CONTINUOUS IMPROVEMENT CSF FRAMEWORK FOR ASSESSING CI MATURITY IN ISO AND NON-ISO CERTIFIED CONSTRUCTION CONTRACTING ORGANIZATIONS

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ABSTRACT

Continuous Improvement (CI) is being recognized as key enabler for productivity improvement within the construction industry especially since it was emphasized in the Egan Report in 1998. However, core business processes within the construction industry have not been able to take advantage of this philosophy. Research and development efforts in this area has been lacking in terms of its applications from a construction industry-specific perspective. Attempts to focus on CI through specific TQM and of recent ISO 9000:2000 efforts seem to have had little impact, especially complicated by the unique features of the temporary nature of construction project organizations. It has been identified that construction suffers from delays, cost overruns, rework, variations, claims, poor contract administration and lax supervision by the client's representative. Taking into account that construction projects are unique, temporary and embedded in sub-contracting culture, the task of achieving productivity improvement requires addressing the CI of specific processes. Hence, the first objective of this research is to determine the Critical Success Factors (CSFs) for Continuous Improvement (CI) as a focused independent management tool in the Planning and Scheduling (P&S) of construction projects. 38 Success Factors of CI for P&S of construction projects from literature review were listed and verified using three rounds of Delphi Method This constituted the CI Maturity Assessment Framework that was used to assess ISO and Non-ISO construction organizations. The finding shows that, ISO certified companies exhibit a comparatively correlation with CI maturity level, however not being significant enough than non-ISO companies. Hypotheses testing used to compare both groups, and it was found that 35 out of 38 of the CSFs did not show any significant difference in CI maturity level. Hence, it cannot be claimed that ISO certified organizations fully practice the principles of CI. Finally, a conceptual framework for implementing CI based on The Kaizen Blitz approach is proposed for construction projects to enable rapid performance improvements over short timescales that is suitable considering the various construction projects peculiarities.

ABSTRAK

Penambaikan Berterusan (PB) dikenalpasti sebagai kunci utama peningkatan penambahbaikan dalam industi pembinaan semenjak penekanannya dalam Laporan Egan 1998.Walau bagaimanapun, proses utama industi pembinaan tidak mengambil inisiatif atas kebaikan falsafah ini, manakala usaha kajian dan pembangunan dalam bidang ini juga berkurangan. Fokus PB dalam Pengurusan Kualiti Menyeluruh serta ISO 9000:2000 juga memperlihatkan kesan yang sedikit akibat pengaruh komplikasi unik dan ciri-ciri sementara organisasi pembinaan; disamping pengaruh faktor-faktor lain yang menolong kepada pencapaian pengamalan konsep PB. Bidang pembinaan juga dikenalpasti menghadapi masalah dalam isu kelewatan, terlebih kos, kerja yang berulang, variasi, tuntutan, pengurusan kontrak yang lemah dan juga kelemahan penyeliaan dari wakil klien. Menyedari hakikat bahawa projek pembinaan adalah unik, bersifat sementara dan berselindung disebalik budaya sub kontraktor, kerja untuk mencapai penambahbaikan produktiviti yang meletakkan PB sebagai proses yang spesifik amat diperlukan. Objektif pertama kajian ini adalah untuk mengenalpasti Faktor Kejayaan Kritikal (FKK) bagi PB sebagai faktor tidak bersandar didalam fasa Perancangan dan Penjadualan (P&P) projek pembinaan. Sebanyak 38 FKK PB dikenalpasti melalui kajian literasi dan diverifikasikan melalui teknik Delphi tanpa penambahan sehingga ke akhir pusingan Satu Kerangka Penilaian (CI Maturity) digunakan untuk menilai tahap kematangan PB bagi syarikat yang mempunyai persijilan ISO dan bukan ISO. Hasil kajian mendapati syarikat persijilan ISO menunjukkan perbandingan korelasi yang kuat dengan tahap PB yang dilaksanakan, tetapi ianya tidak menunjukkan signifikan yang kuat. Oleh itu, ujian hipotesis dilakukan dan didapati 35 daripada 38 daripada FKK tidak menunjukkan perbezaan yang signifikan. Ini tidak dapat simpulkan bahawa syarikat persijilan ISO mengamalkan segala prinsisp PB didalam organisasi mereka. Akhir sekali, satu kerangka konseptual yang dipanggil Kaizen Blitz dibangunkan bagi melaksanakan penambahbaikan dalam tempoh yang singkat bersesuian dengan pelbagai jenis keunikan di dalam projek industri pembinaan

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LIST OF ABREVIATIONS

AHP	-	Analytical Hierarchy Process
BS	-	Balance Scorecard
CENTRIM	-	Centre for Research in Innovation Management
CI	-	Continuous Improvement
CIDB	-	Construction Industry Development Board
CIMP	-	Construction Industry Master Plan
CINET	-	Continuous Improvement Network
CIRCA	-	Continuous Improvement Research for Competitive Advantage
CONQUAS	-	Construction Quality Assessment
CPM	-	Critical Path Method
CSFs	-	Critical Success Factors
DMAIC	-	Define, Measure, Analyze, Improve, and Control
DRIVE	-	Define, Review, Investigate, Verify and Execute
DRIVE	-	a framework for a structured approach to problem solving
EFQM	-	European Foundation Quality Management System
FKK	-	*Faktor Kejayaan Kritikal*
G6	-	Grade 6
G7	-	Grade 7
ISO	-	International Standard Organizations
JIT	-	Just In Time
KAIZEN	-	Japanese Philosophy for Continuous Improvement and pronouns as *Kai Zen*.
KCs	-	Key Characteristics
P&P	-	*Perancangan & Penjadualan*
P&S	-	P&S
PDCA	-	Plan-Do-Check and Act

