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MAINTENANCE MANAGEMENT FOR PUBLIC INFRASTRUCTURE FOR MALAYSIAN LOCAL AUTHORITIES

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ABSTRACT

Proper and timely maintenance and rehabilitation of facilities is essential for safe operations and the overall economics. Decisions as to what, where, when, and how maintenance and rehabilitation should be performed need to be made. These decisions must consider condition, but budget constraints and other tangible and intangible issues also affect the decision-making process. However, this public satisfaction level is unachieved due to lack of proper facilities management and lack of awareness among the local authorities' staffs in Malaysia. This research investigates current implementation in maintenance management and to make recommendations to improve infrastructure maintenance management in Malaysian local authorities Through the interviews and questionnaires that are directly being conducted with the maintenance personnel give a clearer picture on the problems arise by the maintenance personnel in local authorities during carrying out their infrastructure maintenance work. Approach used by most of the local authorities in taking action on the maintenance of infrastructure works are almost the same except their different ways of selecting or appointing the contractors are a bit different. Views from the maintenance personnel regarding the obstacles arise in carrying the maintenance works has to be address correctly, so that the maintenance works for the infrastructure facilities are to be carried out effectively.

Keywords: maintenance management, local authorities.

INTRODUCTION

Maintenance aspect needs to be part of integral part of a project. However, over the years, use and the environment cause infrastructure to deteriorate. Compounding the problem, the ever-increasing frequency of heavy loads on pavements and track serves to accelerate the degradation process and profoundly affect vehicle operation. Infrastructure deteriorate translates into money requirements. This, in turn, increases maintenance and rehabilitation costs (McNeil, Markow, Neumann, Ordway, Uzarski, 1992). Before examining the tools available for infrastructure management, the process used is briefly reviewed (McNeil *et al*., 1992). Therefore, these constraints have to be considered and to study the level of it influence towards the decision making of carrying maintenance work. If the maintenance cannot perform well, therefore it shall tarnish the image of the respective local authority.

Local Authorities in Malaysia have responsibilities to ensure its public infrastructure facilities performing well up to public satisfaction level. However, this public satisfaction level was unable to achieve due to lack of proper facilities management and lack of awareness among the local authorities' staffs in Malaysia. In addition to that, lack of maintenance culture of the facilities in Malaysia is also brings poor maintenance activities carried out (Abdullah, 2006). Under Ninth (9^{th} Malaysia Plan), the Government has allocated a total of Ringgit Malaysia 1, 0179 million (GBPound 230 million) for 'upgrading and renovation' as part of its developmental budget. It clearly reflects the Government's commitment in ensuring the facilities are upgraded, maintained and managed. Despite the Government commitment and the mechanisms that are in place, there is evidence of shoddy work, and buildings falling into despair a couple of years upon completion (Hassan, 2007). Poor awareness and management have caused short of maintenance activities. Moreover, proper management for government buildings and public infrastructures facilities has been carried out, which has caused the government losing billions of Ringgit (Abdullah, 2006). Maintenance, repair, rehabilitation, and reconstruction of infrastructure are important to the economic well-being of the nation. An appropriate maintenance management tool should be used and any suitable tools available can be used to assist decision makers to ensure the facilities are well-managed (McNeil *et al*., 1992).

Problem statement

In Malaysia, the idea of a scientific and systematic facility audit for performance, effectiveness and efficiency is in its infancy. The awareness level from the society is very low. When the economy is booming, costly repairs and maintenance may be done as a routine exercise, but when the reverse occurs, too often only emergency maintenance and repair is undertaken (New Straits Times, 2001). This has shown that the priority was not carried out for the maintenance works for the available facilities in Malaysia. Furthermore, to make it worse, there are also vandalism activities that take place, which regards to the public facilities. According to Abdullah (2007), heavy punishment should be imposed to the people who caused vandalism and to the officers who fail to carry out proper maintenance of the government facilities towards developing maintenance culture in Malaysia. All government departments should setup their own monitoring unit to carry out routine investigation on the

asset and facilities to make sure the facilities are in good working condition.

Objectives

The following research objectives are as follows:

a) To investigate the current management practice of the infrastructure maintenance management in local authorities.
b) To compare the current maintenance management practices within local authorities.
c) To recommend a good practice on maintenance management carry out by Malaysian local authorities.

