

Effectiveness of Quality Assessment in Construction Project

Nisamini Subramaniam*¹, Roshartini Omar², Norliana Sarpin³, and Mohd Nasrun Mohd Naw⁴

^{1,2,3} Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia (UTHM), Malaysia

⁴ School of Technology Management and Logistics, Universiti Utara Malaysia (UUM), Malaysia

¹ nishasubra12@yahoo.com

⁴ nasrun@uum.edu.my

Abstract - Malaysia is one of the countries which is growing rapidly and show a great result in construction. In real terms, the Malaysian construction industry registered positive growth, supported by large-scale investments under the government's 10th Malaysia Plan. The growth of construction industry increases the perception of client on Malaysia projects. In current scenario, client have a high level of awareness on quality of outcome. The higher the quality achieved in building projects ensure the marketability and enhance of clients. As such construction projects that are able to be completed with distinctive quality will definitely enable to delight their customers. Thus, this study aims to identify the lacking in quality assessment as a strategy to improve quality of residential project. Therefore, objective of this study is to investigate the implementation of construction quality assessment in reducing number of defects in construction projects. Apart from that, this study conducted to investigate the limitation of construction quality assessment in reducing number of defects in residential projects. This study also conducted to develop a framework of construction quality assessment towards reducing number of defects in residential projects. The conceptual framework consists of major component that show lack of quality assessment and improvements in quality assessment. The finding shows that, there are lacking in quality assessment which affect the quality of construction project. Thus, this framework will be an effective strategy to improve the performance level of construction quality assessment.

Keywords: *Quality Assessment, Project Management, Construction Industry; Building Performance*

1. Introduction

Construction quality assessment was implemented in Malaysia construction as an effective strategy to provide quality product to owner. However, according to [1], defects level in Malaysia residential projects is still does not reach satisfaction level of clients and most of the building facing defects problem due to poor construction material and faulty design. [19], new building are poorly constructed and new buyers keep complaint about their units. Based on previous research indicate that poor workmanship, poor materials and lack of supervision lead to defects in construction projects. Defects defined as a failure in the

building's function and performance [21]. According to [35], defects defined as failure of a building component to be erected in the appropriate manner. In Malaysia, defects are reappearing and reoccur even the building has been rectifying by the same contractor. Managers should more concern on components of the building, selection of materials and good workmanship to resolve defect issues in Malaysia. More involvement of civil engineer compare to mechanical engineers can control defects [39]. Apart from all the solution, applying quality assessment is highlighted as best approach given by many researchers [2].

In this situation, quality assessment was developed in Malaysia construction industry to measure the workmanship quality of a completed building in construction project [18]. Quality assessment is a standard which implement during pre-construction and also post-construction works to make sure the quality of a project. In Malaysia, The Construction Industry Standard (CIS 7:2006) on Quality Assessment System (QLASSIC) was developed on November 2006. The objective of this construction assessment is to evaluate the quality level in construction industry and also to have a standard quality assessment system as a benchmark for quality on construction work. QLASSIC was started to implement in construction project with the hope of it will increase the quality of defect. However, this assessment could not resolve number of defects issues in construction project. Thus, this study was carried out to identify the lacking of quality assessment. Improvements in this quality assessment may will helpful to decrease the number of defects in construction project.

2. Literature Review

In Malaysia, construction industry considered as a major contributor to country economy which lead to big profit and working opportunity for people. More construction projects have been taken to complete customer needs and reach client satisfaction. New technologies, new design and creative skills are applied in current construction projects to attract all the purchasers over the world. Meanwhile, quality being a very important part in

every construction project. Client those willing to pay billions of money are expecting a good quality product from the developers. However, based on previous studies it can be conclude that, satisfaction levels of client on residential projects are very low due to defects issues in projects [41].

Defect can be defined as a part which affects the quality of projects. It is proven that, quality of a project is based on the defect level. Quality assessment was started to apply in construction projects to increase the quality of a projects. Somehow even after applying quality assessment also, defects issues could not to control and does not reach the satisfaction level of clients. Thus, this chapter will study previous research on defects issues to resolve issues which rise in residential project. At earlier, concept of defects has been research and developed by Philips B. Crosby during 1960's. He is best known for popularizing the 'Zero Defects'. Zero defects theory is based on four elements for implementation in real projects. Quality is a state of assurance to requirements. Therefore, zero defects in a project means fulfilling requirements at that point in time. Right the first time is highly concern in zero defect. Quality should be integrated into the process from the beginning, rather than solving problems at a later stage. Apart from that, quality is measured in financial terms. One needs to judge waste, production and revenue in terms of budgetary impact. Performance should be judged by the accepted standards, as close to perfection as possible.

According to [3] defect describe as deterioration, damages, default or deficiency in construction projects. Damages are included of damages those are can see obvious or hidden. The obvious defect can be found out easily where the hidden defect may only can be found after few years [21]. Researcher also clarifies that construction defects can be defined as a failure or shortcoming in the building's function, performance, statutory or user requirements. However, various type of defects may occur in construction project. According to [33], defects are including of dampness, honeycomb, roof defects, erosion of mortar joint, foundation failure, peeling paint and timber rot. Defects may occur since the designing phase and also early of construction process. It may occur because of any reason. Include of poor workmanship, selection of materials, poor design, and supervision the common cited may causes of defect. This statement has been researched and declared that defects may occur cause of insufficient skill, limited manpower, work execution not in proper manner and lack of site layout studies.

