A STUDY ON THE POTENTIAL 0F INCLUSION OF ENVIRONMENTAL MANAGEMENT ELEMENTS IN CONTRACT DOCUMENTS OF CONSTRUCTION PROJECTS IN MALAYSIA

by

ASYIRAH BINTI ABDUL RAHIM

Thesis submitted in fulfilment of the
requirements for the degree of
Doctor of Philosophy

JULY 2007

A STUDY ON THE POTENTIAL 0F INCLUSION OF ENVIRONMENTAL MANAGEMENT ELEMENTS IN CONTRACT DOCUMENTS OF CONSTRUCTION PROJECTS IN MALAYSIA

by

ASYIRAH BINTI ABDUL RAHIM

Thesis submitted in fulfilment of the
requirements for the degree of
Doctor of Philosophy

JULY 2007

ACKNOWLEDGEMENTS

In the name of Allah, the most merciful and the most gracious. Alhamdulillah, praise to Allah Subhanahuwata'ala for giving me the opportunity and strength to explore and delve into this research and successfully completing this thesis.

I am deeply indebted to Professor Dr. Ir. Mohd Omar Ab Kadir, my main supervisor and Assoc. Prof. Dr. Nik Norulaini Nik Ab Rahman, my co supervisor, who have supervised this study from its initiation to its completion. Their commitments, comments and suggestions have been helpful towards the progress of this study.

I am grateful to Universiti Sains Malaysia and the Government of Malaysia for providing financial support throughout the period of my study via the Academic Staff Training Scheme (ASTS) fellowship. My appreciation goes to the Dean, School of Humanities, Universiti Sains Malaysia for giving me the opportunity to pursue my studies in environmental management. I am also grateful to the Construction Research Institute of Malaysia (CREAM) for awarding a research grant to carry out this study. Special thanks are obliged to Ir Dr Zuhairi Abdul Hamid, Ir. Mohamad Mohd Nuruddin, Puan Maria Zura, Encik Gerald Sundaraj and Encik Zulkefli Ismail of CREAM for the support, assistance and great cooperation throughout the study especially in jointly organizing the workshops.

I would also like to express my deepest gratitude and appreciation to all the postal survey respondents and workshops participants across Malaysia who have contributed their valuable views and opinions for this study. I am indebted to Dr Roslan Taha and Encik Meor Mohamad Haris from the Environmental Branch of Public Works Department, Malaysia; Puan Zalina Ibrahim, Encik Suresh Lachimpadi and

Puan Susilawati from Putrajaya Holdings Sdn Bhd.; Encik Yong Nan Sing from Putra Perdana Construction Sdn Bhd.; Encik Zamry Mahput and Puan Arduni Abu Bakar from Peremba Construction Sdn. Bhd.; and also to Ir Hasnida Abdul Manan and Puan Sarimah Talib from Sime UEP Development Sdn Bhd. whose kind cooperation and assistance during the field studies has enabled me to pursue this study with the minimum of difficulty.

I would like to acknowledge the lecturers of Environmental Technology Division, School of Industrial Technology, Universiti Sains Malaysia for their comments and guidance throughout my studies. Special thanks are accorded to all the research officers Cik Shalima Thamarakshan, Cik Sabariah Samsun and Encik Wan Mohd Saidi for the cooperation and commitment in conducting the postal survey, the nationwide workshops and other administrative tasks throughout the research period. Sincere thanks are also due to all my colleagues and friends especially Dr Norli, Dr Norhuda, Dr Ahmad Kamarulnajuib, Cik Fera Fizani, Puan Harlina and others for their continuous support, good thoughts and help in one way or another. The assistance of others from School of Industrial Technology is also acknowledged.

Finally, I would like to express my heartiest gratitude to my mother, Puan Rohani Md Noh and to my in-laws, Encik Amir Rasul and Puan Che Som Abdul Rahim for their sacrifices and prayers. My warmest love to my PhD babies Nur Sabrina, Mohamad Danial and Nur Aliyah for all the time I had to be away from them; and most of all to my beloved husband Mohamed Amin; whose love, blessing, encouragement and prayers over the years has enabled me to successfully complete the study.

TABLE OF CONTENTS

CHAPTER 4 : RESULTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

WTO	World Trade Organization
GATS	General Agreement in Trade and Services
CIDB	Construction Industry Development Board, Malaysia
PMI	Project Management Institute
PMBOK	Project Management Body of Knowledge
DOE	Department of Environment, Malaysia
TCPD	Town and Country Planning Department, Malaysia
LA	Local Authorities
DID	Drainage and Irrigation Department, Malaysia
EMS	Environmental Management Systems
SMM	Standard Method of Measurements
CESMM	Civil Engineering Standard Method of Measurements
PAM	Persatuan Arkitek Malaysia
IEM	Institution of Engineers, Malaysia
PWD	Public Works Department, Malaysia
SO	Superintending Officer
EU	European Union
GATT	General Agreement on Tariffs and Trade
EA	Environmental assessment
LCA	Life cycle analysis
EMAS	Eco-management and Audit Scheme
ISO	International Standard Organization
EQA	Environmental Quality Act, 1974 (Act 172)
EIA	Environmental impact assessment

LCP	'Laporan Cadangan Pemajuan'
CP	Construction players
RII	Relative importance index
MBAM	Master Builders Association of Malaysia
REHDA	Real Estate and Housing Developers Associations of Malaysia
AECCOM	Association of Environmental Consultants of Malaysia
ACEM	Association of Consulting Engineers of Malaysia
NGO	Non governmental Organizations
ANOVA	Analysis of variance
SD	Strongly disagree
DA	Disagree
QA	Quite agree
A	Agree
SA	Strongly agree
ERP	Emergency response plan
EMAR	Environmental monitoring and audit report