Overview on maintenance management in Malaysia

According to Hassan (2007), the facilities on the infrastructure maintenance are not in good working condition when assets like machinery, utilities, roads, sewage systems, buildings and vehicles are in good working order, there will be substantially less wastage of time and resources on repair and rework, as well as fewer delays due to breakdowns of assets. This in turn will lead to the improvements in service delivery. For local authorities, service delivery to the public is very important since the public pay tax to local authorities and of course they expect a good delivery of service by the local authorities. However poor maintenance of public infrastructure tends to tarnish local authorities' image besides giving much problems in repairing it in future which involve high cost.

There should be a review being set up to improve the maintenance process. The review process must also take into account capacity building or facilities necessary to facilitate effective asset management. Hassan (2007) also emphasized the importance of inculcating the maintenance culture in Malaysia and should not be treated as a peripheral function but should be consider as an integral part of projects. The construction players should factor in the cost of maintenance of assets and budget for it.

He contended that all projects and purchases of assets must include the cost of maintenance. In order for asset management to become part of Malaysian culture, Hassan (2007) urged Malaysian construction players to look at it in a different light. Maintenance should not just be confined to specific agency or department. Malaysian construction players should bothered about the lack of maintenance of other organizations and agencies and should be able to point out the weaknesses whenever they are encountered. Maintenance and asset management is everybody's business and everybody's responsibility and explained about the importance of maintaining the infrastructure facilities as an asset in order to make sure that the facilities are in good working order. By doing this, it shall improve the delivery of service to the public. Malaysian construction players have a lack of maintenance culture due to poor understanding on the infrastructure maintenance as discussed in this study.

Definition of infrastructure

A more generic definition of infrastructure is the network of assets "where the system as a whole is intended to be maintained indefinitely at a specified standard of service by the continuing replacement and refurbishment of its components." In this paper, the infrastructure works consists of roads, drains, street lightings and traffic lights and were financed by the public via taxes, public charges or other. It is in any case the citizen who pays and, of enjoys the benefits derived from their existence. Our generation must not leave the burden of maintenance or replacement of too short-lived structures to future generations (Rackwitz *et al*., 2004). These various elements may collectively be termed civil infrastructure, municipal infrastructure, or simply public works, although they may be developed and operated as private-sector or government enterprises.

According to Wireman (1990), maintenance management can be defined as a combination of all technical, administrative and managerial actions during the life cycle of an item, intended to retain it or restore it to, a state in which it can perform the required function. Maintenance management plays an important role to determine the successful of maintenance work carry out by one department or organization. Therefore, to ensure the effectiveness of maintenance, it is important to have good management applied to execute the maintenance work. However, according to Armstrong (1987), maintenance management defined as the organization of maintenance within an agreed policy that determine the maintenance objectives and responsibilities and how to implement them by means such as maintenance planning, maintenance control and supervision, and several improving methods including economic aspects in the organization. This definition of maintenance management is very aligned to other such notions found in modern maintenance literature such as Campbell and Jardine (2001), Campbell (1995) and Shenoy and Bhadury (1998).

Wireman (1998) considered maintenance management as the management of all assets owned by a company, based on maximizing the return on investment in the asset. He said that maintenance management would include, but would not be limited to, the following: preventive maintenance (PM), inventory and procurement, work order system, computerized maintenance management systems (CMMS), technical and interpersonal training, operational involvement, proactive maintenance, reliability centred maintenance (RCM), total productive maintenance (TPM), statistical financial optimization, and continuous improvement. Each of these initiatives is a building block of the MM process.

Duffuaa *et al*. (2000) indicated that how a maintenance system can be seen as a simple input - output system. The inputs are the manpower, management, tools, equipment, etc., and the output is the equipment working reliably and well configured to reach the planned plant operation. They show that the required activities for this system to be functional are maintenance planning (philosophy, maintenance workload forecast, capacity, and

scheduling), maintenance organization (work design, standards, work measurement, and project administration) and maintenance control of works, materials, inventories, costs, and quality oriented management. 'Maintenance' in the context of this report is defined as the work necessary to realize the originally anticipated life of an asset. 'Repairs' are work completed to restore damaged or worn out facilities and assets to their normal operating condition. Repairs are curative, while maintenance is preventative.