3. Malaysia Construction Project

The construction industry is one of the pillars of the domestic economy for most countries. The construction environment plays an important role in developing the economic and status of the country. An efficient and successful construction project is indicating by project completion on time, within the budget given and to the specified quality [43]. The construction environment carries social responsibility as to produce safety buildings and structures that give minimal impact to the environment and provides infrastructures support, to other sectors. However, due to insufficient and inefficient management practices, the construction environment has led to excessive costs, time waste, increase errors and misunderstanding [34]. The Malaysian Government has realized the importance of building up the construction industry to benefit other sectors along the way [24].

Even though Malaysian construction environment has undergone several transformations and become one of the most important industries that contribute to economic growth, they are still at par with other developing countries [44]. Thus, government started to invest in construction industry. Construction projects can be classified into civil engineering, non-residential building, special trades activities and residential. Among this, residential highlighted as a major project which carry out in construction project. A building should be regarded as residential when more than half of the floor area is used for dwelling purposes. Other buildings should be regarded as non-residential. Type of residential can be divided into landed and high-rise building. Landed can be explained as, private residential area which not share with nearby in vertical and horizontal.

Example of landed is terrace house, townhouse, semi-detached and bungalow house. High rise residential is refer to condominium, apartment and flats. Unlike landed houses, high rise residential contain several units in one building. The building itself is owned by one individual or company, but each unit is rented out to a different tenant. The number of residential units varies from one apartment complex to the next and the price tag also varies from cheap to expensive, depending on the size and location of the building. High rise usually come with basic facilities such as swimming pools, security systems, and gyms.

Apart from that, residential projects also can be classified based on the cost of project. Based on the Ministry of Housing and Local Government, the house price categories can be divided into low-cost housing (Malaysian Ringgit below 40,000), low-medium cost housing (Malaysian Ringgit 40,001 to 60,000), medium-cost housing (Malaysian Ringgit

60,001 to 100,000) and high-cost housing (Malaysian Ringgit more than 100,001). In this term, expectation level of high cost housing residents is higher than low medium due to amount they invest for their property. In any construction there are defects, but in large residential developments defects are frequently replicated across lots, which can mean significant rectification costs. The most common complaints with new apartments concern waterproofing, with roofs, balconies, wet areas and planter boxes featuring heavily. Here, not only could the rectification costs be significant, but consider also the cost of alternative accommodation.

However, in current scenario, defects issue and claims are more arise from high rise residential project compare to landed [42]. High-rise building defects claims, legal disputes, litigation, and lawsuits frequently involve liability to building owners arising out of combination of design and construction negligence attributable to architects, engineers, builders, general contractors, and subcontractors. On the other hand, building design defects may be more subtle, resulting from a design that lacks sufficient detail or a design that is impractical or difficult to implement. On the construction side, general contractors and their subcontractors may be negligent in failing to follow clearly specified design instructions or failing to supervise those tasked with implementing the design. Contractor liability can also arise from failing to notify the owner's architect of difficulties encountered with implementation of the architect's design in the field. High rise residential developers are remain receiving a lot of complaints due to number of defects. Consequently, it also affects the customer satisfaction level on Malaysia residential development [10]. While concern about this, quality assessment was started to implement in construction industry to make sure provide quality product to client. However, client is still struggling to received high quality project with less defect. Thus, this research was carried out with aim of evaluate the implementation of construction quality assessment toward reduce number of defects which occur in residential project.

Defect issues were being a major problem facing in construction project. There is much type of defects which may occur in each in every construction project. In this research, defects which occurs in residential has been found out based on previous researches. According to [30], construction defects can be defining as a failure of a building component to be erected in the appropriate manner. Defects can be refereed as patent defects and also as latent defects. Patent defects refer to defects which can be found out easily and visible easily. Latent defect is referring to defects which may

occur after many years of building operation. Thus, patent defect always highlighted by developer due to it occur within two years of defect liability period.

Based on the previous research findings, the most frequent defects have been found out to be highlighted. Those are water leaking, cracks, wall finishes, corrosion on steel and foundation failure. According to Malaysia Housing Building Association, client those are facing defects issues are worried to invest their money with the same developers' projects. Poor experience with a developer may affect the loyal customer's perception. Currently in Malaysia, most of the developers prefer to use flat roof concept compare to traditional pitched roof. Flat roof has been created based on modern concept design and ease of maintenance.

However, since Malaysia having high annual average rain intensity of 250cm, it effects and lead to many water proof related issues [27]. Incorrect installation of waterproof is one of the most important concern which taken by developers. Many leakage problems are caused of poor waterproofing which may lead to moisture surface and quicker degradation of building. Waterproof will be installed in washrooms, balconies and terraces. According to [35], balcony is also one of the most important area which should put more concern. This is because, balcony is exposed to receive rain directly. Any outside open area to the elements will get moisture and incorrect waterproofing will only allow water to get straight into the building through the open pores of cracks [21].

Bituminous membrane causes regular problem as a root cause of waterproof issue [42]. When the burning process of membrane was not properly carried out, it will be resulting the weak bonding to the substructure. Water may enter between membrane and slab and create leaking issues. Waterproof issue can be dissolving if workers install waterproof by follow the strict instruction. Thus, water leaking, cracks, wall finishes, corrosion on steel and foundation failure are highlighted as frequently occurred defect in residential project. Water leakage or water seepage is one of the major causes of common building defects. If water leakage can be prevented, almost 80% building defects can be eliminated. Leaking and seepage may occur at deterioration of waterproofing layer, leakage at access doors or top hatch doors, deterioration of corrugated steel roofing materials and joints and defective enclosure for water tanks. There are many causes for leaking. For example, leakage from bathroom or kitchen above usually caused by seepage from fitments,

bathtubs, shower trays, buried pipes or drains due to improper Construction of joints, installation of sealants or occurrence of cracks. Apart from that, waterproof cement rendering underneath floor tiles for the floor above not installed specified or such waterproofing features damaged by installation of sockets or conduits. As in strata, property damage caused by water leaking from a broken pipe or appliance such as a water heater is generally covered under a property policy if the damage occurs suddenly.

