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**JUDUL:** **THE MAINTENANCE MANAGEMENT OF MARINE PORT FACILITIES: CASE STUDY KUANTAN MARINE PORT**

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# THE MAINTENANCE MANAGEMENT OF MARINE PORT FACILITIES: CASE STUDY KUANTAN MARINE PORT

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A thesis submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Civil Engineering

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NOVEMBER 2010

I declare that this thesis entitled ***"The Maintenance Management of Marine Port Facilities: Case Study Kuantan Marine Port"*** is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Special dedication to:

For My Beloved Father, Nordin Bin Daim

For My beloved Mother, Robiah Bte Daud

Beloved Siblings: Normamla Bte Nordin

And

My Beloved Person

Thank You for Everything .....

I love all of you ....

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# ABSTRAK

Pengurusan fasiliti adalah satu bidang yang sedang berkembang di Malaysia. Ia merupakan suatu perkara penting yang diambil berat oleh pemilik bangunan terutama bangunan atau fasiliti yang melibatkan operasi 24 jam setiap hari bagi memastikan pengguna dapat bekerja dengan selesa dan selamat. Maka, penyelenggaraan diperlukan bagi mengekalkan fungsi kemudahan yang sedia ada seterusnya memenuhi kehendak pengguna. Keberkesanan aspek-aspek penyelenggaraan seperti perancangan, pengawasan dan pengurusan organisasi amat diperlukan agar prestasi bangunan sentiasa berada pada tahap yang baik sepanjang masa. Dalam menentukan aspek-aspek penyelenggaraan di dalam pengurusan fasiliti, satu kajian telah dijalankan di Pelabuhan Kuantan, Pahang. Pengumpulan maklumat dijalankan melalui temubual dengan pihak yang terlibat dengan pengurusan penyelenggaraan dan juga mendapatkan system kerja-kerja penyelenggaraan. Berdasarkan kajian kes, didapati bahawa aspek-aspek penyelenggaraan dalam pengurusan fasiliti Pelabuhan Kuantan terdiri daripada perancangan keja penyelenggaraan, sistem kerja penyelenggaraan, pembahagian keja dan juga merekod kerja. Hasil daripada kajian, aspek-aspek daripada penyelenggaraan dapat mempengaruhi dari segi kos untuk penyelenggaraan berdasarkan kos penyelenggaraan tahunan. Dalam kajian ini, beberapa penambahbaikan pengurusan penyelenggaraan bangunan dan fasiliti di pelabuhan Kuantan turut dikenalpasti. Ia harap dapat dijadikan panduan dalam pengurusan fasiliti dan juga penyelenggaraan.

# ABSTRACT

Nowadays, facility management plays an important role in building industries in Malaysia. It become importance for many building owner especially building or facility involve in 24 hours everyday operation. For this reason, it should have a good maintenance services to sustain the function of all facilities in building whereby it will fulfil building users need. The effectiveness of the aspects of maintenance such as planning, supervision and organization management will maintain the building quality performance all the times. In order to determine the maintenance aspects in facility management, a case study was conducted on Kuantan Port, Pahang. The data was collected via interview with people who involved in maintenance management and also identify the system of maintenance works. Based on the case study, it found that the maintenance aspects in facilities management of Kuantan Port consist of planning, maintenance work system, scheduling of work and work record. The result from this study, the aspects of maintenance can influence the maintenance costs base on the annual maintenance cost. In this study, several improvements to existing building maintenance management have been identified. It is useful as a guideline for an effective facilities and maintenance management.

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# LIST OF SYMBOLS AND ABBREVIATIONS

| | | |
|---|---|---|
| BIFM | - | British Institute of Facilities Management |
| BMS | - | Building Management System |
| BS 3811 | - | British Standard 3811 (1993) |
| CMS | - | Computer Management System |
| ECER | - | East Coast Economic Region |
| KCT | - | Kelang Container Terminal |
| KPC | - | Kuantan Port Consortium |
| KPM | - | Kelang Port Management |
| KTM | - | Keretapi Tanah Melayu |
| LCM | - | Life-Cycle management |
| NDSB | - | Northport Distripark Sdn Bhd |
| PM | - | Preventive Maintenance |
| TCIR | - | Total Case Incident rate |
| WO | - | Work Order |

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background of The Study

Over recent years there have been many there have been many developments of a generic nature that have had a profound effect on the manner in which estates are managed and maintained. A significant drivers has been the rapid growth of facilities management, and connected with this, directly and indirectly, have been initiatives in procurement strategies, contracting out, and performance monitoring and measurement.

This chapter examines a number of these developments but uses as a starting point the growth of facilities management. Many of the issues discussed have a relationship with facilities management, it is emphasized that in some cases they are of wider significance in relation to managing building maintenance. (Barrier Chanter and Peter Swallow, 2007)

In a places or building that make attraction to people look and coming that places are the facilities system. The facilities system must be operate and function by the organizer or contractor that made the building. With exist that facilities, people and the places be comfortable and easier to be operational. The facilities system will start operate when the building or places are in still or end of construction that with

installed the facilities until the end of operation of building or demolished. The growing of economic competes with the development in city. So, to develop the cities need the infrastructure such as building to manage the cities. The example management building like as government building, airport, harbor and many things include the building to develop economic.

The facilities that exist in operational of building include the use of new technologies in system such as integrate Building Management Systems (BMS) using networks locally, regionally or worldwide. As an essential basis, interconnecting devices in these ''intelligent buildings'' must support the interoperability between controllers or control stations and sensors and actuators. Internet or Intranet solutions provide a powerful, convenient and low cost means for intelligent building network integration following their popular use in business and daily life. It is also allow a better coordination of different building services systems and convenience of management. The uses of internet or intranet are very wide; it's include the intelligent in security system, lift system and connecting people. It's very commercial in office building and factory. (Shengwei Wang, 2002)

Other than that in facilities that present to people and the building management must have to building that are services. Services are including such as electric, piping, lift for high rise building, maintenance, worker that handle in cleaning, security and etc. Within this equipment, this will help the public want to come and come again in building and very satisfied with the services system. This also can increase the economic system in that city actually. Facilities Management involves services associated with real estate management and systems. Of course the motivations for outsourcing in any industry are driven by an ever-greater organizational pursuit to ensure cost discipline, whilst improving quality of service and delivery capability.

However, as the outsourcing has become a popular mechanism for differentiation by contracting out the non-core activities, the differences in the motivations for outsourcing have emerged. This has been ignited by the debate as to what is core and what is non-core function. For instance, noted that back office

functions are considered as key contributors to competitive advantage. In this respect, organizations can benefit by drawing learning from different types of outsourcing and the outsourcing practices in different geographic locations.

## 1.2 Problem Statement

The facilities commonly must have in such of many building in Malaysia. So now, what are the differences between the building in Malaysia like airport, port or shopping complex. The different between them are the facilities. What are their facilities in their building? How they manage their building? With the infrastructure building or management building such as airport, immigration complex and government builds office. The differences between them both two building facilities system are so many, it's based on the technologies using, services system or security system.

So, why the building need the facilities especially for management building? That because there are lots of people coming from other places not only to manage something but want to fell the comfortable of facilities and then to share the experience with the other people outside there. If there no facilities, that will cause of economic will down. Example like in Klang port, the facilities are almost very completed with the information system, lobby, the ship parking system, the cargo services and security system.

Now, people compete to build the building with full infrastructure and facilities. But now, the facilities must be maintenance to make sure the building can operate like usually as daily. Who are those manage in this facilities and maintenance to make it longer function? So, that must have the strategies how to manage and maintain the facilities.

So, the researching being progress to observe and evaluate how the effectiveness and importance of management facilities system in commercial area especially. Other that, it's also to determine the strategies taken by the building management to against the weakness of management facilities system that have exist also the strategies to improve the system for the future.

Malaysia have about 105 of port it's include the harbor and jetty. Ports in Malaysia are divided to two categories that it's major port and minor port. There are about 17 main ports in Malaysia that is divided to federal ports and state ports. The ports are:

a) The Federal ports

1. Kelang Port
2. Tanjung Pelepas Port
3. Pulau Pinang Port
4. Johor Port
5. Kuantan Port
6. Kemaman Port
7. Bintulu Port

b) The State ports

1. Kuching Port
2. Rajang Port
3. Miri Port
4. Kota Kinabalu Port
5. Sandakan Port

Therefore, the port will be the place and continued my study to complete this study and included all studies and data that will be implemented in this thesis. Port will be selected for the studies are Kuantan Port in Pahang. In addition, there are also other ports will be visit such as Johor Port to compare in terms of facilities.

## 1.3 Objective Of Study

The objective that want to achieve is determine the effectiveness of management facilities system that have done can be maintain based on assets, workers and technologies also improving the quality to saving the cost for long term. Following that the list of objective that wants to achieve that related to this topic:

1. To determine the aspects taken of maintenance management building of port.
2. To determine the skill, knowledge of personal handling port facilities management

## 1.4 Scope of Study

Scopes for this research are to focus on the assets in building especially for port such as services, maintenance, security system and human resource. Other that, this researching will to focus how to apply and implementation the facilities system management for building in port and how it will be applied.

Beside that of the research, how can the currently of facilities system management by port can effective to the cost, time and quality. Aspect that will be focus are the organization of building maintenance system and the operation of the maintenance that provide to all facilities in port. The respondents involved in this study are the user of port like as the companies' do the maintenances, the worker and manager.

## 1.5 Importance of study

There are many importance of this study to relate in the new facilities system especially in Malaysia port. The importance are:

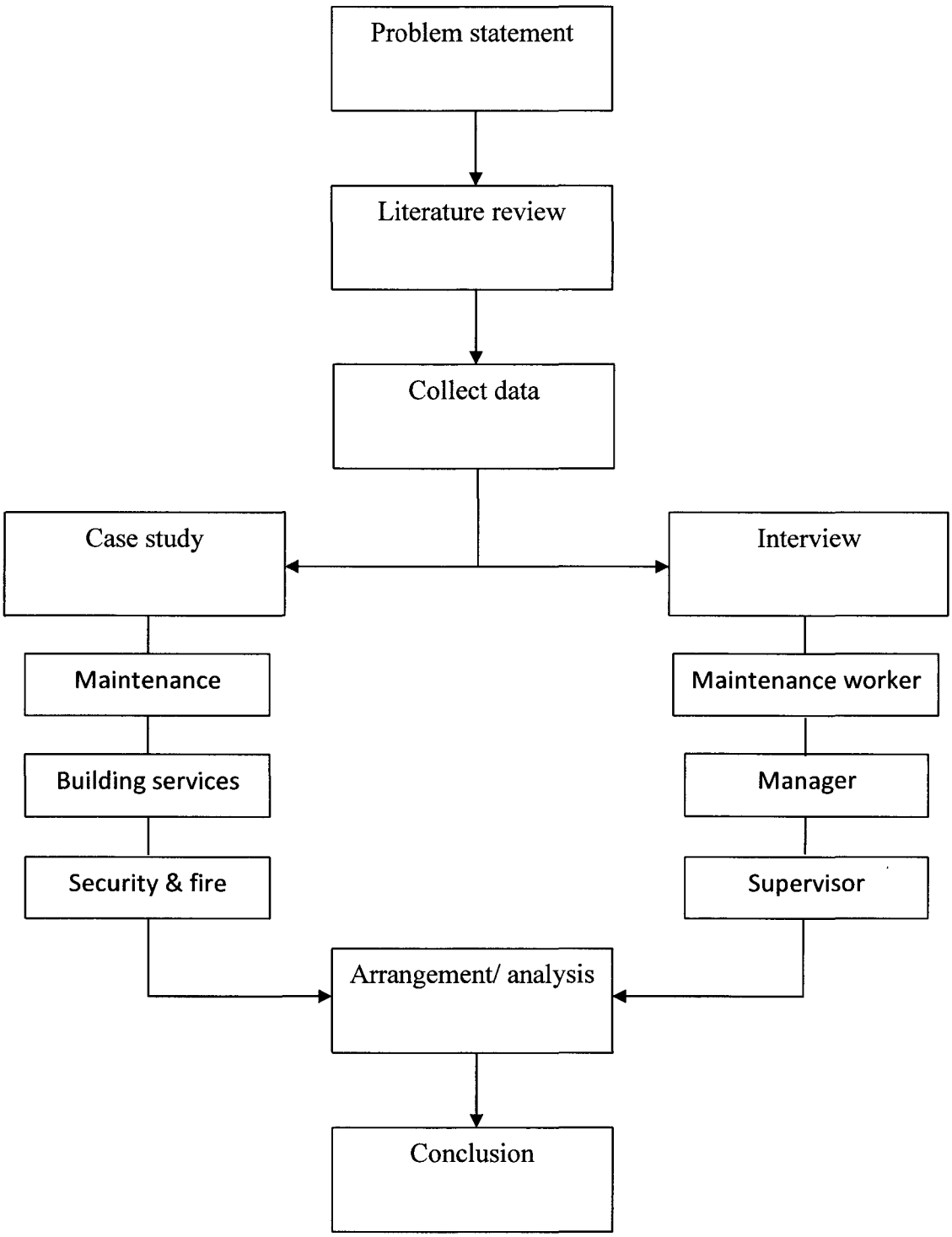
a) To help the maintenance management units to determine the problem that they have manner before and try to develop and apply the new procedure of effective maintenance.

b) To improve the facilities and maintenance management with the skills and to determine the weakness that have in system and try to improve the quality of system and make advice to create the effective maintenance system.

c) To make a guide for building management of port for being the great management system in port also to improve the service to make the good quality with the minimum cost for being the long term life cycle.

From these all importance, that will help the building management to evaluate the weakness and the problem and how to handle and try to solve the problem that they manner before. For the strength that they have now, they need to maintain and improve the skill related with the new technique and new technologies to being with the other developed countries.

## 1.6 Flow chart of methodology



# CHAPTER 2

# LITERATURE RIVIEW

## 2.1 Introduction

System management facilities is one of the system that integration of management of each assets by balancing the provisions and efficient for each assets. In this system, each asset will put into the checklist or inventory list for easier checking for the next time. The data will be record in systematic to database and then update by the time. Each assets will observe and checkup by periodically based on program provided and then implementation assets maintenance.

Facilities management involves the evaluation of building quality that measure commonly. Facilities management field is very broad and covers all matters. It needs the effective management system to be the systematic. Maintenance is the part of facilities management that needs to be focus. In construction, maintenance get less attention, while it's very important part for maintain the quality that can be function. Maintenance needs since when the construction is done. This because, maybe potential of facilities get broke is high when it not maintain. So, the maintenance system management needs for maintain and care the building.

With increasing automation and the reliance on large complex container cranes complete with substantial mechanized backup equipment, maintenance in modern port operations has assumed a very large impact on port economics. Unfortunately, the effectiveness of the maintenance performed at many ports has lagged behind that of operations. This has been due in large part because of the emphasis placed on cargo handling and the related technical advancements in cargo handling equipment. Cargo operations, by its very nature is amenable to monitoring and control as operating statistics, containers handled per berth hour are easily computed and can be compared to budgeted. Control parameters useful for managing the maintenance function, however, are more difficult to quantify which may explain its lack of development as compared to cargo operations.(Stephen R. Brown, 2001)

Following tend to characterize most port maintenance programs:

- Most of the maintenance work is unscheduled and is related to equipment breakdowns affecting cargo operations.
- Senior management personnel tend to view maintenance personnel primarily in a standby mode, to be called upon in the event of critical breakdowns.
- Maintenance organizational accountability tends to be centered around shift coverage, rather than on area or equipment groups.
- Direct and indirect (loss of loading/unloading time) maintenance costs are higher than they should, or could be.

