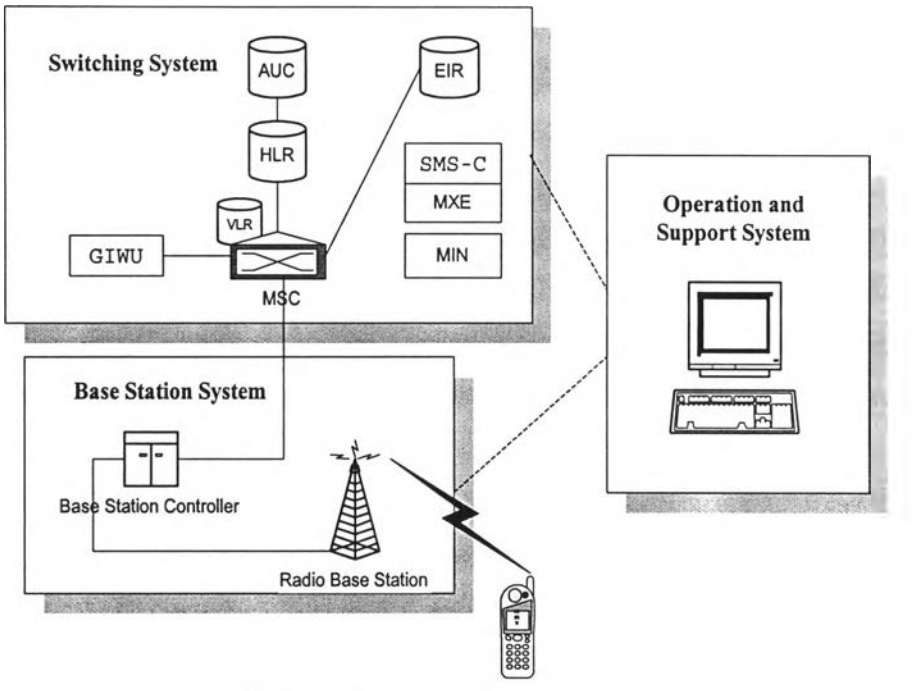


Figure 3.2 GSM system

- *Switching System (SS)*

  In this system, the main components are:

  - Mobile Services Switching Centre (MSC) – the central controller unit in the network
  - Visitor Location Register (VLR) – the database which having current visiting subscribers information.
  - Home Location Register (HLR) – the database which having registered subscribers information.
  - Authentication Centre (AUC) – the functional unit to provide security and privacy for subscribers.
  - Equipment Identity Register (EIR) – the database which having information for Equipment Identity checking.
  - Mobile Intelligent Node (MIN) - the node for implements Intelligent Network (IN) functions.
  - GSM Interworking Unit (GIWU) - Hardware interface between fax and data transmission.
  - Short Message Service Centre (SMSC) – Centre for transferring a text message consisting of up to 160 alphanumeric characters from one point to another.
  - MXE - Standard name of Ericsson solution for multimedia messaging that provides open system platform with real time processing and signaling interfaces to other network node, and messaging system for voice, text, data and fax.

- *Base Station System (BSS)*

  In this system, there are two main components:

  - Base Station Controller (BSC) – the unit which administering cells and radio channels.
  - Base Transceiver Station (BTS) – the unit which handling the radio transmission to and from mobile phones.

- *Operation and Support System (OSS)*

In this system, it is mainly concerned about controlling and reporting the status of equipment, and sending an alarm to the Operation and Maintenance Centre (OMC) when it detects a fault. This centre is responsible for planning, operating, maintaining, supervising, and developing the entire network. Telecommunications Management and Operations Support (TMOS) has been developed and implemented into the OMC in order to do the major functions of OSS: Configuration management, Fault management, Performance management, Subscriber and network management, and Common function.

- *Mobile Station (MS)*

In this part especially for GSM system, it consists of two parts: Mobile Equipment and SIM card.

- Mobile Equipment (ME) - electronic equipment for transmitting and receiving radio signal.
- Subscriber Identity Module (SIM) card - smart card which contain subscribers information.

For NMT system, it consists of only one part that is called Mobile Station.

- Mobile Station (MS) composes of transmitting and receiving radio equipment. The subscriber information is programmed in the memory of the equipment.

3.1.1.3 Difference between NMT and GSM system

- *Voice quality*

Both systems provide good quality of sound. But NMT system is easier to be disturbed by environment such as engine start or nearby radio frequency. For GSM system, using modulation in TDMA frame eliminates this problem. So, GSM system gives better quality of voice.

- *Network equipment*

Due to many manufactures in GSM system, there is competition in developing the quality of network continuously. And each manufacture produces the equipment in the same standard, so it makes the company have bargain in purchasing. This makes convenience in expanding the network and lower cost when comparing to NMT system which has a few manufactures.

- *Security*

In GSM system, both information and signal will be encrypted with special code before sending in the air and be decrypted at the terminal or mobile phone. So it is impossible to trap the information; especially listen to the conversation. Besides, GSM mobile phone has SIM (Subscriber Identification Module) card that the user has to input secret code before using them. This makes more secure for the customer to identify the owner. In NMT system, SIS (Subscriber Identification Security) system has been developed in order to protect coning or signal tuning.

- *ISDN communication*

  Owing to GSM system has been designed on the same basis as ISDN (Integrated Service Digital Network) system, it make the GSM system be able to develop into the next evolution of mobile phone system that links into multimedia. For example, linking with computer in sending information and picture at the same time with high speed, and linking with fax machine in sending and receiving message. This makes the company be able to develop more services in form of data and high-speed communication. Then new value-added services can be created such as Internet/Intranet applications.

- *Special services*

  According to NMT system is innovated before GSM system, NMT mobile phone and system can support only basic services such as voice mail service, conference call and call waiting. But GSM mobile phone and system is developed in more advanced technology so it can support more special services such as sending e-mail, internet integration, web messaging, and short message service (SMS).

- *International Roaming*

  NMT system has limitation in using international roaming. It can be used local services only, not international roaming. Conversely, GSM system is implemented in many countries at the same standard so the customers can bring their mobile phone to use in other countries by requesting the international roaming service to the home operator.

Second product is Mobile Phone. According to the company's mobile phone services, mobile phones in the market are classified into 2 types also: Analog (NMT) and Digital (GSM) system. Analog mobile phone uses Frequency Division Multiple Access (FDMA) in sending signals as same as other radio waves such as conventional radio broadcasting. This serves a conversation in one channel. One channel uses a pair of frequency: uplink and downlink. For Digital mobile phone, it uses Time Division Multiple Access (TDMA) in sending its signals. Eight timeslots is used for one frequency. This can serve eight conversations in one channel at the same time. So in the digital system, it can serve eight times customers more than in the analog system. Generally, Analog mobile phone supports only basic services such as voice mail service, conference call and call waiting, but Digital mobile phone can support more advance services such as sending e-mail, internet integration, web messaging and short message service. Besides, Digital mobile phone can give better quality of sound than Analog mobile phone.

