

Mukhtar Che Ali¹

Article info:
Received 15.12.2013
Accepted 27.02.2014

UDC – 625.143.2

EXPLORING THE POTENTIAL OF INTEGRATION QUALITY ASSESSMENT SYSTEM IN CONSTRUCTION (QLASSIC) WITH ISO 9001 QUALITY MANAGEMENT SYSTEM (QMS)

Abstract: *Quality has been identified as one of the fundamental needs of clients. As such construction projects that are able to be completed with distinctive quality will definitely enable to delight their customers. In this regard, Construction Industry Development Board (CIDB) has introduced two quality related programs namely ISO 9001 DIY Scheme and QLASSIC. The later is essentially a quality performance assessment tool to evaluate the level of quality of a building construction work based on quality standards stipulated in CIS 7:2006. One of the key deliverables of QLASSIC is QLASSIC Score which denotes the level of quality of the assessed construction project. Potentially there is a strong correlation between QLASSIC and ISO 9001 QMS. However there is lack of knowledge in the industry in amalgamating QLASSIC with ISO 9001QMS towards attaining high quality performance. Indeed it is noticed that not many studies have been undertaken in this area. Thus it warrants to undertake a study that deliberates on the relationship of practicing ISO 9001QMS with the achievement of QLASSIC Score. Therefore among the key objectives of this research are generally to investigate the relationship between practicing ISO 9001 QMS principles with QLASSIC performance and to examine the expected business outcomes for ISO 9001 certified contractors that are able to sustain relatively high QLASSIC Score. Eventually it is postulated that the output of this research would enable to elevate the level of quality performance in the Malaysian construction industry.*

Keywords: *Construction, Contractor, ISO 9001QMS, QLASSIC, QLASSIC Score, Quality Performance*

1. Introduction

QLASSIC was introduced by Construction Industry Development Board (CIDB)

somewhere in late 90's which led to the introduction of QLASSIC Guideline. Eventually in the year 2006, this document was reviewed and subsequently upgraded to Construction Industry Standard (CIS) known as CIS 7:2006 'Quality Assessment System for Building Construction Works'. The main

¹ Corresponding author: Mukhtar Che Ali
email: mukhtar@cidb.gov.my

assessment elements in this standard are adapted from Construction Quality Assessment System (CONQUAS) practiced by Building and Construction Authority (BCA) in Singapore. In lieu of this there are several similarities in the assessment structure of these assessment systems.

One of the key deliverables of QLASSIC is the certificate that signifies the result of the assessment known as QLASSIC Score. The later is in percentage of conformance to the quality standards stipulated in CIS 7:2006. Thus the QLASSIC Score deemed to indicate the level of quality for a given construction project. Generally the higher the QLASSIC Score will proportionately reflect the higher the quality output of the assessed construction project. In relation to this, QLASSIC can be considered as one of the assessment tools to measure the effectiveness of the established ISO 9001 QMS. This can be monitored through the trend analysis of the QLASSIC Scores. If the said scores fluctuate erratically then it indicates that the established QMS is not effective. Indeed the incredible amount of data generated during the QLASSIC assessment has the potential to be analyzed to ascertain areas for improvement which eventually can lead towards continually improves the quality performance of the building construction works.

ISO 9001 QMS is the internationally accepted quality management system. The current ISO QMS is ISO 9001:2008. This standard was introduced somewhere in 15th November 2010 to replace ISO QMS version 2004. The latest ISO 9001 QMS has no major changes on the standard requirements but elaborate further clarity on some elements. One has to remember that ISO 9001 QMS is a generic and prescriptive management standard. One of the key areas being emphasized in ISO 9001 QMS is performance measurement towards continual improvement (Mukhtar *et al.*, 2010). The later is stated under several clauses for instance clause 4.1, clause 5.1, clause 6.1, clause 8.1 and clause 8.5.1 under ISO

9001:2008 requirements. According to Tsai (1998), performance measurements can be financial or non financial. For the case of QLASSIC, it is a non financial performance measurement.

Having said the above which leads to several research questions as follows:

- Conformance to which clauses of ISO 9001:2008 can have a significant impact on QLASSIC Score?
- Is there any strong relationship of practicing principles of ISO 9001 QMS to the achievement of high QLASSIC Score?
- What are the expected business outcomes of continuously attaining high QLASSIC Score?
- Can QLASSIC be integrated with ISO 9001 QMS?