The objective of port maintenance should be to ensure the operability of equipment as to maximize discounted cash flow for the port over its lifetime. Meeting this objective requires a substantial amount of planning and resource control on the part of maintenance management personnel. In our experience over the past decade in maintenance management consulting around the world in various industries, the objective can best be met through the implementation of an integrated management system, along with related training, containing the following elements:

- An organization structure emphasizing accountability and the means to measure performance.
- Planning and scheduling for the short term (each shift) as well as forecasting for the intermediate and longer terms.
- Short term performance monitoring based on scheduled milestone events during the course of daily work.
- Accurate documentation of work performed, and its entry into equipment history files.
- Effective preventive maintenance program.
- Reporting of performance indicators appropriate to the organizational level being monitored.
- The remainder of this paper deals with suggested approaches to implementing these elements in a port operation.

Ports contributed to the stable development of industries and improved the lives of people by securing links with trade partners around the globe. Historically, port developments and their evolution have begun, motivated by both economic and technological pressure resulting from the global industrial revolution. (Gregory P. Tsinker, 2004).

## 2.2 Definition of Facilities

Facilities can be translated as infrastructure that includes equipment, program, and worker. In typical, it refer to material or assets that completing the building and office. It's the physical facilities and service that provide for the area places.

Refer to the act of city planning and rural 1976 (act 172), facilities means:
The qualities or condition a places or area that can make the places be attraction and fun, harmony and feel the good include field, playground, theme park and garden house. It does explain the facilities can make easier and fun to human.

## 2.3 Facilities management

Refer to British Institute of Facilities Management (BIFM), facilities management is a activities in all discipline to be the effective environment and management to human and work places. The human refer to workers, users, customer from inside or outside and also visitor. Work places is include the physical element and not physical of a building.

Danny (1999) state, facilities management is the management field that mixed with human, wealth, and another process for making the good services to support the organization.

Facilities management is include about five elements that is space management, long term management, wealth and assets, landscape and space management and project management. For be care the life of building, the long term management are more needs. This is include the costing for being the management and services also the information system of facilities management.

For the building owner, they want the profit being the building income. Other that, the facilities or assets must be managed so kindly to attract the investor for get a place in the building. The security is the important for many high rise building. It's include the fire protector, exist way, wealth fire protection and environment threat. For a building, the arrangement of cabinet inside must be consider also the space.

The purposed to do that, is to make the comfortable for users or workers being the work quality can be achieve.

### 2.3.1 Port facilities management in Malaysia

Ports in Malaysia have about 105 ports and the main ports are about 17 ports. Large ports need to deal with a number of disparate activities: the movement of ships, containers and other cargo, the loading and unloading of ships and containers, customs activities. As well as human resources, anchorages, channels, lighters, tugs, berths, warehouse and other storage spaces have to be allocated and released. The efficient management of a port involves managing these activities and resources, managing the flows of money involved between the agents providing and using these resources, and providing management information. (Port Klang, Wikipedia)

The priority ports that the ship will anchor their ship in harbor in Malaysia are port Klang. The Klang port is the famous and it is very strategic places and sheltered from the northeast monsoon wind. The Port Klang Authority administers three ports in the Port Klang area namely Northport, Southpoint and Westport. Prior to the establishment of the Port Klang Authority, South Port was the only existing port and was administered by the Malayan Railway Administration. Both Westport and Northport have been privatized and managed as separate entities. The total capacity of the port is 109,700,000 tons of cargo in 2005 compared to 550,000 tons in 1940

Northport is owned and operated by Northport (Malaysia) Bhd and comprises dedicated multipurpose port facilities and services. The Northport entity was a merger of two companies; Kelang Container Terminal (KCT) and Kelang Port Management (KPM). Its operations also cover South Port, which was

renamedSouthpoint for conventional cargo handling, and acquired Northport Distripark Sdn Bhd (NDSB) as part of its logistics division.

Westport is managed by Westports Malaysia Sdn Bhd (formerly known as Kelang Multi Terminal Sdn Bhd). A passenger port, The Star Cruises Terminal, opened in December 1995 at Pulau Indah which is located next to the cargo terminals of Westport. Cruise line ships drop anchor in any of the three berths at the Star Cruises Terminal.

Port Klang is served by several KTM Komuter stations (including the Port Klang Komuter station) which link it to Kuala Lumpur, Petaling Jaya, Shah Alam and other parts of the Klang Valley. A ferry terminal to Pulau Ketam and an International terminal to Tanjung Balai and Dumai in Indonesia are also located in the area. The old ferry terminal used to serve regular passenger boats to Pulau Lumut and Telok Gonjeng terminal until the completion of Northport Bridge link.

### 2.3.2 The Facilities and Services in Port

In port commonly there must have the great facilities to make the work easy and for comfortable users. In order to ensure safe and efficient shipping traffic to and from the port, ships entering or leaving can call on a number of services offered by the Port Authority and private companies. Commonly, the services used the human power or machine. Example like Ships' masters can call on the advice of pilots for navigating and maneuvering their ships. Piloting of ships and coordinating the flow of traffic on the Scheldt is done by the Pilot age.

For navigation on the Scheldt, ships can call on the assistance of tugs from the human power and tug ship for make tugging the cargo ship near to the port. Maneuvering a seagoing ship within the dock complex is a critical task. Ships

can be assisted with this by one or more of the Port Authority's tugs. The Port Authority's fleet of nine tugs also provides firefighting support.

The Harbourmaster's Office actively manages shipping traffic so that vessels are able to reach the port, stay there and leave it again, all as quickly, efficiently and safely as possible. Further, as required by law, it shares responsibility for maintaining public safety and care for the environment within the port area, and exercises independent supervision of compliance with the laws and regulations. This means that it actively monitors all transports of dangerous goods, investigates all cases of damage or pollution and takes appropriate measures where necessary.

Port Authority has three floating cranes and more than 30 dock-mounted cranes, all of which can be rented out within the port area. The Floating Crane department manages and maintains the Brabo, which can lift up to 800 tonnes, together with the Portunus and Titan, each with a lifting capacity of 40 tonnes. The Dock Crane department has among others 10 or so mobile cranes that can operate anywhere, with lifting capacities of up to 100 tonnes. The cranes can be rented for long or short periods.

### 2.3.3 The Facilities required in port

There are many types of facilities in port. Facilities in port will help the management of port and improve the work skill to develop the port areas. Within the good facilities in port, this will help the ship anchor easily and save the time also decrease the risk in ports. But not all of ports especially in Malaysia have these all facilities. The facilities that required in ports are:-

a) **Berth**

Kuantan Port Consortium (KPC) prides itself in providing a variety of excellent berthing facilities totalling 3,213 metres in length to cater to the various cargo compositions handled by the port. Initially designed to handle general cargo, KPC today has expanded itself into managing newer shipping trends and cargo packaging from break bulk to palletisation, unitisation, dry bulk, containerisation and liquid handling. KPC has dedicated facilities for liquid chemical products and container handling operations where two container berths measuring at 400 metres are available. Currently, 14 regularly container shipping services are available at Kuantan Port provided by 7 liner operators. For the chemical trade, all the major tanker operators like Stolt Nielsen, MISC, Odfjell Tankers calls in regularly.These facilities include :

i. Container
ii. Break bulk
iii. Dry bulk
iv. Liquid (oil, chemical)
v. Passenger
vi. Bunker

**b) Storage building**

i. Conventional storage- There are 7 godowns with a total floor area of 32,500 sq metres available for rent. Total Open Storage Yard is 41,250 sq metres.
   - Transit Shed
   - Warehouse
   - Open yard

ii. Tank storage

The port industrial land is available to companies to build their own tank farm. A number of companies have taken up leases to build and operate their

own tank farm i.e. Kaneka, BP Chemicals, Petronas, BASF-Petronas Chemical, Shell, ExxonMobil and Hexion Speciality Chemicals.

There is also a common user tank farm facility operated by Dovechem Malaysia Sdn Bhd. This company has numerous tanks of various size for rent to third parties or users handling various chemicals. For edible oils, Felda Installation operates a tank farm to handle all grades of edible or vegetable oils.

**c) Equipment**

i. Quay crane
ii. Rubber-tyred Yard gantry crane
iii. Mobile crane
iv. Straddle carrier
v. High stacker
vi. Prime mover
vii. Trailer
viii. Bulk crane

Another facility that can be applied in ports are:-

a) Transit system (KTM)
b) Air transport system
c) Highway system

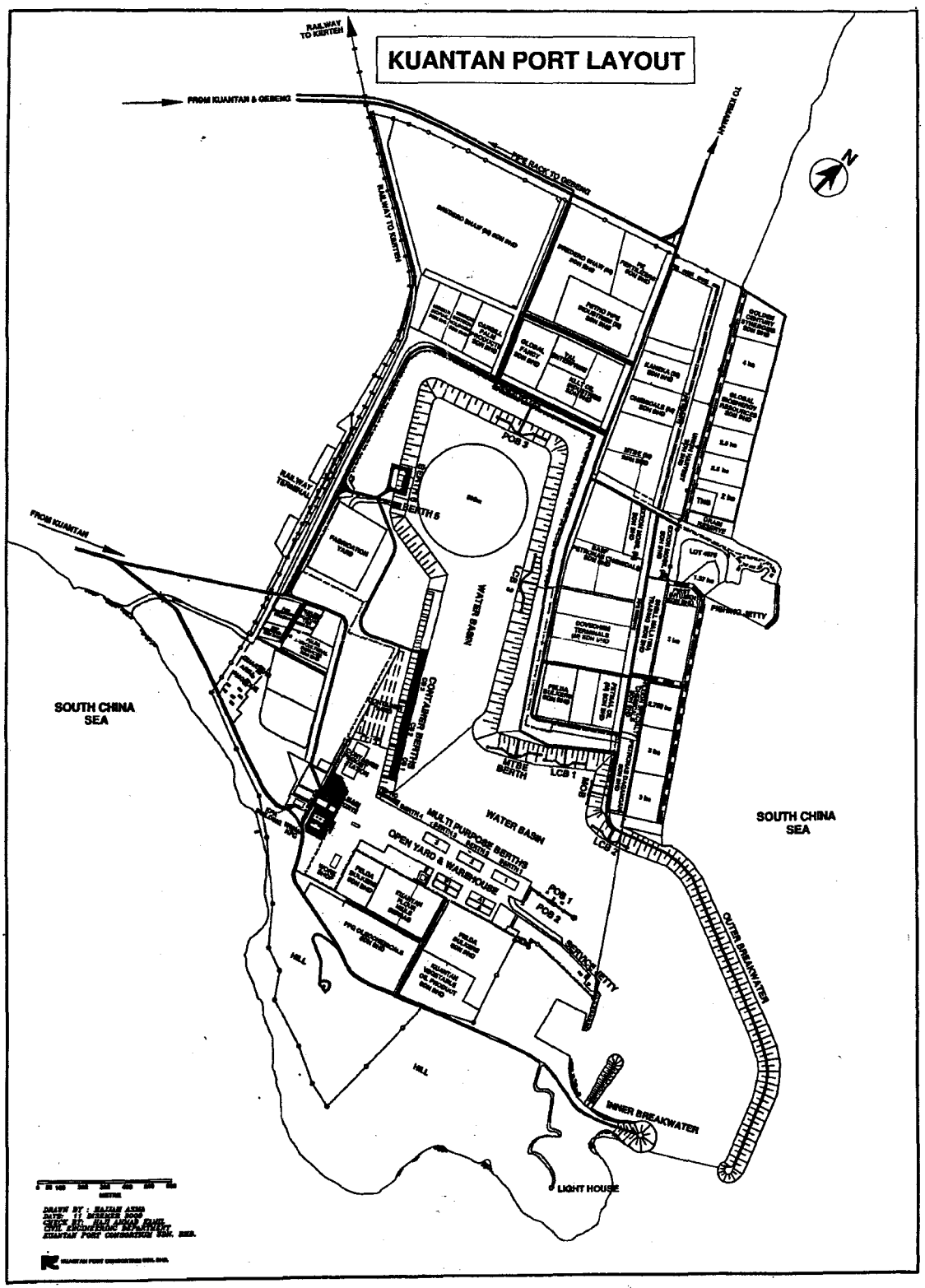



**Figure 2.1** : The Kuantan port layout

## 2.4 Fire and Security Facilities Management

### 2.4.1 Security department

To avoid any risk and a responsibility, a port must have a security team to ensure smooth management of the port. Security forces must be composed of units trained to overcome all difficulties easily. Units of the security forces have their own objective, which is the department manned by Auxiliary Police Officer which is vested with police powers to ensure law enforcement within the port premises. Their mission is to ensure that the port is crime free. And their roles are to establish a responsible, reliable and competent work force to keep order and security within the port areas and to undertake measures and steps to prevent crime or crime related incidences. The responsibility of security force includes are:-

i. Security of port areas
ii. Security of cargo assets
iii. Monitoring of vessels alongside
iv. Manning of accesses
v. Investigation and prosecution of selective cases in the port area
vi. Compounding of offences under Port Authority Act

### 2.4.2 Fire and Safety department

Port is a place of high-risk for burns because there are dangerous materials such as chemicals, petroleum and flammable materials. To prevent incidents of fire that can cause severe damage in the port, an anti-fire security force established. This team will monitor and act to remove the fire in the port immediately to avoid a more

severe fire in the harbor. The establishment of anti-fire team goal is to strive towards a safer working environment. The responsibility of this unit includes:

i. Safety in the port premises
ii. Safety of cargo operations
iii. Safety of workers
iv. Environmental aspects land and water
v. Fire protection
vi. Fire prevention

## 2.5 Maintenance Management definition

Based on the British Standard 3811 (1993), maintenance is defined as the technical and administration, including overseeing the work undertaken to maintain or improve an element that can fulfill the desired function. Technical steps that involved in the maintenance work are filling, replacement, maintenance or clearing and maintenance or service. While the elements referred to is all the office space and facilities involved.

Maintenance management is a combination of technical and administrative activities carried out for maintenance. Success of any maintenance work that much depends on how, or how well it is managed. Management that includes six items:

- setting policy / objectives and standards of maintenance
- development and management organization structure
- determining the appropriate maintenance system
- work planning and the creation of appropriate work program
- supervision of work and resources (labor, costs, equipment)
- development of information and communication system in maintenance management

Maintenance management is a measure of performance to the standards required and accepted by the process of repair and restoration, as well as space for employee benefits and good value for the assets and meet important goals.

## 2.6 Operation and Maintenance

Some organizations still view operations as the customer and maintenance as the supplier. A customer-supplier relationship between operations and maintenance undermines equipment reliability improvements.

