DEVELOPMENT OF AN EVALUATION MATRIX OF OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT SYSTEM FOR CONSTRUCTION COMPANIES

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ABSTRACT

Occupational Safety and Health management system is often a neglected area and a function that has not been pursued systematically in the construction industry. Implementation of the occupational safety and health management system has resulted in improvements of workplace health and safety while simultaneously achieving significant cost reductions. The study has three main objectives: (a) To identify the key process areas and key processes of occupational safety and health management system, (b) To identify the key practices of enablers to indicate whether the implementation and institutionalization of the key processes is effective, repeatable and lasting, and (c) To develop an evaluation matrix of the occupational safety and health management system for construction companies. The key process areas, key processes, and key practices of enablers were identified through the comparison study of the 4 international standards of occupational safety and health management systems. The identified elements were tailored into the concept of Capability Maturity Model. They were validated again through the interviews and industry wide questionnaire. The analysis showed that the two categories of construction companies, Kuala Lumpur Stock Exchange listed construction companies and Construction Industry Development Board Malaysia Grade7 construction companies shared the same results even though they were from the different categories. The analysis concludes that the key processes and key practices of enablers are suitable to indicate the implementation and institutionalization of the occupational safety and health management system. The industry also agreed that the occupational safety and health evaluation matrix provides a systematic, structured, and continual improvement approach to the evaluation of occupational safety and health management system of construction companies. The occupational safety and health evaluation matrix can also help the construction companies to prioritize their

occupational safety and health management plans and focus on those improvements that are most beneficial given their occupational safety and health goals.

ABSTRAK

Sistem pengurusan keselamatan dan kesihatan pekerjaan selalu tidak diambil berat dan pengurusan aktivitinya juga tidak sempurna dalam industri pembinaan. Pelaksanaan sistem ini mampu meningkatkan tahap keselamatan dan kesihatan tempat kerja serta mengurangkan kos secara langsung. Kajian ini mempunyai tiga objektif: (a) Mengenalpasti proses utama bagi sistem pengurusan keselamatan dan kesihatan pekerjaan. (b) Mengenalpasti praktis 'enablers' bagi memastikan pelaksanaan proses utama adalah effisien dan berulangan. (c) Membangunkan satu matrix penilaian sistem pengurusan keselamatan dan kesihatan pekerjaan bagi syarikat pembinaan. Proses utama dan praktis 'enablers' dikenalpasti melalui perbandingan antara empat sistem pengurusan keselamatan dan kesihatan pekerjaan yang bertaraf antarabangsa. Proses utama dan praktis 'enablers' yang dikenalpasti akan diubahsuaikan untuk memasukkan dalam konsep 'Capability Maturity Model'. Proses utama dan praktis 'enablers' yang berdasarkan konsep 'Capability Maturity Model' akan disahkan melalui proses temubual dan edaran borang soal selidik. Keputusan analisis menunjukkan bahawa proses utama dan praktis 'enablers' yang disahkan adalah sesuai digunapakai untuk menilai sistem pengurusan keselamatan dan kesihatan pekerjaan bagi syarikat pembinaan. Industri pembinaan juga bersetuju bahawa model penilaian ini menyediakan pendekatan untuk penilaian pengurusan keselamatan dan kesihatan pekerjaan bagi syarikat pembinaan secara bersistem, berstruktur dan mempunyai sifat penambahbaikan secara berseterusan. Ia juga dapat menolong syarikat pembinaan memberi prioriti kepada perancangan pengurusan keselamatan dan kesihatan pekerjaan dan fokus dalam penambahbaikan perancangan pengurusan keselamatan dan kesihatan pekerjaan bagi mencapai sasaran yang ditetapkan.