2. Literature review

In 1993 Standard and Industrial Research Institute of Malaysia (SIRIM) has introduced the MS ISO 9000, a quality standard system recognized throughout the world, to the Malaysian construction industry (Yusoff *et al.*, 1996; Mokhtar, 1996). Implementation of ISO QMS in construction has direct impact in delivering quality deliverables in construction projects. This is because QMS emphasized greatly on proper planning, well organize in optimizing resources, effectively monitor and control the performance as well as endeavor for continual improvement which ultimately would delight the customer (Mukhtar, 2010a). Quality management provides the culture and climate essential for innovation and construction innovation advancement (Djebarni and Eltigani, 1996). By establishing proper QMS the contractor is expected to manage systematically the scope, time, cost and resources in meeting the project objectives. Consequently it enable to address some of the major contemporary issues prevailed in construction industry i.e. work defect, cost overrun and delay of construction project. Commonly the parameters used by the ISO

9001 certified contractors to indicate their quality performance are number of client's complaints, scoring from customer's feedback forms, wastage of materials, number of defects works, failure in inspection, failure in testing results etc (Chen, 2007). Apart from these metrics, QLASSIC Score can also be used to measure the quality performance in construction projects.

2.1. Overview Relationship of Quality Assessment System in Construction (QLASSIC) and Quality Management System (QMS) in construction

QLASSIC (CIDB, 2006), was designed and developed to enable the user to achieve any of the following objectives:

- To benchmark the level of quality of the construction industry in Malaysia
- To have a standard quality assessment system for quality of workmanship of building projects
- To assess quality of workmanship of a building project based on the approved standards
- To evaluate the performance of contractors based on quality of workmanship
- To compile data for statistical analysis

Basically QLASSIC is an independent method to assess and evaluate the quality of workmanship of building projects based on CIS 7: 2006 document. The later is intended to complement the normal contractual drawings and specifications in the project. It is not intended to be used independently as working specifications. The contractors have to abide strictly to technical specifications prepared by the respective consultants. Where else the Superintendent Officer (SO) still hold the responsibility to ensure that the quality of the construction works conforms to the approved standards, practices, specifications and drawings. Generally, the Quality Assessment System for Building Construction Work covers four main components as follows:

- Structural Works
- Architectural Works
- Mechanical and Electrical Works (M&E)
- External Works

Each of these components is assigned a weightage which differ from one category to another, as shown in Table 1. Among these building components, noticed that the architectural work is being allocated comparatively with a higher weightage. Since the architectural work is being allocated comparatively with a higher weightage therefore QLASSIC score broadly signifies the quality of the finished construction works. Generally these weightage are allocated according to the distribution between the cost proportions of the four components in the various categories of building and also preferential is given to aesthetic consideration.

The QLASSIC assessments are conducted by the assessors appointed by CIDB. Therefore QLASSIC can be considered as the third party assessment. The appointed assessors will conduct the physical assessments by using appropriate tools for building inspection. Marks are being awarded if the inspected building components comply with quality acceptance criteria stipulated in CIS 7:2006. These marks under each building component are then summed up to give a total quality score in term of percentage known as QLASSIC Score for the building project. However, the assessment excludes works such as piling, foundation and sub-structure works which are heavily equipment-based and normally called under separate contracts or subcontracts.

Even though the application of QLASSIC at this moment is on voluntary basis however ISO 9001 certified contractors are encouraged to adopt it in their established QMS.

Firstly QLASSIC score can be used as quality objective to reflect the overall quality performance of a given construction project. Secondly the scoring point attained can be

used to benchmark project performance of similar project scope internally and externally (i.e. among competitors). Thirdly the trend analysis on QLASSIC scoring marks can be used to reflect the effectiveness

of the developed QMS. Fourthly by performing descriptive analysis on the elements under each component of building category can assist the contractor to prioritize the areas that need to be improved.

Table 1. Allocation of weightage for components of the building construction work according to building category

Component	Category A Landed Housing	Category B Stratified Housing	Category C Public Building	Category D Special Public Building
Structural work (%)	25	30	30	30
Architectural work (%)	60	50	45	35
M&E work (%)	5	10	15	25
External work (%)	10	10	10	10
Total score (%)	100	100	100	100

Hence the introduction of QLASSIC is expected to address several of the predominant quality issues that prevailed in the construction realm (Mukhtar, 2010b). Indeed according to CIDB (2013), one of the findings on the impact study of QLASSIC by CIDB (2012), unleashed that 84% of the respondents agreed that implementation of ISO 9001 QMS can assist the contractor in attaining high QLASSIC score.