If maintenance is the supplier, what is it a maintenance department supplies? In the organizations where maintenance is a supplier to operations, maintenance usually supplies time and material to operations. Since operations pays the bill for the services supplied by maintenance, maintenance will always be viewed as a pure cost, not as a resource that can deliver value.

Common problems often created with a customer-supplier relationship are:

- Maintenance becomes more reactive because few operators see or understand the long-term effects of lubrication, alignment, balancing, preventive maintenance, etc.
- An operation usually likes to have maintenance handy in case of a breakdown. Therefore, the amount of maintenance people on a shift increases.
- "Honey-do" jobs that often aren't necessary increase because maintenance is more readily available.
- Less preventive maintenance is done because there is more focus on reactive work.

Some organizations have drawn this system to an extreme with the "kid in the candy store with unlimited resources" mentality. Here, operations is the customer but doesn't have to pay for any services and has very limited responsibility for the maintenance budget. In my opinion, if you have a customer-supplier relationship, operations should at least be responsible for the maintenance budget.

Maintenance, engineering and operations should be partners in production. Production reliability is, therefore, defined as equipment reliability (where maintenance and maintenance engineering have primary skills) together with process reliability (where operations and process engineering have the primary skills).

When going to breed a partnership organization in a plant, following work processes are key items:

- Operations has a central contact point to screen and set preliminary priority on all work requests (notifications) coming in from operations.
- Jointly decide what work to do and jointly prioritize work according to clear guidelines. A daily meeting (a maximum of 15 minutes) is the best way to accomplish this.
- Jointly go through the backlog on a set interval.
- Maintenance informs work requesters on the status of each job in the backlog.
- Jointly perform root cause problem elimination.
- Jointly tackle equipment and process inspection. Operations and maintenance have their own routes, but at least once a month, execute the routes jointly with a maintenance person and an operator. Report the inspection results to the operations and maintenance supervisors.

## 2.7 Safety and Reactive Maintenance

Reactive maintenance is here defined as all maintenance work that was scheduled less than 20 hours before it was executed.

It makes sense that there is a strong correlation between safety incidents, injuries and reactive maintenance. In a reactive situation you might not take the time you should to plan and think before you take action. The urgency also call out the so common hero in maintenance crafts people and they take risks they should not take.

Because of the strong correlation between reactive maintenance and safety incidents and injuries proposed that organizations use this as a key performance indicator. To measure it will drive down both safety incidents and the volume of reactive maintenance. This in turn will result in increased quality production throughput and consequently lower maintenance costs.

It is a well known phenomenon that many maintenance improvement initiatives are too short lived to generate the substantial results that are possible. One of the major reasons for this is the mobility of top management and the new initiatives that then follow. This disrupts and confuses organizations and after many repetitions of the above people loses faith in the longevity of the initiative and will only pretend to implement improvements.

According to the Pulp and Paper Safety Association, the Total Case Incident Rate per 100 employees and year (TCIR) have gone down from 8.92 in 1990 to 3.05 in 2002, and if we go back twenty years the results are more impressive. It is not through better planning and scheduling of maintenance, because that is still not being done much better than 1990.

## 2.8 Importance of Maintenance

A building can achieve the long term of life if the assets are in control and caring. Anderson (1969) say, the maintenance and care of building very important for purposed:

1. To maintain the assets and wealth in building for being the function.
   The satisfied of users must b consider to make the evaluation the achievement of building. Toilet, lift, air-condition and electrical are supposed to function well for users needs.

2. To show the image of building and the good condition to people.
   Usually, the conditions of building make the image of the building. The clean building gives the good impact to visitors. The component like floor and wall must be considered the quality and condition for make the attraction to visitors.

3. To improve the investors value
   If looking from investment side, the good building with the physical condition can make attraction and influence the rate of users to buy or rent the lots. This will increase the investment to the building prospect.

## 2.9 Aspects of Maintenance

For achieve the objective to being the building long life, the maintenance work must starts after the building get finish of construction. The aspects that have in maintenance management are:

1. Maintenance work planning
2. Maintenance work system
3. Distribution of maintenance work
4. Maintenance work control
5. Record system
6. Maintenance expenditure

## 2.10 Organization Structure of Maintenance Management

Organization structure is the combined of man power involved in planning and control in maintenance operation. It's the important part in maintenance management.

This because to be function as advisor and observer to the maintenance work. The objective establishment of organization in maintenance management is for:

1. To maximized the productivity or services of facilities to be low costing, great quality, and fulfill the standard.
2. Determine and implement the cost reducing to provide the training skill to worker to be skillful.
3. To limit the using of equipment and renew the assets.
4. To optimum the machine, when where the component like machine needs the man power if the machine not working

In the maintenance units, commonly it lead by manger and assist by the technicians, supervisor and operator experience in their field. The example of organization maintenance as below:

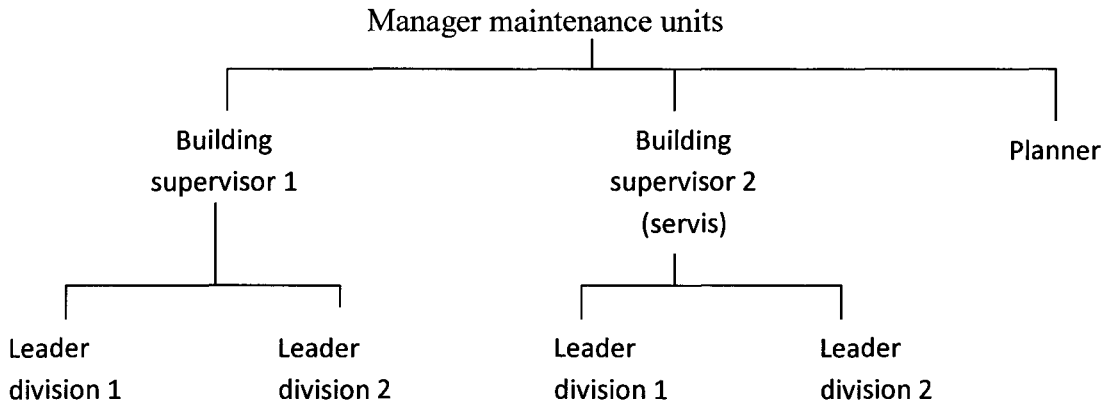



**Figure 2.2** : The organization structure
World Class maintenance Management

The single most important factor in achieving satisfactory equipment availability rates and maintenance cost performance is an organization structure emphasizing accountability. The most elaborate and sophisticated computer based systems will remain largely unused and ineffective unless the organization exists as a part of the overall system and it is structured with a high degree of accountability.

We define accountability in an organization as the ability to identify the one person responsible for realizing a specific result. In such an organization it is easy to trace responsibility up and down the structure. Obviously, at each higher level in the structure additional functions and results are identifiable to a specific individual. Ultimately, at the top of the organization, the Chief Executive Officer is responsible for the results of the entire organization.

Organizations at variance with our suggested model tend to have various manifestations of the matrix structure with its associated functional responsibilities whereby a particular result area has more than one person accountable. In some types of operations elements of the matrix structure are unavoidable, however, they should always be minimized.

The important factor here is that the planners must not report to a central planning group, separate from the performing maintenance organization. The planners must report to a relatively low level in the organization: one that is responsible for the performing maintenance and is being treated on its effective performance.

## 2.11 Maintenance Planning and Control

The basic concept of maintenance planning is to identify required work, plan the resources required for it to be accomplished, and schedule it to be accomplished under controlled conditions when it will have the least effect on cargo handling operations. In many existing port operations, this approach is not used. All too often the work is identified when equipment breaks down when it is urgently needed for ship loading/unloading, and the maintenance work force reacts as best it can under far less than optimum conditions. (Stephen R. Brown)

The effective planning of maintenance requires a data base of jobs that is obtained through the identification of necessary work, before it becomes critical. The manipulation of this data base is ideally suited for a computer. Until recently this meant a mainframe, or min-computer complete with a data processing department, extensive staff of programmers all with their attendant costs. With the advent of personal computers, network software and powerful, but user friendly data base software such as dBase III and Rbase System V, sophisticated maintenance

management systems are now available to even small port operations. More importantly, computer users now have some control and no longer must rely on central corporate data processing departments with their armies of programmers.

### i. Work identification

Work that must be performed by the maintenance department will ultimately identify itself. Eventually equipment will break down and cargo operations will be reduced or halted. When maintenance is managed this way, very little sophistication is required. Tradesmen are simply dispatched to "fix it". Unfortunately, the correct spare parts may not be on hand, particularly where the developing world is concerned, and costs of lost loading time increase.

### ii. Work request

Work requests should be initiated by anyone desiring work to be accomplished, however, appropriate approvals are required depending on the nature of the work requested. Normally, a cost center and port area/equipment group will be noted on the request as a means of charging costs to the job and to sort the backlog from the computer system. Work requests are normally turned into the appropriate planner where they are entered into the data base, either by a clerk or the planner himself.

### iii. Preventative maintenance

All equipment must have preventive maintenance (PM) and lubrication check sheets developed for them. The key to effective PM is good quality PM check sheets and supervisory follow-up. The instructions on the sheets should be "active" if possible. "Active" instructions require measurements or adjustments to be made rather than passive checks. Once the PM inspection sheets have been completed they are turned into, and reviewed by the second level maintenance supervisor to ensure compliance and to check on defects found.

### iv. Predictive maintenance

The predictive maintenance program is developed by identifying those components that wear, and require maintenance after a known number of operating hours, or tonnage throughput. The data base management program can be organized to compare hour meter readings since the last maintenance was performed. A weekly schedule of predictive maintenance work can then be printed out each week.

### v. Equipment history

Once work is completed, if it is of an important nature, it should be entered into an equipment history data base. Completed daily work schedules, job cards, and work orders are turned into the second level supervisor for review. Following this review, the paperwork goes to the planner. Both the planner and the second level supervisor determine which jobs should go into the history file.

### vi. Management reporting

Once the information described above has been entered into the data base manager, reports can be designed to extract the data to allow monitoring of performance by supervisor, equipment group, area and cost center. The data can also be summarized into larger and larger groups, which facilitates performance analysis all the way to the top of the maintenance organization. The reporting indices must be arranged in a hierarchy that corresponds to the organization. Summary indices, such as mechanical availability of the straddle carrier fleet, are designed to alert higher management to problems on an exception basis.

### vii. Control

The organization and maintenance management system identified in the preceding pages have been structured to optimize control. Control is the analysis of actual results as compared to desired results, and where a deviation is evident, the taking of appropriate corrective action. No matter how well the maintenance management system is designed; management personnel at each level must use the system to actively control the results in their particular area of responsibility.

## 2.12 Developing and retaining future craft skills

Developing and Retaining Future Craft Skills is often mentioned that this is a future crisis, from the observations that the crisis is here now and it will be worse in the future.( Don Armstrong).

Some organizations try to get out of the problem by outsourcing maintenance. A contractor recently told that they had to sell the contract based on lower labor rates than the plant's own employees. This doomed them to hire unskilled people at low rates and poor benefits and then train them on the job. One serious problem was that electricians only stayed an average of 18 months, and then they left for permanent and better terms.

Training is not always looked upon as an investment by management. Training budgets are often suffering from cost reductions by managers who suffer from short sighted initiatives from top management.

## 2.13 Other Building Facilities System in port

Apart from facilities in the port, there are also facilities that need to be there at the port as other buildings. Because this is the basic continued development of an area, especially in the harbor and then improve the work area.

Facilities and Maintenance system management that work in office building have different system depend on the design of building, condition, policies and other. But the facilities in building are same. The facilities are:

1. Power supply and electrical system
   Electric are the important thing in building especially for high rise building. Need the lightning to give the comfortable for user and visitor.

2. Lift system
   It is the important facilities to easier for people moving from level to another level without waste time and energy.

3. Fire protection system.
   It is provide in building to against the fire if it's happened. Now, with the new technologies, it's controlled by computer sytem in controlling room.

4. Building Controlling System
   It is provide to control the insect infection like rat, termites and another pest.

5. Air-conditioning system
   To supply the oxygen and give the fresh air in building and avoid the warming in building.

6. Water supply and piping system.

It's the system that supplies water to building for users.

## 2.14 Summary

The facilities management is the wide part. In this topic, it gives the explanation about facilities management being with maintenance management. In building management, there are many aspects that need combined and work in level to produce the good work while saving cost. The good building maintenance can improve the image of building and improve the investment value. So, the clear achievement must have to achieve the maintenance work on facilities can be success.

Most companies need to better specify the term reliability. It will help employees understand what the goal is when we refer to production reliability. In maintenance management, we primarily focus on equipment reliability.

To summarize, the effective management of port maintenance in either developed or developing countries requires an organization emphasizing accountability, effective planning, scheduling and reporting of results, usually using a computerized data base management system, and active management control at all levels. Personnel with the necessary education and training to ensure the successful implementation of the systems described in this paper are available in both developed and developing countries.

# CHAPTER 3

# METHODOLOGY

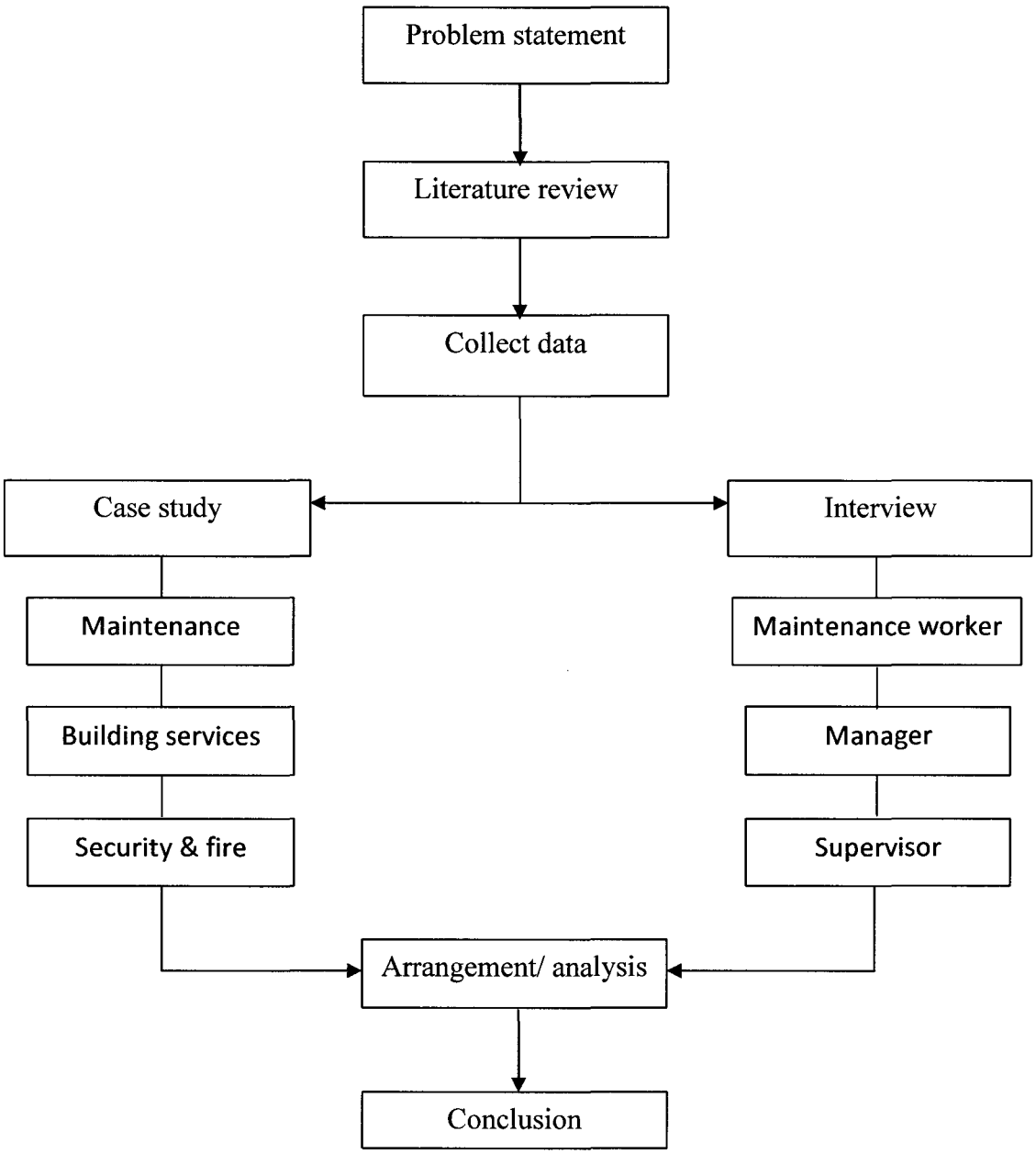
## 3.1 Introduction

Planning and selection of appropriate methodology is appropriate and important elements that need to be emphasized before a study began. This is important research to ensure smooth and orderly and planned according to schedule. This can also help researchers to systematically manage time to ensure that this study will be completed within the stipulated time.

