



A REVIEW ON HOSPITAL BUILDING MAINTENANCE THROUGH QUALITY FUNCTION DEPLOYMENT IN INDONESIA

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Abstrak

Dalam suatu usaha untuk meningkatkan kesihatan awam, kerajaan Indonesia telah meningkatkan kapasiti dan kualiti hospital di seluruh Negara. Walaubagaimanapun, usaha kejayaan belum diambil tindakan susulan dengan penyenggaraan hospital secara optimum, sementara itu jumlah kekerapan pesakit/pelanggan semakin meningkat. Penyenggaraan perlu diberi keutamaan secara geografi dan menyebabkan ianya terdedah kepada malapetaka, terutamanya gempa bumi yang boleh menyebabkan kerosakan bangunan. Masalah penyenggaraan bangunan berlaku bukan sahaja di Indonesia tetapi juga di banyak negara lain. Oleh itu, terdapat strategi yang digunakan untuk penyenggaraan termasuk penyenggaraan yang pembetulan, preventif dan berasaskan keadaan. Dalam menyediakan perkhidmatan, penting untuk mendapat kepuasan pelanggan dengan mengemukakan keperluan pelanggan atau pemegang saham. Kertas ini bertujuan untuk mengenalpasti konsep "Quality Function Deployment" (QFD) dalam melaksanakan penyenggaraan optimum sesebuah pembinaan hospital.

Kata Kunci: Hospital, Penyenggaraan, Kualiti, Indonesia

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Abstract

In an effort to improve public health, the Indonesian Government has increased the capacity and quality of Hospitals throughout the country. Nevertheless the success of the government's efforts have not been followed up with optimal maintenance of Hospitals, whilst patient/customer frequency is only increasing. Maintenance should take precedence given the geographical location of Indonesia being so vulnerable to disasters, particularly earthquakes which can damage buildings. The problem of building maintenance occurs not only in Indonesia but also in many other countries. As such, there are strategies to be used for maintenance including corrective, preventive and condition-based maintenance. In providing services, it is important to gain customer satisfaction by addressing customer or stakeholder needs. This paper aims to identify the concept of Quality Function Deployment (QFD) in order to implement the optimal maintenance of a hospital building.

Keywords: Hospital, maintenance, quality, Indonesia

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1.0 Introduction

In the past decade, the Indonesian government has proactively made efforts to improve public health. Some of the efforts include: development and deployment of Hospital infrastructure; increasing the capacity and quality of various types of Hospitals, namely A, B, C and health centers that are spread throughout the Province, Regency/City and villages; deregulate the involvement of private sectors in Hospital infrastructure development; and increasing cooperation with agencies and the world health programs such as MDGs (MDG Health, 2010-2015).

Tangible manifestation of the government's efforts for hospital development can be seen from the growing number of hospitals in Indonesia. Of the total 1234 hospital recorded in 2003, this number increased significantly up to 1320 in 2008 (Department of Health 2009). In other words, a total of 86 new hospitals have been built between 2003 and 2008, averaging of 1.14% per year. As a result, the numbers of hospital managers authorised by the government has also increase significantly. However, the government's efforts to improve the numbers of hospital and infrastructure is yet to be followed by a systematic maintenance programme. The tendency to ignore maintenance is sure to directly impact the entire hospital infrastructure though damage, obsolescence, etc.

The need for a systematic maintenance approach is crucial, in line with economic growth, population growth and lifestyle changes. All of which demand hospitals improve management of their infrastructure, particularly the management of building maintenance and other support facilities. Moreover, Indonesia (particularly Sumatra) is one of the areas most vulnerable to disasters, especially earthquakes (Bappenas, 2007) which tends to cause widespread building damage.

The problem of building maintenance not only occurs in Indonesia, but other countries too. In Nigeria, according to Iyagba and Adenuga (2005), public buildings are in poor and deplorable conditions of structural and decorative disrepair. In spite of millions of Naira having spent to erect all these buildings, they are left as soon as commissioned to face steady deterioration and dilapidation. According to Horner et al. (1997) the cause is due to the drafting of maintenance management strategies and programs that are not based on a plan. Rather, they tend to be based on the available budget. Thus maintenance management becomes based on needs which fall within the available annual financial budget.