2.2. The issues and challenges of implementing Quality Management System (QMS) in construction

Intense competitive pressures in the construction market demand new ways to improve performance and better satisfy clients’ needs (Xiao and Proverbs, 2002). The later interest lies on the exceptional quality of construction projects. However, construction quality may sometimes be taken for granted and insufficient attention may be paid to it. One of the ways to attain quality in construction is by embracing a systematic quality management system (QMS) whereby an internationally accepted QMS regime is ISO 9001 QMS. ISO 9000 compliance is rapidly becoming prerequisite for construction companies seeking contract and a competitive position in the construction market (Xiao and Proverbs, 2002).

Notwithstanding the facts on the benefits of embracing quality management system in construction ironically majority of our local contractors are not favorable in getting themselves certified to ISO 9001 certification.

As at March 2011, a total of about 66,210 contractors have been registered with CIDB (CIDB, 2012). Generally contractors are graded according to their technical capability and financial capacity. It started with lowest grade known as G1 to the highest grade registered as G7. From this total number of contractors almost 4,668 are G7 contractors. Taking into account of 4,668 G7 contractors about 1,888 of them (40%) are certified to ISO 9001:2008. This showed that even the highest grade of contractors is relatively low in their interest in getting them certified to ISO 9001 certification. Thus there are few prevalent issues and challenges prevailed in driving the contractors in pursuing for ISO 9000 QMS certification.

Generally the contractors are preoccupied with the perception that practicing ISO 9000 QMS tend to increase unnecessary project management cost. The establishment and maintenance of a documented QMS can be a costly undertaking (Beattie and Sohal, 1999). This statement seems to concur with Mallak *et al.* (1997), also address the question of

costs, believing ISO 9000 to be costly and time consuming. In Malaysia (Rosli *et al.*, 2009) the contractors preferred to appoint consultant to develop their respective QMS which would involve an expenditure of approximately RM 30,000. This is inline by the statement issued by Douglas *et al.* (2003), that an added cost when implementing ISO 9000 is the cost of consultants. Having said that the cost of development of QMS may vary which depend on the size of the company and the level of complexity of project normally executed by them. Inevitably the contractors have to invest in getting them certified to ISO 9000 QMS. However they failed to understand that by having a proper QMS would enable them to minimize defects which eventually would reduce the cost of rework. That phenomenon could bring saving to them in the future. The saving accumulated over the years may result in covering all the expenses in getting the mentioned certification. This is one of the challenges that need to overcome.

Another negative perception on ISO QMS as found by Kong (2010), are more time spent in management, more paper work and increased bureaucracy. Another deterrent factor for the contractors in getting ISO QMS certification is the no security in securing the next projects. The contractors have to bid for projects. They will be awarded with projects if they are successful in their bidding process. Hence there is no assurance of continuity in getting the next projects after completion the project in hand. There are extreme cases where the contractors are unable to secure any projects

within few years. In this scenario would create unnecessary financial burden for the contractors to maintain their ISO QMS certification.

These are some of the issues and challenges encountered in the construction landscape in an effort to implement QMS. It deemed to construe that implementing ISO QMS can cause additional burden to the management rather than ensuring the improvement in the quality performance. Taking cognizance of these challenges thus it warrant a more aggressive effort in educating the players in the construction industry on the importance of adopting ISO QMS as way forward for quality enhancement.

2.3. Overall observation on implementation of QLASSIC

As mentioned earlier QLASSIC program was introduced in late 2006. For a period of 5 years almost xxx projects were being assessed by QLASSIC. From Figure xxx exhibits that there is an incremental increased in the average QLASSIC Score from 60 % in year 2007 to 70 % in year 2011. In term of number of applications there is an indication of gradual increase from year 2007 to year 2011. In the year 2007 the number of applications recorded is 40 and in 2011 the number of application recorded is 122, an increase of almost 200 %. This shows that the demand for QLASSIC grows exponentially. If this momentum of demand is able to sustain then it is expected relatively high number of applications in years to come.