Marketing unit has mainly responsibility for this product; mobile phone. They do all marketing activity to sell mobile phone in both system, and take them to register with the company's system. They sell them through representative in franchise system, dealer, direct sales and corporate sale.

3.1.1.4 NMT mobile phone

For the case company, there are now 2 brands of NMT mobile phone selling in the market: Nokia and Ericsson.

Figure 3.3 NMT mobile phones

3.1.1.5 GSM mobile phone

For the case company, there are now 10 brands of GSM mobile phone selling in the market: Alcatel, Audiovox, Bosch, Ericsson, Motorola, Nokia, Panasonic, Philips, Samsung and Siemens.

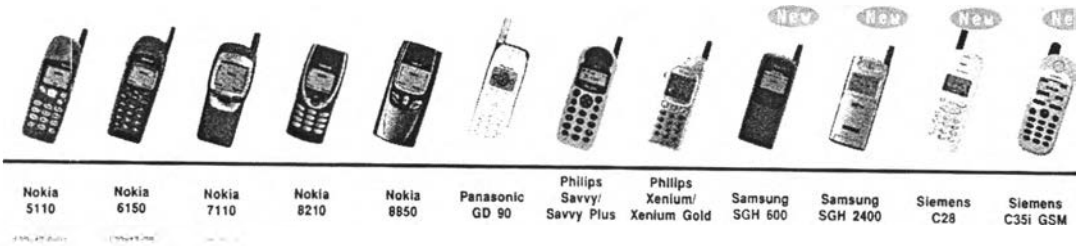


Figure 3.4 GSM mobile phones

3.1.2 Company service charge

Normally, the company's revenue comes from Registration fee, Monthly fee and Airtime fee. However, all of these are under control of TOT who give the concession to the company. Nowadays, service charge can be divided into 2 categories: post-paid and pre-paid.

3.1.2.1 Post-paid service charge

Post-paid service charge is the charge of service after the customer has already used the service. It will be paid in the next month as the rate follow:

Domestic service charge (exclude tax)

1. Registration fee	1,000	baht
2. Monthly fee	500	baht
3. Airtime fee		
- Same area	3	baht/minute
- Adjacent area	8	baht/minute
- Detached area	12	baht/minute
4. Guarantee fee (return when cancel service)	3,000	baht

International service charge (Support only GSM customer). Service charge rate is classified into 2 cases:

(1) When domestic customer bring the mobile phone to other countries, the service rate consists of

1. Registration fee (include tax) 1,500 baht

2. Airtime fee

2.1 Make call Airtime fee (in the country) + Company fee (37% of airtime fee)

2.2 Receive call Long distance fee + Receive call fee (in case) + Company fee (37% of long distance fee + receive call fee)

(2) When foreign customer bring the mobile phone into the country, the service rate consists of

1. Make call (per minute)

1.1 domestic call 9 baht (normal period), 12 baht (hot period)

1.2 international call Long distance fee + 3/4/6/9 baht (normal period) or 3/4/8/12 (hot period)

2. Receive call (per minute) 9 baht (normal period), 12 baht (hot period)

3.1.2.2 Pre-paid service charge

Pre-paid service charge is the charge of service before the customer uses the service. It has launched since July 1999. This kind of charge is used in GSM system. The customer has not to pay for monthly fee and registration fee. Scratch card is introduced in the market. Customer can purchase it anywhere such as bookstore, convenience store, petrol station, music shop, and etc. This kind of service charge makes the company bring new forms of product. They are classified into 3 types:

(1) Phone Kit

In the Phone Kit, it composes of mobile phone, SIM card and Scratch card. This is suitable for the customer who never has GSM mobile phone.

(2) Starter Kit

In the Starter Kit, it composes of SIM card and Scratch card. This is suitable for the customer who has GSM mobile phone and wants to buy only SIM card.

(3) Scratch card

This is suitable for the customer who has GSM mobile phone and SIM card already. Scratch card has 3 types:

Type 1	500 baht for 1 month
Type 2	800 baht for 2 month
Type 3	1,500 baht for 4 month

Pre-paid service rate is followed:

- Airtime fee (include tax)

- Same area (as on SIM card)	5.5 baht/minute
- Adjacent area	6 baht/minute
- Detached area	12 baht/minute

3.1.3 Company organization chart

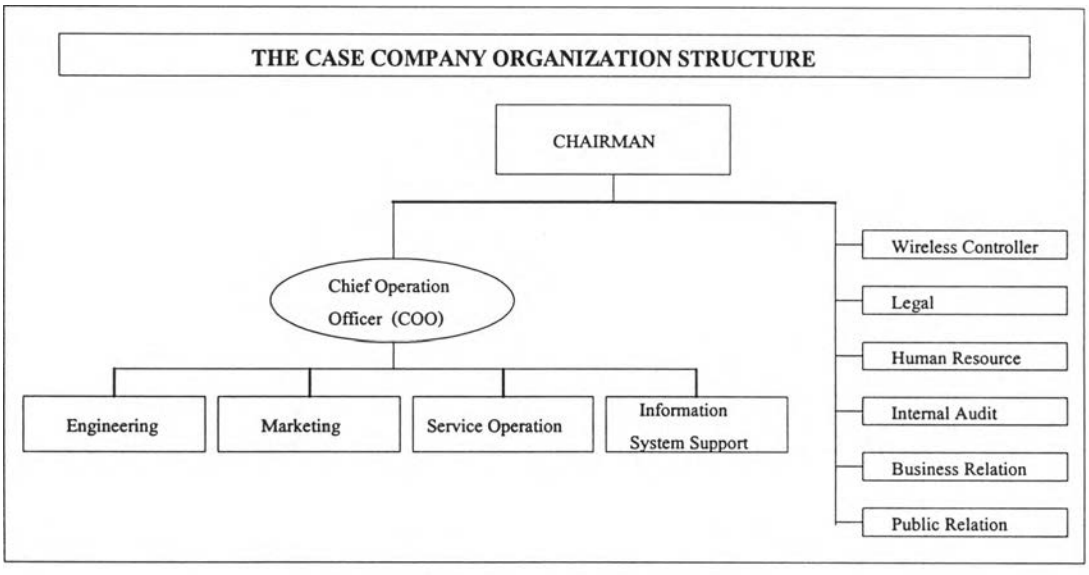


Figure 3.5 Company organization chart

The case company organization structure consists of two main functions: Operation and Support. In the operation leg, there are Engineering, Marketing, Service Operation, and Information System Support which all are under the supervision of Chief Operation Officer (COO). In the Support leg, there are Wireless Controller, Legal, Human Resource, Internal Audit, Business Relation, and Public Relation which are under the supervision of Chairman. The brief function and responsibility of each function unit are as follow:

Engineering

Concern in implement, operate, and maintenance the mobile phone network to qualify the technical standard in order to satisfy customers' needs.