PDPC	-	Process Decision Programme Chart
PhD	-	Doctor of Philosophy
PM	-	Performance Measurement
QA	-	Quality Assurance
QC	-	Quality Control
QLASSIC	-	Quality Assessment in Construction
QM	-	Quality Management
QMS	-	Quality Management System
SFs	-	Success Factors
SPSS	-	Statistical Package for Social Science
TQM	-	Total Quality Management
UK	-	United Kingdom
UTHM	-	Universiti Tun Hussein Onn Malaysia

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The construction industry is often criticized for its poor level of productivity and performance, the Malaysian Government has also emphasized on the need to improve the level of productivity, which is notably highlighted within the Construction Industry Master Plan (CIMP) as one of the main five thrusts. These ongoing efforts by the Malaysian Government are however primarily focused on the aspect of using cross-industry continuous improvement (CI) methodology. However, due to the specific peculiarities within the construction industry, such as project-based, unique and temporary project organizations, as well as that of being fragmented with a sub-contracting culture, it is important to explore CI approaches that are more relevant and industry-specific. It is within this context that it is found to be of importance to identify the critical success factors of continuous improvement for particular key processes of the construction project. This chapter provides an outline of the area of research, specifically with respect to critical success factors (CSFs) of the continuous improvement aspect of construction planning and scheduling**.** It is without doubt that planning has always been a theme when it comes to improvements of productivity in all businesses, and the construction industry is no exception.

The potential to enhance productivity and performance is critical to any organization's success. Hence, organizations are attempting to implement various methodologies and techniques, both from a short-term and long-term basis, to ensure

their success. Amongst many such methodologies and techniques, such as six sigma, balanced scorecard approach etc., CI is one such methodology or technique. CI is considered a fundamental element for organization success, as it consists of eliminating defects, reducing waste, managing production time and improving productivity and performance.

1.2 Background of research

The construction industry of any country is the backbone of its infrastructure and economy. It is one of the largest industries and is regarded as one of the main contributors towards a country's economy (Ngai et al., 2002); and contributes to about 10-11% of the gross national product (GNP) in industrialized countries (Navon, 2005; Meiling, 2010). Construction industry is an important sector in the economy, not just because it directly provides input-driven growth to the GDP, but more importantly, helps other sectors contribute to GDP (CIDB Malaysia, 2007). The construction industry enables the growth of other industries through its role as a fundamental building block of the nation's socio economic development. Educational institutions, government offices, some tourist attractions, transportation infrastructure (airports, seaports, roads), housing, commercial property – all the essential elements of a healthy, functioning economy, need to be built and maintained by the construction industry. Besides, enabling socio-economic development, construction activities generate tremendous spillover opportunities. It contributes to the growth of other industries in its role as a large user of manufactured goods (building materials, iron, steel, etc.) of specialized tooling and heavy machinery and the financial services sector.

The construction industry is unique, fragmented in nature and involves extraordinary diversity of professions, specialists and suppliers. The image related to construction industry has traditionally been one that is noted to place poor emphasis on productivity improvements; either through technology, people or process enhancement. It is pointed out by Wan Mahmood et. al, (2006) and Aktas et al, (2012), that many

criticisms have been faced by the construction industry with respect to issues related to workmanship performance, construction processes, complexity due to the many sub-organizations involved, the poor handling of materials on site, issues related to quality systems implementation, safety etc.

12.1 Malaysian Construction Industry Scenario

Within the Malaysia context, the construction industry contributes significantly to the economic growth of the country. The types of construction projects, consists of a wide spectrum ranging from residential, commercial to infrastructure. The construction industry has contributed approximately 3.3% of the country's gross domestic product (GDP) value in 2012, with a forecasted 11.2% growth in the subsequent year (Department of Statistics Malaysia, 2012a). The labour force serving the construction industry also accounts for approximately 9.2% of the country's total labour force in 2011 (Department of Statistics Malaysia, 2012b). Given this, under the Tenth Malaysia Plan (2011-2015), the Ministry of Works plans to inject an estimated RM 138 billion (approximately US$46 billion) to enhance the long term growth of the construction sector (CIDB Malaysia, 2010). It is estimated that there will be 52 high impact projects worth RM67.2 billion (Euro 16.8 billion) that will be implemented via privatization or public-private partnership agreements. Some of the projects to be considered in the pipeline are toll highways, coal fired power plants, rail projects, airports expansion, public housing, development of the Malaysian Rubber Board land (3,300 acres), setting up of hospitals and university campuses, development of a 'Media City', development of integrated transport terminal and privatization of a sea port. (RHB Invest, 2010). One such example under this plan is the Mass Rapid Transit (MRT) system, which costs over RM40 billion with an estimated demand for up to 130 000 construction workers of various trades.

The construction companies in Malaysia consists of mainly contractors of varying grades based on contract sum range of licenses, specialist contractors,

architectural and engineering consultant companies, and other related consultancies. The size of the companies in terms of personnel does vary to a great extent. Based on the Report on Survey of Construction Companies (Malaysian Statistics Department, 2009), a total of 34.6% [206,080 employees] of the total employees fall under the employment size group of 100-499. This is followed by the group employment for 1,000 and above accounting for 26.8% [182,302 employees]. However, most establishments i.e. as many as 78.6% [4,355 establishments] have employees of below 100 persons but only contributed 22.4% [RM 13.9 billion]of overall gross output compared to 1,188 establishments in the group size of more than 100 persons who contributed 77.1 % [RM 46.8 billion] gross output and 77.6% (461,980 employees) of total employment as shown in Table 1.1.