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LIST OF ABBREVIATIONS

AIHA	-	American Industrial Hygiene Association
CIDB	-	Construction Industry Development Board Malaysia
CMM	-	Capability Maturity Model
CMMI	-	Capability Maturity Model Integration
ILO	-	International Labour Organization
JCSHA	-	Japan Construction Safety and Health Association
KLSE	-	Kuala Lumpur Stock Exchange
KPA	-	Key Process Area
OHSAS	-	Occupational Health and Safety Assessment Series
OSH	-	Occupational Safety and Health
OSHMS	-	Occupational Safety and Health Management System
SA-CMM	-	Software Acquisition Capability Maturity Model
SE-CMM	-	Software Engineering Capability Maturity Model
SOCSO	-	Social Security Organization
SPICE	-	Standardized Process Improvement for Construction Enterprises

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Construction industry has earned the reputation of being a highly hazardous industry because of the high incidence of accidents and fatality rates. It is needed to look into a new way in improving its image. One key to success in business is minimizing cost. Providing a safe and health workplace is one of the most effective strategies for holding down the cost of doing construction business. Accidents frequencies and property losses create great impact to construction company. Not only do they cause delays in operations but also directly and indirectly incur cost. Therefore, it is mandatory for all construction companies to provide a safe working environment for their workers and subcontractors.

Occupational Safety and Health (OSH) at work is an issue affecting all businesses. OSH is a major issue for companies mainly due to the fear of prosecution. With better enforcement of the legislation and commitment from employers and employees, construction safety has received greater attention (R.Kunju, A.G.F.Gibb & R.McCaffer 1999). Consequently, the improvement of safety and health in construction is a necessary goal for all participants in the construction process. Besides that, safer workplaces will help to improve productivity accompanied by reduced costs, better time performance and increased profitability.

In the increasingly global competitiveness of the construction business, quality control and quality assurance for a consistent level of performance in OSH is

no longer optional. OSH management system is a decisive factor in the effectiveness of the operations of construction companies. The implementation of OSH management system provides a structured process to minimize potentials of work-related injuries while simultaneously achieving significant cost reductions. It provides a foundation for construction companies to implement a documented approach to continual improvement of its OSH performance.

But until now, no uniformly accepted international OSH performance measurement tool currently exists. Current measurement of safety performance is based on post-accident data with little focus on pre-accident factors. They are unable to show the actual performance of their OSH management system. Real process improvement must follow a sequence of steps, starting with making the process visible, repeatable and measurable.

With this in mind, this research is based on a model containing a series of evolutionary steps. It will focus on the use of the Capability Maturity Model (CMM). CMM is a framework that describes the key elements of an effective software process. Key elements are the essential discipline-unique and common management tasks that any company must perform. It is a periodic measurement tool to evaluate the capability of the company's processes. It is also a road map for the company to achieve the goals of continual improvement.

CMM describes an evolutionary improvement path for software company from an ad hoc, immature process to a matured, disciplined one. Immature management system is characterized as unpredictable, as they rarely met the estimated cost and program and sometimes even over-run. In contrast, mature management system leads to a disciplined behavior, less rework, better product quality and improved project control. Increasing process maturity will be characterized by more accurate and realistic estimated time and cost, predictability of product quality and ability to absorb innovation and technologies advances.

This research is to develop an OSH evaluation matrix that can increase the process capability of OSH management system. The evaluation matrix aimed to

tailor the original CMM framework into a construction occupational safety and health specific maturity model. The core idea of the research must be abstracted and recreated in a form to fits local conditions. The evaluation matrix framework comprises two elements, the key process areas (KPA) and the enablers. The framework must be based on principles designed specifically for continual improvement of the OSH management system.

The OSH evaluation matrix is used to assist the construction of an OSH management process and OSH management system performance continual improvement. It is imperative that a methodology based on the process focus be highly effective in improving the quality of OSH management system in construction company. The application of a mature and effective OSH management system can lead to a safer workplace of construction industry and reduce incidence of injuries and work related diseases.

1.1 Problems Statement

The construction industry is an important sector of any national economy, especially regarding its employment potential. But accidents, incidents, injuries and fatalities continue to occur unabated on construction sites around the world at consistently high rates (Hinze, 1997; Berger, 2000). The construction industry tends to have a low awareness of the long-term benefits of safety practices, while the tendering process often gives little attention to safety, resulting in cost and corner cutting (Theodore, 2001). Sometimes, safety is found to be the first item to face cost cutting. This is because some of the employers often believe that the implementation of OSH management system will cost more.