Marketing

Concern with promotion, tariff package and retain the existing market share. In addition, try to get new solution to attract new customers.

Service Operation

Concern in providing information and service to the customer, especially after-sale services.

Information System Support

Concern in developing information system to support each functional unit in order to reduce workload and unnecessary paper work.

Wireless Controller

Concern in controlling the entire work process and improve of the work flow between function unit in company such as budget and planning, administration, purchasing, accounting, finance, and system support.

Legal

Concern in advising the law information and responsible for approving and revising any government or private's contact.

Human Resource

Concern in administrating and supporting the human resource to each functional unit. Meanwhile, responsible in recruiting and maintain the quality of employees to fit the company needs.

Internal Audit

Concern in checking and recommending some improvement of each function unit in order to increase work process efficiency.

Business Relation

Concern in contacting the government's authority (CAT, TOT) by internal and external letters.

Public Relation

Advertise the company's information and gather competitors' information.

3.1.4 Company market

In Thailand, the competition in this industry are continuous higher and higher both in price and promotion. However, now there are 7 mobile phone systems in the country: NMT900, GSM900, AMPS800, PCN1800, GSM1800, NMT470, and CDMA. The comparisons of these systems are in appendix A. As in the appendix, there are now 6 companies in the market.

Network Operator	System
1. Company A (Case company)	NMT 900 and GSM 900
2. Company B	AMPS 800 Brand B and PCN1800
3. Company C	GSM 1800
4. Company D	CDMA
5. CAT	AMPS800 Brand A
6. TOT	NMT 470

Table 3.1 Network Operator in Thailand

According to the case company's information, the company B is the major competitor because company B has high potential in network and distribution channel, so company B can respond the customer demand quickly. For other companies, they still have financial limitation so they can compete with some limitation. On Dec 31, 2000, the market share of case company and company B are 52 and 40 percentage consequently.

Network Operator	Market Share (percentage)
1. Company A (Case company)	52
2. Company B	40
3. Company C	6
4. Other	2
Total	100

Table 3.2 Percentage of Market Share

For the case company, the total customer number is 1.98 million subscribers in both NMT and GSM system (Dec 31, 2000). It can be divided into each type of service charge as follow:

Service Charge	Number of Customer
1. Post-paid	
- NMT system	465,600
- GSM system	1,157,200
2. Pre-paid	354,500

Table 3.3 Number of Customer

Besides, the case company has segmented the customer into 4 main groups according to the customer 's monthly payment. This make the company be able to develop the marketing activity in each period in order to satisfy the customer's need more easily.

(1) Very high value customer - the customer who pay monthly to the company more than 1,750 baht

(2) High value customer – the customer who pay monthly to the company 1,000-1,749 baht

(3) Medium value customer – the customer who pay monthly to the company 750-999 baht

(4) Low value customer - the customer who pay monthly to the company less than 749 baht

3.1.5 Mobile Type Approval

According to section 6 of the Radiocommunication Act B.E. 2498 (1955) of Thailand (Appendix B), "Any person is prohibited to make, possess, use, import, export, or trade any Radiocommunication equipment unless that person has been granted a license from the Authorized Licensing Officer". In addition, The Post and Telegraphs Department (PTD) which responsible for assigning Radio frequency Spectrum and to regulate Sound Broadcasting has set the regulation for doing radio equipment type approval; including mobile phone (Appendix C). The radio equipment that will get permission to import into the country has to pass the theoretical basis and standard of PTD.

Type Approval means to certify the radio equipment sample that has never got the permission to use or import into the country. As mobile phone is radio equipment, it is essential to do type approval for each new model in order to import and sell it in Thailand. This is called 'Mobile Type Approval'

Besides, there are two State Enterprises (The Telephone Organization of Thailand (TOT) and The Communications Authority of Thailand (CAT)) which grant concession to the private company to run business in mobile phone services. They request the company for doing mobile type approval also. List of companies that was granted concession is shown below.

State Enterprise	Private company
1. TOT	Advanced Info Service PLC.
2. CAT	Total Access Communication PLC. Digital Phone Company Wireless Communication Service Company Tawan Mobile Telecom Company

Table 3.4 List of companies that was granted concession

In the case company, one section has established in order to do type approval also. It is in the Engineering unit. This unit name is 'Handset Technology'; in short 'HT'. HT mainly responsible for does testing the new model of mobile phone that will be launched in the market, and contacts the State Enterprise for do type approval. Mainly, HT tests the new model of mobile phone with test equipment, live network, and SIM card in order to assure that there is no problems occur when the customer use this model. The topics for testing are listed as follow:

- Test with test equipment

Test equipment is the equipment for measuring the value in the mobile phone whether it is in the specification. When testing with test equipment, the tester has to connect the mobile phone sample to the test equipment with a cable; called 'RF cable', and then run test following to the test topic. For HT, there is 2-test equipment; one is for testing GSM specification (6 topics in each channel; so measuring in 3 channels then totally 18 topics), and the other one is for testing applicability of tests (620 test topics). All of the test topics are shown in the appendix D and E.

- Network Test

Network test is about testing the efficiency and capability of mobile phone in supporting the services of network. Topics for testing network can be divided into 4 main groups: Tele services, Bearer services, Supplementary services, and network features. These topics are shown in the appendix F. When testing Network test, the tester has to put the SIM card into the mobile phone sample. Then try to use each service and check whether the mobile phone can do as requirement.

- SIM Test

SIM test is about testing the efficiency of SIM card when using with the mobile phone such as Location information, and Short Message storing in SIM card. Technology of SIM card is developed from 8-MB to 16-MB memory and 16-MB to 32-MB memory. Power supply for SIM card is developed from 5 Volt to 3 Volt for conservative battery power. This may have some effects with mobile phone so SIM test is also necessary. For the case company, there are 3 SIM suppliers. Topics for testing SIM card are shown in the appendix G.