Research methodology is a description of the method used to obtain information relating to the research process and analyze data to meet the objectives and requirements of the study. For this study, several methods and approaches for data and information and further data is analyzed to obtain conclusions before the proposals submitted.

What is the important in this study is that every problem will be assessed and linked to problems faced in the real world. Then this problem will be resolved with effective methods to agree in this study. Information obtained will be analyzed to clearly to avoid any doubt. So, from the study that will be conducted in stages, so that a data obtained. It is divided into six main parts that it's Early stage research:

a) Literature review stage
b) Level data collection
c) Analysis stage
d) Conclusion stage



## 3.2 Early stage research

At this stage, the location of research will be selected. The criteria of places must be the port where the cargo ship will anchor the ship in port and must be the place of business. There are about many ports that known can be the research. So the finally, the Kuantan Port be the place of my research and conform to the research objective that will be the guidance in the method research selection.

## 3.3 Literature review stage

Research literature seeks to understand concept, scope and objectives of the study and provide disclosure about how the idea of a more effective organization through reading materials. Besides it also aims to collect data and theory related research as possible. The data collected through the first reading of thesis, journals, reference books, newspaper cuttings and also through electronic media such as browsing the Web on Internet.

The aspects that will be research in this literature review include:

i. definition of facilities management from the point of economic and engineering

ii. method of execution management facility

iii. applications and systems used in facilities management

## 3.4 level Data collection

Data collection process is the stage where the information needed to study obtained. There are two main categories in the data collection process that data and primary data secondary data.

### 3.4.1 Primary Data

Primary data research is where the data obtained in directly. In this study, I have identified several methods that will be used effectively to obtain information on the study. The methods that will be used include:

a) Site visit

Site visit was conducted to obtain primary data for this study. This site visit includes a visit to the site for observation with a scheduled inspection conducted and also visit to the site where repairs are being carried out.

Study conducted by the officer on duty and also checks for officers to run a scheduled site inspection which includes inspection at ports. Inspection is carried out inspection of building structure and various types of structure in port used. Emphasized that other inspections such as building inspection, jetty, roads and others involving the maintenance system in civil engineering. Examination of each asset initiated by ensuring the ability and functions of the asset itself is in good condition. Next, asset condition is assessed by looking at the overall condition of assets and explore whether there is a sign of damage to the assets.

If there is any damage to buildings or other equipment and so forth, each would be recorded in the damage assessment form and sketch the location and any information about the damage.

b) Interview

Several interview sessions involving officials and employees who are directly involved with facilities management system implemented in the port. Between the parties involved including the port and also the company that manages the maintenance of facilities in the port.

In this interview, the objective is to get a detailed explanation about the implementation of the port and also their views about the effectiveness of the welfare system in the management of assets to stay in a safe and comfortable to use, and also get information about the weaknesses of the system and recommendations to improve effectiveness.

Several employees and the port will be interviewed to obtain information, and then information will be analyzed and restructured. The following are questions to be asked to the management port:

i. How long this facility management system has are coordinated by the port?
ii. Why implementation of this system required by the port?
iii. How this system implemented?
iv. The process contained in this system?
v. How this system can assist in the management system in terms of cost?
vi. Who the parties involved in the implementation of this system?

### 3.4.2 Secondary Data

Secondary data is data acquisition research results from books, thesis, Internet and related reference materials. Information obtained is a method of implementation and maintenance of facilities management. Data obtained from the database management system available.

## 3.5 Analysis stage

After completion of data collection work is done, the information obtained has been investigated; arranged next analyzed using the method appropriate to the objectives and scope of the study. The result of analysis will be shown in graphic form, whether in the form of pie charts, bar charts or in table form to give a more clear and effective for consumers. The analysis method used is the average index, analysis frequency and percentage. For data that have scale, the average index and the frequency of analysis will be used.

## 3.6 Conclusion stage

Based on the analysis and research that have been made, the formula for the three objectives, namely to know the level of user satisfaction or shipping company to use facilities at the port, and the study of aspects that are taken in the management of maintenance at the port, and also the study of employee skills and knowledge in operating machinery at the port must be applied at each port in Malaysia. Finally, the

proposal of the action taken to improve performance management submitted to the maintenance of port management.

# CHAPTER 4

# CASE STUDY

## 4.1 Introduction

In the early days practitioners of facilities management preoccupied themselves not only with issues of definition but also as to whether it represented a profession, discipline or simply a concept. In Malaysia, the facilities management is the important element work that must be provide at all the building in Malaysia especially in urban area. This is because; the business and administration are concentrated at urban area. The rural areas also are growing to be the industrial centre as agro culture and craft. The important to provide the facilities management are because the building needs to be functioning and operation. So, different businesses are different building and different management are provides. So, the facilities are also different. Facilities management in port are very different with other building.

In this case the data that obtained from interview with facilities management officer such as how to handle the facilities at port especially, the maintenance that provide at port and the method to use in port management system.

## 4.2 Kuantan Port

Every building that be construction have the unique and functions by itself. Kuantan Port is a multi-purpose, deep-sea port located in the Malaysian State of Pahang. It operates 24 hours a day, 365 days a year. Kuantan Port serves the hinterland of the East Coast, from Kelantan to Johor. It is a wholly owned subsidiary of IJM Corporation Berhad as a public listed company on Bursa Malaysia. Kuantan Port is principal port of the east Coast Economic Region (ECER). Kuantan Port is handling by Kuantan Port consortium Sdn Bhd that is privatized. Then, KPC operation fully the port and done the construction by phase for develop the port for future.

Kuantan Port is the centre of the industrial area in Pahang that located near to Kuantan port that is Gebeng Industrial Estate. Its strategic location within one of the main shipping lanes and trading areas of the Asia Pacific region, modern infrastructure, and world class facilities that adhere to the highest safety standards make it the undisputed petrochemical hub of Malaysia. Kuantan port also prides itself of its strong relationships with government agencies, business partners, local communities and most importantly, its own staff. The advantages of the industrial park that near to the port is to easy transport, import and export product by water way especially to overseas. Kuantan port is centre to peninsular of Malaysia and covering the economic development initiative by the Malaysian government. Five clusters have been identified to move the region economy up the value chain. They include tourism; oil, gas and petrochemical; manufacturing; agriculture and education. The Kuantan port is covering the state of Kelantan, Terengganu, Pahang and the district of Mersing in Johor.

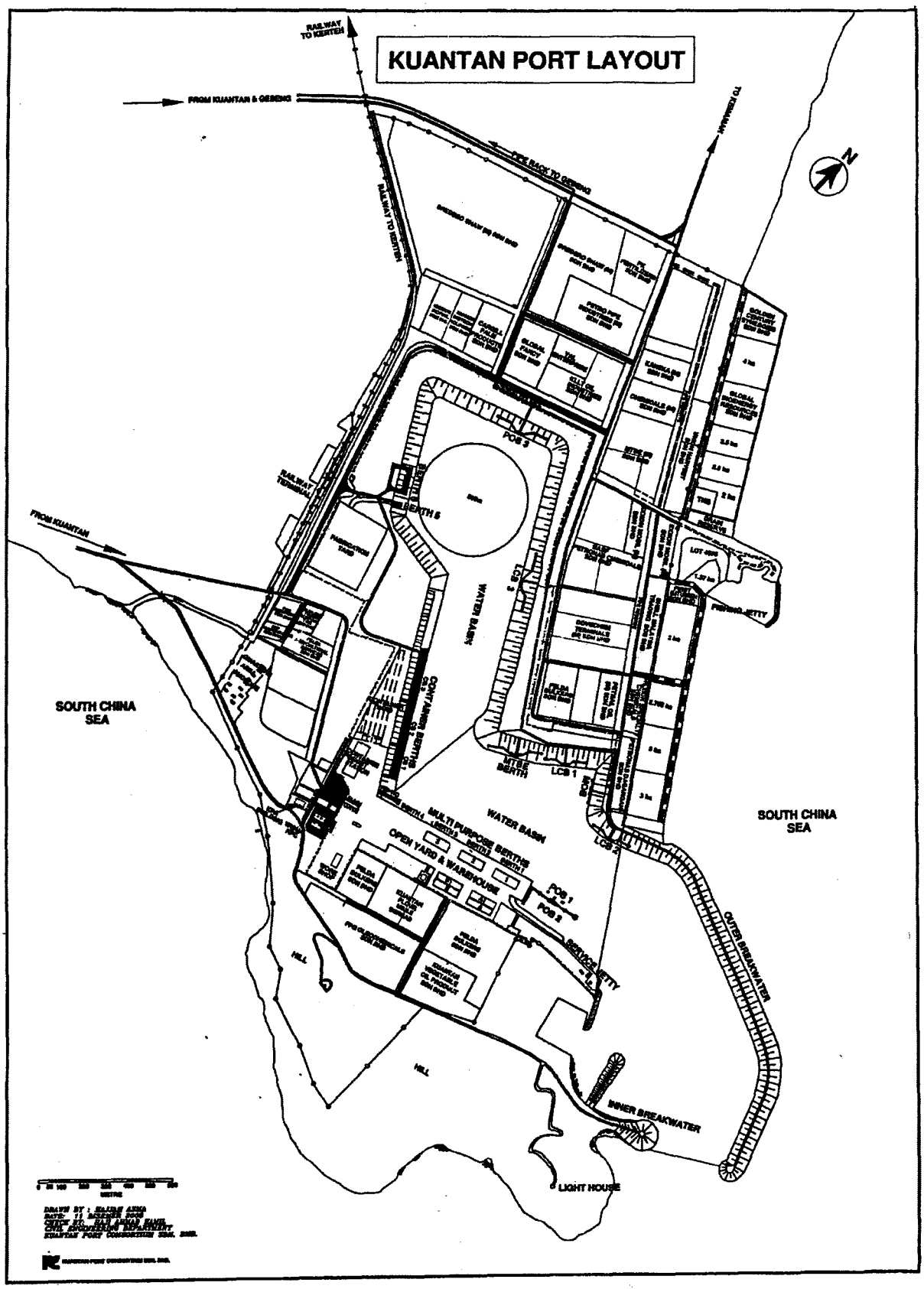



**Figure 4.1** The Layout of Kuantan Port, Kuantan

## 4.3 Kuantan Port Consortium Sdn Bhd

Kuantan Port Consortium Sdn Bhd (KPC) is solely owned by IJM Corporation Berhad, a public listed company on Bursa Malaysia. KPC are the responsible to handle the Kuantan Port involve to planning, implement a project and operate the port until now. KPC operates on a concession period of 30 years with an additional 30 years being negotiated with the Government.

Kuantan Port, an all-weather port operating 24 hours daily and 365 days a year is a multipurpose deep sea port facing the South China Sea. It plays a key role in catalysing the development of the East Coast Corridor which is featured as the heartland of the petrochemical industries.

Strategically located in the state of Pahang on the eastern seaboard of Peninsular Malaysia, Kuantan Port is developing into a major international port in tandem with the rapid expansion of the industrial and manufacturing activities of the East Coast Corridor. Supported with excellent port facilities and services, a vast market outreach and a strong network of global shipping connections have strengthen the position of Kuantan Port as a petrochemical hub port and a major container terminal of the East Coast region.

### 4.3.1 The organization operation of Kuantan Port Consortium (KPC)

For smooth the operation system in port, KPC established a work team for implement the operation. The management are lead by Operation Director and assist by chief of maintenance team. Department of maintenance is a department of engineering that located at KPC building. KPC building has the department of civil and structural engineering, electrical engineering and mechanical engineering. Each of department will assist by technicians. The engineering department will make sure

the port operate smooth and safe without any accident. The department also responsible to implement the new project for develop the port.

The single most important factor in achieving satisfactory equipment availability rates and maintenance cost performance is an organization structure emphasizing accountability. The most elaborate and sophisticated computer based systems will remain largely unused and ineffective unless the organization exists as a part of the overall system and it is structured with a high degree of accountability.

We define accountability in an organization as the ability to identify the one person responsible for realizing a specific result. In such an organization it is easy to trace responsibility up and down the structure. Obviously, at each higher level in the structure additional functions and results are identifiable to a specific individual. Ultimately, at the top of the organization, the Chief operation is responsible for the results of the entire organization.

The important factor here is that the planners must not report to a central planning group, separate from the performing maintenance organization. The planners must report to a relatively low level in the organization: one that is responsible for the performing maintenance and is being treated on its effective performance. Figure 4.3 are shown the organization chart for maintenance operation.