Table 1.1: Number of Establishments, and Employment by Size Group 2007
(Source: Report on Survey of Construction Companies: Department of Statistics Malaysia, 2009)

Employment size Group	Establishments	Total Employment
<100	4355	133,159
100-499	976	206,080
500-999	140	96,457
≥1000	72	159,443
Total	5543	595,139

1.2.2 Issues and Challenges in Malaysian Construction Industry

Despite its growth and healthy contribution to the GDP, the Malaysian Construction Industry is under constant pressure to improve its performance, productivity and intention to increase efficiency in construction projects (Erikshammar et al., 2010). According to the Construction Industry Development Board (CIDB) of Malaysia, the

general perception regarding the Malaysian construction industry as a whole is that it is underachieving, with many issues such as poor communication and adversarial attitude contributing to inefficient and ineffective construction practices, payment defaults, construction delays, cost overruns, and disputes (CIDB, 2009).

CIDB in Malaysia has been set up since 1994. It is a statutory body under Minister of Works, Malaysia. Established in July 1994 to coordinate all activities in the construction industry and increase its competitiveness. Specifically:

- To coordinate the needs and wants of the construction industry;
- Planning the direction of the construction industry;
- Addressing the pertinent issues and problems faced by the construction industry;
- Making recommendations in the formulation of policies for the construction industry.

One of the specific functions of CIDB is to promote and stimulate the development, improvement and expansion of the construction industry, and in so doing often the approach has been to address issues from three fundamental perspectives, i.e. people, technology and process.

a) People Perspective

Currently, the Malaysian construction sector is still hugely dependent on the services of unskilled foreign, which further complicates the attempts to improve the image of the industry, as it resorts to the use of cheaper foreign labour whilst it is widely acknowledged that ‘cheaper does not mean better’. Due to the availability of employment opportunities, foreign workers have been transferring an estimated RM5.0 – RM6.0 billion out of the country on an annual basis. From a people perspective, an inconsistent foreign workforce has critically, undermined efforts at a national level to develop a permanent and highly productive local workforce (CIDB, 2009). It has been reported that this phenomenon is affected by local citizens who are not interested in involving themselves in the construction sector due to an unattractive payment structure and service terms that do not guarantee job security. On an annual basis, CIDB has been training an average of 20,000 local construction workers and youths as an effort to

reduce the need on foreign workers. However, its efforts have been impeded by the availability of more job opportunities in other sectors. In construction sector, there are about 312,573 foreign workers. This number makes up 41.2% out of the total number of work force in construction. In 2008, the cumulative number of construction personal registered with CIDB rose by 13.0% to 934,590 under various categories. Out of this total, 709,724 personal [75.9%] were local construction personnel, whereas the rest were foreign construction personnel as shown in Table 1.2.

Table 1.2: Construction Personal Registered With CIDB (Source: CIDB Malaysia, 2009)

Category	2004	2005	2006	2007	2008
Construction Worker	249,389	298,647	356,385	419,951	487,956
Semi-skilled Worker	29,878	34,165	38,161	42,293	43,989
Skilled Worker	94,274	101,242	111,087	123,460	129,234
Construction Site Supervisor	54,806	58,374	628,68	73,017	77,234
Construction Manager	37,705	40,067	43,593	48,503	51,755
Administration Personnel	51,271	65,776	89,587	119,616	144,422
Total	517,323	598,271	701,681	826,840	934,590

There is considerable skills training being provided in an ongoing process by CIDB, however this does not seem to have impacted much in terms of increased productivity.

b) Technology Perspective

The current level of technology application is viewed from the extent of mechanization of the production process. Various efforts are being undertaken to spur the construction industry towards higher productivity through the use of more efficient technology. One such attempt is the incentivization programme for the use of industrialized building systems (IBS). It has been identified that there is a rather slow uptake of IBS within the industry, main reasons being attributed to that of increased costs and lack of an integrated value chain (Abd. Shukor A.S. et. al. 2011)

c) Process Perspective

Amongst the three perspectives of people, technology and process: the aspect of 'process' has often been tackled in the least vigorous manner in most industries. This seems to be the case of the construction industry as well. There are some attempts by CIDB to address this problem. However, most of the initiatives are based on ensuring quality of the finished product, for example in the use of QLASSIC. Hence, the aspect of process is often placed within the scope of general management theory and practice. However, it is contended in this research as being a fundamental flaw, as clarified below; requiring a rather different and more industry-specific approach to deal with the issue of improving productivity by working on enhancing key production processes.

The construction industry in Malaysia is rather complex. Kamar (2011), remarks that the project complexity has increased due to extant of scope, requiring fragmented parties around the world to communicate with one another for efficient project execution. The complexity of projects is reflected by the large number of specialists who contribute to the decision-making process. In this regard, the fragmented construction industry retards the development of industry-wide information and knowledge sharing because most of the time, planners, architects and designers interact only minimally among themselves and none benefit from the experience of others (Bahtiar, 2011).

Furthermore, it is noted by Gao and Pheng, (2013) that the diffusion of construction activities amongst so many parties and enterprises in so many diverse segments, each of which pursuing diverse specific and tangible goals, reduces the ability to focus on improvements. Additionally, recent literature indicates that construction projects continue to be often completed with extended schedules, large cost overruns and quality concerns. As highlighted in the Sunday Times (2007), construction industry has numerous weaknesses in the delivery system resulting in excessive cost overrun and quality deficiencies in the final output.

Thus, the current situation necessitates a comprehensive framework to ensure that a strong foundation will be laid and that construction players will be well positioned to compete globally. Following the recommendations of the CIMP and related literature (CIMP,2005; Abdul Razak et al, 2010), the critical success factors are viewed as the

elements that are imperative to the success of the achievement of the strategic thrusts and strategies of the CIMP, however serious efforts towards such initiatives from the process perspective seems to be lacking. It is noted by Al-Moumani (2000), that in order to successfully execute construction projects and keep them within estimated cost and prescribed schedules and thus avoid facing the traditional problems identified with the poor image of the industry a methodology with sound engineering judgment is required that can lead to a proper planning and scheduling process. It is recommended that factors for ongoing improvement in the successful completion of projects be investigated thoroughly, particularly those that affect the project success, and structured attempts be undertaken to overcome the problems.