Surface cracks are commonly found on the floor screed and normally caused by improper curing process. Curing is the process of maintain the moisture content and temperature of freshly mixed concrete [56]. If the moisture of concrete is over concentrated or over diluted, it may affect the mixture and lead to crack. One more type of joint is referring to joint crack. According to [4], This kind of crack can be found on structural elements such as column, brick wall and beam which caused of excessive movement of the building structure, unwanted ground settlement, serious overloading, weaknesses caused by corrosion of materials, poor design. Detailed investigation must be carried out during curing process to prevent occurrence this kind of defects. Apart from that, applying repair mortar on affected area with 3mm together with suitable wire meshes can be one of the proper ways to prevent crack defect in construction projects [3]. Crack gauge also can be used to measure the crack progress to ensure no crack movement in future.

Wall finishes is one the defect which frequently occur in Malaysia construction projects. According to the research which taken at Socso Kuala Lumpur by [39], it has been proved that wall finishes in one of the serious problems and hard to dissolve in construction projects. There are many types of defects in wall finishes. Those are, debonding, rapid drying, grinning, expansion and popping. Debonding is refer to the excess of thick layer, deboned from wall when the outside skin shrinks at different rate than the plaster in contact with the wall. Rapid drying is also a defect which causes of excessive of early moisture loss by evaporation when plastering in sun and wind [1]. Apart from that, grinning is a situation where clear visible of mortar joints. This defect may occur cause of difference in suction between the masonry units and the mortar. Expansion and popping is defect of swelling, layer crack and break out of plaster surface. Major cause of these defects is poor workmanship. Strict supervision should be implemented to prevent construction project from wall finishing defect.

Steel concrete interface defects were classified into two main groups. Those are macro defects and

micro defects. Gaps formed beneath horizontal reinforcement as a result of bleeding and settlement of fresh concrete were analyzed for macro defects. Micro defects presented no signs that could be identified by visual inspection and resulted not only from controlled pull-out of the steel bar but also from bleeding and settlement [3]. Macro defects have referred to effect on corrosion, where micro defects have no significant effect on corrosion. The corrosion clarify has come to be termed as 'cancer' for concrete. Good quality concrete is supposed to provide adequate protection to the embedded steel. This is due to the protective alkaline environment provided by fresh concrete resulting in formation of protective coating on the surface of the steel, which passivates it from further corrosion. However, due to carbonation or ingress of chloride ions, pH value starts declining slowly and alkaline surrounding of the reinforcement bar is lost, heralding the corrosion process, which in turn causes cracks of concrete [25]. It would thus be realized that the crucial factor giving quality and durability of concrete appears to be its permeability, which can be ensured by providing sufficient cement content, complete compaction and curing.

Foundation failure in a building can occur due to several causes. Most commonly foundation failure is caused by the movement of expansive and highly plastic soils beneath different sections of the foundation footings. This movement of soil can be shrinkage, which causes settlement to expansion. When dry conditions prevail, soils consistently lose moisture and shrink. In addition to expansive soils, subsurface peat, which has a low bearing capacity can also cause differential settlement. According to Ying (2016) [55], poor drainage from yard run-off and gutter downspouts discharging at the base of the foundation also other reasons. Excess moisture around the foundation can cause the soils to become over saturated and lead to bearing pressure. Transpiration refer to absorbing of water from the soils beneath and around. Failures and defects are being common phenomena in construction industry. It may lead to many problems in future, such give a bad perception to client and decrease the performance quality of a company. Thus, cause of defects has to be found to resolve the root cause of quality issues. Based on previous researches, many causes of defects have been found out. Each of the researchers have their own causes for the defects.

Developers always required qualified workmanship to build a good construction project. Workmanship issues is not a problem which occur with sub-contractors, but it is also a problem among main contractor. Poor workmanship may occur because of less training and less experience in construction works. According to Allotey (2014) [3], some

contractors also willing to use non-professional workers just to save their cost in worker's salary. Malaysian government through various entities has been making efforts to improve knowledge and skill of workers by conducting field training, seminar and short courses. But they still having less responds from contractors [11]. It meant that, the awareness among contractor on quality of construction is still low and most of them does not concern about it. Most of the buildings in Malaysia was using building materials which was made and available locally [8]. In material management of buildings should understand the nature of building materials. In order to handling defects, architects, contractors, engineers and all the partied those involve in construction should understand well the common use and deeper understanding into the proper techniques of preservation of materials and structure. According to Fuziah (2014) [22], good quality materials have higher durability. When contractor use good quality materials, for example they use high quality of aggregate as a base of concrete project. In this situation, the durability and strength of the base will be very quality and clients no need to worry about any defects and it is also very safe.

Cost always playing an important role in design of the project. A common design error is always made, usually in effort to save the construction cost. This scenario always occurs in reducing the size of columns, the size of reinforcement bars and foundations. At the initial stage, developers can reduce the cost by designing error design but at the end of construction they might face a lot of problems cause of error design. It may lead to uncertainty situation in the future where the structure cannot withstand the load and finally fails. Faulty design also leads to instalment problem when sizes are not perfect for installment. According to [22], a better design can get rid of workmanship defects and will help to reduce the level of defects. From using the proper design, workers will have a good instruction and procedure to carry out the task. Wrong specification and uncertain designs always cause low constructions quality. Soil analysis and preparation is one of the top first steps during construction project. According to [21], soil analysis is referring to the investigation and testing on the land which undergoing construction area.