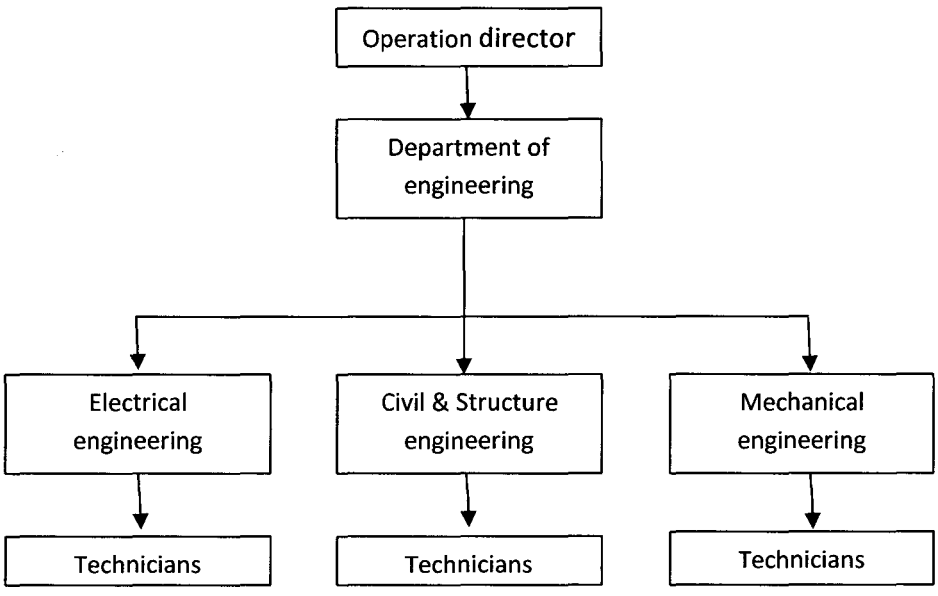



**Figure 4.2** The organization chart for KPC maintenance operation

## 4.4 Gebeng Industrial estate

Kuantan Port is connecting the Gebeng Industrial Estate for import and export business to other country. A comprehensive 8600 hectare petrochemical and chemical manufacturing facility makes up the Gebeng Industrial estate. Complementing this thriving industrial estate is the recently completed Gebeng bypass, which has played a key role in easing the traffic flow between the Gebeng Industrial estate and Kuantan Port.

The bypass links Kuala Lumpur and Kuantan directly via the east Coast Highway. This new route provides a more cost-effective, convenient means of transportation between the two destinations, enabling a more efficient transfer of freight and raw materials between the Gebeng Industrial Estate and domestic as well as international channels. Because of its strategic location, the Gebeng industrial Estate is home to multinational corporations such as BASF Petrronas Chemicals Sdn Bhd, Estman Chemical Sdn Bhd, Polyplastic Asia pacific Sdn Bhd, Kaneka (Malaysia) Sdn Bhd, Cryovac (Malaysia) Sdn Bhd, WR Grace Specialty (Malaysia) Sdn Bhd, and Toray BASF PBT Resin Sdn Bhd.

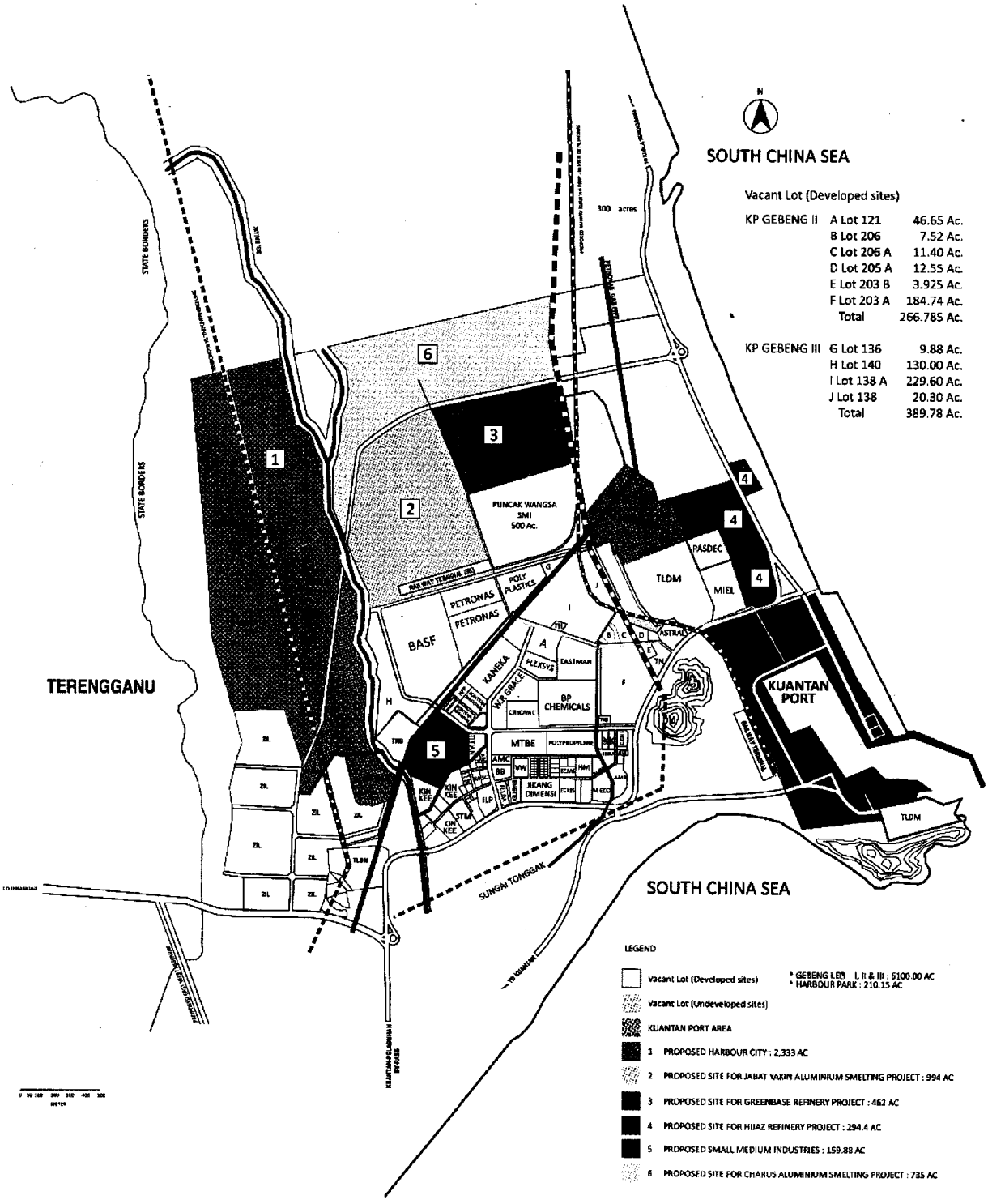



**Figure 4.3** The layout of Gebeng Industrial Area

## 4.5 The Aspects of Maintenance

There is having several aspects of maintenance that involve in Port building. The aspects of maintenance are such as planning the maintenance work, system of maintenance works, distribution works of maintenance and recordings. All the works in aspects of maintenance are done by Kuantan Port Consortium Sdn Bhd itself. Kuantan Port have the own department that observe the port still maintain and operation in well. The department is department of civil engineering and infrastructure that own by kuantan Port consortium Sdn bhd.

With increasing automation and the reliance on large complex container cranes complete with substantial mechanized backup equipment, maintenance in modern port operations has assumed a very large impact on port economics. Unfortunately, the effectiveness of the maintenance performed at many ports has lagged behind that of operations. This has been due in large part because of the emphasis placed on cargo handling and the related technical advancements in cargo handling equipment. Control parameters useful for managing the maintenance function, however, are more difficult to quantify which may explain its lack of development as compared to cargo operations. The objective of port maintenance should be to ensure the operability of equipment as to maximize discounted cash flow for the port over its lifetime. Meeting this objective requires a substantial amount of planning and resource control on the part of maintenance management personnel.

### 4.5.1 Maintenance planning

The key to effective planning and scheduling of maintenance is a good backlog of work required. Therefore, the work identification step is a critical and necessary component of the planning and scheduling system. Planning includes

determining what manpower, materials and equipment are required to complete the work and what sequence of activities must occur. Many times coordination with other organizational entities is required. Each work order, having been entered into the data base system, is now planned. Estimated hours for each trade are entered, as well as material required. Warehouse stock numbers can be entered as well as information about direct charge material if necessary. Each of these data are flagged with the work order number in the data base to allow all information to be tied together. Necessary information on the job is obtained by the planner from visiting the job site, discussing it with the responsible foreman, and other knowledgeable personnel. If the planner determines support is required from other workshops, he will write a work request to the planner of the work shop from which the support is required.

In Kuantan Port, there are many facilities that provide for user especially for the ships. Kuantan Port Consortium Sdn Bhd (KPC) as the main contractor does a planning, design, implements the construction and operation. So, in operation part, there involve the maintenance, services and operational. So, KPC have the big responsible to manage all the facility in port. The team will identify the facility that need to manage or operate base on the specific work of the department of engineering.

For the implement new project such as develop a new wharf or excavation a new water basin for port or build a new berth, Kuantan Port Consortium (KPC) will offer a tender to any contractors to bid a tender. In this system, its involve the preparation of tender document and pricing for the project by the contractor also the scope work provides. After dealing the contract with contractor, KPC will observe the work that do by contractor to make sure the work can implement as fast as possible and can operate fully after finish.

For KPC itself, they will work on the project of maintenance works and prevention. The maintenance work need to implement for prevent from damage happened. The element or areas that need to inspection are:

Major of maintenance:

a) Wharf checking area
b) pipeline checking
c) breakwater checking
d) berth / storage
e) road

Minor of maintenance:

a) storage
b) equipment and machine
c) electrical
d) air-condition
e) other structure maintenance
f) Lift and escalator maintenance.

From all of the work above, maintenance that done by KPC in port are divide to each department of engineering that are civil engineering, mechanical engineering and electrical engineering. So, the works that implement by different department with their specific works will help and improve the maintenance and always systematics.

### 4.5.2 System of maintenance works

During the maintenance works on, Kuantan Port consortium will conduct of element system of works. This is involved the management and workers of KPC and other worker in port itself. The element of system maintenance works are prevent maintenance, area checking, services need and response. The elements are as is in figure 4.5.1 below.

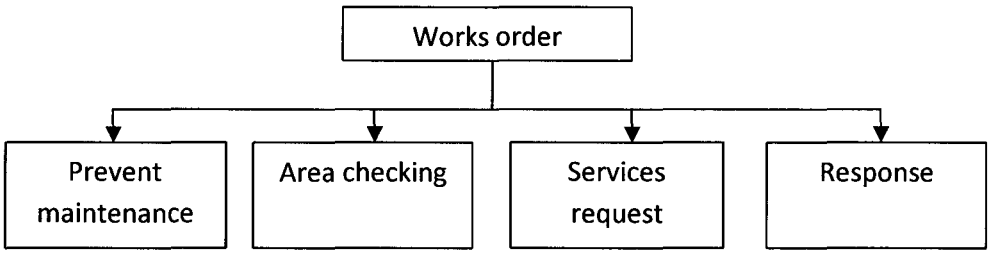



**Figure 4.4** The works order for maintenance operation

#### 4.5.2.1 Prevent maintenance

All equipment must have preventive maintenance (PM) and lubrication check sheets developed for them. The key to effective PM is good quality PM check sheets and supervisory follow-up. The instructions on the sheets should be "active" if possible. "Active" instructions require measurements or adjustments to be made rather than passive checks.

Prevent maintenance in port will implement follow the schedule of works that provide and arrange at first stage. Checklist for prevent maintenance will apply based on the status of maintenance and the condition during maintenance works and will be a basic to planning the work for future. For the first stage, the form works order will be give to the chief of maintenance team. Any damage pr crack will be emergency to repair to avoid more of damage happened.

The chief of maintenance will approve the schedule of works and then order to technician to implement the works. When the works are finish, the chief of maintenance team will approve the status of works before send to the operation director of port.

#### 4.5.2.2 Area checking

Work that must be performed by the maintenance department will ultimately identify itself. Eventually equipment will break down and cargo operations will be reduced or halted. When maintenance is managed this way, very little sophistication is required.

The KPC also do area checking for identify the problem that have to the facility of port. There have the schedule of work that need for each department to patrol around and checking all facility in ports. The workers that responsible to check are checking the defect or corrosion of facility. This is because; the port building usually or structure commonly will get defect and corrosion.

Any workers that identify any problems or damage in port building and port facility need refer to chief of maintenance team then need to records the problems in document of works order form. The chief of maintenance will approve the schedule of works and then order to technician to implement the works. When the works are finish, the chief of maintenance team will approve the status of works before send to the operation director of port.

#### 4.5.2.3 Services request

Work requests should be initiated by anyone desiring work to be accomplished; however, appropriate approvals are required depending on the nature of the work requested. Normally, a cost center and port area/equipment group will be noted on the request as a means of charging costs to the job and to sort the backlog from the computer system. Work requests are normally turned into the appropriate planner where they are entered into the data base, either by a clerk or the planner himself.

As the planned maintenance system becomes more effective, we would expect to see a higher proportion of work requests initialed by maintenance personnel. This indicates that maintenance personnel are actively managing, rather than merely reacting to breakdowns reported by operating personnel.

All the facility in port sure gets decrease of function. So, there are services request to maintenance the function of facilities. The request to maintain the facilities commonly are from the users of port such as to maintain roads, berth and storage.

Every request to need services will be recorded and then will send to operation manager to get the permission to implement the works. Then the works will identify and need to emergency repair or not. The chief of maintenance will approve the schedule of works and then order to technician to implement the works. When the works are finish, the chief of maintenance team will approve the status of works before send to the operation director of port.

#### 4.5.2.4 Response

To make improvement the quality that provides to the port facility, response and comment are required. Any response will evaluate and improvement will get the permission from the operation director. All the response needs to records. The order will give to technician to implement the works. After the works finish, the status of works will informs to operation directors. Response are the method to know how the status of works that user are satisfied with the maintenance and need to improve for the future.

### 4.5.3 Distribution of maintenance work

For looking the great and smoothing of maintenance works, schedule of each works must be planned at early stage. Implement of each works based on the needs. From the data and the report, the maintenance for buildings and structure facility in port such as wharf structure, breakwater, road or another building structure that are maintenance for three to five year. This because, every each maintenance works needs high cost and long term to maintain and repair. Moreover, structure facility could be durability for long term. But the physical inspections to the structure need to inspection minimum are one year. The maintenance such as cracks, corrosion or pipe line leak needs every month check. But the maintenance will implement emergency if the damage of facilities got worse and can make dangerous to other people. For any maintenance such as lift, lighting, network system, or machine are need be maintain always because these things always used and will interruption the work if not fixed as fast as can. Any inspection will process as usually follow the schedule that provides. The maintenance will got maintain and repair immediately if the status of facilities get worse.

### 4.5.4 Works recorded

Every works that done will be record in works order form or it will be recorded daily log book. All the data that get will transfer to computer systems that call computer management system (CMS). This system can improve the process to identify services that provided, works order, preventative maintenance process, daily works on facility and to analyse the status of facilities.

There are about four of screening that can be full fill with any available data that related to facility maintenance, operation and current report requirements. The screening such as works order screening, users screening, preventative maintenance screening and assets management screening.

#### 4.5.4.1 Works order screening

For this screening, it is very useful to submit the works order to the technicians. Operation director can do inspection or analyse the report of work to get the complete data for the works activities that delayed, the finish work implement, the location of works that facing a problems, costing, duration needed to implement works, component maintenance and other. In this screening, there have two main parts that is part for before and after the works order implementation. The data are such as number of works order, location, and date of receive complaint, name of complainer, types of works order, problem explanation, the works finish date and costing.

#### 4.5.4.2 Users screening

For this screening, user detail or profile that use facility in port need to be record. The records of users put into CMS such as type of services, location, name of user, contact number and other. There are two type to screening the data of users or customer that are type of facility or name of customers.

#### 4.5.4.3 Asset management screening

The purpose of this screening to save the records that related with asset in the port facility. This is to know the decreasing value of assets and to assist the management team to do an inspection on the value of assets at now. The data needs to full fill in screening in this part are assets name, model number, series number, date of purchase, and value of facility, rates of value decreasing, comment and assets explanation.