3.2 Mobile Type Approval Process

3.2.1 High-level flow diagram

The high-level flow diagram of mobile type approval process is shown in the figure below:

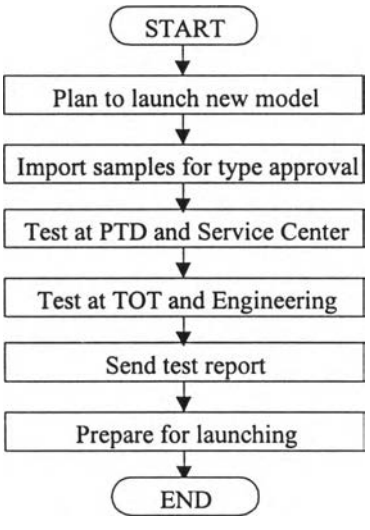


Figure 3.6 High-level flow diagram of Mobile Type Approval Process

Mobile Type Approval process starts when the marketing department has planned to launch a new model of mobile phone in the market. They will request PTD and TOT for import 2 sets of mobile phones for type approval. Marketing sends them to run test with test equipment and basic usage test at Service Center before sending to PTD. After passing test at PTD, the mobile phones are sent to Engineering department. Engineering will take in engineering department itself. After finishing all the tests, the test report is created and sent to Marketing. Then marketing will prepare for launching the new model.

3.2.2 Functional units in the process

In Mobile Type Approval process, it consists of mobile phones suppliers, 2 State Enterprises (PTD and TOT), and 3 functional units of the case company. The workflow across vertical organization from each functional unit and other companies is shown in the flow diagram in the figure below:

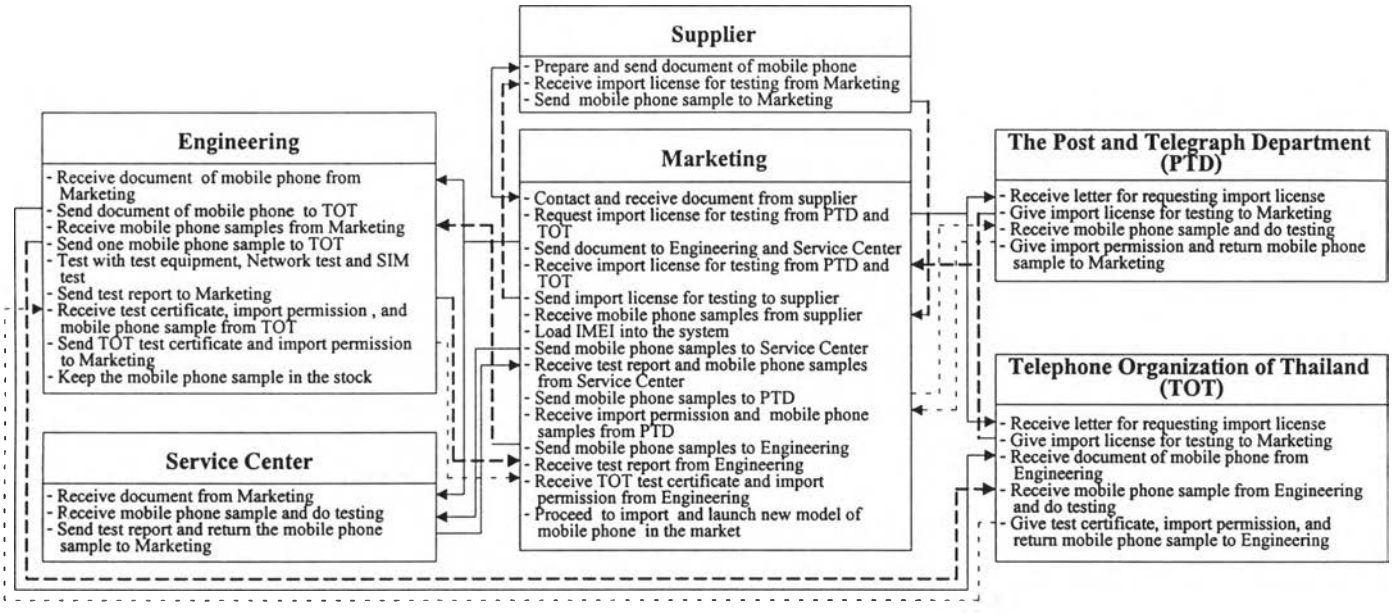


Figure 3.7 Functional units in the Mobile Type Approval Process

3.2.2.1 Mobile phone suppliers

Ericsson, Nokia, Philips, Siemens, Alcatel, Bosch, Panasonic, Samsung, Motorola, and Audiovox are mobile phone suppliers for the case company. In the mobile type approval process, they have responsible for 3 functions:

- Prepare and send document of mobile phone
- Receive import license for testing from Marketing
- Send mobile phone sample to Marketing

Firstly, the suppliers have duty to prepare the document that Marketing requests for doing type approval. Those are technical specification, user manual, service manual, circuit diagram, brochures or catalogue, test result from test house, and full type approval certificate. All of them are in 5 copies for 5 functional units (Marketing, Service Center, Engineering, PTD and TOT). Secondly, after Marketing has requested and received the import license from PTD and TOT, the suppliers take it to the Department of Customs in order to import the mobile phone samples for testing or doing type approval. Normally, two samples of mobile phone are allowed to import for testing. In addition, the suppliers have to provide the cable for connecting the sample to the test equipment also. Thirdly, when the mobile phone samples are already imported into the country, the suppliers send them to Marketing. Besides, suppliers still contact the marketing for supporting information as requests; especially technical aspect.

3.2.2.2 Post and Telegraph Department

Post and Telegraph Department (PTD) is a government agencies under the Ministry of Transport and Communications. And its main functions and responsibilities are as follow:

1. Developing systems and technologies, and submitting the recommended policies, measures and proposed tariff of postal and telecommunications services of the country. Preparing and collaborating the implementation plans of PTD in conformity with the master plans and policies of the Ministry. Following up and evaluating the implementation of work plans and projects. This also includes systemizing, surveying, data collecting, data evaluating, and utilizing management information system (MIS) for postal and telecommunication services as well as training for human resources development.
2. Representing the Government in all international postal and telecommunications matters at an Administrative level
3. Managing the radio frequency, issuing radiocommunications licenses, inspecting and monitoring the uses of radio frequency and taking appropriate actions as authorized by radiocommunications laws and regulations
4. Setting and inspecting technical specifications and standards of radiocommunications equipment and its accessories
5. Performing other tasks within the authorized functions conferred by related laws to PTD or any assignments ordered by the Ministry of the Cabinet.