1.3 Research Problem

It has been identified that construction suffers from delays, cost overruns, rework, variations, claims, poor contract administration and lax supervision by the client's representative (Chini and Valdev, 2003). A reliable construction industry in terms of high productivity and performance can provide the basis for sustaining strong economic growth. However, large-scale engineering and construction projects have traditionally dominated the subject of project management and implementation. According to Pinto (1986), the project management process is complex, usually requiring extensive and collective attention to a broad aspect of human, budgetary and technical variables. Projects possess a specialized set of critical success factors, which if addressed and attention given, will improve the likelihood of successful implementation. On the other hand, if these factors were not taken seriously, it might lead to failure in managing the project, hence this will cause to the problem of delays and effect many problems like cost overrun, disputes, arbitration, litigation, and total abandonment (Sambasivan and Soon, 2007).

Nowadays, the construction industry in Malaysia is facing critical problems, especially in terms of delay in the completion of projects (see Appendix A). Even

though the projects have already been completed, there still exists problems of safety, quality and esthetic values (Othman, 2006). This is evident from increasing building defects and issues on quality of product and service occurring in Malaysia. For instance, the case of the MRR2 (Middle Ring Road 2), whereby it was forced to be shut down because of cracks found on its piers. Another example would be the cracking and settlement of various newly constructed schools and computer laboratories which was a big national issue (Othman, 2006). One of the main reasons for this problem was identified as the failure in the monitoring and controlling process. Additionally, numerous government reports have criticized the industry's poor performance, especially in terms of productivity, quality and quality systems (Ali Azlan, and Rahmat,Ismail, 2010).

There have been many attempts to improve quality performance in the construction industry. However the attempts have often been focused on the outcomes, rather than the process. Although the construction industry has applied various techniques and tools for achieving quality improvement, there has been very little attention focused on developing sustainable approaches such as "Continuous improvement (CI). However, taking into account recent developments within industry regarding the emphasis on CI, it is evident that this concept is being incorporated within many organization-wide initiatives, such as ISO. By embodying continuous improvement worldwide, ISO has opened the door for all types of firms all over the world to begin their journey to excellence performance. However, as stated by Stankard, (2002) " ISO .. **alone** is insufficient to achieve durable competitive advantage and high performance.. it's scope is too narrow."

CIMP 2006-2015 has stressed out the various issues facing the Malaysian Construction Industry and identified CI as one of the important mechanisms in order to achieve successful implementation of the seven thrust of the CIMP. Attempts to focus on CI through specific TQM and the recent ISO 9000:2000 series efforts seem to have had little impact; especially complicated by the unique features or peculiarities of the

temporary nature of construction project organizations and some additional peculiarities of construction projects that has always been debated amongst researchers as being the major constraints in efforts to sustain the CI practice as undertaken in other major industries (Koskela, 2005).

In this respect, all these peculiarities influence the current implementation and practice of CI concept - as is currently being attempted, which is based on the similar approach as that within other major industries. The most current is the use of business excellence approach (EFQM,, 2003) as a 'generic process' application approach. The traditional methodology or technique in the use of the CI concept as a wholly dynamic process for construction contracting organizations is clearly a problem. Working from a traditional CI perspective involves the complete assumption of being CI being amendable to cross-cultural adoption of its principles through a generic methodology. This is a problem for construction contracting organizations as they are bound by contracts and generally work to satisfy requirements spelt out within the specific contract. They are generally not motivated to initiate improvements beyond requirements. A notable feature of this problem is within the Planning and Scheduling (P&S) phase of the project. Extant literature search on the application of the CI methodology with respect to the P&S phase in the construction industry has not resulted in any success.

This scenario, gives the impression that there is no continuous improvement concept or lesson learnt within the industry within the P&S phase of the project, which is clearly a critical phase in the successful delivery of construction projects. Additionally, attempts to identify previous research on key factors for the successful undertaking of the P&S process of construction projects has also not resulted in any success. Hence, this research focuses on identifying an approach to tackle the above issues related improving productivity within construction projects, which is to focus on CI of particular key processes of the construction project delivery process. Hence, requiring the identification of the Critical Success Factors (CSFs) of Continuous Improvement for construction projects in Malaysia, particularly that of the P&S process and hence develop a mechanism to enable construction project practitioners to undertake and sustain the practice of CI.

1.4 Research Questions and Objectives

It is clear that the Malaysian Construction Industry is currently facing certain critical challenges in having to improve its image, one of it is very low level of productivity, with associated delay and quality issues, rework and cost overrun. Hence, this research seeks to answer the following research questions on CI for the customized construction project planning and scheduling process in the Malaysian Construction Industry context as shown in Table 1.3 below.

Table 1.3: Research Questions and Objectives

Research Questions	Objectives
RQ1: What are the factors related to continuous improvement of the planning and scheduling (P&S) of construction projects in Malaysia?	Determine the CSFs of CI for Planning and Scheduling of construction projects
RQ2: How are these P&S success factors correlated to the level of CI within the ISO and non-ISO certified construction contracting organizations?	Study the level of CI implementation in ISO and non-ISO certified construction contracting organizations according to Planning and Scheduling Critical Success Factors (CSFs).
RQ3: Does the P&S Success Factor of CI Maturity level amongst ISO and non-ISO certified construction contracting organizations differ from each other?	Compare difference of CI Maturity Level between both ISO and non-ISO certified contracting construction organizations in Malaysia based on Planning and Scheduling CSFs.
	Develop and structure a Framework for effective CI implementation focused in achieving high performance 'Planning and Scheduling' of construction projects.

1.5 Research Framework

A conceptual framework is the system that consists of concepts, assumptions, expectations, beliefs, and theories that supports and informs about the research and it also is a key part of the research design (Miles & Huberman, 1994; Robson, 2002).

Figure 1.1 illustrates the way in which a framework assists in conceptualizing the relationship between a range of activities of this study to achieve the research objectives based on the concepts reviewed and methodology used.