LIST OF SYMBOLS

Σ	Summation
w	Weighting given to each factor
A	Highest weight
N	Total number of samples
COV	Coefficient of variation
S	Standard deviation
x_w	Weighted mean of sample

KAJIAN POTENSI PENERAPAN ELEMEN PENGURUSAN PERSEKITARAN KE DALAM DOKUMEN KONTRAK BAGI PROJEK PEMBINAAN DI MALAYSIA

ABSTRAK

Industri pembinaan di Malaysia sangat memerlukan pengurusan persekitaran strategik untuk menterjemahkan misi pembangunan mapan dan memastikan keberkesanan amalan baik alam sekitar di tapak binaan. Penerapan elemen pengurusan persekitaran dalam dokumen kontrak bagi projek binaan telah dipilih sebagai satu strategi pembangunan mapan di peringkat projek. Kajian ini bertujuan menentukan posisi strategik pengurusan persekitaran dalam projek binaan dan mencadangkan pemacu perubahan untuk memastikan strategi ini menjadi tindakan. Analisa pengurusan persekitaran strategi telah dijalankan daripada tiga perspektif projek binaan: aspek dalaman, jaringan dan luaran. Kajian ini merujuk kepada pihak yang terlibat dalam industri pembinaan di Malaysia melalui soal selidik pos, perbincangan panel pakar dan kajian kes. Bagi meneroka dan mendalami cadangan penerapan elemen pengurusan persekitaran dalam dokumen kontrak. Hasil kajian menunjukkan kepentingan integrasi pengurusan persekitaran ke dalam pengurusan projek, skop elemen pengurusan persekitaran, jadual bahan yang terperinci untuk elemen pengurusan persekitaran dan pengetahuan, kepakaran dan kelayakan sumber manusia sebagai aspek dalaman projek binaan yang mempengaruhi penerapan elemen pengurusan persekitaran ke dalam dokumen kontrak. Pengaruh aspek jaringan industri pembinaan ke atas strategi adalah komitmen terhadap pengurusan persekitaran daripada pihak yang terlibat dalam pembinaan, budaya terhadap kualiti, kos dan masa, dan keupayaan agensi teknikal. Aspek luaran projek binaan pula adalah pelaksanaan polisi alam sekitar pada peringkat tempatan dan projek, mekanisma penguatkuasaan undang-undang dan penyertaan aktif daripada awam dan badan bukan kerajaan.

Berdasarkan dapatan kajian, penyelidikan ini merangka dan mencadangkan enam pemacu perubahan untuk penerapan elemen pengurusan persekitaran dalam projek binaan: i) integrasi pengurusan projek, ii) pengurusan persekitaran dalam dokumen kontrak, iii) pembangunan modal insan, iv) perubahan organisasi dan budaya, v) mekanisma institusi dan undang-undang, dan vi) inisiatif kerajaan dan awam. Kesimpulannya, kajian ini mengetengahkan faktor yang mempengaruhi penerapan elemen pengurusan persekitaran dalam dokumen kontrak, menyediakan asas yang kukuh untuk pihak CIDB dan pihak lain untuk meningkatkan prestasi industri pembinaan di Malaysia, dan menyumbang terhadap pengetahuan mengenai pengurusan persekitaran strategik dalam industri pembinaan.

A STUDY ON THE POTENTIAL OF INCLUSION OF ENVIRONMENTAL MANAGEMENT ELEMENTS IN CONTRACT DOCUMENTS OF CONSTRUCTION PROJECTS IN MALAYSIA

ABSTRACT

Strategic environmental management in the Malaysian construction industry is very much needed to translate the mission of sustainable development for effective environmental best practices at construction site. Inclusion of environmental management elements in contract documents of construction projects was chosen as the sustainable development strategy at project level. The study aimed to determine the strategic position of environmental management in construction projects and to recommend key drivers for changing the strategy into action. Strategic environmental management analysis was conducted from three perspectives of construction projects: internal, network and external aspects. The study consulted the Malaysian construction stakeholders via postal survey, expert panel discussions and case studies to explore and scrutinize the proposed inclusion of the environmental management elements in contract documents. The research revealed the importance of integration of environmental management into project management, scoping of environmental management elements in contract documents, specifications for environmental management elements, itemized environmental management elements in bill of quantities; and human resources knowledge, competence and skills as internal aspects of construction projects that influences the inclusion of environmental management elements in contract documents. The construction project network influences on the strategy were, the commitments of the construction stakeholders on environmental management, the culture on quality, cost and time, and the capabilities of the technical agencies. The external aspects of construction projects determined in the study were implementation of environmental policy at the local and project levels, the legal enforcement mechanisms and the active participations of the public and the

NGOs. Based on the findings, the study formulated and recommended six key drivers of changes for inclusion of environmental management elements in contract documents of construction projects: i) integrated project management; ii) environmental management in contract documents; iii) knowledge and capacity building; iv) organizational and cultural changes; v) institutional and legal mechanism; and vi) government and public initiatives. Thus, in conclusion this study elucidates factors that influence inclusion of EMS elements in construction contract documents, offer leverage to CIDB and other related parties to improve environmental performance of the Malaysian construction industry, and contributed towards better understanding of the area of strategic environmental management in construction industry.