According to number 4 of PTD's functions and responsibilities, PTD has 4 functions in the mobile type approval process: Those are

- Receive letter for requesting import license
- Give import license for testing to Marketing
- Receive mobile phone sample and do testing
- Give import permission and return mobile phone sample to Marketing

Firstly, Marketing of the case company sends the letter to PTD to request for import license of new mobile phone model. After PTD receives and considers the requested letter, PTD will give and send the import license for testing to Marketing. Normally, PTD allows the company to import only two samples of mobile phones for testing, as mention in the import license. At this period, PTD waits for Marketing to take the mobile phone sample out of Department of Customs. After that Marketing sends the mobile phone samples with document to PTD. PTD connects the sample with the test equipment and run test. If the test result is passed according to the specification, PTD will proceed to issue the import permission and return the mobile phone sample to Marketing. The samples of import license for testing and import permission are shown in the appendix H and I.

3.2.2.3 Telephone Organization of Thailand

Telephone Organization of Thailand (TOT) is a State Enterprise under the Ministry of Transport and Communications. Its functions and responsibilities are about providing landline telephone network and services throughout the country. Besides, TOT has granted a concession to the case company in order to operate mobile phone network and services in NMT 900 and GSM 900 system. According to the permission, the case company has to do the type approval with TOT before launching the new model of mobile phone in the market. Therefore, TOT has 5 functions in the mobile type approval process: Those are

- Receive letter for requesting import license
- Give import license for testing to Marketing
- Receive document of mobile phone from Engineering
- Receive mobile phone sample from Engineering and do testing
- Give test certificate and import permission and return mobile phone sample to Engineering

Firstly, at the same time as Marketing of the case company sends the letter to PTD to request for import license, Marketing also sends another letter to TOT for requesting the import license for testing. After TOT receives and considers the requested letter, TOT will give and send the import license for testing to Marketing. After this, Engineering department will take care all activities about doing type approval with TOT. Then when Marketing receives documents from suppliers, Marketing will forward them to Engineering in order to proceed the type approval with TOT. When TOT receives the documents for type approval, TOT will check them and then inform the fee. At this period, TOT waits for Engineering to take the mobile phone sample to do testing. When Marketing finishes the type approval at PTD, Marketing will forward the samples to Engineering. Then Engineering takes one of the samples to do testing at TOT. TOT has set the testing period for one model not more than 30 days. After finishing testing, TOT will give test certificate, import permission, and return the mobile phone sample to Engineering. Then Engineering will forward the test certificate and import permission to Marketing in order to proceed launching the new model of mobile phone in the market.

3.2.2.4 Marketing

In this case, Marketing is sub company of the case company. It acts as trading company of mobile phones. There are other companies that run business as trading company of mobile phones also. However, the Marketing is the major trading company of mobile phones for the case company; 7 brands out of 10. Not only selling the mobile phones to the customer, but Marketing also registers them into the case company's mobile phone services also. Besides, Marketing department responsible for setting price and promotion. Market research is important and necessary in order to create new value-added service to satisfy the customer's need. Moreover, Marketing acts as contact point between the case company and other companies; especially suppliers. In the mobile type approval process, Marketing responsible for 15 functions:

- Contact and receive document from supplier
- Request import license for testing from PTD and TOT
- Send document to Engineering and Service Center
- Receive import license for testing from PTD and TOT
- Send import license for testing to supplier
- Receive mobile phone sample from supplier
- Load IMEI into the system
- Send mobile phone samples to Service Center
- Receive test report and mobile phone samples from Service Center
- Send mobile phone samples to PTD
- Receive import permission and mobile phone samples from PTD
- Send mobile phone samples to Engineering
- Receive test report from Engineering
- Receive TOT test certificate and import permission from Engineering
- Proceed to import and launch new model of mobile phone in the market

First of all, Marketing contact to the suppliers in order to plan and bring new model of mobile phone into the market. After negotiation, the suppliers send the document to Marketing for doing type approval with PTD, TOT, Service Center and Engineering department. Then Marketing sends letter to PTD and TOT in order to request import license for testing. At the same time, Marketing forwards the document to Service Center and Engineering department. After PTD and TOT send import license to Marketing, the import license will be forwarded to suppliers. Then the suppliers will take the samples out from the custom and send them to Marketing. And then Marketing will proceed to load the IMEI (serial number of mobile phone). For Thailand, it is necessary to load IMEI into the system otherwise the mobile phone can not access to the system. At the same time, Marketing sends the samples to Service Center

in order to pre-test before testing at PTD. Service Center will run test with test equipment and print the test report. Then the samples and test report are sent back to Marketing. If anything goes wrong, Marketing will try to contact the supplier to correct it. Marketing forwards the sample to PTD and wait for import permission. When PTD finishes testing, PTD sends the import permission and return the sample back. Marketing proceeds to forward the samples to Engineering for doing type approval with TOT and with the company's services. After Engineering finishes testing, the test report is returned to Marketing. And when TOT finishes testing, the TOT test certificate and import permission will be sent to Engineering. And Engineering sends them to Marketing. When all tests are completed, Marketing will proceed to import and launch new model of mobile phone in the market.

3.2.2.5 Service Center

Service Center is also sub company of the case company same as Marketing. It acts as the center to train and support the dealer. Besides, Service Center involves in this mobile type approval process in doing pre-test the sample before sending it to the PTD. Pre-test makes the process be quicker in discovering some hidden problems and proceeding to solve them earlier. Owing to Marketing does not know so much about technical aspect of mobile phone, Service Center has responsible to support and suggest for testing at PTD. Therefore, in the mobile type approval process Service Center has responsible for 3 functions:

- Receive document from Marketing
- Receive mobile phone sample and do testing
- Send test report and return the mobile phone sample to Marketing

Firstly, Marketing sends the document about new model of mobile phone that is going to do type approval to Service Center. Then Service Center just receives and prepares for the incoming mobile phone sample. And when Marketing sends the mobile phone sample to Service Center, Service Center will test with the test equipment and print the test result for Marketing. If there are some problems and errors in mobile phone sample, Service Center will contact the Marketing in order to inform the supplier for correcting them. If there is no problem, Service Center will send test report and return the mobile phone sample to Marketing. Moreover, Service Center also supports PTD in doing type approval also.