The unsatisfactory OSH record of the construction industry has always been highlighted. It is because the OSH management system is a neglected area and a function that has not been pursued systematically in the construction industry. Safety is an important issue, but many employers do not feel it is vital to the success of

companies. According to Radhlinah (2000), the construction industry can benefit from an improved attitude change that cultivates a vision for the future which elevates safety concerns and effectively integrates them into the overall management mix. Research by Tang (1997) into the injuries on 18 construction projects suggested that the higher investment in safety, the better the safety performance.

Over the years, OSH management of the construction industry has evolved into a system that has been strengthened by the design, implementation and enforcement of the regulatory systems and standards. However, until now, the construction industry still has not had a recognized methodology or framework that is based on an OSH management process improvement initiative (Finnemore & Sarshar, 2003). The construction industry has lacked a recognized OSH performance measurement tool to improve the OSH management system. Without a standard measurement tool, construction companies are difficult to benchmark and measure their OSH management system performance with time or relative to other companies. Any improvement initiatives without guidelines have found that the efforts are always isolated and benefits cannot be coordinated or repeated (SPICE, 2002).

The construction accidents and fatalities may be mitigated by good construction practices. As reported by Young (1996), the key distinction of outstanding performance of companies outside the construction industry is that these companies have safety as a value enshrined in their culture and every employee. Smith (1999) agrees that there is a need to develop evaluation tools for construction companies to enabling them to benchmark their overall safety performance. With the standard measurement tool, construction companies can increase their capability to determine the performance with time of their OSH management operation, benchmarking with other organizations and provide a clearer understanding of the implementation management activities.

The measurement of OSH performance has traditionally focused on the measurement of outcomes, such as the lost time injury frequency rate and post-accident data. Measuring safety performance using reactive measures does not yield

a true measure of safety. They are unable to systematically assess OSH management system process, prioritize process improvement and direct resources appropriately. The limitations of reliance outcome measures as an indication of OSH performance have made it necessary for construction industry to consider a proactive way to measure their OSH performance.

There is a need to change from measuring loss-type accidents to embrace proactive measurement. It is important to develop a proactive measurement tool to evaluate the performance of an OSH management system for the construction company. High rates of injury are primarily due to inadequate or non-existence of an OSH management system. According to Monk (1994), many occupational accidents and injuries are due to a breakdown in the existing OSH management system. Therefore, the application of an 'effective' management can lead to safer systems of construction and reduce incidence of injuries and work related diseases (Davis and Tomasin, 1999). This study will develop an OSH evaluation matrix for the construction companies to enable them to evaluate the performance of the OSH management system based on process capability.

The need of the OSH evaluation matrix is necessary. This is because to improve construction safety performance, statistical data and various management elements need to be analysed (J. Lin & A. Mills, 2000). In order to achieve the highest level quality of OSH management system, the construction company must give the highest priority to process improvement efforts. The OSH evaluation matrix must be able to examine the OSH management system needs and identify the problem areas. It describes the current state of OSH management in a construction company and serves as a basis for making decisions regarding the allocation of resources. The OSH evaluation matrix is a forward-looking approach that indicates process capability before a process takes place.

Safety performance is more that just a measure of lack of safety. The evaluation matrix will provide the opportunity to monitor the OSH management system of construction companies and not just record them. It may assist their OSH management function to be more flexible, to minimize cost and to improve quality

and productivity. By having a simple and complete measurement tool, the level of OSH performance in construction companies will be improved.

1.2 Objectives

Purpose of the study is to develop a framework which can evaluate the performance and process capability of an OSH management system for the construction companies. The objectives of this thesis are:

1. To identify the key process areas and key processes of OSH management system.

2. To identify the key practices of enablers to indicate whether the implementation and institutionalization of the key processes is effective, repeatable and lasting.