Proper analysis was carrying out to help the developer to know about the property of the land. This will help the developer to create a right strategy to utilize the land [41]. According to [18], soil analysis is a vital and necessary step of construction process. Developers should not mis look on this soil analysis. Characteristics of soil can be very significantly depending on location and can

affect the stability of the foundation. Apart from that, other factor such as weather, soil management and climate changes also can affect soil properties and structure of building.

Supervision play an important role, either small or big construction projects. Supervision play their role in prevent accident in construction site and also to be a guidance in each task. Apart from that, typical supervision function includes in planning, allocating work, making decisions, monitoring performance, build teamwork and also ensuring workforce involvement. According to [42], lack of supervision and poor workmanship were led to biggest causes of injuries in construction industry. When research back on building failure cases, most of the incident occur due to poor supervision [28]. Supervision should be started strongly from the upper stream of level. And it has to continue until the lowest level of worker. This will help the management to avoid wrong communication and wrong understanding on a task.

4. Limitation of Quality Assessment

Defect defined as errors which occur due to poor workmanship. In this term, quality assessment was started to implement in construction industry to evaluate the workmanship of worker and make sure provide quality project. However, developer is still struggled to reduce number of defects in residential project even implement quality assessment in their project. According to [4], waterproof issue, crack, soil settlements, wall finishes and staining are common defects which received by developers.

Curtis (2015) [19] mentioned that, clients facing defects such as faulty electrical wiring and/ or lighting, inadequate or faulty drainage system, cooling or heating system and inadequate fire protection. In proper manner execute poor material usage and not according to specification, lack of supervision and limited time manpower allocation may lead to those kind of defects [19]. Incorrect levelling, lack of protection, faulty design and work in accordance to specification being a reason for occurrence of defects [56]. In this regard, quality assessment was started to implement in construction industry to improve quality of workmanship.

However, quality assessment could not to resolve defect issues in residential projects. It has proven that, quality assessment has limitation which effects the performance level of itself. Limitation of quality assessment was stand from, lack on less supervision by CIDB on the assessment by the appointed assessors, less capability and competency of quality assessors, QLASSIC assessors are taking long period to complete the evaluation report, widen the implementation of

mechanical and electrical component rather than basic mechanical and electrical fittings, evaluation on training for workers and also safety management on workers, does not contain evaluation assessment on structural and architectural design work, and quality assessment also does not consider and carry evaluation on soil investigation.

Table 1. Limitation of Malaysia construction quality assessment

Author	Limitations
Razak (2010)	Inspection on training for workers
Talib (2014)	Mechanical and electrical component
Hong (2014)	Lack of supervision CIDB on assessors Low capability and competency of assessor
Suffian (2013)	Does not consider soil settlement
Ali (2014)	Longer time taken for assessment report
Zakaria (2016)	Inspection on safety management
Ying (2016)	Does not consider architectural and structural design

Source: [35]; [39]; [2]; [42];[51];[56]

Furthermore, quality assessment does not evaluate the training which has been provided to workers. Training is a process and an activity where sharing of knowledge with down line workers. Training also defined as investment with major payoff for a company. From training, top management can transfer a lot of information to the all level workers. Each company have their own mission to be accomplished in their company. Workers should know the company mission to work hard and reach for it [56]. Apart from that, each and every task have to show practically to make sure workers done with good quality and do not done any mistake faulty work which done by workers can lead to minor and also major defects sometimes. The construction industry has seen some wide-ranging changes over recent years as the sector has modernised. Developments in other industries have been making their way into construction, digital and technological progress has meant new developments in materials technology too, and it's changing the way in which we work in every sector, not just construction [29].

Whilst traditional construction skills are still a vital part of our industry, the progress in other areas of construction mean that those working in the industry can benefit their careers by keeping up to

date with the new developments. The construction industry has changed in recent years as new technology and materials have been developed, providing the industry with all the advantages of digitization. This has resulted in those working in the industry needing to update their skills and knowledge in line with these new developments. It's also the case that health and safety at work legislation changes regularly to make the workplace safer and this means that keeping up to date with the changes is vital in order to comply with legislation and best practice [6]. Education always leads to progress, whatever field you work in so for those who wish to advance their careers within construction, learning new skills, acquiring knowledge and staying up to date with industry developments is vital for career progress in today's world.

QLASSIC carry 25% for mechanical and electrical weightage [12]. Electrical system design and workmanship issues are a frequent component of disputes arising out of building fires. While such disputes generally relate to electrical faults (short circuits), a discussion of fire cause and origin is beyond the scope of this text. In the context of multi-tenant buildings, electrical disputes typically focus on fire safety issues regarding utility penetrations in rated walls, or separation of electrical devices on opposite sides of the demising walls. In more complex structures, disputes typically involve design assumptions for connected loads and diversity factors, design coordination of power data curves, fabrication and assembly of motor control centers, workmanship of power circuits and connections and similar issues which arguably cause equipment damage or performance failure. Damages related to heating, ventilation and air condition (HVAC) claims may be in bodily injury (typically respiratory) or property damage (typically heat and moisture impact).

For industrial processes, HVAC claims may also include elements of lost production, damaged product, and lost sales. The standard causes are typically alleged and include design negligence, workmanship defects, product (equipment) defects, or a combination of these causes. According to [9], defect numbers of electrical and mechanical fitting were kept increase year by year in residential projects. Defects on mechanical and electrical work was classify as joint and gap, alignment and evenness of fitting, material and damages, functionality, accessory defects, accessibility and safety of mechanical and electrical work. According to Tawii (2014) [55], accessory defects are highest records number of defects in this component. Thus, widen the implementation of mechanical and electrical component rather than basic mechanical and electrical fittings is needed.