CHAPTER 1

INTRODUCTION

1.1 Preamble

In construction, environmental impacts arise during the construction process as well as from the physical existence and operation of the completed structure (Carpenter, 2001a). Significant contributions of construction activities to the degradation of environmental quality and the mission of sustainable development have put pressure on the construction industry to improve their environmental performance (Ofori, 1992; Spence and Mulligan, 1995; Rees, 1999; Dulaimi et al., 2001; Ofori et al., 2002).

One of the frameworks suggested, to achieve sustainable development in construction industry is the use of Environmental Management System (EMS) (Hill and Bowen, 1997; Ofori et al., 2000; Ofori et al., 2002; Shen and Tam, 2002). In general, EMS can be defined as part of the overall management system which includes the organizational structure, responsibilities, practices, procedures, processes and resources for determining and implementing the firm's overall aims and principles of action with respect to the environment (Kolk, 2000). Organizations implement EMS to address an organization's impact on the environment, maintain compliance with environmental regulations, lower environmental costs, reduce risks, train employees, develop indicators of impacts and improve environmental performance (Christini et al., 2004). EMS also can provide opportunities for creative prevention of pollution. Instead of only looking at 'end of the pipe" solution, an EMS develops procedures to help a company minimize its overall environmental impact (Sasseville et al.,1997).

However the construction industry is still facing problems due to the prevalent construction culture where clients view time, quality and cost as the well excepted objectives of every construction project (Ofori, 1992; Havranek; 1999). Therefore, Ofori (1992) suggested that proper managing of the environment should be the fourth objective of the construction project; and this is in concordance to the opinion held by Havranek (1999), who pointed out that project management must satisfy environmental requirements in all the three objectives i.e. time, quality and cost.

The measures being taken in relation to environmental issues have had many consequences in the construction industry. According to Ofori (1992), the Economic Commission for Europe considered environmental measures were felt mostly through an increase in investment costs and a lengthening of the process of designing, planning and carrying out of the construction. According to Christini et al. (2004) there are significant resource requirements for an EMS, especially management and worker time in developing plans, documenting the EMS, undertaking training, accomplishing EMS tasks and undergoing environmental audits. Accordingly, environmental management requirements designed for construction projects were suggested to be included in the construction contracts to ensure implementation and improved environmental performance (Sanvicens and Baldwin, 1996; Hickie and Wade, 1997; Hill and Bowen, 1997; Hill, 2000; Carpenter, 2001c).

Construction contracts are the written agreements signed by the contracting parties (mainly the project proponent and the contractor), which are binding and defines relationships and obligations (Zaghloul and Hartman, 2003). Smith (1995) added that contracts are also a planning tool, whereby, in developing contracts, the spectrum of potential risks can be identified and then addressed in contract language. In essence, a contract is a handbook of performance; it will set out clear, consistent

and concise language, the procedures to be followed for such things as inspections, tasks, roles, responsibilities, payments, and interpretations of the contract documents.

1.2 Rationale for Research

Carpenter (2001a) defines construction as fitting parts or materials together to make something – such as a structure to provide shelter, a bridge or foundation to carry loads, an embankment to support raised way or a dam wall to impound water. In its broadest sense construction is responsible for the 'built environment'. The construction industry participates in every phase of the development, from investment and financing to site planning engineering, and architecture; through project execution; and even into facilities management. It is clear then, that the construction industry plays a central role in the economic development (Moavenzadeh, 1994).

Around the world, construction processes and practices are under scrutiny. Changing markets, new technology and rising client expectations are stimulating radical reviews of how the industry can be re-engineered to enhance its environmental performance (Yitmen, 2007). Construction has a poor image mainly as a result of the industry's failure to change the attitudes, technologies, processes and culture (Moavenzadeh 1994, Dulaimi et al. 2001, CIDB 2000; Yitmen 2007).

The traditional concern of designers and builders had been the protection of constructed items from the effects of the environment. However, the industry had realized that together with the industries that supply the building material, construction industry is also one of the largest exploiters of natural resources. Construction projects may have environmental implications arising from the nature of the design, the method of construction, the location and layout, the physical structure or its use. Accordingly the effects of construction operations and products on the environment

have received much attention (Ofori, 1992; Spence and Mulligan, 1995; Carpenter, 2001b).

Jamaluddin (1999) indicates that one important aspect within the natural process system is response and the physical environment is very sensitive to disturbance either natural or due to human activities. Environmental deterioration starts to occur when the disturbances exceed the optimum level and no appropriate management measures are taken. Environmental impacts of construction activities are typically classified as air pollution, waste pollution, noise pollution and water pollution.

Issues relating to the environment are receiving attention from governments, non-governmental organizations and trade associations in most sectors of the economy, as well as the general public. The implications of these trends result in heightened pressure to consider environment as part of the culture of the construction industry (Ofori, 1992). Environment and development are not separate challenges; they are inexorably linked (Jamaluddin, 1999) and research conducted in this topic have shown that environmental management is essential to safeguard the environment and ensure sustainable development (Ofori, 1992; Sanvicens and Baldwin, 1996; Hickie and Wade 1997 and 1998; Hill, 2000; Ofori et al., 2000). Consequently, environmental management in the construction industry has been implemented in many countries throughout the world such as the United States of America (MacDonald, 2004), Kuwait (Kartam et al., 2004), South Africa (Hill, 2000), Hong Kong (Shen and Tam, 2002), China (Zhen et al., 2004), Singapore (Ofori et al., 2000) and Sweden (Faith-Ell et al., 2006).