Miller and Rice (1967) argued that the reason for the poor performance of building maintenance management is mainly caused by the lack of integration between the individuals within the organisation, as well as the complexity of the implementation of maintenance management conducted. Meanwhile, according to Hudson et al. (1997) the ineffective situation of maintenance management is not only caused by a lack of technical competence, but also due to a range of institutional factors including lack of money, ignorance of good maintenance factors and mismanagement.





Thus, all organisations must have a strategic plan of maintenance management to prevent and ensure that the maintenance management work can be carried out when necessary. Without effective planning and strategy, management of maintenance is impossible to achieve (Kister and Hawkins, 2006).

Hospitals serve patients receiving medical treatment and thus customer satisfaction is paramount. Often, maintenance does not consider customer satisfaction and service performance, both of which are critical success factors.

From the description above, we can infer that as long as Hospital building maintenance performance is poor, customer satisfaction will not be achieved. Consequently, it is necessary to find a way to perform maintenance effectively and efficiently.

2.0 Literature Review

Prior to the early 1900s, maintenance was considered as a necessary evil. Technology was not in a state of advanced development, there was no alternative for avoiding failure, and the general attitude to maintenance was: "It costs what it costs." With the advent of technological changes after the Second World War, maintenance came to be considered as an important support function for production and manufacturing. During 1950-1980, with the advent of techniques like preventive maintenance and condition monitoring, the maintenance cost perception changed to: "It can be planned and controlled." Today maintenance is considered as an integral part of the business process and is perceived as: "It creates additional value" (Liyanage and Kumar, 2003). Performance measurement of maintenance has also become an important requirement for the industry today. The paradigm shift in maintenance is described in the following figure.

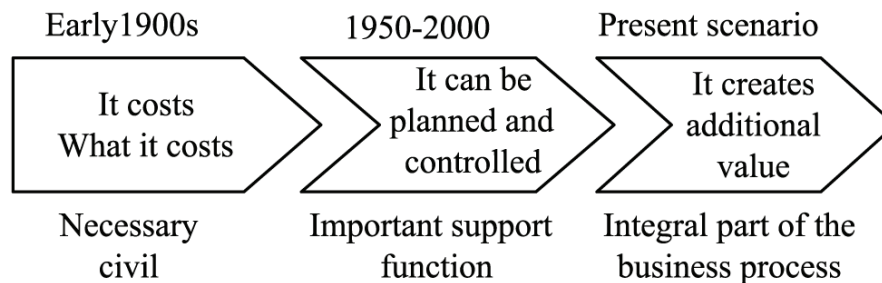


Figure 1: Paradigm Shift in Maintenance

Source: Parida A. and Kumar U. (2006)





Building maintenance is defined as “work undertaken in order to keep, restore or improve every part of a building, its services and surrounds, to a currently accepted standard, and to sustain the utility and value of the building”. Mann et al. (1995), state that maintenance is performing repair, replacement and maintenance of equipment in order to avoid unexpected failure during usage. Based on PERMEN-PU RI NO: 24/Prt/M/2008: maintenance of the building is the activity to maintain the reliability of the building and its facilities and infrastructure in order to always be feasible in functions.

Lateef et al. (2009) describe maintenance as the process required and the service performed to preserve, protect, enhance and maintain the buildings and services upon completion, along with the applicable standards to enable the building and services provide appropriate functions intended throughout the useful life of the building without disturbing the basic features and its usefulness.

Performance of the hospital building and its components depends largely on continuous periodic maintenance and plans, challenging owners and facility managers to conduct proper planning based maintenance programs. Despite the growing need for lower operating costs, facility managers must ensure that the facility is built and maintained efficiently without compromising safety. In addition, decision-makers with regard to the maintenance of hospital buildings are often called upon to decide whether the maintenance tasks are to be performed by permanent internal personnel (in-house provision) or by an external contractor (outsourcing).

Maintenance has become a principal phase in the life-cycle of built assets. The high performance of hospital buildings requires that maintenance considerations be taken into account at early stages of design. Maintenance management issues play a major role in the performance of constructed facilities. Outsourcing of one or more maintenance services may entail various difficulties, such as unemployment issues, loss of skills, lack of internal expertise to manage outsourcing contracts, potential loss of control, etc. On the other hand, outsourcing may result in cost savings, improved quality, the transfer of knowledge from outside specialists to internal personnel, etc. (Atkin and Brooks, 2000; Valence, 2000; Harris et al., 1998). Jashapara and Kisters (2000) showed that none of the London hospitals were interested in input specifications that involved detailing of inputs, such as labour, materials, methods and frequency of inspections. Instead, hospitals favoured output specifications, as they defined the desired performance of the service providers. This allows the latter to utilise their own expertise and to develop innovative approaches to service delivery.