Figure 3. QCLASSIC Score from the year 2006 till year 2011 (Mukhtar, 2012)

After almost 5 years implementation of QCLASSIC, obviously its presence has generated some kind of impact to the construction industry. On that note that in the year 2012, CIDB has conducted a study to ascertain the impact on implementation of QCLASSIC. Several of key findings from the impact study (CIDB, 2013), are as follows:

- Majority applicants (76%) of QCLASSIC are companies which have been awarded with ISO 9001 QMS. This indicates that majority of the applicants were contractors and developers that are certified to ISO 9001 QMS which were interested to measure the level of quality of their construction output.
- Majority of the respondents (84%) opined that practicing ISO 9001 QMS can influence in achieving QCLASSIC Score.
- QCLASSIC has proven to help improve the performance of a construction project. The study showed that majority of respondents (85%), agreed with the statement that QCLASSIC helps to improve the quality of a project

- QCLASSIC Score can also increase company marketability. A major percentage of respondents (67%) agreed that the QCLASSIC effectiveness help to increase a company's marketability
- Overall, the QCLASSIC implementation is well received by the developers and contractors, whereby the research results showed that majority of the respondents, who were formerly involved with QCLASSIC, would like to continue practicing QCLASSIC in the future.

Based on the above findings one can deduce that generally QCLASSIC can drive towards improving the quality of project performance as well as enhance the business opportunity of a company.

2.4. Advantages of implementing Quality Management System (QMS) in construction

Generally the implementation of QMS in construction projects is to integrate the resources effectively towards improving the quality performance of construction works. This concurs with Abdul-Rahman (1997), that quality management is a critical

component to the successful management of construction projects. The common features of construction projects usually have a prescribed scope, schedule and budget to produce quality ‘product’ (Aoieong, 2004). The four common characteristics as outlined for a given construction project are as follows:

- Each project is unique and not repetitious.
- A project works against schedules and budgets to produce a specific result.
- The construction team cuts across many organizational and functional lines that involve virtually every department in the company.
- Projects come in various shapes, sizes and complexities.

With the emergence globalization economy, the local contractors need to compete with foreign contractors for market share. In this scenario contractors with effective QMS may have the advantage to survive. As a result a well established QMS enable the contractors to improve the management capacity and capability to produce a desirable quality product or service, is becoming the most important decision in business nowadays (Abdulah, 2004). The tools and methods used to manage QMS have emerged from those based on statistical techniques, quality circles, quality standards to those broadly categorized under the label of total control/management (Lee *et al.*, 1999).

Based on literature review many researchers have reported the advantages in implementing QMS in construction companies. (Djebarni and Eltigani, 1996). Based on these reports, Mat Naim Abdulah (2004), had summarised the list of advantages as follows:

- a) communication would be improved
- b) reduce rework
- c) time and money would be saved
- d) increase work performance and increase market share

Based on a survey in Hong Kong (Lee,

1998), the benefits derived by the ISO certified firms are achieving better team spirit, having fewer staff conflicts, reducing wastage, increasing efficiency, improving sales through new customers and getting less customer complaints. About a similar survey conducted in Malaysia (Rosli *et al.*, 2009) found out that implementing ISO QMS can tantamount to improving project productivity as well as enhancing company competitiveness.

Taking into account the result of the survey conducted locally (Chen, 2007) discovered that among the significant areas of improvement at project level by Malaysian contractors after having certified to ISO QMS are listed below:

- Improve storage and traceability of project quality records
- More organized and systematic submission of VOs
- More organized of inspection
- Improve overall site management
- Improve testing and commissioning activities
- Facilitate the preparation of handing over project
- Improve control of construction drawings on site

In view of the above explanation denoted QMS incorporated practices that can generally influence the performance of the organization. Lakhali *et al.* (2006), discovered that there is a positive relationship between the quality management practices and organizational performance.

3. Problem statement

Quality has been identified as one of the fundamental needs of clients (Kometa *et al.*, 1995; Chinyio *et al.*, 1998). Hence the craved for quality has and will always be the prime concerned of the project stakeholders in the construction industry (CIDB, 2009). Quality is an integral element in construction from its inception to completion (Alcock,