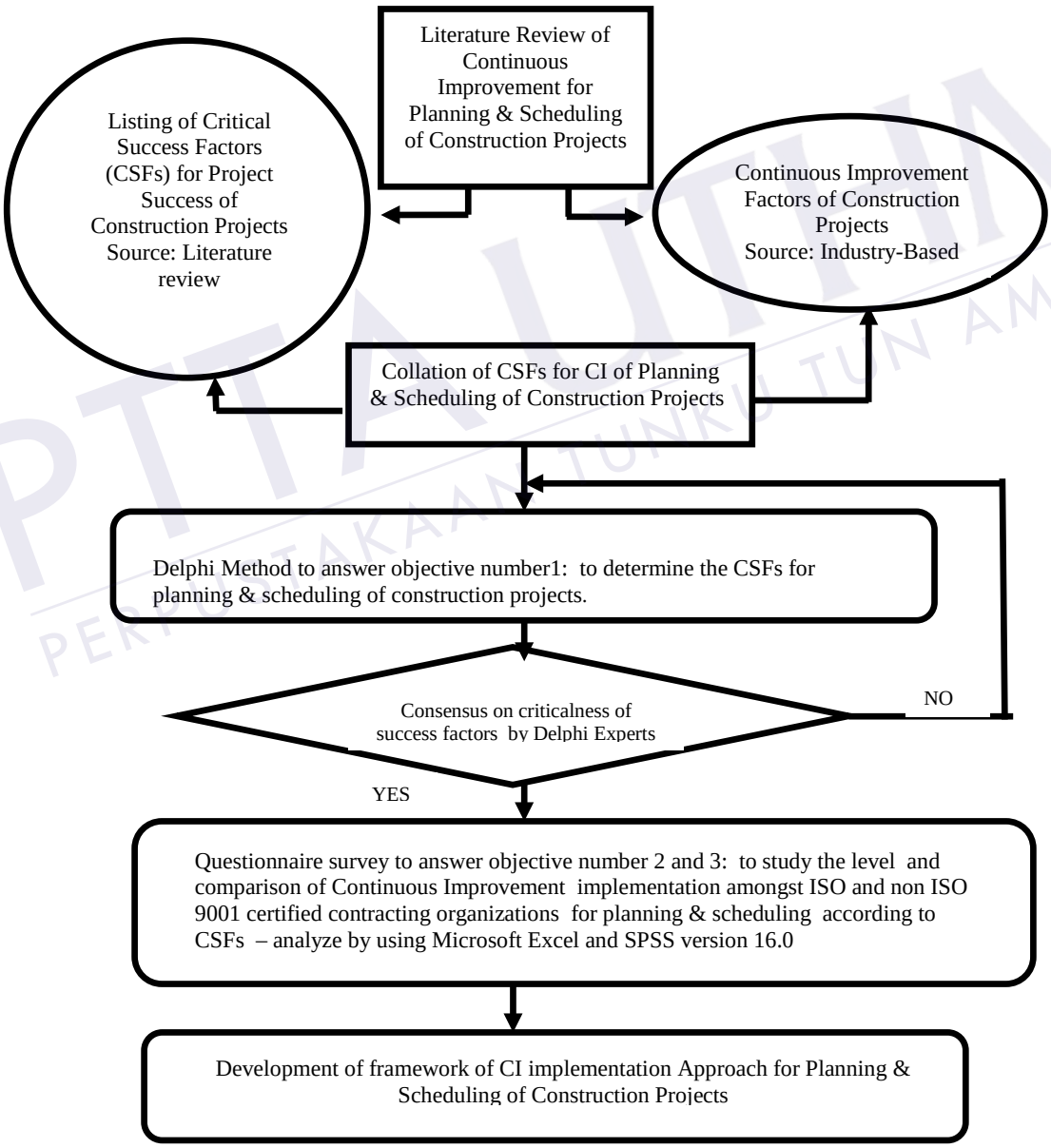

Figure 1.1: Research Framework

1.6 Scope of Study

This research is focused on contractors throughout peninsular Malaysia. However, the population of study is scoped to G6 and G7 contractors.(construction organizations). This is due to the fact that the majority of construction contracting companies that are ISO accredited in Malaysia belong to the G6 and G7 CIDB category. Additionally, as the ISO accredited companies are deemed to have a continuous improvement practice based on the ISO 9001:2000 series, hence this was used as a logical population from which the sample of respondents was finally chosen (purposeful sampling).

The G6 and G7 contractors are assumed as belonging to the category of Large Contractors (taken as the research population). Hence, based on there being eighteen (18) G6 and two hundred (200) G7 ISO registered contractors at the time of the data collection process, the approach was to have a total sample size of 200 ISO and 200 non-ISO construction contracting organizations as the target sample. Hence, this research is primarily focused on higher grade (G7 and G6) construction contracting organizations who act as main contractors in construction projects.

The main thrust of this study is to investigate the implementation of Continuous Improvement according to the CSFs of CI for both ISO and non-ISO certified contracting construction organizations in Malaysia. Additionally, it is anticipated that such large organizations would have in place a more systematic system and organization structure in order to provide the opportunity for exploring the issues of CI, and larger organizations such as G6 and G7 would be more appropriate to be the focus of study.

Finally, the construction phase that is focused on and explored in this research is the Planning and Scheduling (P&S) phase. The P&S process is of paramount importance for the success of construction projects and it impacts on all activities from concept to project completion.

1.7 Research Methodology

Basically this study involved a combination of quantitative and qualitative methods. It is noted by Creswell (2006) that in attempting to achieve quality data, the use of multiple expert views, theories, methods, and empirical materials, the researcher can hope to overcome the weakness or intrinsic biases and the problems that come from single method, single-observer and single-theory studies.