#### 4.5.4.4 Preventative maintenance screening

Every thing that related with the facility in the port facility will record. From the data, the duration to implement the preventative maintenance activities for each facility will be arranged. The data needs to full fill number of facility, location of facility, name of facility, type of maintenance, date of maintenance, and materials need for preventative maintenance.

### 4.5.5 System Approach to Inspection, Maintenance and Repair of Kuantan Port structure

Maintenance and rehabilitation of port structure is a fairly complex process which due to the substantial costs associated, requires a high level of optimization. The traditional and proven way to optimize the multiparametic activities of this kind is to develop a system approach to their implementation. The most recent trend with regard to the maintenance of port structures is a commitment to consider seriously a life-cycle management approach to the problem. Life-cycle management is based on a consideration of four major aspect of infrastructure maintenance; financial, technical, environmental and safety versus the phase in service life facilities; design, construction, operation and removal.

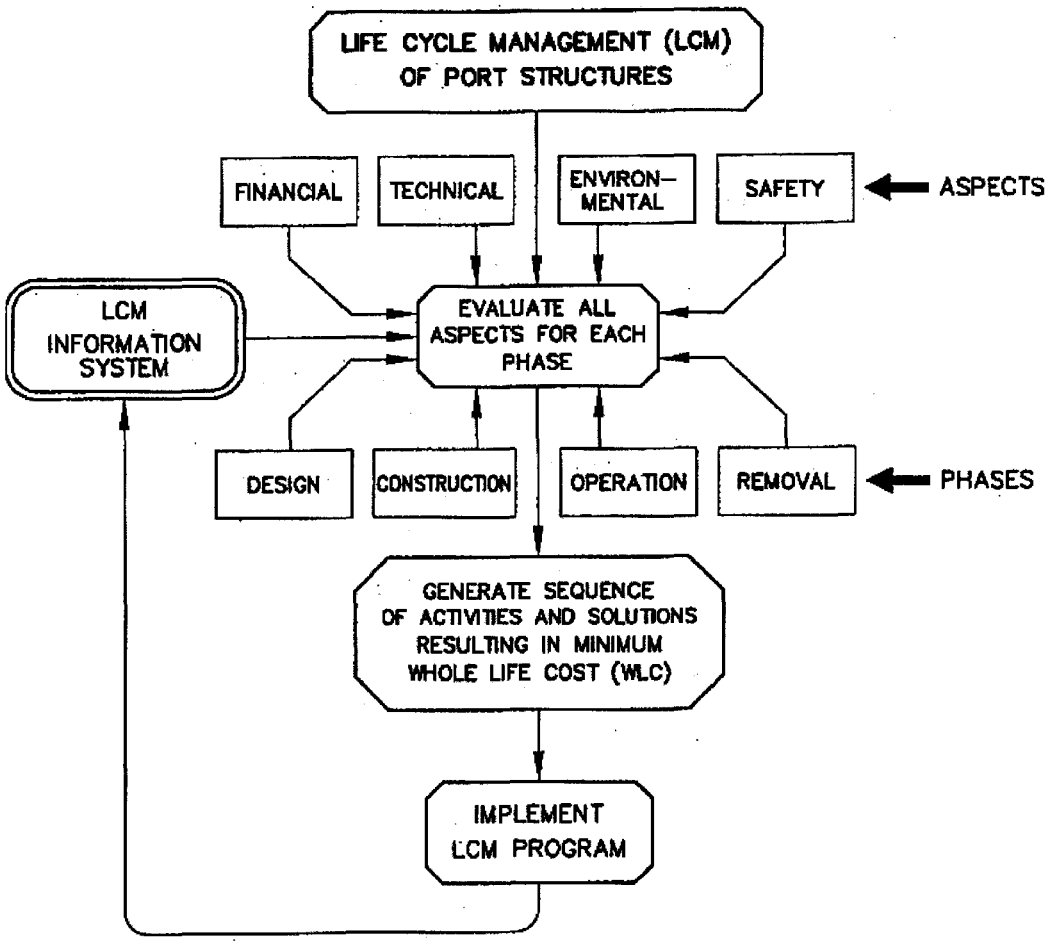



**Figure 4.5** principal component and activities of an LCM program at port. (From Buslov, 2001)

### 4.5.6 Maintenance and Inspection Procedures

The system approach at the foundation of LCM should be extended into all aspect of LCM, particularly into organization and implementation of the maintenance or inspection program. A typical inspection program operation is shown in the flow chart in figure 4.6. Maintenance inspection is performed on a regular basis. The program operation need for preconstruction inspection, condition surveys and special inspection based on the result of maintenance inspection. Maintenance inspection is the only type of survey that is schedule and executed at fixed intervals regardless of other current activities on the wharves.

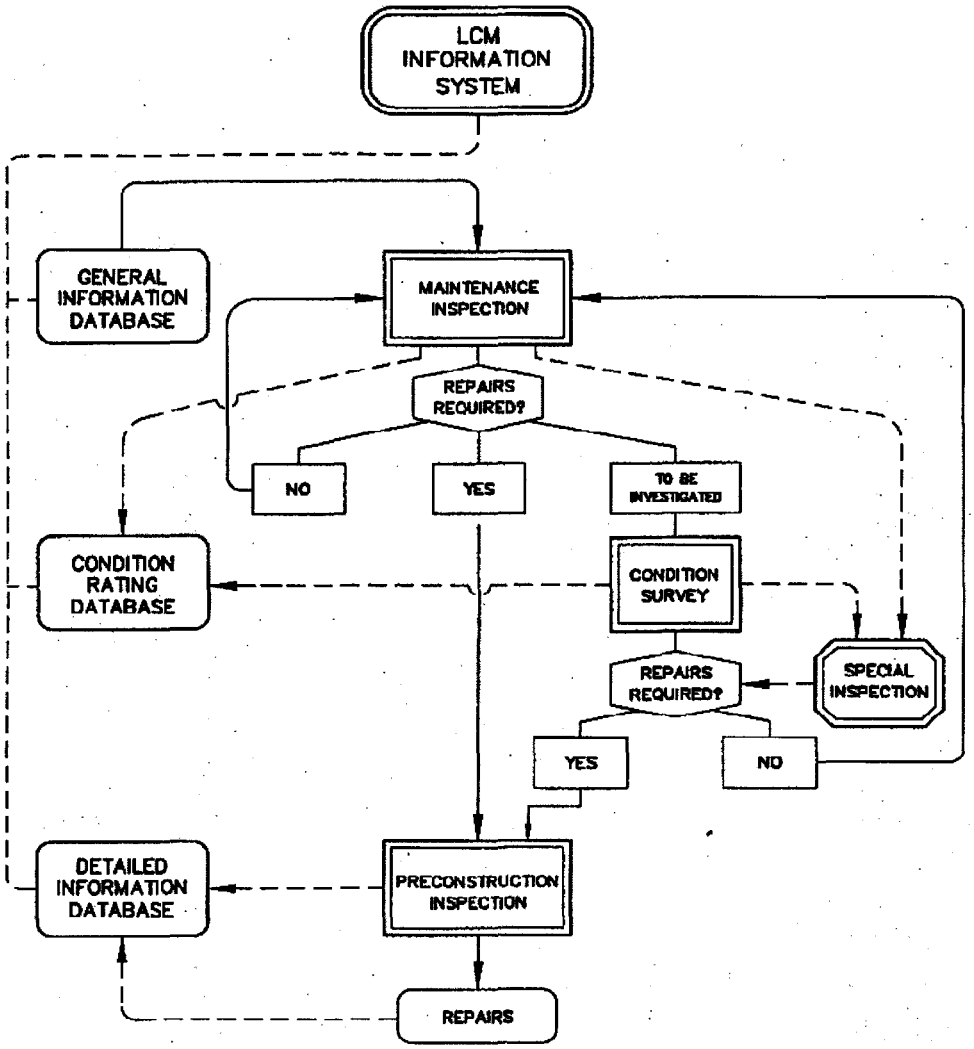



**Figure 4.6**: Inspection and maintenance procedure of an LCM program at port. (From Buslov, 2001)

During the maintenance works, the workers that responsible to do the maintenance and inspection need to know the procedure how to implement the maintenance works. The procedure below has shown the procedure how to implement the inspection and maintenance wharf at port. The procedures are:

1. The technicians or executive officer will go to the wharf for do the physical inspection minimum in a year per works. Checking and inspection will do to wharf structure include the accessories of wharf such as bollard, fender and the related structure such as operation room and control room. The inspection form or checklist for wharf used for record the physical structure and the accessories of the wharf.

2. If there have any damage on wharf structure, other structure or wharf accessories, the technician or executive officer will inform will report and inform to the director of civil and infrastructure engineer for next actions that needs to maintenance or repair immediately by the department or done by tender to contractor.

3. The manager of civil and infrastructure engineering will order that needs to maintenance by the department or by tender and supervised by the technicians.

4. The technician or executive officer will go to site or wharf for follow up inspection to identify the damage or maintenance that need to implement.

5. If the repairs can be made by the, Senior Civil Technician will work out plans for implementing the work force department. Executive Officer will monitor the progress of work to get the status to be updated every week until the completion of work. After that the report that already sign by manager of civil and infrastructure engineering department will provide.

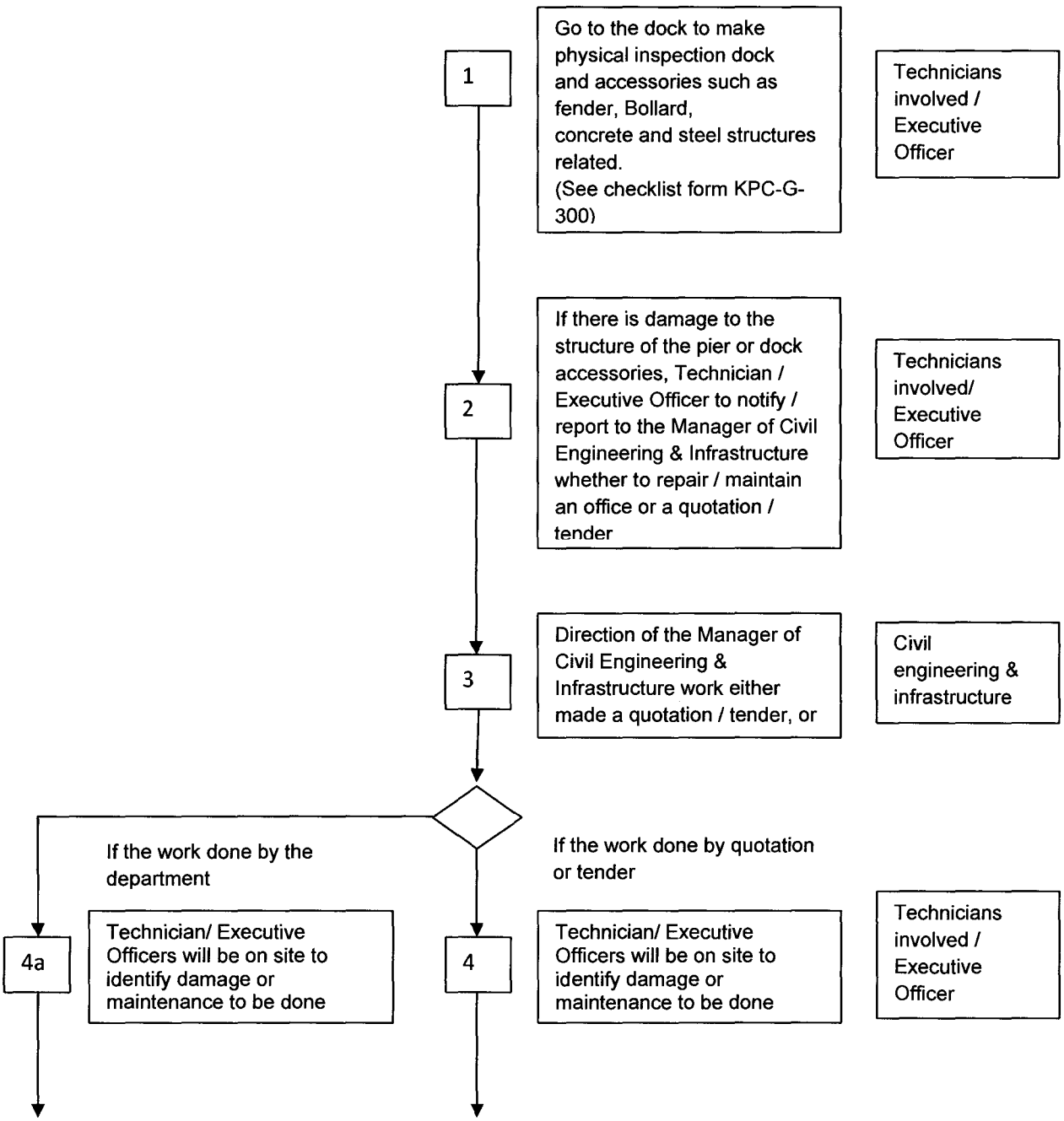
6. Should be implemented in quotation / tender, BQ, and the estimated price will be provided by technicians who are involved and signed by the Manager of Civil Engineering & Infrastructure work for approval by the Managing Director.

7. After get the works approval, contractor that chosen will called.

8. The tender works are providing in Control Document for produce the tender offer.

9. Once this contract work is completed, completion reports prepared and signed by the Manager of Civil Engineering & Infrastructure engineering.

The figure shown the flow chart the inspection and maintenance of wharf in port on July by department of civil and infrastructure engineering.