A global research agenda on environmental management in construction industry has emerged after the publications of the Bruntland Report also known as *Our Common Future* which was published in 1987. This report put forward a key statement on sustainable development. Considerable effort has been devoted to research in this area and has been conducted along several fronts for example: integrated project management (Hill, 2000; Zhen et al., 2004), monitoring systems and follow-up activities (Harrington and Canter, 1998); environmental management systems (Zhi et al., 2000; Tam et al., 2004; Ofori et al., 2000; Zhen at al., 2004); environmental management system in design (Aminatuzuhariah, 1996); environmental performance indicators (Tam et al., 2006); waste management (Kartam et al., 2004); environmental management plan (Hickie and Wade, 1998; Sanvicens and Baldwin, 1996); environmental requirements in construction contracts (Ofori and Chan, 1999; Faith-Ell et al., 2006); eco-labelling in construction (Ball, 2002) and strategies and challenges in construction industry (Dulaimi et al., 2001; Cheng et al., 2004; Yitmen, 2007).

Smith (1995) identified environmental compliance and constraints as construction risks and suggested that allocation of these risks by improving contracts and contracting practices would save construction costs. Faith-Ell et al. (2006) conducted two studies of the implementation of environmental requirements in Swedish road maintenance contracts. The studies examined the fulfillment and follow-up of the requirements, the client's intention behind the requirements, and factors influencing the contractors' environmental performance. Ofori and Chan (1999) discussed the contractual provisions for sustainability in construction in Singapore. Review on the works of Sanvicens and Baldwin (1996), Hill and Bowen (1997) and Hill (2000) revealed that the authors dealt with in-depth discussions on the implementation of environmental management system in construction. However, applications of

environmental management in construction contracts were only briefly mentioned in the papers to support the framework suggested by the authors.

In Malaysia, considerable effort has been devoted to the study of environmental management. For the most part investigations have concentrated on environmental impact assessment (EIA) reviews (Ahmad Kamarulnajuib et al., 1998), studies on environmental parameters in EIA (Haslynda, 2000; Al-Madhoun, 2004); environmental monitoring and audit (Abdullah, 1997), and the usage of expert system in EIA (Aljack, 1997; Foo, 1998; Sehkaran, 1998). However, few scholars had examined environmental management in construction for example sustainable architecture (Ahmad Sanusi, 2004) and construction waste management (Begum, 2007).

Studies on ISO 14001 environmental management systems in Malaysia were conducted by Wang (2002), Samuel (2002), Lee (2004) and Low (2004). Lee (2004) conducted a survey on ISO 14000 certified companies registered with SIRIM, the registering authority in Malaysia. The author reported that most of the certified companies were electrical and manufacturing.

There are very few studies on environmental management in construction industry. Hasmawati (1997) investigated and developed a model to establish environmental management within remit of construction professionals in procurement of building projects. Contract law and its application in relation to environmental problems in Malaysia were examined by Muhammad Rizal (2002). It is clear that this represents a lack in our knowledge on environmental management in construction industry and this need to be addressed. In essence, the potential of construction contracts for attainment of proper environmental management in construction projects has not been fully investigated by the researchers in this area.

1.3 Scope of Research

Given the unsatisfactory state of environmental management in construction industry and the limited research conducted on its inclusion in contract documents, it is compelling to undertake a research on environmental management elements in the contract documents for construction projects in Malaysia. Accordingly, this research explores and identifies the status of construction projects in implementing measures to improve environmental management in construction. Based on the strategic management approach (Johnson and Scholes, 2002), this research investigates four major themes in order to identify the strategic position of construction projects to include environmental management in construction contracts. Firstly, the influence of external environment on construction projects; secondly, the internal factors such as the capabilities of construction projects; thirdly, the expectations and purposes (network factors) required of construction projects; and fourthly, the inclusion of the environmental management elements in the contract documents.

This research, therefore, has been structured around four key questions. Firstly, what are the external factors that influence employment of environmental management in construction projects in Malaysia? This demands investigations on the global influence on construction industry and on the inclusion of environmental management in construction contracts. Secondly, what are the internal factors (capabilities) required to include environmental management elements in construction contracts? This question demands identification of the success factors which includes the knowledge and competence required and assessing the construction projects resources in meeting these factors. Thirdly, what are the expectations and purposes (network factors) of the construction stakeholders in relation to the strategy? The question requires assessment of the roles, responsibilities, culture, organizational and ethical issues of the stakeholders in relation to environmental management in

construction projects. Finally, the last question, what are the changes required for attainment of environmental management in construction contracts? This part requires establishment of specific findings on which to base practical recommendations of key drivers to improve environmental management in construction projects via inclusion of environmental management elements in contract documents.

Environmental management elements and contract documents are terms used in the present research to signify the strategic measures and instruments chosen to improve implementation of environmental management in construction projects.

1.4 Research Objectives and Methodology

To probe the key questions outlined above, seven research objectives were identified for further investigation in this study. These are listed below:-

1) To establish the concepts and characteristics of contract documents in construction projects;
2) To explore the concepts and characteristics of environmental management in construction industry;
3) To verify the external environment influence on the inclusion of environmental management elements in construction contracts;
4) To ascertain the resources and competence required for environmental management in construction contracts;
5) To determine construction stakeholders expectations and purposes in relation to implementation of environmental management in construction contracts;
6) To investigate environmental management elements in construction contracts of selected construction projects;

7) To elucidate specific findings to base practical recommendations of key drivers for the inclusion of environmental management elements in contract documents.