CIDB's supervise the appointed external assessors and the competency of the assessors during assessment. One of the challenges in conducting QLASSIC assessment is the constraint of manpower in CIDB. Consequently, that had warranted CIDB to outsource the QLASSIC assessments to external assessors. These assessors are essentially technical personnel from construction industry that have met to the vital requirements to become QLASSIC assessors as outlined by CIDB. The issue arise is that these external assessors may come from competitors' companies that may give rise to elements of prejudice during assessments. Thus, in order to address this issue that it is recommended CIDB officers to frequently supervise assessments by the appointed external assessors so as to ensure elements of integrity and the impartiality among the assessors prevail during assessments.

Apart from that, majority of the QLASSIC assessors are largely of technical personnel in construction but not many are accredited as a professionally qualified person. Technically they are not qualified to undertake testing and commissioning of mechanical and electrical works. QLASSIC assessment comprised of quantitative and qualitative measurements. The later are likely subject to discrepancies among the assessors because the defects are assessed merely by visual inspections. If any contentions arise from the applicants on the assessors' decisions of non-compliance, the assessors are able to provide acceptable technical explanations.

Quality assessment is carrying inspection for input, which is stand from architectural, structural and mechanical & electrical. Soil settlement are excluded in this assessment. Soil settlement is called as most important foundation work for built a building. Improper soil settlement may lead to major defects and also building failure sometime. Soil Investigation is a procedure that determines the stratigraphy and relevant physical properties of the soil underlying the site. This has carried out to make sure substructure, which is eventually going to hold up homes, is safe and enduring.

For any civil engineering project, however big or small, it is of primary importance that a proper field survey investigation be conducted. Geotechnical investigation is an integral part of the construction process which is done to obtain information about the physical characteristics of soil/rock around a site. It is a below-ground investigation wherein the soil strata is sampled and tested to establish its characteristics, which will influence the construction project. These investigations form the basis for planning, designing, and constructing the structures. The

serviceability and performance of the structure depend on the accuracy and adequacy of these investigations. How accurate the information in the geotechnical report is strongly influences the design, construction, project cost, and safety. Unfortunately, many people underestimate the importance of proper geotechnical investigation during the conceptual phase of a project. One of the greatest causes of foundation failure is insufficient knowledge of ground conditions. Thus, soil investigations provide the engineer with knowledge of the subsurface conditions at the site of an engineering project. It allows the engineer to work out safe and economical design of a project and inform the construction engineer about the material and conditions he will encounter in the field. According to [39], soil settlement is being one of critical problem to buildings and infrastructure. Building apron, retaining walls, perimeter roads and fencings are the most part which will affected by soil settlement. According to Mishra (2013), 85% of foundation failure occurs due to soil movement. Type of soil and capability of soil have to be investigated very deeply before start the construction work as a precaution for defects in future.

According to developer's time taken by CIDB to issue QLASSIC reports and QLASSIC score are long. Normally more than six weeks from the last date of assessment. Preferably the duration for producing the required reports should be reduced. Many applicants such as developers and contractors required faster QLASSIC reports for them to have an insight on broad indication on the level of quality of their completed projects. Indeed, QLASSIC score can also reflect on the possible level of customer satisfaction that can be associated with the expected number of complaints from the customers. Relatively longer time in producing QLASSIC assessments reports can become a deterrent factor for applications of QLASSIC assessments.

Apart from weightage, quality assessment does not consider the effectiveness of the contractor's safety system [7]. Safety is not important to protect the material form any damage and to lead effects in future, moreover it is important to make sure the workers work in safety environment. High number of accidents during construction is not a culture of a good quality construction project. Since safety plays an important role in construction, safety management should be undergone inspection to carry a marking system. Numbers of accident and nearly missed numbers of accident have to be evaluated to identify the quality of workmanship. Safety in construction is not a matter to be taken lightly [40]. In fact, health and safety needs to be front of mind in every aspect of construction at all

times. The construction industry is prone to many hazards and accident potential. Construction materials, tools, machinery and handling techniques all come with their own dangers. The main types of accidents which cause death or serious injury on construction sites include falls, incidents with site vehicles, collapsing materials and contact with overhead power lines [48]. Most accidents can be avoided by implementing stringent health and safety protocols and ensuring those protocols are constantly maintained. H&S methods will ensure the construction site has good design, good planning and uses tried and tested safety techniques. There is simply no excuse for slacking or cutting corners when it comes to health and safety in construction. Poorly implemented health and safety techniques, design and management can result in accidents, illness and even death. Thus, evaluation on safety management have to be carried to find out quality of workmanship in construction project.

There are many different types of drawing can be used during the process of designing and constructing buildings. Architectural drawing, structural drawing and mechanical electrical drawing are main drawings in construction [50]. Each drawing carries their own important role. Drawing will be prepared by respective team and will be used by all the team those involve in construction phase. In this scenario, when occur a faulty design during preliminary phase it will affect the whole construction phase. There are several common mistakes that can be made when prepare drawings [39]. Mistakes on drawings can lead to costly delays and remedial work if they are not corrected. A very common mistake is drawings are not complete. This can be a particular problem where designers do not have the necessary experience, supervision, quality systems or time to produce the drawings required. Incomplete drawings can lead to requests for information and change orders when the works start on-site. According to [42], quality assessment carries evaluation on component such as structural, architectural, mechanical and electrical and external work.

However, design work does not evaluate at any stage of construction in quality assessment. Moreover, some of the consulting firms are hiring some fresh graduate to become design engineer and they are lack of experience to handling project but only can use what they have studied to apply on works and hence caused the mistake done at design stage. According to [4], there are always some unexpected defects happened during construction stage like window size cannot fit into the window, insufficient reinforcement bar concrete cover, wrong position or missing of power socket. Thus,

this part was explained on limitation of construction quality assessment which has been proposed by few researchers based on their research results. These limitations were applied as a major content in proposing a framework to construction quality assessment towards reducing number of defects in residential project. Improvement in quality assessment has proposed as effort to overcome the limitation which has found in current quality assessment which issuing in our construction projects.