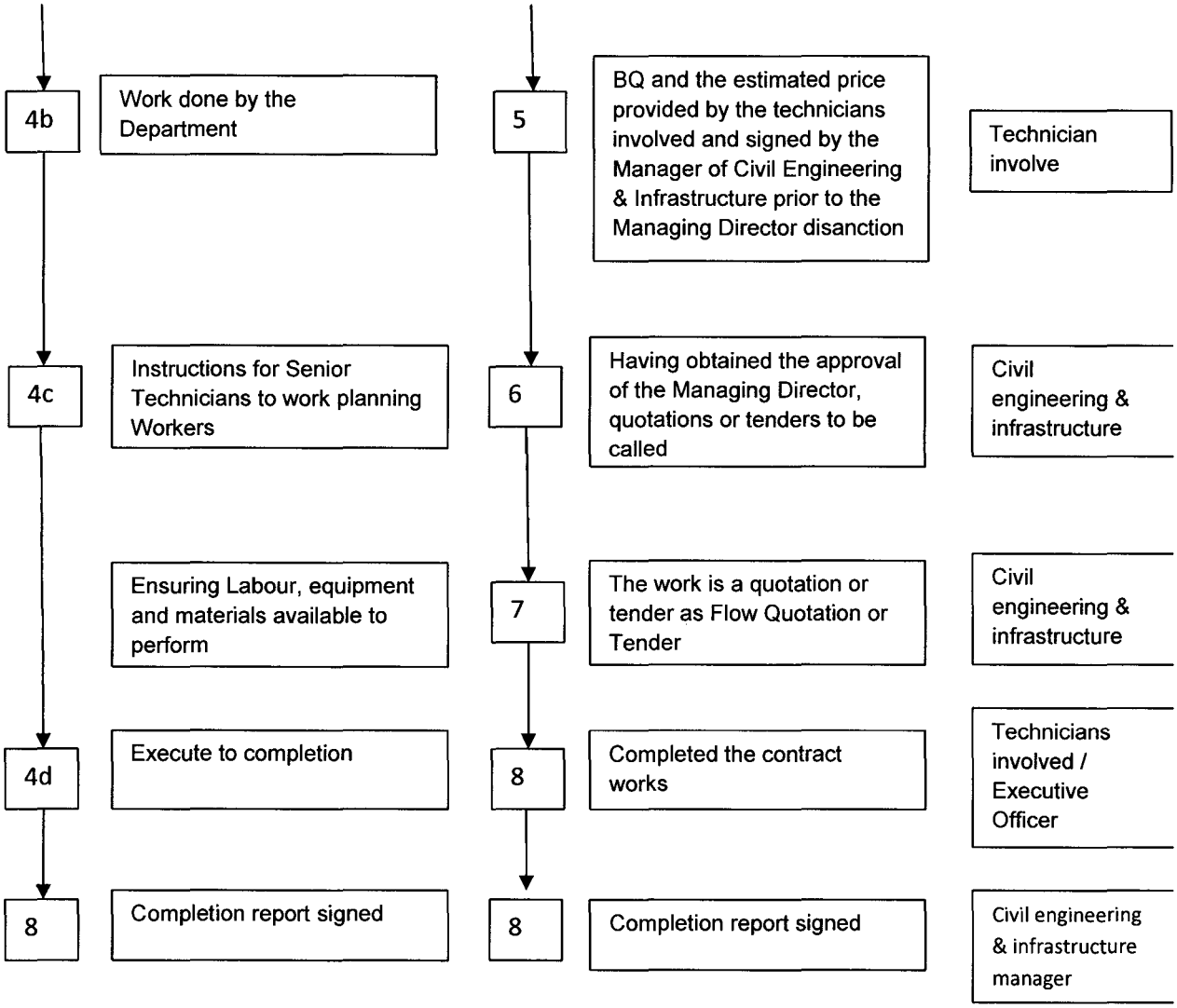



**Figure 4.7:** The flowchart of maintenance wharf procedure at Kuantan port

## 4.6 Maintenance Works Operation

Every month, KPC engineering department will analysis the implementation of maintenance works activity in port. The data that implemented and the delayed works will be present into statics data and then documentation by the administration. This is because easy to claim of the total cost to implement the maintenance and repair works. KPC have state the works order forms for smoothing during the works implements. The works order includes preventative maintenance, area checking and inspection, services request and response from the users. In port, there have many facilities that must be maintenance because the port are always used for 24 hour a day and 365 days a years and operation about 30 years. So, there must have many old building and need to maintenance always. This is the weakness for old building because durability are decrease. So, the responsible person must check around the port building to report the damage and cracks. Other those, corrosion are the enemy for building nearest to beach or seas. This is because, sea water is the main and can faster the corrosion process.

So, the KPC with the work team have struggle always to make sure the building can operate as usually for 24 hour a day. The cost of maintenance that earn from services to the users can help to cover all costing additional get funds from the owner and share holder of Kuantan Port. The services such as berth facilities services, port tariff, and taxes that charge to users. With the income, KPC can manage the maintenance work as usually.

Implementation of the Life-cycle management program for a new and existing structure follows basically the same path that shown in figure 4.8.

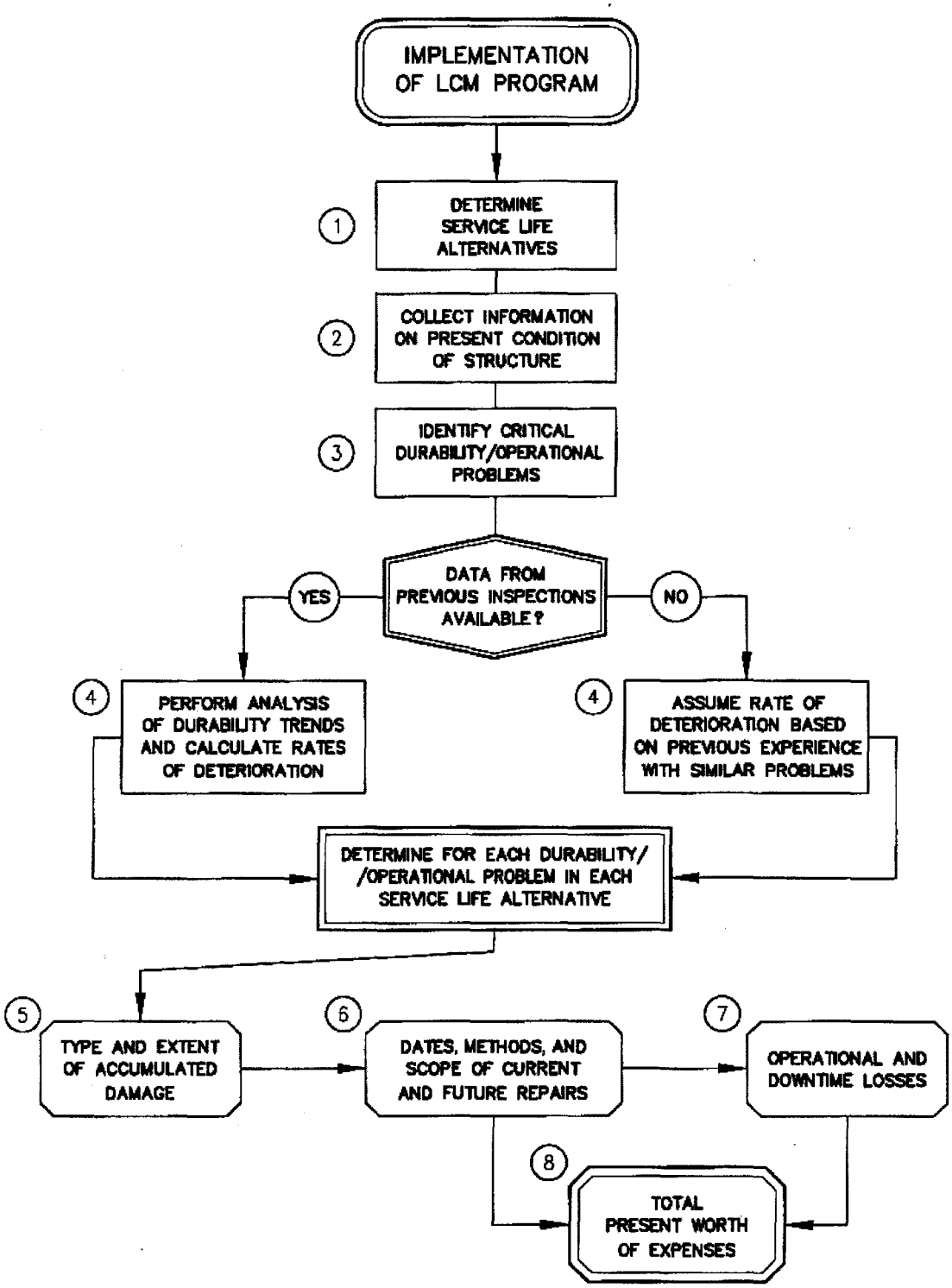



**Figure 4.8** : Implementation of an LCM program at port. (From Buslov, 2001)

## 4.7 Data Analysis

The implementation of facilities management system in Kuantan port gives the good effect and advantages to the management team that is Kuantan Port Consortium (KPC) because there was a reduction in annual maintenance cost, addition also can maintain the assets value and make sure the assets are in good condition, safe and can operate properly for daily works. The cost of maintenance and repair for 4 years continued that start from 2005, 2006, 2007 and 2008 that obtained from database of Kuantan Port Konsortium (KPC) are compare and shown in the table below:

**Table 4.1** Comparison of maintenance costs in Kuantan Port for 2005 to 2008 (sources: Kuantan Port)

| Years / Activity | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|
| **Labour cost** | RM 310,705 | RM 351,705 | RM 320,765 | RM 388,620 |
| **Building & facilities maintenance** | RM 291,563 | RM 135,061 | RM 98,290 | RM 308,846 |
| **Equipment & machine maintenance** | RM 13,650 | RM 16,519 | RM 21,180 | RM 31,024 |
| **Other maintenance** | RM 56,126 | RM 82,374 | RM 74,645 | RM 70,334 |
| **Total cost** | RM672,044 | RM585,659 | RM514,880 | RM798,824 |