In order to achieve these objectives, the study employed several research methodologies which are briefly described below. Detailed discussion of these methodologies is given in Chapter 3. A literature review is employed to appraise environmental management in construction is important to achieve all the research objectives, but was of particular important for objectives 1 and 2. Postal survey and expert discussions were designed to achieve objectives 3, 4 and 5. Environmental audit protocol was developed to assist case studies and satisfy objective 6. Strategic analysis such as SWOT analysis, power/interest matrix and sustainability/ cost matrix were employed which lead to the main findings and accordingly became the basis for recommendations to satisfy objective 7. In conclusion, employing these methodologies mean that all the objectives of the research could be achieved and the four key questions posed in this research are explored in a scientifically rigorous manner.

1.5 Limitation of Research

A study on the status or position of environmental management in construction can be very broad. The current research is conducted on an exploratory manner to distinguish the position from the perspectives of the construction stakeholders. Thus, it is important to note that detailed environmental management elements being practice in the construction industry is not investigated. The subject of study, contract documents are confidential and have legal implications, therefore, the extent to which the documents may be reviewed are very limited.

In conclusion, this research represents a significant contribution to environmental management research in the construction industry. In particular, this research will: (i) elucidate factors that influence inclusion of EMS elements in construction contract documents; (ii) establish Guideline for EMS in Contract Documents for improvement of Bill of Quantities and Specifications for environmental best practices in construction projects; (iii) offer leverage to CIDB and other related parties to improve environmental performance of the Malaysian construction industry, environmental management in construction industry; and research on sustainable development strategy in construction industry.

CHAPTER 2

LITERATURE REVIEW

This chapter starts with the description of construction industry, projects and contracts. Strategic environmental management concept is discussed as the theoretical framework and followed with an appraisal of issues related to the strategic environmental management in construction industry. It is important to note that most of the reviews were based on researches, practices and experiences of other countries. Hence, a section of this chapter was devoted to review the environmental management in the construction industry in Malaysia as the procedure and practices may be different from other countries.

2.1 Construction Industry

Construction is defined in various ways in literature. Webster's Revised Unabridged Dictionary, defines construction as a process or art of constructing; the act of building; erection; the act of devising and forming; fabrication; and composition (CIDB, 2000). Carpenter (2001c) defines construction as fitting parts or materials together to make something – such as a structure to provide shelter, a bridge or foundation to carry loads, an embankment to support raised way or a dam wall to impound water. In its broadest sense construction is responsible for the 'built environment'.

According to Fadhlin (2004), the Malaysia Industrial Classification 1972 (updated 1979) followed the definition by International Standard Industrial Classification of all economic activities issued by the United Nations (1968) which defines construction as follows:

"...constructing, altering, repairing and demolishing building; constructing, altering and repairing highways and streets and bridges; viaducts, culverts, sewers and water, gas and electricity mains; railway roadbeds, sub-ways and harbour and water ways; piers, airports and parking areas; dams, drainage, irrigation, flood control and water power projects and hydroelectric plants; pipe lines; water wells; athletic fields, golf courses, swimming pools and tennis courts; communication systems such as telephone and telegraph lines; marine construction, such as dredging and under water rock removal; pile driving, land draining and reclamation; and other types of heavy construction . . . mining services such as preparing and constructing mining sites and drilling crude oil and natural gas wells... specialist trade contractor's activities..."

"The assembly and installation on site of prefabricated, integral parts into bridges, water tanks, storage and warehouse facilities, railroad and elevated right-of-way, lift and escalator, plumbing, sprinkler, central heating, ventilating and air-conditioning, lighting and electrical wiring, etc. systems of buildings and all kinds of structures..."

CIDB (2000) uses the definition given in Construction Industry Development Board Malaysia Act, 1994 (Act 520) which defines construction works as:

"construction, extension, installation, repair, maintenance, renewal, removal, renovation, alteration, dismantling or demolition of:

a) any building, erection, edifice, structure, wall, fence or chimney, whether constructed wholly or partly or below ground level;

b) any road, harbour, railway, cable way, canal or aerodrome;

c) any drainage, irrigation or river control works;

d) any electrical, mechanical, water gas, petrochemical or telecommunication works;

e) any bridge, viaducts, dam, reservoir, earthworks, pipeline, aqueduct, culvert, driveshaft, tunnel or reclamation works."

An industry is a group of related economic activities classified according to the type of goods or services supplied. Following the definitions of construction and industry, construction industry is that sector of an economy which constructs, alters, repairs and demolishes buildings, civil engineering works and other similar structures; the assembly and installation on site of prefabricated components and building engineering services (Fadhlin, 2004).

2.1.1 Construction Project

According to Havranek (1999), the definition of a project has been the subject of considerable debate among the practitioners of the profession. The Project Management Institute (PMI) in the Project Management Body of Knowledge (PMBOK) has published the definitions for a project and various definitions have appeared over time. Havranek (1999) adopts the definition of a project that acknowledges the activities must be completed in accordance with established specifications (scope), must have defined starting and ending dates (schedule), require funding limits (budget), and will consume resources (material, equipment, and people). According to Oberlender (1993) project consists of three components, which is the scope, budget (finance) and schedule. Abdul Rashid and Abdul Aziz (1999) listed various views and summarized 'project' as a process to achieve specific objectives and involves specific phases in the life cycle; short term where temporary organization (ad hoc) is set up; involves one aim, where the final product can be explain from the cost, time and implementation requirements; involves specialists from various profession and organization; assignments are interdependent and need coordination; each project is different due to the different situation, materials and equipments; objective oriented; and product management.

Management can be define and mean different things to different people. According to Havranek (1999) there are five functions or principles of classical management: planning, organizing, staffing, controlling and directing. Abdul Rashid and Abdul Aziz reviewed various definitions of management and concluded that in essence management involves processes (technical and social); decision-making and implementation; decisions that involved limited resources; and also to achieve predetermined aim.