5. Proposed of Study Framework

Conceptual framework is a framework which explains the design of research, flow of research, format of research in a summary way. Conceptual framework will be used as guidance for the research. Figure 1.0 propose of study framework for improvement in construction quality assessment These have been develop base on literature review undertaken of limitation of quality assessment. The conceptual framework consists of three components; firstly, limitation of quality assessment, secondly improvement and followed by benefit of improvement in quality assessment. Limitation in quality assessment is refer to weakness in implementation of quality assessment in construction projects. Limitation in quality assessment may lead to poor performance level of quality assessment. Based on previous records, limitation of quality assessment was stand from, lack on lack on less supervision by CIDB on the assessment by the appointed assessors, less capability and competency of quality assessors, QLASSIC assessors are taking long period to complete the evaluation report, widen the implementation of mechanical and electrical component rather than basic mechanical and electrical fittings, evaluation on training for workers and also safety management on workers, does not contain evaluation assessment on structural and architectural design work, and quality assessment also does not consider and carry evaluation on soil investigation. Consequently, a conceptual framework has proposed based on quality assessment to improve more the efficiency. Improvement in quality assessment has proposed as effort to overcome the limitation which has found in current quality assessment which issuing in our construction projects.

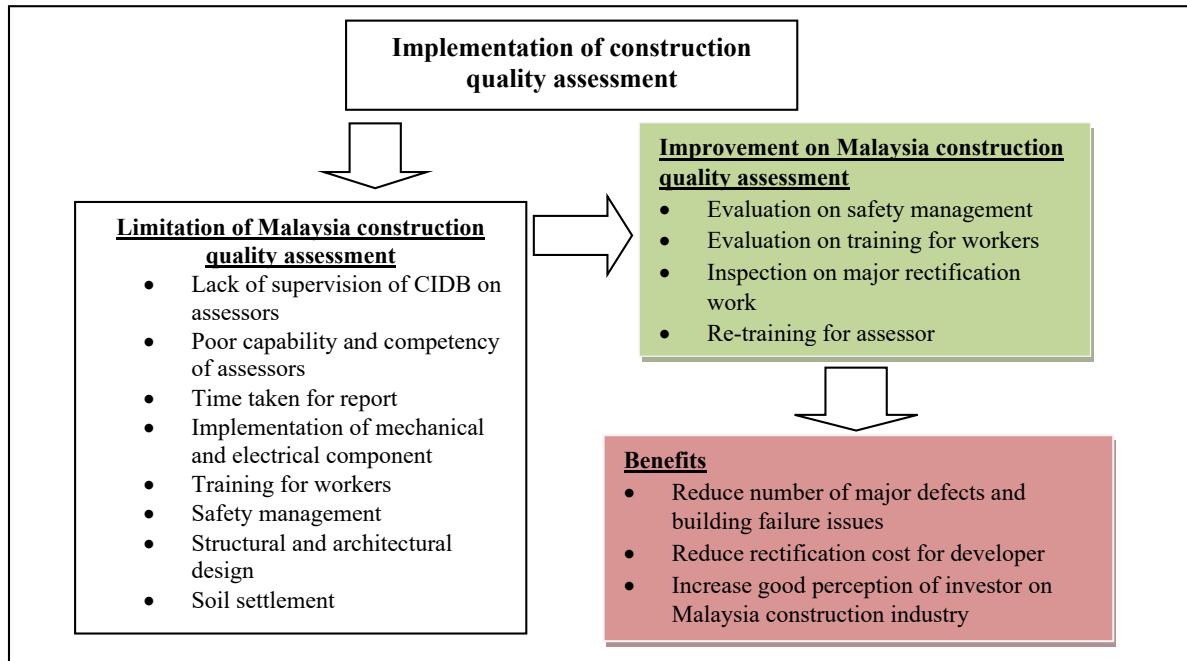


Figure 1. Conceptual Research Framework Implementation of Quality Assessment in Construction project

According to limitation, one of the improvements which have proposed is carry evaluation in safety management. Quality assessment is an assessment which carries out to evaluate the workmanship of contractors in a project. In this regard, safety work has to be evaluated in quality assessment inspection [2]. According to standard, quality assessment carries out evaluation on structural work, architectural work, mechanical electrical work and also external work [13]. Among these components, safety management also have to be included as a step to reduce number of defects. It will be useful

for developer to identify the workmanship of contractor that they have chosen. This assessment can be inspecting in term of safety regulations,

accident rate or near missed incident and safety system of works. Apart from that, evaluation on worker's training has to include in component to increase effectiveness of quality assessment. Training is a process and an activity where sharing of knowledge with down line workers. Training also defined as investment with major payoff for a company. From training, top management can transfer a lot of information to the all level workers. Each company have their own mission to be accomplished in their company. Workers should know the company mission to work hard and reach for it [56]. Knowledge level and culture of workers have to evaluate before they start their roles to make sure the quality of workers in professional levels. Poor workmanship skills among workers will lead to defects in construction projects.