1994). Construction projects that are able to be completed with an exceptional quality will definitely be able to delight their customers. Quality on construction projects, as well as project success, can be regarded as the fulfillment of expectations (i.e. the satisfaction) of those participants involved (Sanvido *et al.*, 1992, Barrett, 2000). Moreover quality can be translated into durability in structural strength, efficiency in functionality and less maintainability on the construction output. In lieu of this, quality is one of the areas that have been stressed in the formulated Construction Industry Master Plan (CIMP), 2006-2015. The referred blueprint has outlined seven Strategic Thrusts (ST), which enable to nurture, transform and elevate the construction industry to a higher level. Strategic recommendations pertaining to quality is spelled out under ST 3, which states that 'Strives for the highest standard of quality, safety and health, and environment practices' (CIDB, 2007). Apparently that had warranted CIDB to develop several programs that deemed to propagate quality in the construction landscape. Among these programs are QLASSIC, CIDB ISO 9001 Do It Yourself (DIY) Scheme and promoting the utilization of Industrialized Building System (IBS) are the three programs that can provide significant impact on the quality in construction. This research is focusing on QLASSIC program in exploring its potentiality to be integrated with the ISO 9001 QMS.

The review of the journals on project success reveals that cost, time and quality are the three basic and most important performance indicators in construction projects (Chan and Chan, 2004; Abdul-Rahman, 1993). Among these three performance indicators cost and time are comparatively easy to measure quantitatively. For cost performance, the main measurable indicator used is on percentage of profit or loss where else for the later commonly the measurable indicator used is percentage of delay or ahead of schedule. But for quality performance there

are several measurable indicators used. According to Chen (2007), the commonly used physical metrics parameters by ISO 9001 certified contractors in measuring their quality performance are % of project delay, % on breakdown of NCR, % of material wastage, lost time accidents (LTA) etc. However another distinctive measurable indicator for quality performance in construction is QLASSIC Score. The latter is one of the key deliverables derived from QLASSIC which denotes the level of quality of the assessed construction project. In view of this QLASSIC can be considered as an assessment tool. Literally QLASSIC can be used to measure the effectiveness of the established ISO 9001 QMS in managing the construction projects. This led to one research question that is whether there is any correlation in practicing ISO 9001 QMS principles and the achievement of QLASSIC Score. However not many studies have been undertaken to ascertain the relationship QLASSIC with ISO 9001 QMS. Notwithstanding that fact that one of the proponents in this research is to conduct an empirical study to ascertain the relationship of practicing ISO 9001 QMS principles to the achievement of QLASSIC Score. Furthermore this research is intended to provide the solution in integrating QLASSIC with ISO 9001 QMS which will facilitate the ISO 9001 certified contractors to achieve relatively high QLASSIC Score. Apart from that this research will also examine the expected business outcomes for ISO 9001 certified contractors that are able to consistently attained high QLASSIC Score.

ISO 9001 QMS was developed based on 8 internationally accepted quality management principles. These principles are well embedded among the clauses in the ISO 9001 QMS requirements. However these clauses in ISO 9001 are generic in nature so as to be applicable to all sectors of economic activities. In general the requirements of ISO 9001:2008 QMS are divided into 5 main clauses. Under each of these clauses is further divided in sub clauses. Altogether

there are almost 25 sub clauses. Conformance to some of these clauses may have direct positive impact on QLASSIC Score. The related question is conformance to which clauses that can have a significant impact on QLASSIC performance. This is the key area that is going to be investigated in this research. In addition this research is to take an effort to interpret the clauses of ISO 9001 requirements tailored to quality activities in construction so that it can be easily understandable by the construction community.

QLASSIC report generated enormous data that can be used to analyze in determining potential areas for improvement that can lead to continual improvement in projects performance. Hence ISO 9001 certified contractors should leverage QLASSIC for continual improvement. The requirement on the later is stipulated under clause 8.5.1 of ISO 9001:2008 QMS. The related research question arise is to what extent QLASSIS is been used as continual improvement tool by ISO 9001 certified contractors. If there is a poor usage of QLASSIC for continual improvement what are the probable factors? In view of this that this research is also to observe on the level of knowledge and practices of using QLASSIC for continual improvement by ISO 9001 certified contractors.

4. Research objectives

The objectives of this research are as follows:

- 1) To observe the level of knowledge and practices of using QLASSIC for continual improvement in the established ISO 9001 QMS
- 2) To identify the relevant clauses of ISO 9001:2008 that can be associated with the significant impact on QLASSIC Score.