3.2.2.6 Engineering

Engineering department has responsible for three main functions: implement, operate, and maintain the network in order to provide the mobile phone services to the customer. Developing mobile phone network, there are 3 factors that should be considered. Those are Coverage, Capacity, and Quality. First, Coverage refers to the service area for the customer to use his mobile phone. It should be anywhere that the customer wants to use his mobile phone include in-building area, express way, railway station, international cross border area, tourist area, and other places. Second, Capacity refers to the availability of traffic channel for customer to use his mobile phone. It should be sufficient to serve the rapid growth of customer demand both in voice and data. Third, Quality refers to the quality of voice and services. This factor is very important to the customer, therefore the company has to maintain and improve the network and services continuously. For services, the company has to create more value-added services for the customer. Besides, Engineering department also supports Marketing department to implement the system in order to launch new value added services and mobile phone to the market. Therefore, Engineering responsible for technically supporting information and testing all services that provide to the customer. This is included in Mobile Type Approval. In the mobile type approval process, Engineering responsible for 9 functions:

- Receive document of mobile phone from Marketing
- Send document of mobile phone to TOT
- Receive mobile phone sample from Marketing
- Send one mobile phone sample to TOT
- Test with test equipment, Network Test and SIM test
- Send test report to Marketing
- Receive test certificate and import permission from TOT
- Send TOT test certificate and import permission to Marketing
- Keep the mobile phone sample in the stock

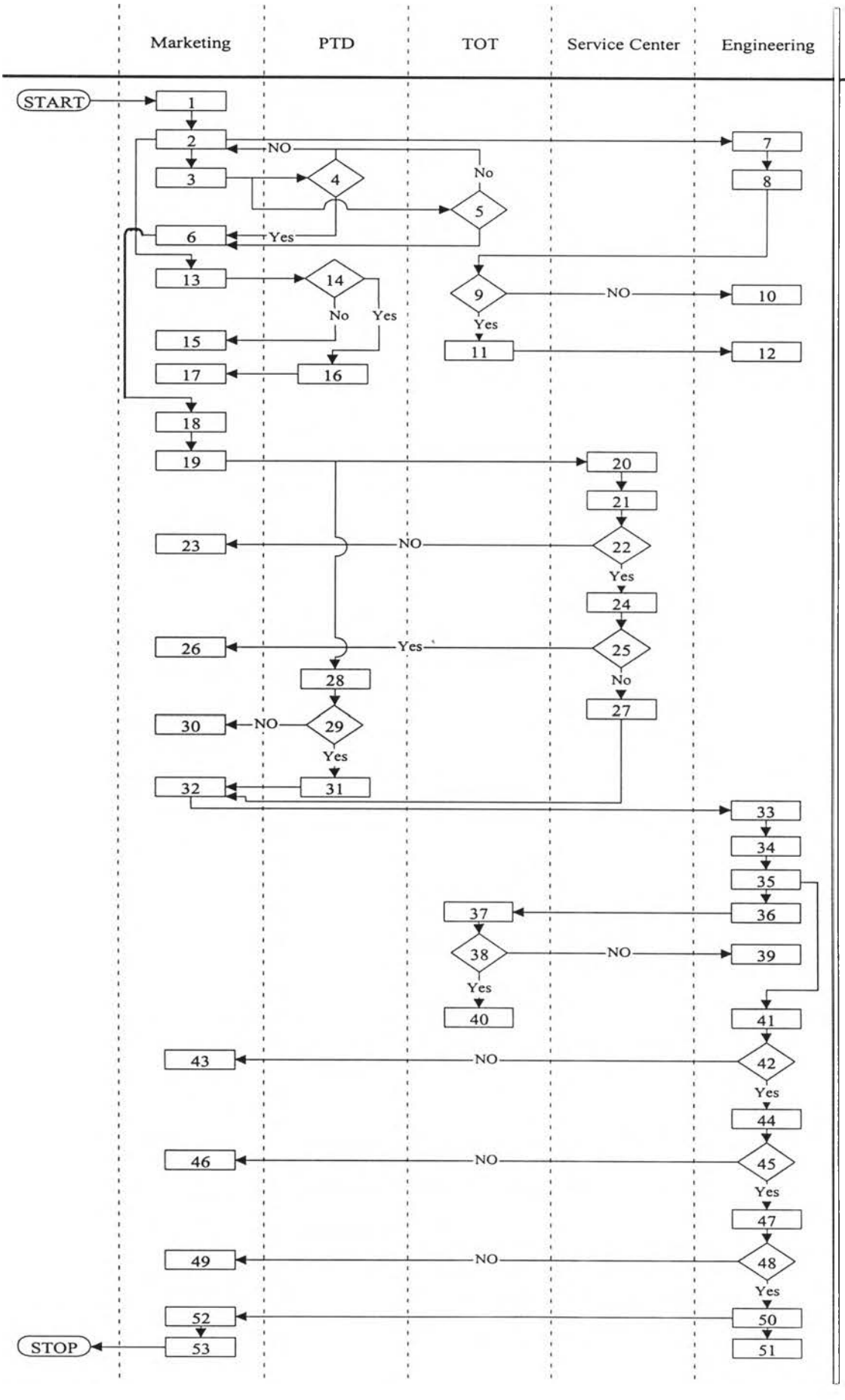
First of all, Engineering receives document of mobile phone from Marketing. According to the promise between the case company and TOT, the case company has to do type approval for new model of mobile phone with TOT. So Engineering writes the official letter and sends one document of new mobile phone model to TOT for requesting to do type approval. When Marketing sends the mobile phone samples to Engineering, Engineering sends one of them to TOT. With another sample of mobile phone, Engineering brings it to test with the test equipment, network, and SIM card. After finishing all the tests, Engineering sends the test report to Marketing to confirm that there will be no problem and error with the new model of mobile phone when using with the company's network and services. And when TOT finishes testing, TOT will send the test certificate and give the import permission to Engineering in

order to import and sell the new model of mobile phone in the market. TOT also returns the sample to Engineering. Then Engineering keeps all of the samples in the stock. In addition, these samples will be taken out to test again when the company wants to launch new services.

3.2.3 Functional flowchart and average processing time & cycle time

Owing to the objective of this research 'To improve efficiency and reduce timing in Type Approval process', the figure 3.6 (High-level flow diagram of Mobile Type Approval Process) and figure 3.7 (Functional units in the Mobile Type Approval Process) are pictured in the functional flowchart as figure 3.8 (Functional flowchart and average processing time & cycle time). In the figure, there are functional units dividing in the vertical, and show how the activities are flowed horizontally across each functional unit. This figure aims to show the movement between different functional units and its timing.

In Mobile Type Approval process, it can divide into 53 activities in the functional flowchart. Their processing time and cycle time is shown on the right side of the figure. Time is measured in the units of working days. This value comes from the average of used time. Dash line '-' means that that activity is just activity to perform the work; no processing time and cycle time. Besides; each activity is represented by number in the box, therefore the name of activity and its description are shown in the table 3.5 (Activities and its responsible area).