Moreover, in current construction site workers are stand from different country. Their technics and skills are having to be evaluate before they enter construction site. In this regard, contractor have a hug responsible to provide training and arrange courses for workers. However, some contractors are refusing to arrange training and courses for workers due to financial problem. Thus, to make sure contractors play their responsible, this have to be evaluated by quality assessment assessors. Another improvement which has proposed is inspection on major rectification work. According to Meulenberg (2018) [34], in food industry evaluation will be carry out on rectification work. Quality assessment in food industry will be inspected and remade process will occur in case there is any mistake in end product. These methods have to be implemented in construction quality assessment as a strategy to improve quality of project before handover to clients. In QLASSIC evaluation of each work will be carry out just once and will provide QLASSIC score. Disadvantage of this technic is, in case major defect or failure found out mean it will be given a score but will not be evaluate back after rectification work.

This may be not in concern of contractor and lead to major failure in future. Thus, to avoid thus kind of issues, evaluation have to be carried out on rectification work to make sure the project is safe to be use by people. According to zero defect theory, rectification work has to be done to make sure provide quality on product as promised. Apart from that, re-training for assessors in proposed as

improvement in quality assessment. majority of the QCLASSIC assessors are largely of technical personnel in construction but not many are accredited as a professionally qualified person. Technically they are not qualified to undertake testing and commissioning of mechanical and electrical works [56]. QCLASSIC assessment comprised of quantitative and qualitative measurements. One of the recommendations to address this issue is CIDB to have periodic re-training for the assessors as well as calibration workshops among the assessors to harmonise the difference of opinions among the assessors on the selected building defects that can be considered as non-compliance of this framework may lead to reduce number of major defects and building failure issues. Evaluation on safety management, evaluation on training for workers, inspection on major rectification work, re-training for assessors can create a different environment of quality in construction defect reducing strategy. Apart from that, this framework also can reduce rectification cost for developer. The most important benefit is increase good perception of investor on Malaysia construction industry by providing good quality product.

6. CONCLUSION

As a conclusion each and every industry has implemented their own quality assessment to provide good quality of end product to their clients. Thus, quality assessment in construction industry have to be improve more from time to time in a way of higher standard. In this situation, developers are having a huge responsibility to provide each project with high level of quality and most important is built with zero defects. Defects are play an important role in construction project to represent the quality of the project. Thus, awareness on quality assessment have to be very strong among developers as a solution for defects and quality issues. Improvement which prosed in this conceptual framework may helpful to overcome the limitation in quality assessment. Eventually it will increase the quality of project with less number of defects. This is also will be very useful to client to know their rights on the property that they hold.

Acknowledgement

The authors would like to thank the Centre for Graduate Studies (CGS) of Universiti Tun Hussein Onn Malaysia (UTHM) who supported the research.

REFERENCE

[1] Aliyu, H. A. Management Problems Associated with Multi-Tenanted High-Rise

Commercial Buildings in Kaduan Metropolis, Nigeria. Civil and Environmental Research, Vol 8. (2016).

- [2] Ali, M. C (2014). Exploring the potential of integration quality assessment system in construction (QCLASSIC) with ISO 9001 quality management system (QMS). International Journal of Quality Research, 8(1), (2014), 73–86.
- [3] Allotey S.E. (2014). An Evaluation of the Impact of Defects in Public Residential Building in Ghana. Civil and Environmental Research, 58-64.
- [4] Aziz, N. A Study of Contribution Factors to Building Failures . *The 2nd International Building Control Conference 2011*.(2015).
- [5] Ahmad, A. O. Assessing the Implementation of Conquas Standard amongst Contractors towards Improving Quality of Workmanship. Jurutera.(2013).
- [6] Ahmad, F. Significant Characteristics of Scheduled and Condition-Based Maintenance in Office Buildings. J. Perform. Constr. Facil. 28(2), 257–263. (2014).
- [7] Arah, O. A. Performance Reexamined. Concepts, Content and Practice of Measuring Health Performance. Amsterdam: Academic Medical Center, University of Amsterdam, (2015).
- [8] Smith. High Society: Housing provision in Metropolitan Hong Kong 1954-1979. A jubilee Critique. Hong Kong. University of Hong Kong. (2001).
- [9] Shittu, A. A. Appraisal of Building Defects Due to Poor Workmanship in Public Building Projects in Minna, Nigeria. Journal of Engineering (IOSRJEN), 30-38. (2013).
- [10] Ahzahar, N. A Study of Contribution Factors to Building Failures . *The 2nd International Building Control Conference* (2011).
- [11] Ani, A, I. Building Condition Assessment for New Houses: A Case Study in Terrace Houses. Journal Technology. (2014).
- [12] Cama. Improving Occupant's satisfaction With Effective Maintenance Management of HVAC System In Office Buildings. Automatic in Construction. 43, 31-37. (2014).
- [13] CIDB. Developing Quality Management System in Construction – A Guide Book for Contractor. (2013).
- [14] CIDB. Construction Quarterly Statistical Bulletin – First quarter. (2012).
- [15] CIDB Impact Study on the Implementation of Quality Assessment System in Construction (QCLASSIC) for building construction work. (2014).
- [16] Cherng, L. Y. Application comparison between construction assesment system for construction project. 116. (2017).