- 3) To determine the relevant quality construction activities that can be related to the respective clauses of ISO 9001:2008
- 4) To investigate the relationship on practicing ISO 9001 QMS principles with the achievement of QLASSIC Score
- 5) To examine the relationship of expected business outcomes to ISO 9001 certified contractors that are able to consistently attained high QLASSIC Scores

5. Scope of study

The scope of this study shall be confined to the following:

- 1) The main focus of this research is to integrate QLASSIC with ISO 9001 QMS
- 2) This study shall confine to building construction works with reference mainly on CIS 7:2006 document
- 3) The collection of data preferably to contractors and developers that are either certified to ISO 9001:2008 QMS or that have undertaken QLASSIC assessment or both
- 4) The collections of data will be randomly made on active ISO 9001:2008 certified contractors that are registered with CIDB and primarily located in Selangor and Kuala Lumpur.
- 5) The respondents may adopt a lackadaisical approach in completing the questionnaire forms
- 6) The discussion on common terminologies related to quality system will be limited to quality, quality performance and quality management system

6. Research methodology

In order to achieve the objectives of this study, a research process as shown in the flowchart below:

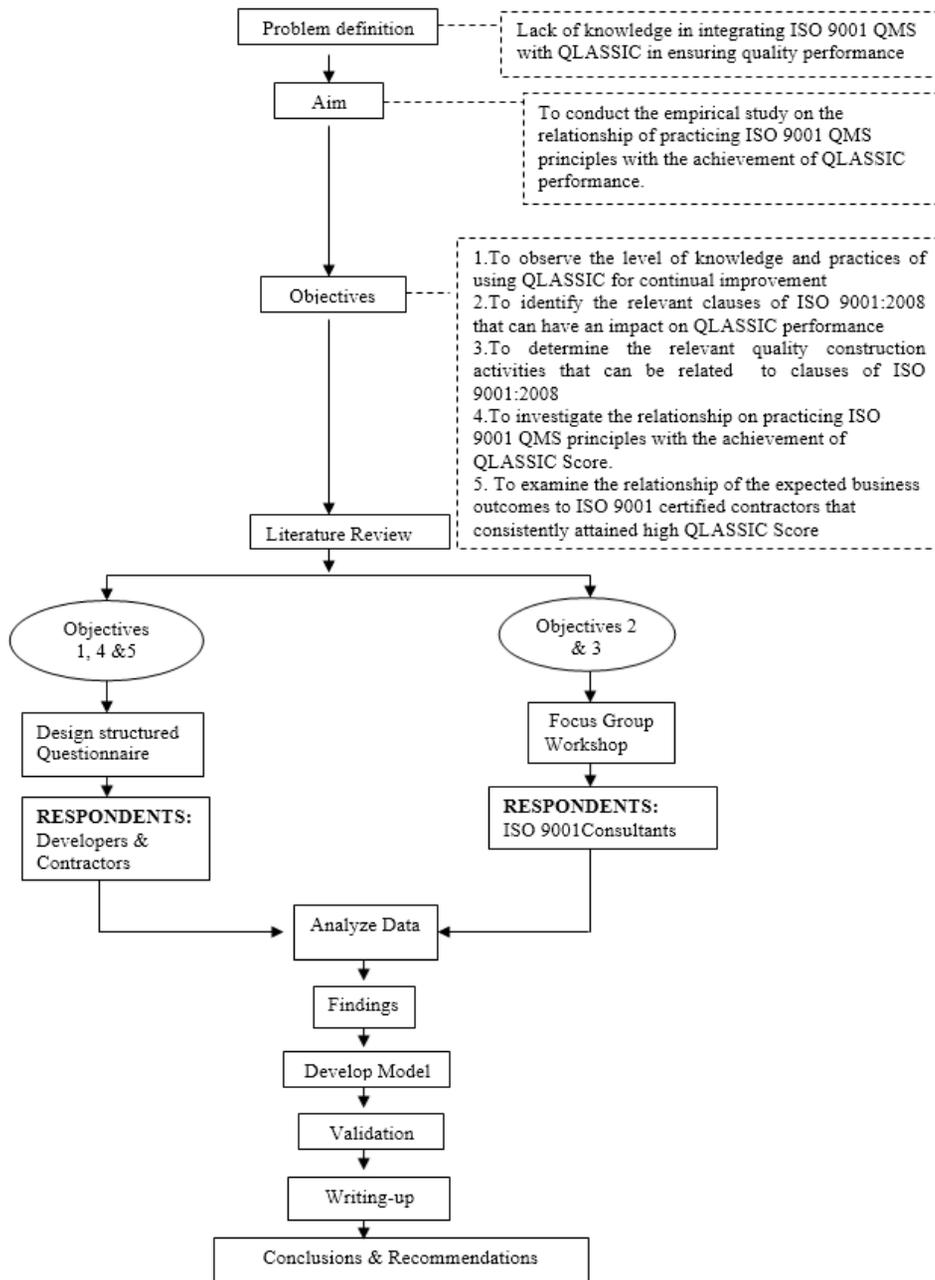


Figure 2. Research Process

The research will be started by identifying the broad research area which interest the researcher and that have the potential application to the construction industry. Once the problem is well defined then