Maintenance Management is the effective planning and execution of tasks performed to maintain the operation of equipment and facilities. It spans many diverse functions and responsibilities, ranging from designing maintenance jobs to providing and managing the resources needed to complete the work. Maintenance operation covers divers' areas including physical plant, production equipment, building service, equipment, building structure, utilities, sanitation, ground care, material handling equipment and compliance with building safety and pollution codes as well as the minimizing of energy expenditures. Sainan (2005) mentioned that accurate information on equipment to be maintained is essential in order to success in planning the maintenance procedure.

Maintenance management is not a static process, but it is dynamic in the sense that the strategy and policies are continually reviewed to ensure that it is in line with the overall objective (Coetzee, 1999). Therefore, local authorities should all the time giving concern and should put an effort for improvements to achieve its objectives in order to make sure its infrastructure facilities are in good condition. Demands by the public as a stakeholders and taxpayers regarding the maintenance of public infrastructure need to be addressed and serious actions need to be taken.

With the competitive marketplace pressure increase, business owners and managers need to find new and better ways to control the cost of doing business and the efficiency of maintenance and engineering department was been given an emphasized. Current building and infrastructures facilities are becoming more complexes. The cost of repairs are getting higher and becoming critical. An appropriate maintenance management are essential in-order to maintain the infrastructure facilities. Sainan (2005) informed that industry statistics show that billions of dollars was spent annually to maintain physical plants, commercial building, educational and healthcare facilities and equipment. Over one-third of all the dollars spent on maintenance was wasted due to poor or inadequate maintenance management.

METHODOLOGY AND ANALYSIS

In-depth interviews were conducted with ten (10) maintenance works personnel from four local authorities. Within the local authorities, maintenance personnel are the key person who carried out the maintenance work beginning from attending the complaints from the public, prepare costing, supervising the work and verify the completed work before payment can be made. These personnel play an important role since there are the right persons who attend to the complaints made by the public, which regards to the poor maintenance or poor condition of the public infrastructure facilities. Input from these personnel are valuable in order to get a clear picture on the challenges facing by the local authorities in carrying out public infrastructure maintenance work. Without addressing these challenges, a good process or procedures being proposed does not work out properly since the challenges are not being well attended. As for the purpose of this research, these maintenance personnel are the ones who give rates on what are the challenges in carrying out maintenance works for local authorities.

The local authorities were AXA Municipal Council in Central Region where most of progress and development is taking place. This is where most of the rapid development takes place and with the highly populated population and with the huge public infrastructure being provided as in relation to this research in terms of carrying out the maintenance works for public infrastructure works. Thus, the samples selected were expected to provide a good representation of the wider population. Other local authorities are BXB Municipal Council, represent northern region. This local authority was chosen due to its locality farther from Klang Valley to the north and their population and rate of development are different from Klang Valley. CXC Municipal Council represent eastern region of Peninsular Malaysia and DXD represent southern region.

For each of the organizations, three personnel from three levels of ranks, i.e., Executive management, middle management and operational management were selected. This is to check the consistency of the responses from the respective personnel in consideration of their different authority, functions, experience, exposure and knowledge of the maintenance work. Their views are vital as they are the person in charged in carrying out maintenance work for local authorities. Each level of ranks probably gives different views about maintenance functions.

These personnel are involved in various types of maintenance work such as maintaining roads within municipal, drainage, street lightings and traffic lights. For the purpose of this study, the respondents were asked to identify the challenges and critical success factors for maintenance work. During interviews session the respondents were asked about overall processes in the department related to maintenance works. This consist of the department strength in term of financial, staffing, maintenance work processes and procurement method in appointing contractor to carry out maintenance works for local authorities.

It must be highlighted again though that the results of this study might not be used to generalize the scenario of the whole local authorities in Malaysia but instead it is specific only to the case study in this research. The research instrument consisted of a face to face brief survey interview questions. The questionnaire on

maintenance management, developed by Wireman (1995) was used to analyse the maintenance organisation of the maintenance department.