3. To develop an evaluation matrix OSH management system for construction companies.

1.3 Scope of the Research

This research will develop an evolutionary step-wise of OSH management system measurement model. It can distinguish levels of increasing process capability by using the concept of CMM. However, the scope of the research is limited to construction companies in Malaysia only. It is not specifically designed for a construction project. Participation in the research of the construction companies can be divided into two categories. They were KLSE listed construction companies and Grade 7 construction companies. These two categories of construction companies were selected as the subjects because they were large companies and most of them were having their own OSH management system.

Large construction company always indicate that the OSH should be integrated into their entire management. Construction companies will find the contribution of this OSH evaluation matrix useful. It will serve as a framework for continuously measuring evolvement and continuously improving processes. The OSH evaluation matrix created in this research could be replicated in another construction company that is similar in terms of size. Actual results obtained in different construction companies could be varying significantly. It can still depend on the company's quality culture, management commitment and availability of facilities and technology.

1.4 Research Methodology

The methodology of this study is shown in Figure 1.1 and consists of the following:

a) Literature review is to determine:
   i. OSH performance of the construction industry.
   ii. Study of four international standard of OSH management systems.
   iii. Comparison of these four OSH management systems.
   iv. Concept of the capability maturity model (CMM).
   v. The tailoring the concept of CMM into the OSH management system.

b) Identify the key process areas (KPAs), key processes and key practices of enablers.

c) To verify the key process areas, key processes, and key practices of enablers through the formal interviews.

d) Develop the questionnaire for the industry wide survey. It is important to collect information from the construction industry to validate the key processes and key practices of enablers.

e) Develop the evaluation matrix for each key process area and establish application procedures of OSH evaluation matrix.

A comprehensive literature review was conducted to study the scenario of OSH performance in the construction industry and the concept of CMM. The essential information obtained from the comparison study of the four international standards of OSH management system is to identify the KPAs and key processes that will affect the OSH management system performance. And the key practices of enablers for each of the KPA were then being identified.

Following an extensive literature review, formal interviews with 5 certified safety experts of construction industry were conducted. It is a survey to determine the importance of the selected KPAs, key process and key practices to evaluate the performance of OSH management system in the construction industry. The response was very positive and recommendations helped to focus on essential OSH management elements. This modification was also achieved by grouping some similar key processes into the same KPA.

An industry wide survey questionnaire was prepared to validate the key processes and key practices of enablers. The questionnaire was posted to 208 construction companies. They were listed construction companies in the Kuala Lumpur Stock Exchange (KLSE) and CIDB Grade 7 construction companies. A successful return of 19.2% was achieved. After the key processes and key practices of enablers had been validated, they were incorporated into the OSH evaluation matrix. The next step was to conduct the interviews with five safety managers to establish the application procedures of OSH evaluation matrix. The framework of the conduction of OSH evaluation matrix was tailored from the concept of Software Capability Evaluation (Byrness & Philips, 1996).

In achieving the objectives of this study, the research methodology comprised 4 essential stages. The integration of the steps as mention above gave the end product "OSH evaluation matrix". The further discussion involves details of the methods and

approaches used to develop an OSH evaluation matrix is shown in Chapter 5. Chapter 5 consists of description, justification and analysis of each step.