- [17] Chuan. The Minister Of Housing and Local Government. Call for check on buildings. (2008).
- [18] Chong, W. K. Assessment of Defects at Construction and Occupancy Stages. *Journal of Performance of Constructed Facilities*, 283-289. (2015).
- [19] Curtis, M. New House Owner's Satisfactory Survey 2015. Study Report SR348. (2015)
- [20] Construction Industry Development Board Malaysia Quality Assessment System in Construction (QLASSIC)(Brochure),Kuala Lumpur: CIDB Malaysia. (2011).
- [21] Enhassi, B. Structural defects in houses. *America's Design-Build Leader*. (2012).
- [22] Fuziah, I. (2014). A Case Study on Moisture Problems and Building Defects. *Procedia-Social and Behavioral Sciences*, 27-36. Seoul, S.Korea.
- [23] Hang. CONQUAS Systems Standard for High Quality Project Management. Vol 1,issue 1, (2016). pp 51-87.
- [24] House Building Association Making A Building Inspection A Norm (PART 3).(2008).
- [25] Hong, T. T. Housing satisfaction in medium and high-cost housing. The case of Great Kuala Lumpur, Malaysia journal homepage: www.elsevier.com/locate/habitatint. (2014)
- [26] Isa, H. M. Tracking Architectural Defects in the Malaysian Hospital Projects. Paperpresented at the 2011 IEEE Symposium on Business, Engineering and Industrial Applications (ISBEIA), Langkawi, Malaysia. (2011).
- [27] Ishak, S. N. H. Implications of Design Deficiency on Building Maintenance at Post Occupational Stage. *Journal of Building Appraisal*, 3(2), 115-124. 2007).
- [28] Idris, N. *Penyelidikan dalam Pendidikan*. Edisi Kedua. McGraw-Hill. (2013).
- [29] Ibrahim, F. A Case Study on Moisture Problems and Building Defects. *Procedia - Social and Behavioral Sciences* 170 (2015) 27 – 36.
- [30] Kariya, N. Investigation of Generic House Components and Their Practical Ways to Be Assessed by House Buyers During Defect Liability Period in Malaysia, *International Journal of Engineering (IJE)*, Transactions A: Basics Vol. 29, No. 10, (2016).
- [31] Kariya. A Study of Contribution Factors to Building Failures and Defects in Construction Industry. *Procedia Engineering*. 20, (2011). 249–255.
- [32] Ling T. T. Managing High Rise Residential Building in Malaysia: Where are we? NAPREC conference, INSPEN. (2014).
- [33] Loong, C. K. New Does't Mean Perfect. *Star Property.my*, (2013).
- [34] Meulenberg, M. Framework for selecting of food product to assess quality related characteristics: EU harmonized testing methodology, developed in close collaboration with experts from member state competent authorities and stakeholders of the food chain. (2018).
- [35] Nabitz, U.. Using concept mapping to design an indicator framework for addiction treatment centres. *Int J Qual Health Care* 2005; 17, (2005), 193–201.
- [36] Norizan, H. Assessing the Implementation of Conquas Standard amongst Contractors towards Improving Quality of Workmanship. *Jurutera*. (2014).
- [37] Naoum, S. G. Dissertation Research and Writing for Construction Students. 2nd. ed. (Elsevier Ltd) The International Conference on Eco Engineering Development 2017 (ICEED 2017) IOP Publishing IOP Conf. Series: Earth and Environmental. (2007).
- [38] Noraziah. The study problem faced by property management in High Rise Condominium in Malaysia. (2006).
- [39] Olanrewaju. Sustainability in the Context of Maintenance: Building Defects in the Malaysian. (2010).
- [40] Othman, N. L. A Case Study on Moisture Problems and Building Defects. *Procedia - Social and Behavioral Sciences* 170, 27 – 36. (2015)
- [41] Okuntade, T. F. Effects of Faulty Design and Construction on Building Maintenance. *International Journal of Technology Enhancements and Emerging Research*, 59-64. (2014).
- [42] Othuman, M. Assessment of Significant Causes to School Building Defects. *Emerging Technology for Sustainable Development Congress (ETSDC) EDP Sciences*, 1-7. (2014).
- [43] Ramanathan, K. The polytrophic of industrial technology indicators at the firm level. *UNDP-UNESCO-LIPI, Jakarta*. (2012).
- [44] Razak, I. Different Approaches to Building Management and Maintenance. *Modern Building Materials, Structures and Techniques, MBMST 2016*, 10. (2016).
- [45] Roca, X. Posthandover Housing Defects: Sources and Origins. *J.Perform. Constr. Facil.* 27(6), 756–762. (2013).
- [46] Rashid, Y. R. Assessment of Residential Satisfaction in Newly Designed Public. (2010).
- [47] Rosli, M.Z., Gui, H.C., & Mukhtar, C.A.. An observation of impact in implementing of quality management system by contractors. *Malaysian Construction Research Journal*, 4(1), (2009), 52-71.

-
- [48] Skogdalen, J.E. Quantitative risk analysis offshore – human and organizational factors. *Reliability Engineering and System Safety* 96, 468–479. (2011).
- [49] Suffian, A. Some Common Maintenance Problems and Building Defects. *Procedia Engineering* 54(2013). p.p 101 – 108.
- [50] Takim, R. Tracking Architectural Defects in the Malaysian Hospital Projects. 2011IEEE Symposium on Business, Engineering and Industrial Applications (ISBEIA), Langkawi Malaysia. (2011).
- [51] Talib, R. Assessment of Factors Affecting Building Maintenance and Defects of Public Buildings in Penang, Malaysia. *Journal Scientific Academic Publishing*, 48-53. (2014).
- [52] Tawii N.M. Building Condition Assessment Using Condition Survey Protocol Matrix: A Case of School Building. *Research Journal of Applied Science* 9 (9), 565-572. (2014).
- [53] Woods, D.D. Resilience and the ability to anticipate. In: Hollnagel, E., Paries, Resilience Engineering in Practice: A Guidebook. Ashgate, Burlington, (2011). pp. 127–143.
- [54] Xiao, F. Neural Network Based Prediction Method for Preventing Condensation in Chilled Ceiling System. *Energy and Building*, 45, 290-298. (2012)
- [55] Ying, Y. S., "Quality management practices and their impact on performance", *International Journal of Quality & Reliability Management*, Vol. 23, No. 6, 625-646. (2016).
- [56] Zakaria. Latent Defects: Approaches in Protecting House Buyers' Right in Malaysia. *EDP Sciences*, (2014).