following the formulation of the theoretical framework for the research has to be executed. It entails in identifying the aim and the objectives of the research, research questionnaire, focus group workshop,

identifying the respondents, research significance, research instruments etc. An extensive literature review will be performed at the initial stage. Reference will be made in data system and websites to gather articles, journals, periodicals, books, reports, standards etc. The collection of primary data was done by using a structured questionnaire. The questionnaire for this research consisted of a few different types of questions, namely open and closed questions. The large part of this questionnaire consisted of closed questions, where the respondents were asked a question and required to answer by choosing between a limited numbers of answers. All data collected will be analyzed using SPSS software. In developing the model the researcher will use statistical tools, namely Factor Analysis and Multiple Regression Analysis (MRA). Subsequently all the generated results will be compiled, consolidated and validated in developing predictive model on impact of practicing ISO 9001 QMS principles to achievement of QLASSIC Score.

7. Significance of study

Craved for quality has been the predominant issue in the construction industry. In an effort to address quality issues in construction, CIDB had formulated two relevant programs i.e. ISO 9001 QMS DIY Scheme and QLASSIC. However there is lack of knowledge in the industry to associate ISO 9001 QMS with QLASSIC to ensure quality performance for a given construction project. This study will provide a significant contribution in integrating ISO

9001 QMS with QLASSIC. The output of this study will enable to elevate the level of quality in construction to a greater height. In addition the output of this study can facilitate ISO 9001 certified contractors to comply with clause 8.4 and clause 8.5.1 under ISO 9001:2008 requirements. Hence it can enhance the effectiveness of the established QMS. An effective QMS, quality related problems can be eliminated and prevented early stages prior to nonconforming occurrences (Battikha, 2002a; Battikha 2002b). Furthermore another contribution of this study deemed to improve on the productivity and the image of the construction industry.

8. Conclusion

ISO 9001 QMS is an internationally recognized quality management regime. Among the key areas emphasized by this management protocol is quality performance measurement. QLASSIC is a quality performance assessment tool introduced by CIDB for assessing the level of quality for a given construction project. Taking cognizance of these statements potentially there is a strong correlation between QLASSIC and ISO 9001 QMS. However the contemporary issue is lack of knowledge in the construction industry to associate ISO 9001 QMS and QLASSIC in ensuring achieving expected quality performance. Hence this study is undertaken to address the said issue. The expected significant contribution of this study would enable to elevate the level quality in Malaysian construction landscape to the next dimension.

References:

- Abdullah, M. (1996). *Pengukuran Kualiti Ke Arah Peningkatan Daya Saing*. Bangi: Penerbit Universiti Kebangsaan Malaysia.
- Abdullah, N.M. (2004). *An application model for effective implementation of quality management system in construction project*. MEng Thesis, Universiti Teknologi Malaysia
- Abdul-Rahman, H. (1993). Capturing the cost of quality failures in Civil Engineering. *International Journal of Quality & Reliability Management*, 10(3).