In this study, three rounds of Delphi were undertaken to achieve the first objective, which is to determine the SFs for CI of P&S. Based on the Delphi Study findings, a structured questionnaire with five point scoring system was designed to determine the CSF of CI implementation amongst construction contracting organizations. In order to achieve objective two and three,; a set of questionnaires were distributed to both G6 and G7 grade of contractors organizations consisting of ISO and non-ISO certified companies. The data collected was also used to compare mean between the groups (ISO and non-ISO) by using independent sample t-test. The data was analyzed with the aid of SPSS package version 16.0 and Microsoft Excel 2003. Finally, a framework for CI for planning and scheduling for construction projects was developed based on the CSFs determined from the first objective.

1.8 Significance of Research

It is without doubt that the concept of Continuous Improvement (CI) implementation in P&S of construction projects is very important. It ensures that the organizational structure of the company complements and supports the people, process, technology, roles and responsibilities and that they can work in conformity with the concept of CI more efficiently. In a certain sense it helps to embed elements of the *culture of excellence* within the organization.

Kang (2004), stated that Continuous Improvement obviously is a ‘process’ by itself in an organization This being the case, the importance of having a clear

understanding of the critical aspects of CI for P&S and how to achieve higher maturity is of primary importance to any organization that wishes to be competitive and successful. As noted by Kang (2004), this concept of CI, if correctly implemented, can help construction contracting companies improve their process cycle times, reduce resource consumption, increase reliability of the process and improve the quality of the project. According to Rummler and Brache (1995), process accounts for about 80% of all problems, while people account for the remaining 20%.; hence by focusing on the CI process in a customized process orientation, the organization should be able to reduce most of its problems in attempting to have effective P&S practice.

The determination of the Critical Success Factors (CSFs) of CI for P&S of construction projects through Delphi Study for achieving the first objective is significant for all construction organizations as it provides a clear indication of the few key factors that organizations should focus on in order to be successful. By identifying the CSFs, it could allow organizations to focus on their efforts on building their capabilities to meet the necessary requirements in P&S. Although the focus of the research has been the larger construction contracting organizations, the analysis acquired from this objective provides the awareness of what are the CSFs of CI for P&S of construction projects as a whole.

The attempt to accomplish objective two and three provides the empirical verification of the level of CI maturity for ISO and non-ISO certified construction organizations in terms of planning and scheduling in the Malaysian Construction Industry context. This will provide the realization of having to focus on CI in a more specific sense rather than to rely on ISO guidelines as a satisfactory means leading to satisfactory CI practice. Through consistent efforts of using the CI framework, it can provide the individual organizations an approach on how to focus on implementing improvement according to CSFs for CI for construction projects. For example from the quick use of the CI maturity level measurement instrument (current research instrument), even sub-contractors would know which level of CI for P&S that they are at currently and can aim to continuously improve their practices of P&S in their construction projects. This concept of CI as proposed in this research, is that of Kaizen-Blitz, that is to focus on improvements to be undertaken in short periods of time, that is

logically the practical form of CI that can have significant results on construction projects and contribute to the body of knowledge (Chapter 7).

1.9 Definition of Terms

a) Continuous Improvement (CI)

Boer et al., (2000) define CI as "..the planned, organized, and systematic process of ongoing, incremental and company-wide change of existing culture aimed at improving company performances." CI in this research will be defined as 'an effort to continuously seek and make change(s) for the better through processes which can be characterized as either incremental or radical transformation and maintain the results.

b) Planning and Scheduling

Planning is the way to organize and sequence the tasks needed to accomplish a goal. Whilst, Scheduling is the development of time requirements for each operation, and the relating of each to calendar time (Weber 2005).

In this case, Planning and Scheduling is defined as the way to organize and sequence all the tasks needed to accomplish a goal by scheduling all the time requirements for each operations and relating each to calendar time.

c) ISO 9001:2000 certified

ISO 9001:2000 certified refers to a company or organization that has been independently audited and certified to be in conformance with ISO 9001 may publicly state that it is "ISO 9001 certified" or "ISO 9001 registered" (SIRIM, 2009)

d) Construction Industry

The construction industry is defined in various ways, depending on an individual's point of view. Construction is generally described as the activities of the creation of physical infrastructures, superstructures and related facilities (Wells, 1985). According to Nam and Tatum (1988), construction is referred to as all types of activities associated with the erection and repair of immobile structures and facilities. Industry on the contrary is a group of related economic activities classified according to the type of goods or services supplied (Abdullah, 2008).

e) Critical Success Factors

According to the definition by Leidecker and Bruno (1984), CSFs as "those characteristics, conditions, or variables that when properly sustained, maintained, or managed can have a significant impact on the success of a firm competing in a particular industry."

Hence, in this study, CSFs is defined as those few things or variables that must go well to ensure success of processes and/or services in organizations to achieve it's aim.

f) Main/Large contractor

Business Dictionary defines Main contractors is an alternative term for prime contractors; they have a contract with the owner of a project or job, and have the full responsibility for its completion. A prime contractor undertakes to perform a complete contract, and may employ (and manage) one or more subcontractors to carry out specific parts of the contract.

The main or large contractor in this study is a contractor who is responsible to oversea all aspects of the project from planning, cost control to project managing.

g) High performance

In this study, high performance means as a notion of extra-ordinary outcomes of work being achieved through extra-ordinary contributions by people that continually aligns organization's strategy, goal objectives and internal operations with the demands of its external environment and relies upon a high degree of commitment, creativity, knowledge and skill.

h) Key Characteristic

A feature of a material, process, or parts (including assemblies) whose variation within the specified tolerance has a significant influence on process of life cycle of project management.

1.10 Outline of Thesis

This thesis is organized into eight chapters. A brief explanation of each chapter is given below.

Chapter One serves as an introduction to the research study. This chapter provides a brief note about the issues of construction industry in Malaysia related to the scope of the research. Subsequently, it looks into issues regarding to success factors implement of continuous improvement (CI) in order to overcome the construction industry problems that cause and effect by improper managing construction project planning. The background research, research questions, significance of the research, and scope of research are also included in this chapter.