The purpose is to get the views, perception and observation of the respondents on maintenance challenges, critical success factor, caused of delays in carrying out maintenance work, ways to improve delays and areas to be emphasized which regard to time, quality and cost. This would enable to gather information pertaining to the reasons why the local authorities having problems in carrying maintenance works in urgent matters.
Among the most important roles of the council are:

a) To plan and encourage the growth of the City according to the laws and guidelines set by the State and Central Governments.
b) To prepare and maintain public amenities such as the roads, drains, sewers, street lights, market places, hawker stalls, bus and taxi stands, and such.
c) To give services related to the city and public health such as the disposal of solid waste, sewerage, road and drain cleaning, and such.
d) To maintain public health by monitoring food producers, preventing contagious diseases, conducting pest control operations, etcetera.
e) Planning and carrying out beautification projects within the city and its tourist attractions.
f) Preparing and servicing sports complexes, recreational centres, parks and other city amenities.
g) Planning and encouraging trade, industrial, and tourism activities in line with the state development strategy.
h) Planning and encouraging the development and growth of small businesses and hawkers by adding facilities and providing licenses.

Malaysian local authorities practicing corrective and emergency maintenance

Basically, Malaysia local authorities practiced corrective and emergency type of maintenance rather than preventive of planning maintenance. Based on the interview held, these factors were due to insufficient budget to carry out the maintenance work by local authorities. They have tried a few times in preparing the planning programme of maintenance work and inspection, however, when it comes to implementation, it will only last a few weeks. They cannot work out what they have planned earlier due to the budget constraints and also due to a lot of emergency maintenance events received as reported by the public, which the department need to made adjustment on, they planned and they cannot stick to what they have planned earlier.

Completed project shall be inspected and verify for payment.

a. Application or request received from public which regards to the maintenance works to be carrying out by local authority. The report or complaint being recorded before it will be sent to the Director of Maintenance Department
b. Instruction will be issued to technical assistant or technician to do the inspection and verification on the request. The technician shall visit the site and prepare report on the findings and costs involve doing the repair works.

Approval files shall be opened which consist of:

- Site photographs
- Copy of the complaint or public request
- Location plan
- Job specification and expected cost

c. The technician shall minuted and completed the report before it was sent for approval
d. The Engineer shall check the documents and do the verification on the report for President approval and for the works to be carried out.
e. Contractor shall be appointed. Different local authorities practice their own method in selecting contractor to do the maintenance project.
f. Award letter shall be issued to the contactor to carry out the project
g. Construction stage and project monitoring works by the local authorities. Report on the progress of work shall be prepared by the technician
h. Completed project shall be inspected and verify for payment

From the interview, it was found that all the local authorities are basically using the same process of work flow in carrying their maintenance project. The only huge different is that they have practices different way in selecting the contractors specifically for the small project under Ringgit Malaysia (RM) 2, 000.00 (GB Pound 300) AXA used direct award method for selecting the contractors. It is normally being chosen from the list prepared by the department based on the registration made by the contractors to the department, which was made at the early period of the year. The selecting contractor exercise is only involving a few people and the exercise were not carried out in public. By using this method there is a tendency of the same contractor is being given more than one project where else other contractors are not getting any job yet. There is a lack of transparency involved whereby only few people are involved in selecting contractor exercise. The information was not disclosed to public whereby the public or contractors do not know their statuses in getting jobs from AXA. Unhealthy perception by public and contractors might happen and it shall tarnish AXA image in a long run.

CXC practices an early of the year registration of contractors, which involve the whole MPK departments. Contractors were invited to register with CXC in order for them to get small project. A list of registered contractor will be prepared which is to be used by all departments in CXC throughout the registration year. An independent

department such as Procurement department shall conduct the processes of choosing the contractors based on the sequence of contractors which were listed in the list. By doing this, there is no chance of one contractor getting more than one job within CXC for the whole year unless the first cycle of the list has been completed. Maintenance department or other departments in CXC shall request name of contractors from the Procurement department when there is a need for any jobs to be carried out. This approach can be used in normal pace of maintenance work and also for an urgent basis maintenance work.