Oberlender (2000) defined project management as the art and science of coordinating human resource, machineries, materials, money and schedule to complete a project within specific time and cost. Given the working definition of a project and understanding of the classical management functions, Havranek (1999) defined project management as:

> *'the art and science of planning, organizing, integrating, directing, and controlling all committed resources – throughout the life of a project – to achieve the predetermined objectives of scope, quality, time, cost, and customer satisfaction.'*

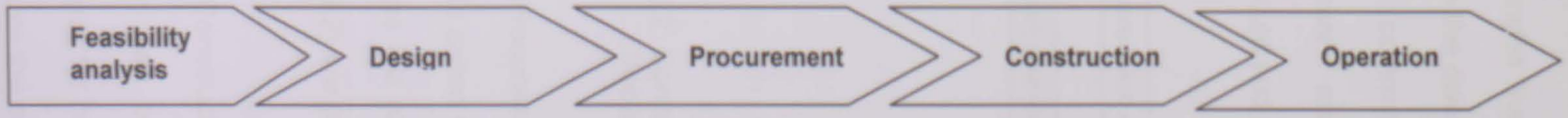
Following the definitions given; construction project is a unique undertaking that constructs, alters, repairs and demolishes buildings, civil engineering works and other similar structures within a specific objective, a series of tasks, defined scope and specifications, schedule for completion, budget and resource consumption. Construction project referred and used in this research is deemed to comprise the civil engineering and building construction works.

2.1.2 Construction Project Value Chain

Construction project process and activities can be described according to the phases and the value chain of the construction project can be summarized as in Figure 2.1. The figure clearly illustrates the main process of the phases and the main players involved during each phase.

The feasibility analysis is performed to examine the proposed investment (project) from several standpoints that is on cost of money, schedule, budget, and market demand. The developer/ client often consult architects and engineers for design advice; and contractors for cost and constructability advice. This phase also requires the developer/ client to secure financial backing for the project (Gould and Joyce, 2003).

Design of the project is usually divided into distinct stages: programming, schematic, design development and construction documents. Programming is a concisely written project objective matched to the owner's budget and schedule; schematic stage is the investigation on different design alternatives that meet the program; design development stage is a continuation and refinement of the selected design and scheme accomplished on a system-by-system basis; and construction documents stage is the preparation of the final documents used to describe the work to the builders. At this last stage of design, the designer creates the final working construction documents used to bid the job for construction and to build the job in the field. These documents are particularly important because they represent the work as it will be actually constructed (Gould and Joyce, 2003).



The process of analyzing the feasibility of the project and securing financial support	The process of translating business/ social needs to knowledge products and produce contract documents	The process of securing the best price for transforming the k-product to built environment and selection of contractor	The process of transforming the k-product to a built environment	The process of utilizing the built environment to meet the business/ social needs
▪ Developer/ Client ▪ Architects ▪ Engineers ▪ Contractor	▪ Developer/ Client ▪ Architect ▪ Engineer ▪ Quantity Surveyor ▪ Regulatory authorities	▪ Developer/ Client ▪ Architect ▪ Engineer ▪ Quantity Surveyor ▪ Main Contractor	▪ Architect ▪ Engineer ▪ Quantity Surveyor ▪ Regulatory authorities ▪ Project Manager ▪ Main Contractor ▪ Skilled & unskilled workers ▪ Suppliers ▪ Plant operators ▪ Financiers	▪ Developer/ Client ▪ Management Corporations ▪ Regulatory authorities ▪ Consumers

Figure 2.1: Construction value chain, main process and main players involved in the chain (adapted from CIDB, 2000 and Gould and Joyce, 2003)

The bid requirements, the agreement, technical specifications, drawings, addenda, and contract modifications all form part of the construction documents. Figure 2.2 illustrates the relationship of the many components. The construction documents translate the owner's needs so that the contractor can execute them correctly, thus they are the communication link among the parties in the project. Therefore, the specifications and drawings must be accurate and clearly communicate the scope of work (Gould and Joyce, 2003).

Construction documents		✓	Bid forms	✓	Bid documents
		✓	Instruction to bidders	✓	
Contract documents	✓	✓	Contract forms	✓	
	✓	✓	General conditions	✓	
	✓	✓	Supplementary conditions	✓	
	✓	✓	Technical specifications	✓	
	✓	✓	Drawings	✓	
	✓	✓	Addenda	✓	
	✓	✓	Change orders		

Figure 2.2: Components of construction documents, contract documents and bid documents (source: Gould and Joyce, 2003 p 175)

Procurement stage involves the overall process of finding and purchasing the materials called for in the contract and hiring the best contractor to build the project. At this stage the related construction documents also known as bid documents (refer to Figure 2.2) are given to intersted parties (Gould and Joyce, 2003).

Construction phase is when the actual works take place. In general, construction activities can be described as: a) handling of materials and equipments and b) techniques for handling them which require the capability and resources of constructors to produce the desired product. The main element involved in construction is the task of managing and coordinating the field operations. This means scheduling the crews in

proper sequence, choosing the most efficient and safe construction techniques and methods, and directing the production process for the activities. To accomplish this task, the construction professional must order the correct materials, ensure an adequate supply of the necessary tools and equipment, and monitor schedule, cost and quality (Illingworth, 2000; Carpenter, 2001c). Another task in this stage is the contract administration which involves controlling changes to the scope of the project, accounting for payments and other costs, maintaining work schedules, keeping track of contract documentation and monitoring quality-control tasks (Gould and Joyce,2003).