Chapter Two explores the literature review pertaining to continuous improvement implementation. It also presents an earlier research work on CI; CI in construction industry; and key areas of concern within the scope of the research. In addition, this chapter also describes several models in terms of CI which serves as a foundation of the research.

Chapter Three examines some of the CSFs for implementing CI that has been undertaken by past researchers which is adapted for this research and confirmed through a Delphi Study. The Delphi questionnaire designed primarily based on the output of relevant literature review.

Chapter Four discusses the overall research methodology: the sampling process; data collection; the research design; Delphi method; questionnaires survey; and the statistical tools used in this research work.

Chapter Five presents the identification of critical success factors using Delphi Technique. It describes the purposed of CSFs; structured questions and the findings of Delphi study.

Chapter Six presents the identification of continuous improvement maturity level using questionnaires survey. It provides the questionnaire survey structure, reliability test and analysis of pilot study. This chapter also presents the results of the questionnaire survey analysis including demographic characteristics of the respondents and their companies, and also presents a discussion on the results of survey findings.

Chapter Seven presents the development of the proposed Critical Success Factors of CI framework including the rationale for developing the framework; flow of the processes and the framework design itself

Chapter Eight presents the conclusion of this research. The suggestions for future research in the area of Continuous Improvement for Planning and Scheduling of Construction Projects are also highlighted.

1.11 Summary

This introductory chapter has outlined the background of the research topic, the problem statement, research questions, objective, and the significance of the research. A basic explanation of the methodology is provided and finally an outline of the thesis is presented.

CHAPTER 2

CONTINUOUS IMPROVEMENT OVERVIEW

2.1 Introduction

Continuous Improvement (CI) has become common in many companies in developed countries. The word indicates a process of incremental improvement of the standard way of work (Chen et al, 2000). It is a compound word involving two concepts: KAI (change) and ZEN (for the better) (Palmer, 2001). The concept of CI has received much attention with respect to being key to Japan's competitive success. A considerable number of studies, which have focused on Japanese management techniques have illustrated the importance of KAIZEN. Furthermore, studies of KAIZEN activities in different countries suggest that the concept of KAIZEN has become routinely accepted throughout the world (Aoki, 2008). Over the past decade, CI has been studied from many perspectives. Hence, this chapter is to highlight the various perspectives from the literature, and to document the significant findings from earlier research that will serve as the foundation for the current investigation. This chapter presents an overview of continuous improvement and covers all the important aspects of CI in order to provide a deeper understanding of the concept.

According to Mat Naim, (2005), CI is the latest evolution in quality management; starting from inspection, then to quality control, quality assurance, quality management and finally continuous improvement. This is similar to Figure 2.1, which illustrates the level of sophistication of quality systems.

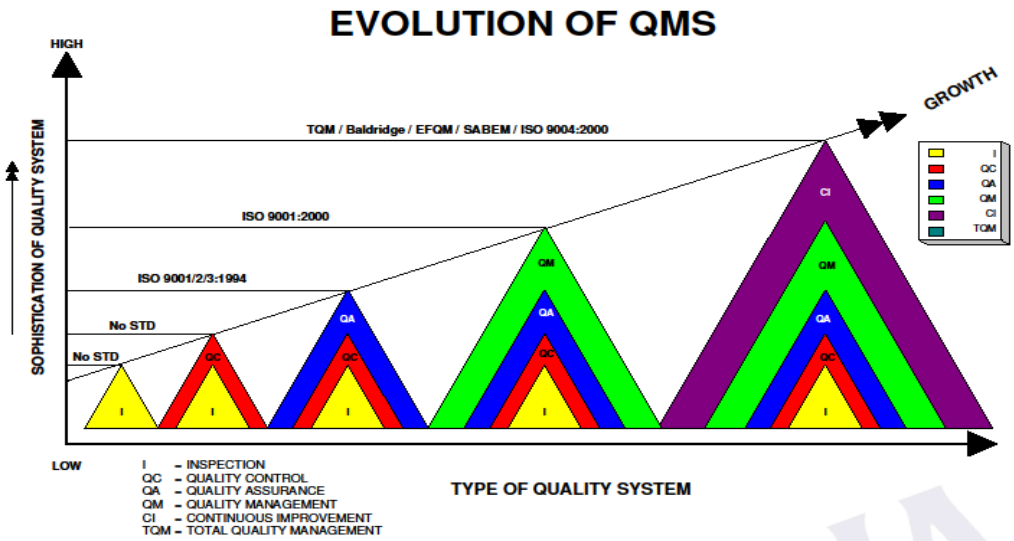

Figure 2.1: Evolution of QMS (http://saqi.co.za.temp.wadns.net/DNN/Portals/0/Publications/EVOLUTION%20OF%20A%20QMS.pdf)

The illustration is in line with Deming's (1986) approach in terms of how the evolution should be developed, founded on three basic precepts: 'Customer Orientation', the notion that 'quality is determined by the system' and "Continuous Improvement'.

It has been established that the benefits of CI are available to organizations of all sizes, across all sectors– see for example case study evidence reported by Oakland (2003), De Jager et al. (2004), Fraser (1995), Taylor and Hirst (2001) and Gallagher et al. (1997). Hamzah et al., (2004), note that in order to meet the challenges posed by the competitive environment, construction organizations must infuse quality and performance improvement initiatives in all aspects of their operations to improve their competitiveness.