BXB practices a balloting method in selection the contractors. They shall stick the advertisement which gives information of the balloting day and what documents the contractors need to bring on the balloting day. The advertisement will be on the information board around their office premises. Normally they practice the balloting exercise at the early week of every month. The contractor shall bring the necessary documents as stated in the advertisement on the balloting day. They should write their company names on the registration form of contractor before entering balloting exercise. This balloting exercise is quite transparent and based on the interview conducted with BXB engineer; he said that until now they have not received any complaint from the contractors regarding that balloting approach in terms of lack of transparency. The only weaknesses in this approach is that, the balloting exercise was only being carried out once in every month and if there is an urgency in carrying out urgent jobs in between the period BXB shall use the normal direct award exercise. The balloting exercise was carried out by independent department which is Procurement department.

DXD practices an open tender approach for the contractors to bid even though the jobs are only small which is under RM20, 000 (GB Pound 4, 000). The maintenance department shall prepare related documents for President Approval. Once they have been approved, they shall open tender the projects on the bill board located around the local authority's office. The tendering processes are to follow the normal tendering processes. The contractor shall buy the tender document and any other information required they have to follow what has been given in the advertisement to call for tender. The engineer or maintenance department personnel shall brief tender board on the short listed contractor's base on their bid. Normally the tender board shall select the lowest price bidding contractor. This tendering approach shall give DXD a cost saving because the contractors tend to lower down their prices during bidding processes. There is transparency elements involve because the selecting of contractors exercise was decided by the tender board rather than being made by a few personnel. These tendering processes take a longer period of time compare to direct award approach, however, it is more transparent and gives cost saving to DXD.

CONCLUSIONS

Different perspectives has been given by different local authorities during conducting the case studies, however generally it has highlighted that maintenance management practice carry out by the local authorities is not the main obstacle or major problems for the local authorities in carrying out infrastructure maintenance works. There are other constraints which may hinder the effectiveness of the maintenance works carrying out by the local authorities as highlighted by the maintenance personnel. Through interviews and questionnaires directly being conducted with the maintenance personnel give a clearer picture on the problems arise by the maintenance personnel in local authorities during carrying out their infrastructure maintenance work. Approach used by most of the local authorities in taking action on the maintenance of infrastructure works are almost the same except their different ways of selecting or appointing the contractors are a bit different. The method of appointing the contractor is important because for instance, if tender process is being chose, it shall take a long time due to it has to go through a long processes of tendering. Current practices in carrying out the maintenance work can be accepted however they have to choose right method of selecting the contractors to carry out their maintenance works. Views from the maintenance personnel regarding the obstacles arise in carrying the maintenance works need to be addressed correctly so that the maintenance works for the infrastructure facilities can be carried out effectively. It can be concluded that:

a) Not enough staff is the most common challenging constraint to infrastructure maintenance programmes. Shortage of experience staff is also becomes a major constraint in carrying out infrastructure maintenance work for local authorities.
b) Sufficient budget is the factor to be critical to the successful implementation of infrastructure maintenance works. Long term financial planning and ring fenced budgets for maintenance are also essential if coherent and comprehensive maintenance management is to be implemented successfully.
c) Preparation of documents is the most contributing to delays in the implementation of maintenance project during the project implementation stages. Appropriate procedures or further improvement in the work processes need to be simplified in order to speed up the preparation of documents. This is to avoid delays in preparing documents before it can be sent for approval by the management.
d) Preparation of documents stage was identified to be the require stage for improvements to enhance maintenance work. Simplification on the current processes should be introduced to speed up the process.
e) There are no regular inspections and no regular maintenance planning programme has been carried out on the infrastructure facilities. Regular inspection is a fundamental part of a preventive maintenance

programme. According to Christian and Pandeya (1997), the economic life of a building or infrastructure can be prolonged through improved initial design and a regular maintenance program. Dealing effectively with condition information from observation is an important part for good maintenance practice. Records and information are vital for the effective maintenance management for infrastructure facilities. This is because effective records detailing the historical development of the facilities and they also helps to explain the cultural history of the facilities. The information or data should also be easily retrieved for strategic processes of maintenance.

The results of the study revealed that there are still issues pertaining to all the factors of adoption that are yet to be satisfied hence, the situation where maintenance of infrastructure facilities are not yet satisfied by the public. There are still major concerns such as short of staff, allocation of budget, work procedures, method for selecting contractors need to be focused beside the good practice of maintenance management being introduced.