Activity	Processing time (days	Cycle time (days
1	-	-
2	-	-
3	1	3
4	-	-
5	-	-
6	1	4
7	-	-
8	1	4
9	-	-
10	1	2
11	2	8
12	1	4
13	1	3
14	-	-
15	1	2
16	2	7
17	1	4
18	5	14
19	1	2
20	-	-
21	0.5	1
22	-	-
23	0.25	0.5
24	0.5	1
25	-	-
26	0.25	0.5
27	0.25	1
28	1	5
29	-	-
30	0.25	2
31	1	2
32	-	-
33	-	-
34	0.25	1
35	1	4
36	2	5
37	5	15
38	-	-
39	0.25	2
40	3	10
41	5	10
42	-	-
43	0.25	0.5
44	2	5
45	-	-
46	0.25	0.5
47	2	15
48	-	-
49	0.25	0.5
50	0.5	2
51	-	-
52	-	-
53	-	-
Total	44.75	144.5
%	31%	100%

Figure 3.8 Functional flowchart and average processing time & cycle time

No.	Activity	Responsible area
1.	Plan to launch new model	Marketing
2.	Receive document from supplier *Supplier sends the document such as product information , technical specification, Test certificate, etc. to marketing in order to request for import license and type approval.*	Marketing
3.	Request for import license *Marketing sends the official letter to PTD and TOT in order to request for import license to do type approval*	Marketing
4.	Approve the request *PTD check and approve the request , then give import license for testing*	PTD
5.	Approve the request *TOT check and approve the request , then give import license for testing*	TOT
6.	Import samples for type approval *When Marketing receives both import licenses from PTD and TOT, then Marketing will proceed to import samples for type approval*	Marketing
7.	Receive document from Marketing *Marketing sends documents to Engineering , and ask Engineering to request TOT for doing type approval*	Engineering
8.	Request TOT for type approval *Engineering setnds the official letter to TOT in order to request for type approval*	Engineering
9.	Check the document *TOT check the document according to the requirement*	TOT
10.	Correct the document *If some document are missing or incorrect , Engineering responsible for correcting them.*	Engineering
11.	Inform fee *After checking document, TOT will inform the fee to Engineering*	TOT
12.	Pay fee *When Engineering receives the information about fee, then Engineering proceeds to pay it.*	Engineering
13.	Request PTD for type approval *Marketing sends the official letter to PTD in order to request for type approval*	Marketing
14.	Check the document *PTD check the document according to the requirement*	PTD
15.	Correct the document *If some document are missing or incorrect , Marketing responsible for correcting them*	Marketing
16.	Inform fee *After checking document, PTD will inform the fee to Marketing*	PTD
17.	Pay fee *When Marketing receives the information about fee, then Marketing will proceed to pay it*	Marketing
18.	Receive sample from suppliers *After getting allowance from Department of Customs, Suppliers send the sample to Marketing.*	Marketing
19.	Register IMEI *For Thailand, it needs to take the serial number of handset or IMEI into the system before using or testing with the network. For testing, IMEI is loaded temporary.*	Marketing
20.	Receive sample and document *One sample and document are sent to Service Center for testing*	Service Center
21.	Run test with test equipment *Put SIM Test into the sample and connect it to test equipment by cable then run test and print the result.*	Service Center
22.	Check if it pass *Check whether the data is in limit . If no, ask Marketing to contact supplier. If yes, do the Basic usage test .*	Service Center
23.	Contact supplier *When there is problem or error, Marketing will cooperate with supplier in order to solve it.*	Marketing
24.	Basic Usage Test *Put the normal SIM Card to the sample, and try to make call and use it as customer.*	Service Center

No.	Activity	Responsible area
25.	Check if there are any problem. *Check whether there are something wrong that should not happen such as hang .*	Service Center
26.	Contact supplier *Same as activity 23*	Marketing
27.	Send test report *After finish testing, Service Center will summarize the result and send test report to Marketing*	Service Center
28.	Test by PTD *One sample is sent to PTD and do testing with test equipment.*	PTD
29.	Check if it pass *Check whether the data is in limit . If no, ask Marketing to contact supplier.If yes, summarize the test result.*	PTD
30.	Contact supplier *Same as activity 23*	Marketing
31.	Give import permission *After finish testing, PTD will send import permission to Marketing*	PTD
32.	Receive samples , import permission and test report *When testing is finished the samples are returned with import permission and test report.*	Marketing
33.	Receive samples from Marketing *Two samples are sent to Engineering, it has to record its serial number and prepare box to keep in stock.*	Engineering
34.	Update Mobile-in Inventory *Owing to the 2 samples will be kept at Engineering, it has to record its serial number and prepare box to keep in stock.*	Engineering
35.	Register IMEI *Due to IMEI is loaded temporary. Sometimes it expires, so Engineering has to ask for register it again*	Engineering
36.	Send one sample to TOT	Engineering
37.	Test by TOT *One sample is sent to TOT and do test with test equipment.*	TOT
38.	Check if it pass *Check whether the data is in limit . If no, tell Engineering to contact supplier. If yes, summarize the test result.*	TOT
39.	Contact supplier *When there is problem or error, Engineering will cooperate with Marketing and supplier in order to solve it.*	Engineering
40.	Give test certificate *After the sample passes the test, then TOT summarize test result and give test certificate to Engineering.*	TOT
41.	Test with test equipment *Put SIM Test into the sample and connect it to test equipment , then manual test and record the result.*	Engineering
42.	Check it pass *Check whether the data is in limit . If no, contact supplier. If yes, record the result.*	Engineering
43.	Contact supplier *Same as activity 39.*	Marketing
44.	Test with network *Put the normal SIM Card to the sample, then try to use all menu in the mobile phone and test with features in the network.*	Engineering
45.	Check if it pass *Check whether it can work normally with the network's features. If no, contact supplier. If yes, record in the test result.*	Engineering
46.	Contact supplier *Same as activity 39.*	Marketing
47.	Test with SIM Card *There are many brands and types of SIM Card launching in the market . So each type of it should be tested with the sample.*	Engineering
48.	Check if it pass *Check whether the sample can work normally with each types of SIM Card. If no, contact supplier. If yes, record in the test result.*	Engineering

No.	Activity	Responsible area
49.	Contact supplier *Same as activity 39.*	Marketing
50.	Summarize test result *After all tests are done, Engineering makes a test report and sends it to Marketing.*	Engineering
51.	Keep mobile in the stock *After finishing all tests, Engineering keeps the samples of mobile in the stock for upgrading software and testing in the future.*	Engineering
52.	Receive test report and TOT certificate *Marketing receives test report and TOT certificate that shows all the test topic that is passed.*	Marketing
53.	Prepare for launching	Marketing

Table 3.5 Activities and its responsible area

3.3 Problem and data collection before improvement

Mobile Type Approval is a business process that consists of many functional units: both inside and outside the case company. From the scope of this research, it is included only the activities inside the case company, so the problems and data collections are from the activities inside the case company also.