The main purpose of maintenance is to ensure a building remains in good condition so that it can perform the functions required.

The objectives of building maintenance are therefore (Alner and Fellows, 1990):

- to ensure that the buildings and their associated services are in a safe condition;
- to ensure that the buildings are fit for use;





- to ensure that the condition of the building meets all statutory requirements;
- to carry out the maintenance work necessary to maintain the value of the physical assets of the building stock; and
- to carry out the work necessary to maintain the quality of the building

Keeping a structure in a good shape for it to perform creditably engulfs a comprehensive outlook. There are questions which need answers as to what to maintain or take away from the structure for it to be able to befit a worthwhile standard. According to Bismark et al. there are three main components of maintenance which are servicing, rectification and replacement.

This current act of repairing a building, plant or machinery for it to be in a good state. It is normally executed at regular intervals of varied frequency to avoid wear and tear of the structure. In most cases servicing includes daily sweeping, removal of cob webs, greasing polishing, painting and the like. It is therefore normally seen as daily or day-to-day activity maintenance.

In terms of buildings, it normally occurs during the design stage of the building process. Normally some of the designs do not fit into the functional requirement of the building, and in some cases, climatic conditions would not allow for the building to last with such designs and as such, the designs need to be corrected. Some need for rectification include installation defects and incorrect assembly, unsuitability of components, damage of goods in transit and so on.

For example, a leaking roof, obsolete door, malfunctioning tap, and so on. Due to the fact that depreciation affects almost every item due to both natural and artificial occurrences, replacements are very convenient to put the building in a good shape. It is however imperative for the manager to use quality materials to avoid frequent replacement.

In maintaining a building, there are usually several strategic options available to management, and many alternative decisions to be considered. There is, for example, the possibility of reducing the demand for maintenance by addressing the actual cause of failure and identifying its consequences. For instance, it may be necessary to decide whether to repair or replace an item, and whether to carry out periodic maintenance at fixed intervals or simply to respond to the requests of the users. Thus, building maintenance can be divided into three strategies (Horner et al., 1997): corrective, preventive and condition-based.

Corrective maintenance is the simplest type of maintenance strategy, where an element in a building is used until it breaks down. It covers all activities, including replacement or repair of an element that has failed to a point at which it cannot perform its required function. Corrective maintenance is sometimes referred to as failure-based or unplanned maintenance. Corrective maintenance tasks often take places in an adhoc manner in response to breakdowns or user requests (David and Arthur, 1989). Thus, corrective maintenance can be extremely expensive for two reasons:





1. The failure of an item can cause a large amount of consequential damage to other elements in the building. For example, failure of the roof could cause damage to the ceiling and the interior of the building.
2. Failure of an item can occur at a time which is inconvenient to both the user and the maintaining authority. This can make manpower and spare parts planning extremely difficult.

Preventive maintenance was introduced to overcome the disadvantages of corrective maintenance, by reducing the probability of occurrence of failure and avoiding sudden failure. This strategy is referred to as time-based maintenance, planned maintenance or cyclic maintenance. Preventive maintenance tasks are performed in accordance with a predetermined plan at regular, fixed intervals, which may be based for example on operating time. Such a strategy is frequently applied to external or internal paint work. The following are the advantages of preventive over corrective maintenance (Raymond and Joan, 1991):

- maintenance can be planned ahead and performed when it is convenient to the building's user;
 - maintenance costs can be reduced by avoiding the cost of consequential damage;
 - downtime, the time that an element of the building or the whole building is out of service, can be minimised so the habitability of the building can be increased; and
 - The health and safety of the user can be improved.
- Nevertheless, preventive maintenance has some disadvantages which must be minimized (El-Haram, 1995):
- Planned maintenance is performed irrespective of the condition of the building elements. Consequently, a large number of unnecessary tasks will be carried out on elements that could have remained in a safe and acceptable operating condition for a much longer time.
 - The condition of an element may end up worse than it was before, as a result of human error during the execution of the maintenance task.
 - Planned maintenance tasks are usually very demanding in terms of spare parts and labour.