Recommendations

This finding is just one of many research conducted on the subject matter. However, the scope of this study has been narrowed down especially with regards to sampling of respondents in terms of geographical area, type of respondents and the variables investigated. However, the study has identified several key points that can be used to further promote and encourage better practices on the infrastructure maintenance for local authorities and what are some of other aspects of the subject matter that can be explored in other future studies to check the consistency of the results and investigate other factors that could be considered vital. The recommendations are briefed as the following:

Construction industry

Infrastructure maintenance in the construction industry requires a fresh and holistic approach if it is to be successful. Every player in the construction industry needs to improve their awareness level towards maintenance work for the facilities. This could be achieved through early consideration being given at every stage of construction started with the design and planning stage rather than being push behind the construction processes as a post construction stage. Early consideration of maintenance factor could help to reduce related cost involved in the future maintenance stage. Maintenance culture should be created in the industry and should treat maintenance as an important aspect of construction rather than being left behind without being attended. The commitment of the broader range of players within the Malaysian construction industry supply chain is vital. This commitment includes the need for a paradigm shift; it requires changes to the respective organizations' practices, knowledge management, communication, work style and most importantly decision making and investment consideration.

Malaysia construction industry development board (CIDB)

It should be an effort to increase level of awareness towards the importance of maintenance works within construction industry players in Malaysia. CIDB definitely plays a central role in promoting it to the industry players through seminars, forum, bulletin, workshop and talks to make known to all. In this respect CIDB should take the lead to work with the industry players, researchers and academia to resolve or overcome the outstanding weaknesses of the maintenance awareness culture level and find a way how to improve it to the industry.

Equally important is the need to close the existing gap within the industry that is causing it to be widely fragmented. CIDB again must play the vital role to seek closer collaboration amongst the industry players, to coordinate and compile the knowledge management aspects of infrastructure maintenance in the country. They should actively conduct programmes that make the players could learn from the past maintenance culture and how to improve it in the future on specifically on the infrastructure maintenance works to make it being considered as an important aspect of construction.

Contractors

The study also found that contractor does have influence over the performance of infrastructure maintenance works carried out. Incompetence contractors during carrying out the construction and during carrying out maintenance works can influence the quality and performance of the facilities. Thorough or strict selection of contractors to do the maintenance job should be introduced to achieve high level of competence contractors in the industry. Contractors should equip themselves with sufficient knowledge and experience in order to remain competitive in the industry. Knowledge sharing through effective knowledge management within contractors in the industry should be prepared to increase level of competencies among Malaysian contractors. It is recommended that the contractors should make allowances for their personnel to go for training and take advantage of programs prepared by agencies such as CIDB to enhance capability of their staff. They are also being recommended to focus on a specific area of construction rather than involve in so many areas in order to make themselves really expert in the related area of maintenance they involved before they start to involve in other area of construction.

Local authorities

Local authorities play an important part in the successful implementation of infrastructure maintenance works for local authorities' within its administration area. They are directly involved in the specific manner which are different from the recommendations being given

before this for CIDB and contractors. They should look into the problems or obstacles listed by the maintenance personnel as derived in this study. The main challenge in carrying out maintenance of infrastructure facilities that was highlighted in this study is not having sufficient staff to carry out maintenance of infrastructure works. It should be given an emphasis since it is also represent the critical success factor which needs to be improved in order to be successful in carrying out maintenance work for local authorities. Local authorities should carry out study on their internal factors which includes strength and weaknesses of the organization in order to be effective in carrying out maintenance job for local authorities. They should not burden their staff with the work which the staff cannot effectively take it. It will subject to delays in carrying out the maintenance job. Delays shall tarnish image of the local authorities in the eyes of the public. Poor response to prepare documentation is also related to overburden of work being imposed to the staff. Sufficient budget are the most important part in determining the successful of infrastructure maintenance for local authorities.

Lack of sufficient fund shall jeopardize the progress of maintenance works. Maintenance works cannot be carried out and it shall hinder all the effort given in the whole processes of carrying out maintenance. Sufficient budget should be allocated and it should be studied from the history of spending from the financial report. Other critical success factors which have been listed are rather important such as contractor's level of competencies, competent staff, sufficient equipment, concise work procedures and the importance of good leadership.