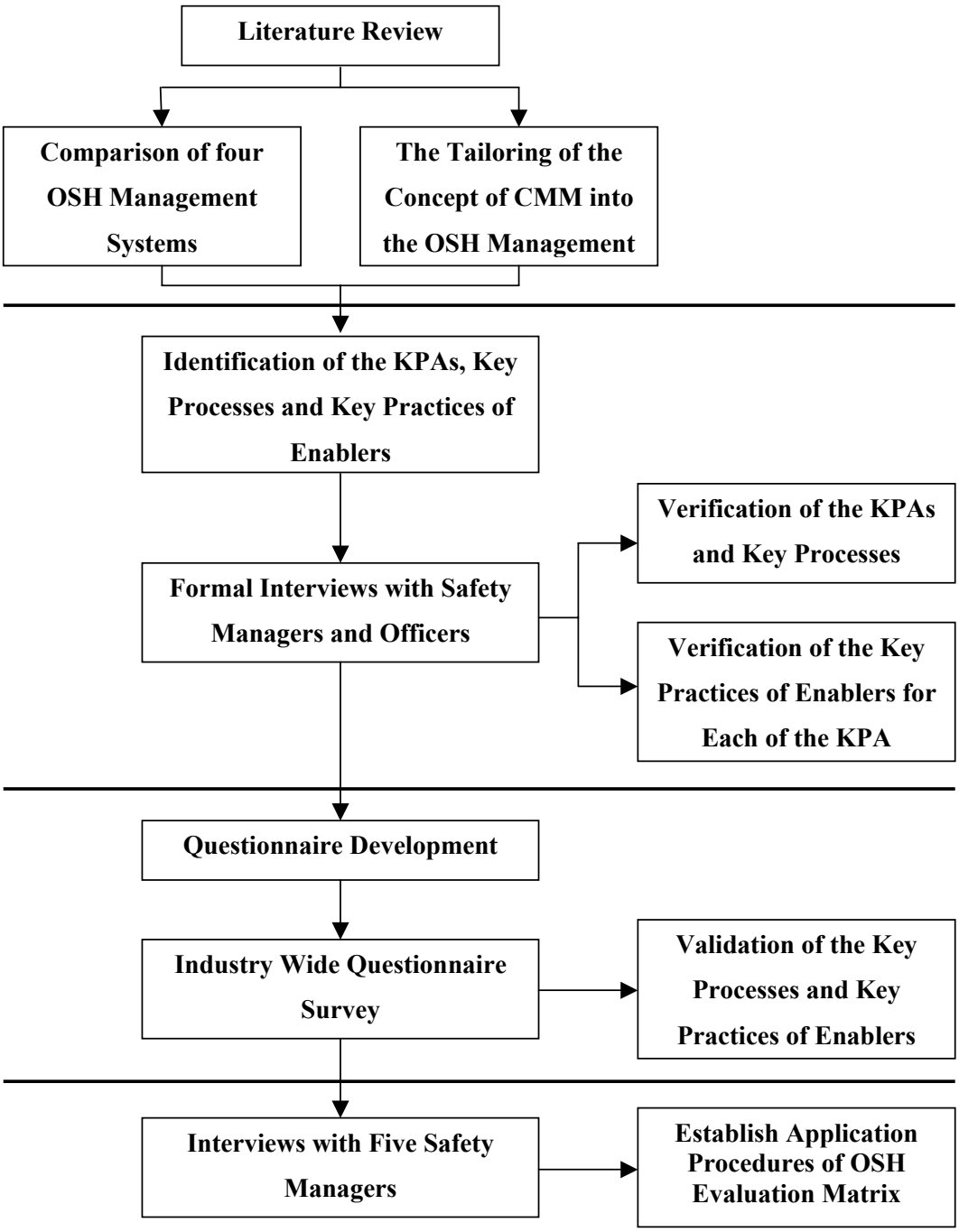

Figure 1.1: Research Methodology

1.5 Structure of Study

The introduction chapter outlines the research problem addressed by this study and general introduction to the subject. It also sets out the objectives, scope of the research and includes a brief description of the research methodology approach that is used.

Chapter 2 is about the OSH performance in the construction industry. This chapter discusses the nature of the construction industry and examines the setbacks of OSH performance in the construction industry. It is important to understand the reasons of the needs for improving OSH performance in the construction industry. This is the main reason why this study was carried out.

In Chapter 3, the characteristics of OSH culture and elements of four international standards of OSH management system are being discussed. It lets us understand the concept of OSH management and the needs for an OSH management system. It also looks at the importance of OSH management to an organization and the requirement of legislation. It is the basis for preparing the OSH evaluation matrix.

Chapter 4 touches on the capability maturity model (CMM). Development of evaluation matrix in this research is based on the concept of CMM. Basic structure and components of CMM are discussed; it includes the key process areas, enablers and maturity levels.

In Chapter 5, methodology to develop the OSH evaluation matrix is being defined. It is initially from the planning on how to start preparing this research step by step until how to achieve the result. It is such a guideline that helps us to finish this research.

In Chapter 6, the key processes and key practices of enablers are validated through the industry wide questionnaire. The research is using different types of statistical testing to analyze the collected data.

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