Condition-based maintenance is defined as: "Maintenance carried out in response to a significant deterioration in a unit as indicated by a change in monitored parameter of the unit condition or performance" (Kelly and Harris, 1978). The condition-based maintenance concept recognises that a change in condition and/or performance of an item is the principal reason for carrying out maintenance. Thus, the optimal time to perform maintenance is determined from a condition survey used to determine the actual state of each constituent item in a building.

In this strategy, maintenance tasks are determined and planned by efficiently monitoring the building's elements such as walls, floors, roof and service equipment such as boilers, pumps, and heating system, to identify which element or piece of equipment requires maintenance before a major failure occurs. To gain the full advantage of applying condition-based maintenance, the condition of an item must be monitored to identify whether there is any evidence of change from a normal to an abnormal condition. This can be





done by selecting the parameter which best describes the condition of the item and monitoring changes using suitable condition monitoring tools. Condition assessments can vary from simple visual inspections to more advanced inspections using a variety of condition monitoring tools and techniques.

According to Horner, El-Haram and Munns (1997) to determine the optimal maintenance strategy for a building, it is necessary to combine all three types of maintenance strategies because not all items are important. Of the important items, some cannot be monitored as condition monitoring techniques are not always available and cost-effective.

British standard (BS3811) classifies and defines the main types of maintenance as follows:

- I. **Planned Maintenance:**
Maintenance organised and carried out with fore thought, control and the use of records to a predetermined plan. The plan should be comprehensive and systematic encompassing both short and medium-term considerations. The program should be based on sound knowledge of the building with particular regards to the life of the building, the standard to be achieved, the financial implications and the responsibility for maintenance.
- II. **Unplanned Maintenance:**
Maintenance carried out to no predetermined plan. It refers to works necessitated by unforeseen breakdowns or damages, for example repairing of a roof after torrential rainfall.
- III. **Preventive Maintenance:**
Maintenance carried out at predetermined intervals or corresponding to prescribed criteria and intends to reduce the probability of failure in a building.
- IV. **Corrective Maintenance:**
Maintenance carried out after a failure has occurred and is intended to restore the facility to a state in which it can best perform its required functions.
- V. **Emergency Maintenance:**
This is maintenance which is necessary to be affected immediately to avoid serious consequences.
- VI. **Conditioned-Base Maintenance:**
The preventive maintenance initiated as a result of knowledge of the condition of an item from routine or continuous monitoring.
- VII. **Scheduled Maintenance:**
The preventive maintenance carried out to a predetermined interval of time, number of operations, seasons, etc.



VIII. Running Maintenance:

This is Maintenance which can be carried out whilst an item is being used such as the day-to-day cleaning of the building.

IX. Shutdown Maintenance

This refers to maintenance which can only be carried out after the building is evacuated or out of service.

X. Deferred Maintenance:

These are maintenance works which have been identified as necessary but put off due to lack of funds.