Owing to time and quality are the important factors of this process, so time has to be short and quality has to be good. In the practical, it is not easy to get both of them as desire. In the Mobile Type Approval process, Marketing department wants to finish the type approval process for each model as quick as possible in order to launch the new model into the market. This will bring more competitive advantage than the competitors and other marketing aspects. The shorter the time to do type approval, the more advantage it is to the company. But Engineering department realizes on the quality more than the time. Engineering department wants the customer to get good quality of product so the process for testing the new model sample of mobile phone before launching into the market is created. If there is any problems in the new model, Engineering can found and solve it earlier.

From the survey of activities in the mobile type approval process, there are four main problems:

1. Time used in the process is long
2. There is nothing to show the progress of each new model in the process
3. Some activities are redundancy and overlap with the others
4. Marketing does not understand what Engineering is testing

3.3.1 Time used in the process is long

For Marketing department as the customer of the process, *Overall target is 35 working days (or 7 weeks) per model* to do Mobile Type Approval process. But in practical, the overall process takes longer than Marketing department expects. The process starts when the supplier sends the document of new model mobile phone to Marketing, and finishes when all test reports (from Service Center, PTD, TOT, and Engineering) are sent back to Marketing. Data collection of time used in the process since Sep'99 to Jan'00 is shown in the table below.

No.	Mobile phone	Marketing receives document (starting date)	Marketing receive all test report (finishing 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 3.6 Total time used in the process since Sep'99 to Jan'00

From table 3.6, there are 12 model of mobile phones sending to do type approval from September 1999 to January 2000. All of them are represented by Model A-L in order not to effect in the marketing perspective. Data is collected from the starting date of the process which is the date of Marketing department receives document from supplier, to the finishing date of the process which is the date of Marketing department receives all test reports (from Service Center, PTD, TOT, and Engineering).

From the data collection in the table 3.6, it is shown the average time used in the process of each model is 58 working days (or about 12 weeks). It is longer than Marketing department expects; *the target for overall type approval process is 35 working days per model (or 7 weeks).* Therefore, *Average delay time is 23 working days (or about 5 weeks).* In addition, Marketing thinks that it is too long for doing type approval of mobile phone. This is because nowadays the technology is changing rapidly. New model is designed and manufactured continuously. And the mobile phone is a worldwide product. If our country launches the new model so late, then we will lag behind other countries; not only the local competitors. So the timing of Mobile Type Approval process should be improved. In addition, the activities outside the case company are not included in the scope of this research. Therefore, the time used in testing at Service Center and Engineering are collected as the table below:

No.	Mobile phone	Service Center receives mobile phone (starting date)	Service Center sends test report (finishing 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 3.7 Time used in testing at Service Center of Model A to L

From table 3.7, Time used in testing at Service Center of Model A to L is collected. Model A to L is the model of mobile phone that suppliers sent to Marketing for doing type approval since September 1999 to January 2000. Normally, Service Center technically supports Marketing in doing pre-test the mobile phone sample before testing at PTD. Both testing at PTD and Service Center are mainly on the specification of mobile phone. The time starts when Service Center receives mobile phone sample from Marketing, and stops (or finishes) when the Service Center sends the test report back to Marketing. For Marketing department as the customer of the process, *the target for Service Center is 2 working days per model* to do type approval.

From the data collection in the table 3.7, it is shown that the average time used in testing at Service Center is 3.3 working days (or about 4 working days). Therefore, *Average delay time is about 2 working days.*

No.	Mobile phone	Engineering receives mobile phone (starting date)	Engineering sends test report (finishing 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 3.8 Time used in testing at Engineering of Model A to L

Same as table 3.7, Time used in testing at Engineering of Model A to L is collected in the table 3.8. Model A to L is the same model as collecting at Service Center. They are also the models of mobile phone that suppliers sent to Marketing for doing type approval since September 1999 to January 2000. Normally, Engineering does type approval for the case company's network and system. Testing does not stress only on the specification of mobile phone as Service Center does, but it mainly on Network, SIM Card, and the company's services also. For Engineering, the time starts when the mobile phone sample is sent, and stops (or finishes) when the Engineering sends the test report to Marketing. Besides, Engineering also responsible for contact and do type approval at TOT also. However, the timing of doing type approval at TOT is not collected due to out of scope of this research. For Marketing department as the customer of the process, *the target for Engineering is 15 working days (or 3 weeks) per model* to do type approval.

From the data collection in table 3.8, it is shown that the average time used in testing at Engineering is 26.1 working days (or about 5 weeks). Therefore, *Average delay time is about 10 working days (or 2 weeks).*

3.3.2 There is nothing to show the progress of each new model in the process

Owing to the test in Engineering department takes long time (about 29 days), so Marketing wants to know what the progress of testing it is, and the expected finish date it will be. But mostly there is no one can answer the question, so Marketing has difficulty in planning to launch the new model into the market. Therefore, sometimes Marketing decides to launch the new model before the test at Engineering is finished. This brings some risk to the image of the case company and also breaks the company' policy to bring good services and quality to the customer.

3.3.3 Some activities are redundancy and overlap with the others

For the overall process of mobile type approval, there is some activity redundancy and overlap with the others. Since time is important factor for success of the process, these activities should be minimized or eliminated. For example, the activity of register IMEI into the system should be only one, not both in Marketing and Engineering department. Another example is about testing. Owing to there is testing at many functional units: PTD, TOT, Service Center, and Engineering, so some test topic are the same. Therefore, it should be compared and reduced to be minimum as much as possible in order to improve the timing of the mobile type approval process.

3.3.4 Marketing does not understand what Engineering is testing

Although Marketing and Engineering are in the same company, both of them have different point of view. For Mobile Type Approval process, Marketing wants to take shortest time in order to launch new model of mobile phone into the market as quick as possible. But Engineering stresses on the quality of product more than timing, so Engineering has developed testing in order to check whether there is any possible error or problem in the new model of mobile phone. This makes Marketing and Engineering does not understand each other. Therefore, it should have some survey on the Marketing's expectation and need of the process.