- Abdul-Rahman, H. (1997). Some observations on the issues of quality cost in construction. *International Journal of Quality & Reliability Management*, 14(5).
- Alcock, T.D. (1994). *Application of ISO 9000 to the Construction Sector*. Master Builders Association, 2nd Quarter, Malaysia
- Aoieong, R.T. (2004). *Capturing quality costs of construction process using the Construction Process Cost Model (CPCM)*. PhD thesis, The Hong Kong Polytechnic University
- Barrett, P. (2000). Systems and relationships for construction quality. *International Journal of Quality & Reliability Management*, 17(4/5), 377-92
- Battikha, M.G. (2002a). QUALICON: computer-based system for construction quality management. *Journal of Construction Engineering and Management*, 128(2), 164-173
- Battikha, M.G. (2002b). *Problem patterns for infrastructure construction quality management*. Proceedings of the 7th Conference on Application of Advanced Technology in Transportation, ASCE, Cambridge, MA, 545-552
- Beattie, K.R., & Sohal, A.S. (1999). Implementing ISO 9000: a study of its benefits among Australian organizations. *Total Quality Management*, 10(1), 95-106
- Chan, A.P.C., & Chan, A.P.L. (2004). Key performance indicators for measuring construction success. *Benchmarking: An International Journal*, 11(2), 203-221
- Chen, G.H., (2007). *Quality performance of ISO 9001:2000 certified contractors*. Msc Thesis, Universiti Teknologi Malaysia
- Chinyio, E., Olomolaiye, P., & Corbett, P. (1998). An evaluation of the project needs of UK building clients. *International Journal of Project Management*, 16(6), 385-91
- CIDB (2006). *Quality Assessment System For Building Construction Work, Construction Industry Standard, CIS 7: 2006*
- CIDB (2007). *Construction Industry Master Plan 2006-2015*
- CIDB (2009). *Developing Quality Management System in Construction – A Guide Book for Contractor*
- CIDB (2012). *CIDB News, issue 01/June 2012*
- CIDB (2012). *Construction Quarterly Statistical Bulletin – First quarter 2012*
- CIDB (2013). Impact Study on the Implementation of Quality Assessment System in Construction (QLASSIC) for building construction work.
- Djebarni, R., & Eltigani, H. (1996). Achieving quality and productivity in the housing building sector. *Property Management*, 14(1), 39-45
- Douglas, A., Coleman, S., & Oddy, R. (2003). The case for ISO 9000. *The TQM Magazine*, 15(5), 316-24
- Komoto, S.T., Olomolaiye, P.O., & Harris, F.C. (1995). An evaluation of the clients' needs and responsibilities in the construction process. *Engineering, Construction and Architectural Management*, 2(1), 57-76.
- Kong, S.M. (2010). *Structural equation modeling on the causal relationship of ISO 9001 registration efforts with quality management practices, company competitiveness, customer satisfaction and business performance*, PhD Thesis, Open University Malaysia
- Lakhal, L., Pasin, F., & Limam, M. (2006). Quality management practices and their impact on performance. *International Journal of Quality & Reliability Management*, 23(6), 625-646.
- Lee, T.Y. (1998). The Development of ISO 9000 certification and the future of quality management – A survey of certified firms in Hong Kong. *International Journal of Quality &*

Reliability Management, 15(2), 162-177

- Lee, T.Y., Leung, H.K.N., & Chan, K.C.C. (1999). Case Studies – Improving quality management on the basis of ISO 9000. *The TQM Magazine*, 11, 88-94
- Mallak, L.A., Bringleston, L.S., & Lyth, D.M. (1997). A cultural study of ISO certification, *International Journal of Quality & Reliability Management*. 14(4), 328-48
- Mukhtar, C.A. (2010b). Understanding the Underlying Principles of QLASSIC Assessment. *Bulletin The Ingenieur*, 45(March-May), 51-54
- Mukhtar, C.A., (2010a). *Development of quantitative quality cost matrix for Malaysian construction quality management system*. MEng Thesis, Universiti Teknologi Malaysia
- Mukhtar, C.A., Rosli, M.Z., Zuhairi, A.H., & Abdul Rahman, A. (2010). Quality cost in the construction industry – preliminary findings in Malaysia. *Journal of Design and Built Environment*, 6, 29-43
- Rosli, M.Z., Gui, H.C., & Mukhtar, C.A. (2009). An observation of impact in implementing of quality management system by contractors. *Malaysian Construction Research Journal*, 4(1), 52-71
- Sanvido, T., Grobler, F.K., Guvenis, M., & Coyle, M. (1992). Critical success factors for construction projects. *Journal of Construction Engineering and Management*, 118(1), ASCE, 94-111
- Tsai, W.H. (1998). Quality cost measurement under activity-based costing. *International Journal of Quality & Reliability Management*, 15(7), 719-752
- Xiao, H., & Proverbs, D. (2002). The performance of contractors in Japan, the UK and the USA – An evaluation of construction quality. *International Journal of Quality & Reliability Management*, 19(6), 672-687
- Yusoff, W., Mahmood, W., & Mansor, N. (1996). Quality Management In Construction Industry - Malaysia Experience. *Jurnal Ukur Bahan*. Skudai: Penerbit Universiti Teknologi Malaysia.

Mukhtar Che Ali

Universiti Sains Malaysia,
Malaysia
mukhtar@cidb.gov.my