After actual construction is complete, the project must be turned over to the owner. However, often this turnover involves complicated technical issues and problems such as training of special equipments installed, certificates of warranty, and obtaining various other legal certificates. Lastly, operational stage is the responsibility of the owner and/ or the tenant of the building and usually does not involve either the architect or the construction professional (Gould and Joyce, 2003).

2.1.3 Construction Contracts

Construction contracts are the written agreements signed by the contracting parties (mainly an owner and a contractor), which bind them, defining relationships and obligations (Zaghloul and Hartman, 2003). Uff (1989) listed the objectives of construction contract: providing necessary resources for the efficient administration of the work; providing an apportionment of risk arising out of the performance of the work and the end product of the work; providing for possible contingencies regarding price, time and other variables; providing for the coverage of any risks which are not to be borne ultimately by the parties; facilitating proper management of the works being carried out; achieving proper economy in regard to performance of the works and the

finished product; maintaining sufficient flexibility to attain the proper objectives of the contract; and dealing appropriately with disputes which may arise out of the contract.

Smith (1995) gave a brief outline of the role of construction contracts where the main role is as a source of rights, responsibilities and procedures. As part of the allocation of rights and responsibilities, contract can also be used to assign risk. Contracts are also a planning tool, that is, in developing contracts, the spectrum of potential risks can be identified and then addressed by contract language. In essence, a contract is a handbook of performance; it will set out with clear, consistent and concise language the procedures to be followed for such things as inspections, payments, and interpretation of the contract documents.

Contract documents are the means by which a designer's intentions are conveyed to the client, the statutory authorities, the quantity surveyor, the contractor and the subcontractors (Murdoch and Hughes, 1996). Components of contract documents are shown in Figure 2.2. The articles of agreement record in general terms what the parties have agreed to do. They identify the parties, description of the project and the work, date of start, date of substantial completion, liquidated damages, the contract sum, progress payment, interest rates, retainage, final payment and enumeration of contract drawings. They tie these obligations to the conditions and to the other contract documents (Murdoch and Hughes, 1996; Gould and Joyce, 2003).

The purpose of the general conditions is to establish the legal responsibilities, obligations, authority, and rights of all parties involved in the project. As the name implies, these conditions are general in nature and apply to any construction project. Special conditions or supplementary conditions are intended to supplement the general conditions and are project specific. Special conditions include additional owner

requirements. However, the special conditions are not contractual in nature; therefore they are properly part of general conditions (Gould and Joyce, 2003).

Drawings are the tools by which the designer's intentions are conveyed to the contractor. The detail design drawings contain information which shows how the separate parts interact and how detailed information from specialist sub-contractors and from other designers is coordinated and presented. In essence, drawings provide information about the shape, appearance and location of the various components which have to be assembled (Murdoch and Hughes, 1996).

According to Murdoch and Hughes (1996), specifications define the materials and products to be used, the standard of work required; any performance requirements and the conditions under which the work is to be executed. The authors also emphasized that in preparing a useful and accurate specification, it is essential to be systematic and methodical.

According to Murdoch and Hughes (1996) the purpose of bills of quantities, and their status, may vary under different standard form of contracts. The bills typically consist of preliminaries, preambles and measured works. The contracts govern the preparation of the bills, typically specifying that bills have been prepared in accordance with the relevant standard method of measurement. Since the bills have such contractual significance, it is often necessary to be fully cognizant of what the relevant Standard Method of Measurement (SMM) contains. Any item of work that is not measured in line with the principles in the SMM must be expressed categorically in the bills, in term of both the nature of the change and which items are affected.

2.2 Strategic Environmental Management

Strategy can be seen in many ways. Strategy can be seen as the matching of the resources and activities of an organization to the environment in which it operates; where the notion is to develop the strategy by identifying the opportunities and adapting resources and competences to make the most out of the opportunities. Strategy can also be seen as building on an organization's resources and competences to create opportunities or to capitalize on them. Therefore strategic decisions are likely to be concerned with the scope of an organization's activities and affect the operational decisions. The strategy adopted is also affected by the values and expectations of those who have power in and around the organization – the stakeholders of the organization (Johnson and Scholes, 2002). Identification of potential opportunities and threats facing the organization based on its strengths and weaknesses forms part of the background to which strategic decisions are made and provides insight into the difficulties of implementing strategic change (Dobson and Starkey, 1993).

Johnson and Scholes (2002) defined strategy as '*the direction and scope of an organization over the long term, which achieves advantage for the organization through its configuration of resources within a changing environment and to fulfill stakeholder expectations*'. Therefore strategic management includes understanding the strategic position of an organization, strategic choices for the future and turning strategy into action (see Figure 2.4) .

The strategic position is concerned with the impact on strategy of the external environment, internal resources and competences, and the expectations and influence of stakeholders. Strategic choices involve understanding the underlying bases for future strategy at both the corporate and business levels and the options for developing strategy in terms of both the directions and methods of development. Lastly, strategy

into action is concerned with ensuring that strategies are working in practice (Johnson and Scholes, 2002).

Kolk (2000) proposed a strategic approach to environmental management implies that three sets of issues can be appraised: the risks that firms may incur from (neglect of) the environment, the possibility of increasing strategic control by integrating environmental aspects into different stages of the value chain, and the market opportunities of developing firm-specific green capabilities. Therefore, strategies can be examined from three inter-related perspectives: outside-in (external influences), inside-in (inside influences) and inside-out (network influences). Table 2.1 lists the aspects for strategic environmental management.