2.2 Concept and Definition of Continuous Improvement (CI)

During the last decade, there has been a growing interest in the concept of continuous improvement (CI), and major industrial enterprises in a general sense have adopted CI to

improve their competitiveness. Most of the enterprises tend to believe that when things are going well, further improvements are possible. Hence, CI has been incorporated within a range of approaches and methodologies for business and operations improvement. Some of these approaches include Total Quality Management, Quality Management (QM) Systems, Benchmarking, Zero Defects, Kaizen, Lean Thinking, Statistical Process Control (SPC), ISO-9000, Business Process Reengineering (BPR), Business Excellence Models, Theory of Constraints (TOC) and etc. Whichever umbrella improvement initiative is preferred, it is important that the concept be understood and applied to a firm's operations to meet the requirement and expectation from the customer's perspective. Handy, (1994) notes that the CI concept was further developed as a new field in Operations and Innovation Management in relation to the Japanese practice of *Kaizen*.

Boer et al. (2000) provide insights into some key aspects and terminology used in the current implementation of the CI concept, namely: a) suggestion, recognition or reward, training systems; b) methods, tools and techniques; c) individual and team-based contributions; d) CI as a normal day-to-day activity; e) Company-wide involvement and commitment; f) Strategy-driven and strategy-forming; g) Empowerment; h) Facilitating individual and organizational learning;; i) Multiple projects (taking place simultaneously); j) and applied in all sorts of organizations.

There are various descriptions and understandings regarding the concept of continuous improvement. For example, Walsh et al., (2002), stated that, the concept of CI is a critical success factor of any organization and should be used as a foundation stone upon which every successful QM initiative should be based upon. It is clear from literature that experts may describe and propose slightly different approaches to continuous improvement (CI). For example, according to Juergensen, (2000), CI is a philosophy that Deming described simply as consisting of "Improvement initiatives that increase successes and reduce failures". Whereas, Hochberg (1996), describes CI as a philosophy and a set of principles by which to operate an organization based upon leadership by everyone, data-based decision making, systems/process thinking, and employee involvement to continuously improve an organization's ability to achieve current and future customer needs.

Bhuiyan & Baghel (2005) define CI as a culture of sustained improvement aiming to eliminate waste in all systems and processes in an organization. CI occurs through a series of improvements: some cases are incremental and others are radical changes. Another definition of CI is pointed out by Bessant et al., (1994), stating that CI is "a company-wide process of focused and continuous incremental innovation." Yet others view CI as either an offshoot of existing quality initiatives like total quality management (TQM) or as a completely new approach of enhancing creativity and achieving competitive excellence in today's market (Oakland, 1999; Caffyn, 1999; Gallagher et al., 1997).

The American Society for Quality (ASQ 2007) defines CI as an 'ongoing effort to improve products, services, or processes. These efforts can seek incremental improvement over time or breakthrough improvement all at once.' According to the European Standard EN ISO 9004: 2000 Guidelines for Performance Improvement (in BSI 2004, p.53), an organization should have a continual process of improvement and there are two fundamental ways to achieve this: breakthrough projects and small-step ongoing improvement activities.

Taking these views and definitions into account, CI in this research is defined as 'an effort to continuously seek and make change(s) for the better, through processes which can be characterized as either incremental or radical transformations geared at maintaining results.' Figure 2.2 illustrates the effect on business performance by applying this form of comprehensive CI concept.

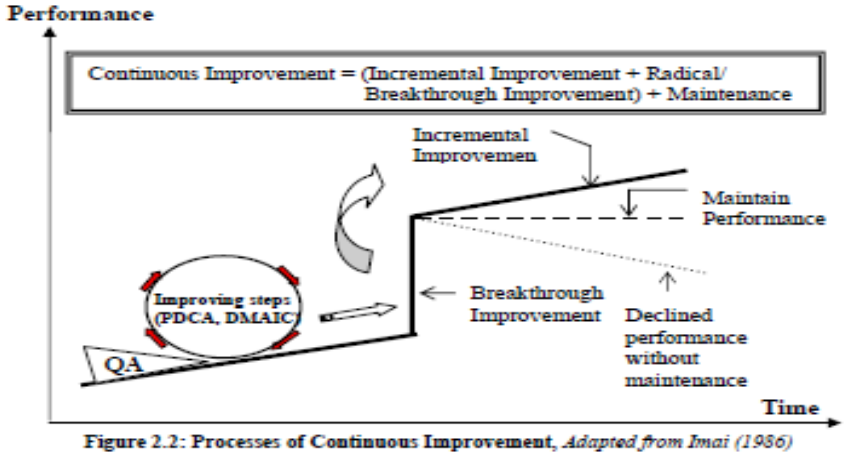

Figure 2.2: Processes of Continuous Improvement, *Adapted from Imai (1986)*

Figure 2.2: Processes of Continuous Improvement (Adapted from Imai,1986)

2.3 History of CI

According to Schroeder and Robinson, (1991), the roots of modern improvement programs can be traced back to initiatives undertaken in several companies in the 1800s which brought positive changes in the organization. Additionally, the author stated that during the late 1800s and early 1900s, much attention was given to developing scientific methods based on time-trials in order to help managers analyze and solve production problems. One such initiative involved the US government, who set up the "Training Within Industry" service during the Second World War to enhance the industrial output on a national scale. This included job method training, a program designed to educate supervisors on the importance and techniques of CI methods. This program was later introduced in Japan by management experts like Deming, Juran, and Gilbreth (Robinson, 1990).

Eventually, according to Imai (1986), the Japanese developed their own ideas, mainly focused on quality control, which was used initially in the manufacturing process, and which later evolved into a much broader term, growing into a management tool for ongoing improvement involving everyone in the organization.

2.4 Benefits and Challenges in the Implementation of CI

Competition and continuously increasing standards of customer satisfaction have proven to be endless driver of organizational performance improvements. Reid (2006) notes that the CI approach constantly seeks to identify and implement ongoing enhancements in a firm's products, services and processes. The benefits of the implementation CI is identified by Cole (2001) as follows:

a) It mobilizes large numbers of employees which improves employee commitment and increases the sources of ideas;
b) A number of small wins can occur simultaneously leading to a magnification of results;

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