In the method of selection of contractors there are different approach being given by the authorities. For best transparencies, it is recommended that the selection of contractors should be carry out using balloting approach or using open tender. For local authorities fund savings, it should be carrying out using an open tender approach. However this approach takes a longer period of time compared to direct award as practiced by certain local authority in this study because it need to go through a tender process and procedures. It is recommended that a combination of this approach being used by the local authorities. There are two conditions that influence the selection. The first one is the work that needs to be carrying out under normal condition without any urgency.

Works under this condition should practice normal open tender procurement system because there is no urgency for the works to be completed urgently. It shall provide saving to the local authority because the contractors tend to reduce their price in the bidding processes in order to get the job. The second one is the job which needs to be carrying out on urgent matters. This maintenance work project should use direct award approach which has to go through a balloting process. The main objective of applying this approach is to enhance transparencies in local authorities in terms of selecting the contractors besides introduced certain savings to the organization.

Maintenance department

A simplification on the current procedures should be carrying out in order to improve the implementation of the maintenance project. This factor has been raised up during the interviews and questionnaires session that has been carried out in the interviews.

It shows that preparation of documents needs to be improved to enhance the effectiveness of the maintenance work. The respective department should scrutinize the current processes and procedures and make adjustment accordingly to make it simpler in order to expedite to preparation of the documents. Late preparation of documents caused delays in approval process and commencement of the maintenance work. Regular inspection programme and regular maintenance scheduling and planning need to be prepared for effective prevention maintenance. This shall reduce the cost involved besides maintaining the infrastructure facilities in good acceptable working condition. Shortage of budget being allocated for the maintenance work has also been identified as a main factor of poor maintenance work been carried out. The respective department who involve in maintenance work should prepare records of cost involved to do the maintenance and to justify with the complaints received in order to request for additional budget from the management.

Maintenance staffs

Knowledge, lack of skills and level of competencies among the maintenance staff are also listed among the top high rank factors of challenges and critical success factors. Continuous learning and training by the staff besides knowledge sharing should be practiced in order to equip the staffs with required level of competencies to carry out maintenance work. Personal effort to learn and explore something new in carrying out day to day job task is demanded from the staff. Immediate action by the staff responded to the maintenance work should be practice without delaying further to improve performance and shortened response time.

Knowledge in the area of maintenance shall expedite the change of mind-set among the staffs with regards to the importance of infrastructure maintenance work and it has to be able to develop a new culture in construction.

There were many difficulties and limitations that were faced throughout the research process during conducting the study. Amongst others are the poor responses from the maintenance staff due to their tight daily schedule in doing daily routine job exercise. They have a hard time to spare their time to contribute to the study despite efforts to convince them of the importance of the study. This is also related to the poor awareness which regards to the importance of the maintenance culture in Malaysian. To ensure better responses in future research on the subject matter, a brief on the subject matter should

be conducted to the highest rank position in the local authorities before it can be brought further to the maintenance staff at the respective maintenance department. The findings of this research have provided a good idea of the subject matter and could encourage other research on the related topics. There is a definitely a need for a further in-depth study on the infrastructure maintenance management in Malaysia. It does not necessary to study on local authorities only but other departmental in government agencies are also require for further studies. The future studies are expected to identify the influenced factors that may hindrance successful implementation of maintenance work being carried out. It shall also provide a better understanding on the influenced factors and proposed ways to improve it.

Factors such as short of budget being allocated, insufficient staff, lack of competence contractors and inexperience maintenance staff, complicated process of preparing documentation would impact the proper maintenance of infrastructure being carrying out. For future research the respondents or sample of study should include all the maintenance staffs involved in all the local authorities in Malaysia. This is important in order to check the consistency, trend and differences of their constraints and opinions based on their respective local authorities. As defined in this study, different local authority has their own different constraints, however if the study involved all local authorities in Malaysia therefore, the trend can be easily determined.

The findings would prove to be vital to provide a better comprehension to authorities and related parties as to why the infrastructure maintenance work in Malaysia and other countries need to be given an emphasized in order to achieve an acceptable condition to satisfy the public.

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