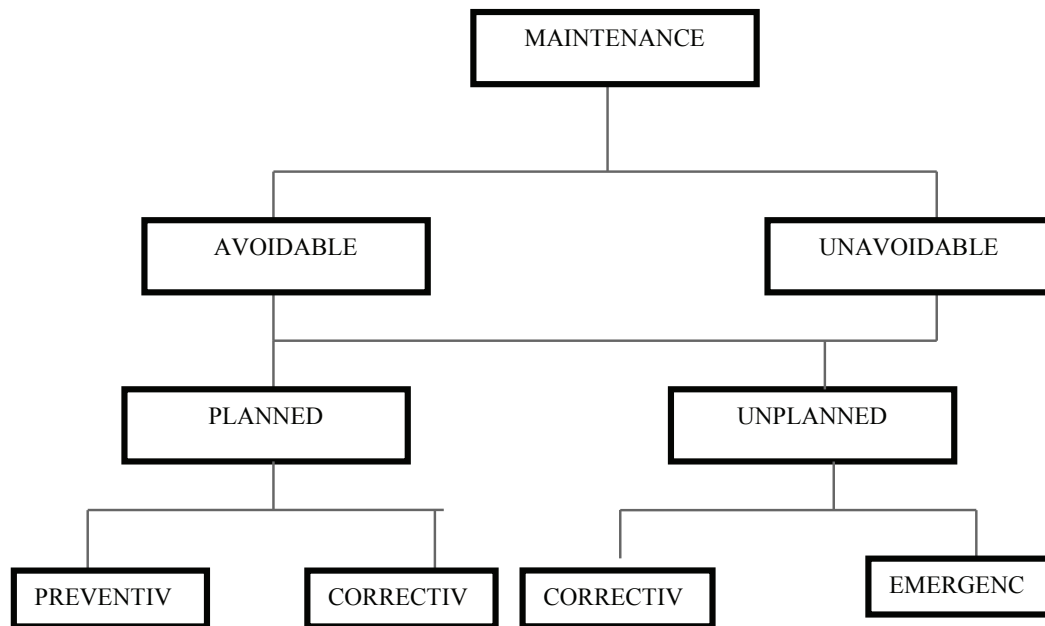


Figure 2: Types of Maintenance



Another approach to maintenance classification has been adopted by Speight (1982). It divides maintenance into three broad categories:

- I. Routine or day-to-day maintenance: This is largely of the preventive type, such as daily sweeping, scrubbing, etc.
- II. Periodic maintenance carried out at specific times such as painting every Christmas or fumigating a school every academic year.
- III. Major repair or restoration: such as re-roofing or rebuilding defective walls and often incorporating an element of improvement.

Maintenance of a Hospital building is how best to achieve customer satisfaction from those occupying it. The above maintenance strategies can be implemented effectively and efficiently to the maintenance of hospital buildings. Recent attempts to apply QFD principles to a hospital building concentrated upon gaining a greater understanding of customers' needs and how to engineer the process to best meet these needs.

2.1 Quality Function Deployment (QFD) method for Hospital Building Maintenance

For the service providers who are engaged in the repair and maintenance of hospital buildings, where the customers can easily come to enjoy their services, the role of Service Quality is paramount. Service Quality is one of the methods used to measure customer satisfaction of the quality of services offered by service providers. Quality of service is described as the totality of the service characteristics that represents its ability to satisfy the customer's desire, both apparent and hidden (Kotler and Armstrong, 2008).

Furthermore, the quality of service can also be defined as an assessment of customers over the superiority or privilege of the overall services (Zeithaml, 1988). It is closely related to customer perceptions about the quality and qualifications of the service. In other words, the better the service performed, the greater the level of satisfaction felt by the customer. Conversely, if the service is unsatisfactory, the business itself is also considered less qualified. Thus, service providers should always strive to maximise their quality of the service.

The first benefit of using QFD is that the method is 100% focused on the customer. It strongly considers customer needs and interests, giving a higher probability of success regarding customer satisfaction. Another benefit is QFD improves communication throughout the team and also to the customers. Horizontal communication falls within the repair and maintenance services company for hospital buildings. More than one department in the hospital will work on the QFD process. This in turn will lead to repair services and building maintenance staff better understanding the needs of customers, thus streamlining consensus around the decision-making process.





Another benefit associated with QFD is the emergence of greater opportunities for improvement of hospital building repair and maintenance services, which can be better implemented in accordance with customers or stakeholder needs customers feedback. By implementing QFD, we can also reduce the number of design changes of repair and maintenance work in the hospital, thus ensuring the best quality of service. Lastly, when focusing on the customers' needs regarding what they deem most important in repair and maintenance services, there is an increased likelihood that services will be carried out to the satisfaction of stakeholders.

QFD process is created using the premise that seeks transformation demands from customers (stakeholders) into quality design of the services/ products, by using different methods to achieve its services/ products as a whole. This is useful in planning the characteristics of services/products that are new or already existing based on company marketing regions. Ultimately, it translates customer desires step-by-step by prioritising many characteristics of the product in accordance with the expectations of the customers (stakeholders).

QFD began thirty years ago in Japan and was made based on the desire to provide products or services in accordance with the wishes of the customer. Thus the QFD process is very focused on effectively achieving customer needs. Founders of the QFD models, Dr. Shigeru Mizuono, Dr. Yoji Akao, Dr. Tadashi Yoshizawa and other qualified researchers, further developed QFD so that it can be applied to different fields and better maintain customers' or stakeholders' satisfaction.

Quality Function Deployment (QFD) is a structured method of product planning and development method that allows a company's team to clarify desired specifications or customer requirements in order to evaluate advantages and disadvantages of each product or service being offered (Cohen, 1995). Approach of maintenance discipline lie in product design, engineering and productivity and provide deep evaluation of a product.