Table 2.1: Aspects to consider for strategic environmental management: three perspectives

Perspective	Aspect
Outside-in (external influences)	- Industry structure (competition, markets, products, environmental risks) - Main regulatory influences (in home and host countries, international) - Other forms of environmental pressure (customers, societal organizations)
Inside-in (inside influences)	- Economic characteristics of the firm (profit, market shares, market strategy, control structure, degree of vertical integration, diversification and internationalization) - Firm-specific resources and capabilities - Organization structure - Environmental impacts and risks
Inside-out (network influences)	- Network and dependency relationships; assessment of core firms - Major environmental problems in product chain (s) and network

Source: Kolk (2000: 78)

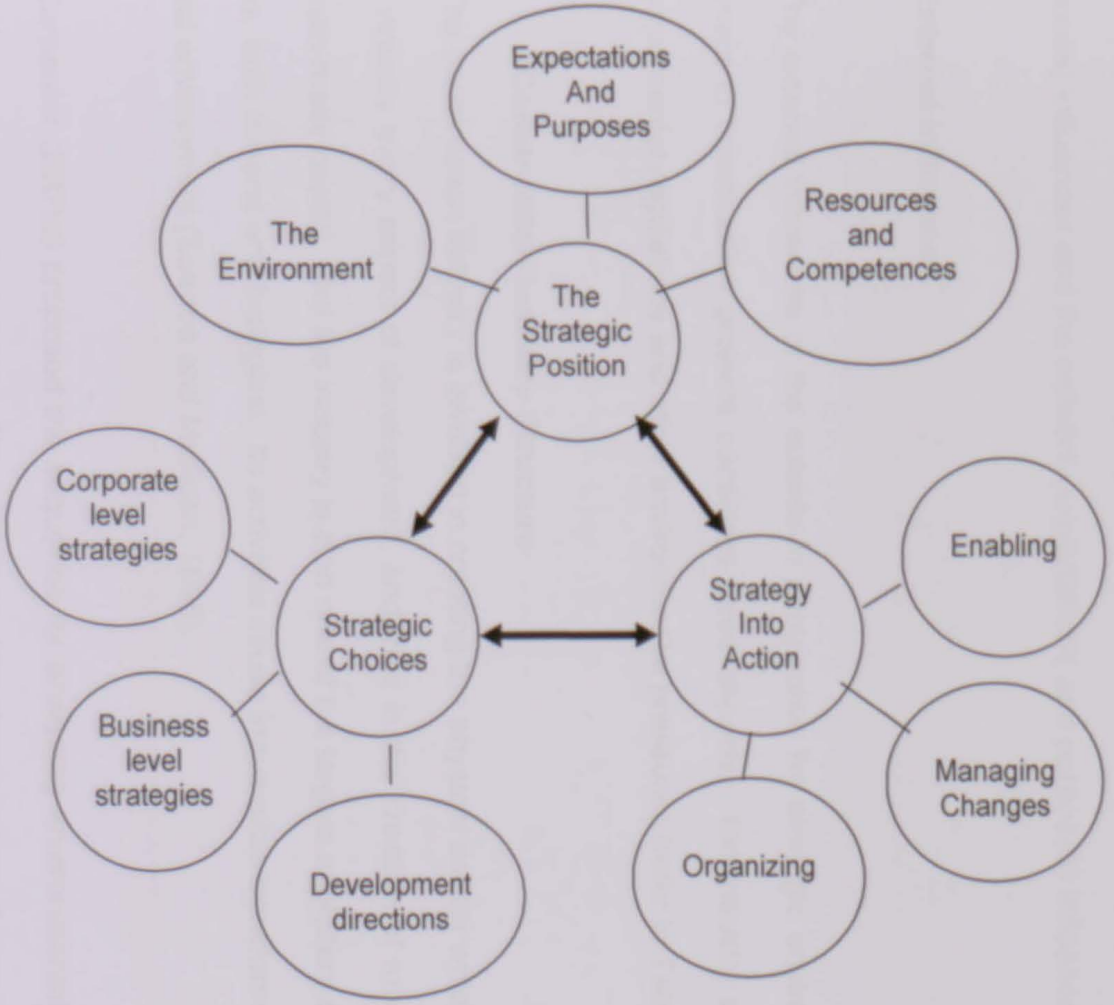


Figure 2.3: Elements of strategic management (Johnson and Scholes, 2002)

Havranek (1999) was also in accord that environmental management issues can be appraised in relation to differing objectives of project stakeholders; charged political nature of construction projects; conflicting regulations; uncertainty/ conflict with traditional engineering process; and unrealistic specifications.

The following sections apprise environmental management in construction projects from three perspectives: the external influences, the internal (resources and competences) influences and the network (expectations and purposes) influences.

2.2.1 External Influences

The external influences or the outside-in perspective for strategic environmental management in construction projects considers three aspects: the industry structure, main environmental regulations and other environmental pressures (refer to Table 2.1).

2.2.1(a) Construction Industry Structure

The construction industry is involved in creating the physical assets which are the basis of virtually every aspect of development, and thus in the creation of much of the world's man-made capital. But the industry is also one of the largest exploiters of natural resources, both mineral and biological. Its activities cause irreversible transformations of the natural environment (Spence and Mulligan, 1995).

Carpenter (2001a) proposed the sequence for analyzing environmental impacts of construction project activities (see Figure 2.6) and in planning how the construction activities shall be undertaken in terms of appropriate equipment and machinery, organization of work sites and accommodation and management of both construction and public traffic. Environmental impacts during construction may arise from the building of foundations; the building of structure; the protection or removal of existing buildings;