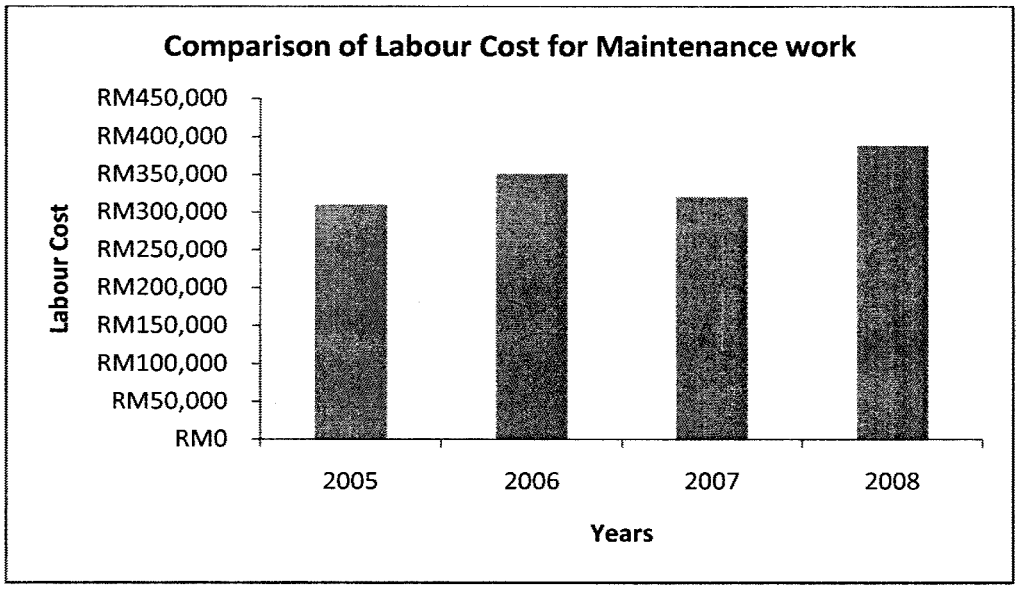



**Figure 4.9** : Comparison of Labour cost for year 2005 to 2008

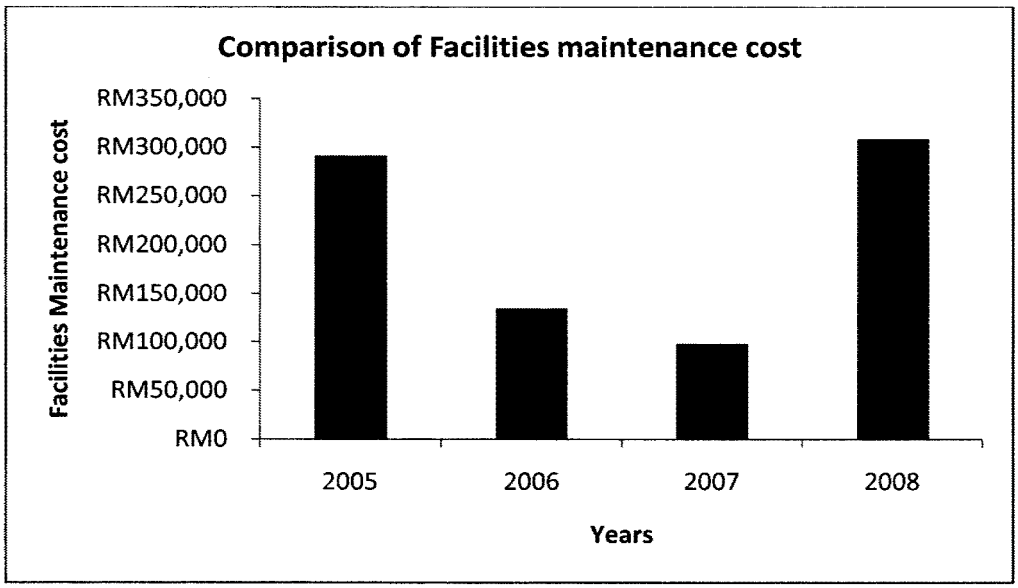



**Figure 4.10** : comparison of Facilities and Building maintenance cost from year 2005 to 2008

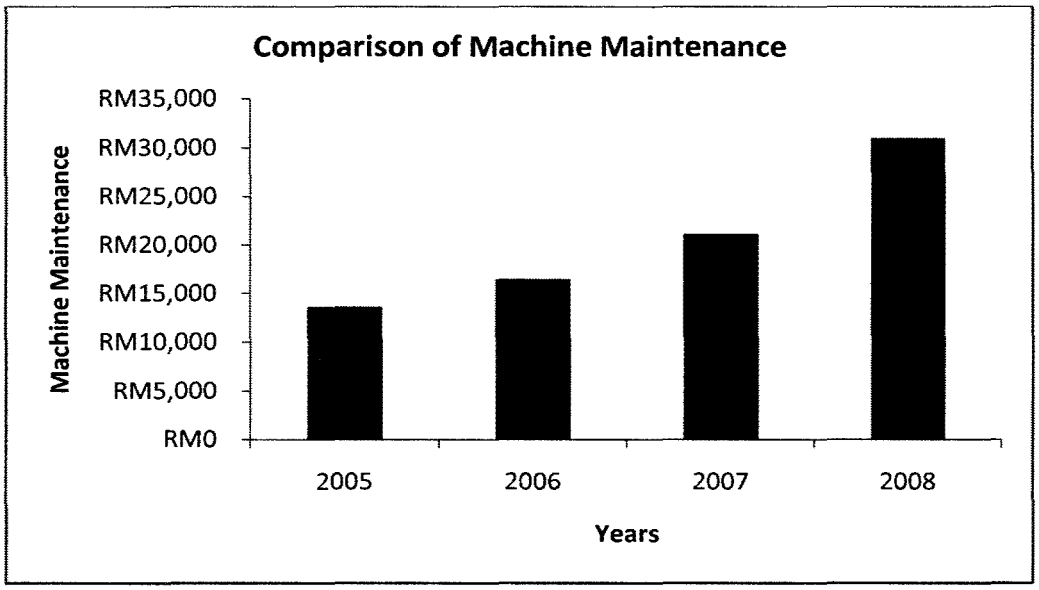



**Figure 4.11** : comparison of Machine maintenance cost from year 2005 to 2008

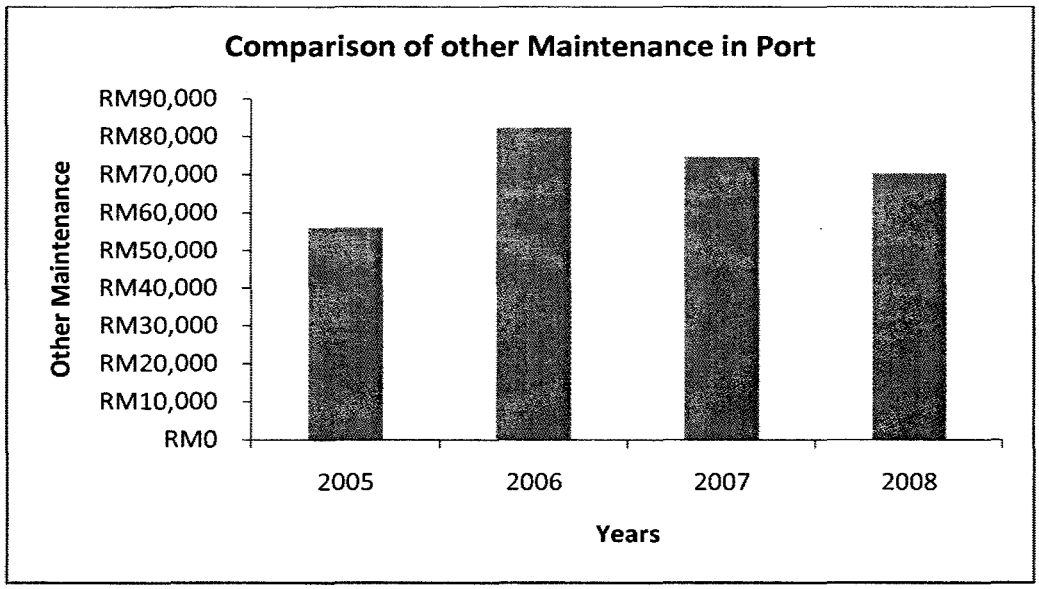



**Figure 4.12** : comparison of other maintenance in Kuantan Port from year 2005 to 2008

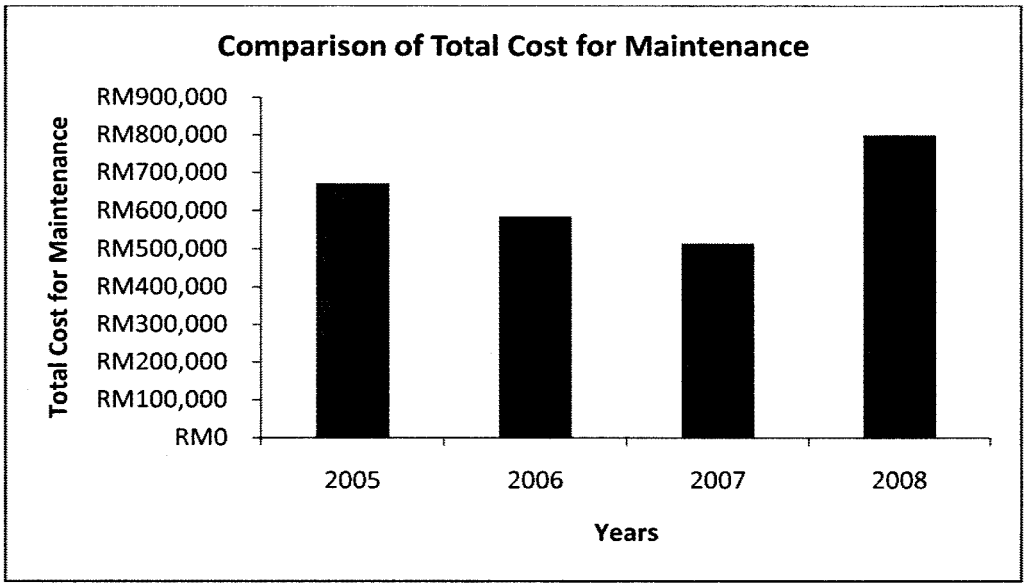



**Figure 4.13** : comparison of Total cost for Maintenance in Kuantan Port for year 2005 to 2008

# CHAPTER 5

# CONCLUSION AND RECOMMENDATION

## 5.1 Introduction

To achieve the objective, the maintenance systems have been discussed in literature review and case study. For overall, the maintenance that implemented is systematic and competitive. Based on the standard have been sets, the procedure and method to implement the maintenance works are involving the preventive and corrective action that can be implemented smooth and properly addition with the skills and knowledge that have for every management team member.

From the effectiveness of skill full and systematic of facility and maintenance management, there can guarantee the quality of facility and building. Because of the management effectiveness, the cost of maintenance can be reduce for every years and the life cycle of facility and building in port especially in Kuantan Port can be extended. The assets value of the facility and building can be maintained and increase the investment value of the facility. Within the effective of operational and maintenance management, the safety and comfort of the facility can be guaranteed.

## 5.2 Conclusion

Base on the comparison of assets maintenance costs in data analysis, I can conclude that the maintenance cost for all type of assets and facilities are reduce for every year. The total for maintenance and facility management cost at Kuantan Port for these three years are reduce that is RM672,044 in year 2005, follow by RM585,659 in year 2006 and RM514,880 in year 2007. But in year 2008, the cost for maintenance is RM798,824. This is because the cost is used for overall repair and improvement the facility and building. The repair for building and facility usually will be implemented every four to five years for each repair.

To make good of port management that provide the good maintenance in port especially in Kuantan Port, implemented the aspect of maintenance works that are planning of maintenance, system of maintenance that applied, distribution of maintenance works, maintenance works records, and inspection and maintenance works procedure are considered. So, after the aspects of maintenance was considered, the maintenance works operation will be implemented to balancing the financial, environmental, safety and technical to make sure the Port will operate as usually for everyday. From the aspects, the skills and knowledge of management are necessary and important to implement the system of management in Kuantan port.

From the objective which are to determine the aspects of maintenance in facility management building and structure in port and determine the skill of management, knowledge of personal handling of port facilities management. With these two objectives, the handling and management in Kuantan port can be smooth and woks of maintenance can be balanced. The core of implemented of the management in Kuantan Port is Kuantan Port Consortium with Kuantan Port Authority were successful to manage the Kuantan Port operate smooth and effective with the system. KPC is just new in port management that about 30 years, but with the good management and administration that they have now, they can handle the problem as good as possible.

## 5.3 Recommendation

Based on the study that is done, the elements that that related with maintenance in facility management can be identify. The elements are operation, managing, organization and implementation. As we know, this facility management especially in port are involving many aspects of maintenance. From the aspects of facility management and maintenance, not all aspects are taken and implemented in facility management. So, there are many of suggestion and recommendation to consider for improving the knowledge in this facility management. The suggestion and recommendation are:

i) To expend scope of study to another part or elements in facility management such as safety and port security and environmental factors in port.

ii) To determine the effective methods that can be apply in facility and maintenance management.

iii) Do a comparison and differentiation of maintenance system that implemented in Kuantan Port facility with another port in Malaysia that have world standard classification such as Klang Port.

iv) To identify the satisfied level of workers / maintenance staff toward their own organization.

v) Do studies of Computer Management System (CMS) more detail.

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# APPENDIX A

## Form for inspection and maintenance in Kuantan port

**JABATAN KEJURUTERAAN AWAM & INFRASTRUKTUR**

**INSPECTION CHECKLIST**

**LOCATION OF BERTH :** _____

| ITEM | ELEMENT / AREA | PHYSICAL INSPECTION RESULTS / MAINTENANCE SATISFACTION SURVEY | | |
|---|---|---|---|---|
| | | Satisfied | Dissatisfied | Remarks |
| **1.0** | ***WHARF FOUNDATION*** | | | |
| 1.1 | Piles | | | |
| **2.0** | ***WHARF SUPERSTRUCTURE*** | | | |
| 2.1 | Concrete Structure | | | |
| 2.2 | Wharf Surface | | | |
| 2.3 | Fenders | | | |
| 2.4 | Bollards | | | |
| 2.5 | Ladders | | | |
| 2.6 | Handrails | | | |
| 2.7 | Angle Edging/Steel Nosing | | | |
| **3.0** | ***MOORING DOLPHIN*** | | | |
| 3.1 | Concrete Structure | | | |
| **4.0** | ***CATWALK*** | | | |
| 4.1 | Steel Structure/Support Structure | | | |
| **5.0** | ***APPROACH TRESTLE (ACCESS BRIDGE AND PIPELINE TRESTLE)*** | | | |
| 5.1 | Steel Structure/Support Structure | | | |
| 5.2 | Concrete Structure | | | |

**JABATAN KEJURUTERAAN AWAM & INFRASTRUKTUR**

**INSPECTION CHECKLIST**

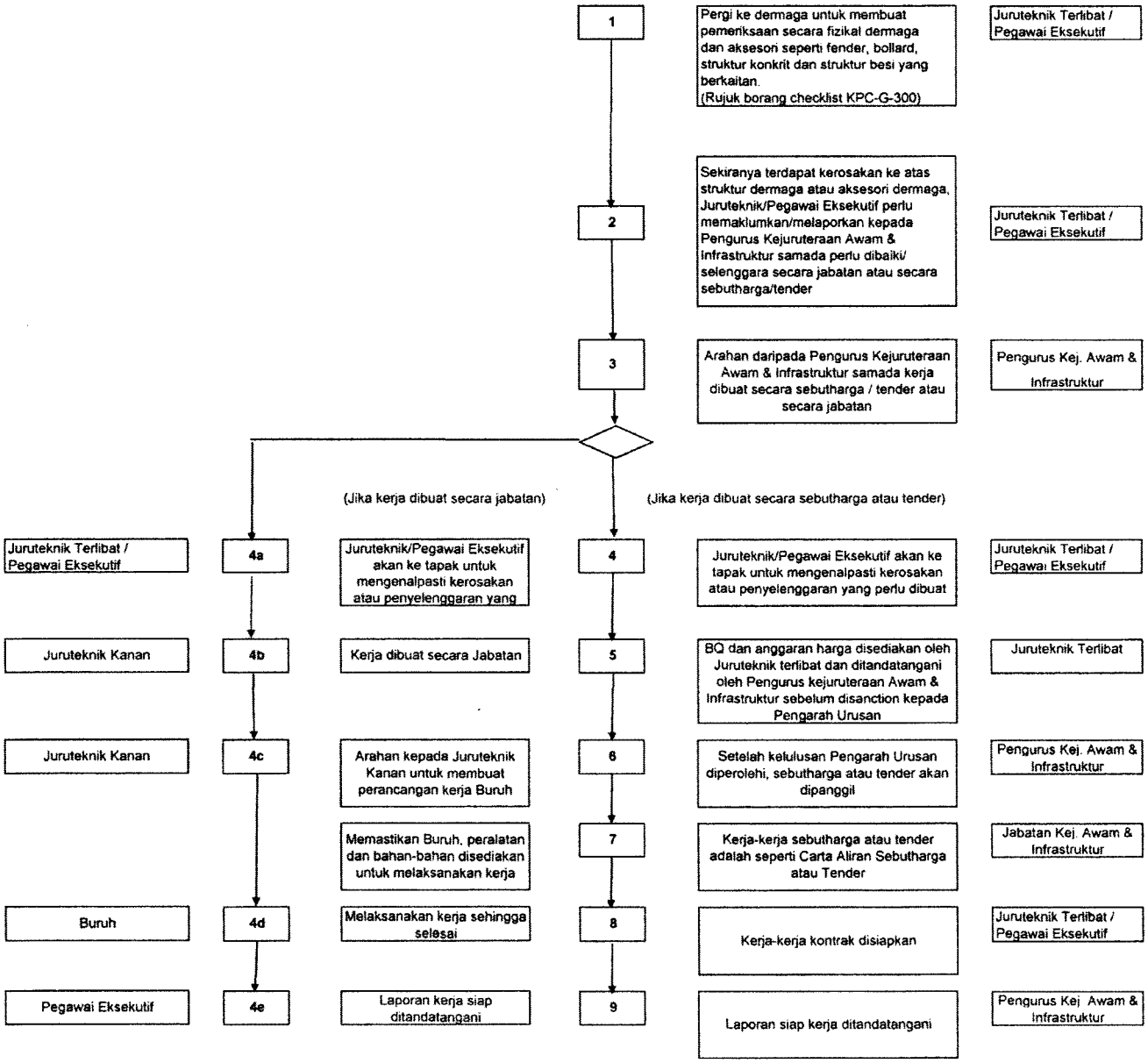
**LOCATION OF BERTH :** _____

| ITEM | ELEMENT / AREA | PHYSICAL INSPECTION RESULTS / MAINTENANCE SATISFACTION SURVEY | | |
|---|---|---|---|---|
| | | Satisfied | Dissatisfied | Remarks |
| **6.0** | ***STEEL STRUCTURE*** | | | |
| 6.1 | Pipe rack on the wharf with staircase | | | |
| 6.2 | Hose rack on the wharf with staircase | | | |
| 6.3 | Walkways on the wharf | | | |
| | - | | | |
| **7.0** | ***CONTROL BUILDING*** | | | |
| 7.1 | Structure | | | |
| 7.2 | Walls (internal & external) | | | |
| 7.3 | Doors | | | |
| 7.4 | Windows | | | |
| **8.0** | ***OPERATION BUILDING*** | | | |
| 8.1 | Structure | | | |
| 8.2 | Walls (internal & external) | | | |
| 8.3 | Doors | | | |
| 8.4 | Windows | | | |
| | - | | | |
| | - | | | |

# APPENDIX B

## The procedure of inspection and maintenance wharf in Kuantan Port

| KUANTAN PORT CONSORTIUM SDN. BHD (374383-H) | No.Dokumen | KPC-G04 |
|---|---|---|
| | Tarikh Pelaksanaan | 23 Julai 2009 |
| | No. Semakan / Pindaan | 00 |
| JABATAN : KEJURUTERAAN AWAM & INFRASTRUKTUR | Muka Surat | 1/1 |
| CARTA ALIRAN : PEMERIKSAAN DAN PENYELENGGARAAN DERMAGA | | |



# APPENDIX C

## Work Order form for Maintenance

| | Work Order | Kuantan Port Consortium |
|---|---|---|

Building :
Work Order # :
Room Number :
W/O Type :

Date Recorded :
Time Recorded :
Receiver Name :
Date Attend :
Time Attend :

Equip. Code Number :

Tenant :
Contact :

Location :
Phone # :

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Cond | ☐ | Electrical | ☐ | Civil/Struc | ☐ | | |
| Fire Fighting | ☐ | Lighting | ☐ | Plumbing | ☐ | Other | ☐ |

Contact Reason:

Report :

| Part Replaced | Part Name | Parts Cost | Parts Type | Expense By |
|---|---|---|---|---|
| 1st Part : | | | | |
| 2nd Part : | | | | |
| 3rd Part : | | | | |
| 4th Part : | | | | |

| | | |
|---|---|---|
| Date Completed : | Work Order Cost: | Owner Expense ☐ |
| | | Tenant Expense ☐ |
| Time Completed : | Over Time Cost : | Comp. Expense ☐ |

Acknowledgement (Work done satisfactorily)

Acknowledged by: Date/Time: Signature :

| | Reported/Work Done By | Checked by/ Supervisor | Endorsed by HOO |
|---|---|---|---|
| Signature | | | |
| Name | | | |

# APPENDIX D

## Picture at Location of Study, Kuantan Port


Wharf


Machine and crane to handle cargo

Building and Structure in Kuantan Port

Fender