According to Ermer (1995), QFD is a quality improvement method based on directly seeking input from the consumer on how best to meet the input. Meanwhile, according to Daetz et al. (1995), QFD is a systematic planning process that was created to help businesses organise all of the elements needed to define, design and make products or provide services that can meet the needs of the customer. QFD is used to capture the sound of customer desires and convert them to the right strategy, using the right products and processes required. The expectations of a customer are translated into specific needs which dictate the direction strategic planning and action techniques should take.

An organization that implements QFD appropriately can improve the knowledge of engineering productivity, quality, and reduce the cost of product development and engineering changes. The purpose of QFD itself is not only to meet customer needs as much as possible, but to try and exceed





customer expectations in order to compete with rivals. The QFD team must make its product more attractive than the existing product or a product more attractive than its competitors.

Application of QFD in the product design process begins with the development of the product planning matrix, often referred to as House of Quality (HOQ). Figure 3 shows the general form of the product planning matrix for the HOQ. The images used in the letter symbols (A) to (F) show the sequence of filling parts of the product planning matrix. Using the product planning matrix, HOQ describes the customer needs, company targets, and evaluation of competitor products, illustrating the design structure in the shape of a house.

a. Section A

The first section of HOQ is the need/desire of the customer, (customer needs and benefits). This phase is using the affinity diagram arranged in a hierarchy from the lowest-level requirements to the highest. Most development teams collect the “Voice of the Customer” through interviews and then arrange them in a hierarchy. Failure to maximise customer engagement often leads to a misunderstanding between the customer and the development team. When a team of product developers do not understand the desire of customers, then product planning activities will run slowly (Cohen 1995).



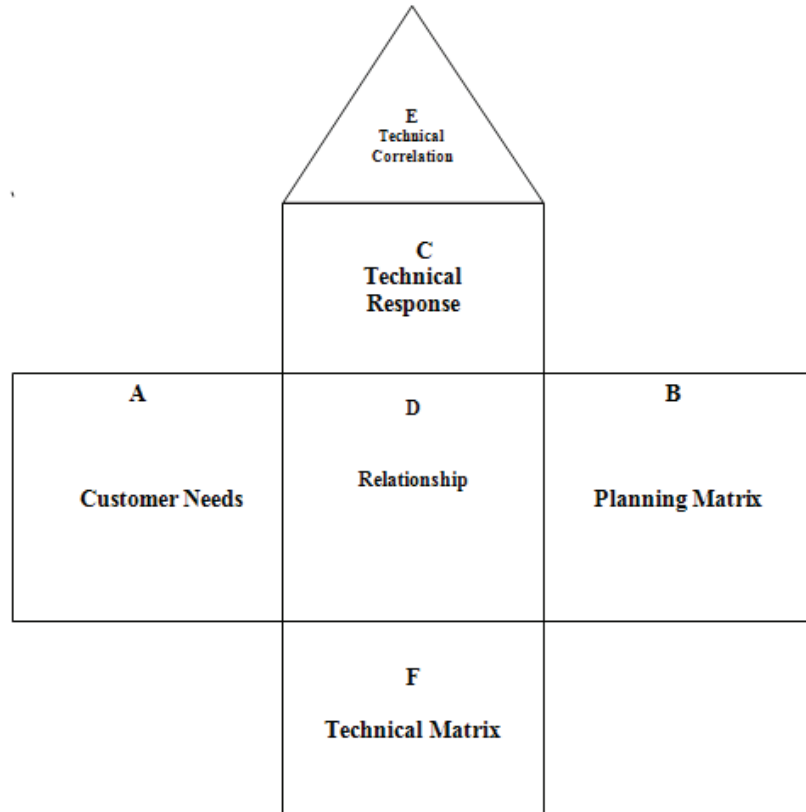


Figure 3: House of Quality (HOQ)

b. Section B

Planning matrix is the second section of the HOQ and referred to the product destination based on the interpretation of the data market research team. Goal setting is a combination





of priority needs of the customer. This is an important stage of product planning (Cohen, 1995). The planning matrix contains three types of important information:

- Quantitative market data, which shows the relationship between the level of importance needs and customer satisfaction, and the level of competition.
- Setting goals/objectives for the product type (new services).
- Calculation of rank order of desires and needs of consumers (Cohen, 1995).

One reason to fill the planning matrix as soon as the Customer Needs/Benefits is completed is because the QFD team may choose to restrict the analysis only to the highest level of customer needs. Consideration of this step is to reduce the time required to complete the QFD process. If the planning matrix is postponed until some time after the Relationship section is filled, then the team will not be able to make any analysis as they will not know what Customer Needs are the highest. But some practitioners are working on the Technical Responses and can even determine the relationship before working on the planning matrix. The advantage of this method is the team will be more familiar with the needs of the customer (Cohen, 1995).

c. Section C

The third section of the HOQ is the Technical Responses; a description of a product or service to be developed. It is usually derived from the first section of Customer Needs from the HOQ. There is some technical information obtained in responses, with the most common alternatives being:

- Top level solution independent measurements or metrics.
- Product or service requirements
- Product or service features or capabilities

Any information selected is referred to as a Substitute Quality Characteristic (SQC). If the customer needs/ benefits represent the voice of the customer, then SQC represents the voice of the developers. By placing both sounds to the left and above the matrix, their relationship can be systematically evaluated.

d. Section D

The fourth section of the HOQ is Relationship, which is the largest part of the matrix and the biggest part of the work at this stage of the priority matrix method. For each cell in a relationship, the team gives a value indicating existence of the SQC (upper column) related with customer needs (left side). This shows the value of customer satisfaction. Symbols used for column



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Relationship, among others, are as follows:



For weak relationship with score 1



For medium relationship with score 3



For strong relationship with score 9

Source: Cohen, L. (1995)

e. Section E

The fifth section of the HOQ is the Technical Correlation Matrix which resembles a roof. This matrix is used to help the QFD team determine where design experience bottlenecks and to determine key communications among designers. Additionally, it shows the correlation between the technical requirements with other technical requirements contained in matrix C.

Symbols used for the technical correlation are as follows:

•	++	=	strong positive
•	+	=	positive
•	0	=	empty
•	x	=	negative
•	xx	=	strong negative

f. Section F

This section contains three types of data, namely:

- Technical Response Priorities: sequence of technical requirements comparing results.
- Technical Competitive benchmarks: information on technical requirements, performance comparison of results of the products produced by the company against the performance of competitors' products.
- Technical targets: technical requirements performance targets for products or services that will be developed.

The explanation of the information is as follows:

- The level of interest is obtained from multiplying the amount of importance to the customer with the value in the technical response column.
- Absolute Performance is the sum of the multiplication of the value of relationships with normalised raw weight.





- Relative Performance is the absolute percent of the total performance.
- Unit of Measure is a unit of technical response.
- Current Product is the value of the product being developed.
- Target Value is the target to be achieved by the development team so as to meet customer desires.

After studying the theory of CRM, SERVQUAL and QFD, all are used for the development of a product, and how best to achieve customer satisfaction. Of the three, the most easily implemented in Hospital building maintenance is QFD (Quality Function Deployment), because:

- a. According to Akao Y. (1996), QFD is an approach to design that focuses on four main processes, namely: product planning, design planning, process planning, and production planning. All of these processes are structured to facilitate the systematic and technicians to realize the desire of consumers appropriately.
- b. Based on research conducted by Duffuaa, Al-Ghamdi, and Al-Amer (2002), the QFD planning matrix was adjusted to design the maintenance work. It has proven to be an effective tool to plan and deploy maintenance work.
- c. According to Cohen (1995), QFD is a method of planning a product or service as well as a structured method which allows a company's development team to explain the specification of requirements and desires of customers. In formulating the needs and desires of customers, especially in the case of maintenance management, the QFD approach and analysis is reliable. We can see the QFD methodology helps in formulating development of team attributes in order to meet the desires and needs of customers.

3.0 Conclusion

This paper attempts to review hospital building maintenance by using a quality function deployment concept. Some issues that can be highlighted are poor maintenance program in place for hospital buildings in Indonesia, which are necessary to provide public health and medical treatment to citizens. Thus, an improve maintenance strategy is required in order to provide the necessary services and gain customer satisfaction. In addition, to determine an optimal maintenance strategy for a building, it is necessary to integrate the three types of maintenance strategies as not all items are significant; not all significant items can be condition monitored; condition monitoring techniques are not always available; and the application of condition monitoring techniques is not always cost effective. Furthermore, QDF is one of methods that is appropriate to use to improve hospital building maintenance in order to fulfill customer and stakeholder expectations.





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