

THE ELECTRONIC PROCUREMENT INITIATION AND ADOPTION IN THE
CONSTRUCTION INDUSTRY

By

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List of Abbreviations

ACEM	Association of Consulting Engineers Malaysia
AEC	Architecture Engineering and Construction
ASEAN	Association of Southeast Asian Nations
ASP	Application Service Provider
BOO	Build, Own, Operate
BOOT	Build, Own, Operate, Transfer.
BOT	Build Operate Transfer
BPO	Business Process Outsourcing
BPR	Business Process Re-engineering
BQSM	Board of Quantity Surveyors Malaysia
CD	Compact Disc
CI	Construction Industry
CIA	Central Intelligence Agency
CIB	International Council for Research and Innovation in Building And Construction
CIDB	Design And Building (D&B)
CII	Construction Industry Institute
DOs	Delivery Orders
EC	Electronic Commerce
EG	Electronic Government
ELX	Electronic Labour Exchange
EP	Electronic Procurement
EPT	Electronic Procurement Technologies
G2B	Government and Business
G2C	Government and Citizen
G2E	Government to Employee
PMS	Project Monitoring System
GOE	Generic Office Environment
HRMIS	Human Resource Management Information System
HTML	Hyper Text Mark-up Language
IAI	International Alliance for Interoperability
ICT	Information and Communication Technologies
IDP	Innovation Diffusion Process
IT	Information Technology
IWS	Internet World Stats
LAN	Local Area Network
MAMPU	Malaysian Administrative Modernisation and Management Planning Unit
MCI	Malaysian Construction Industry
MECM	Ministry of Energy, Communications, and Multimedia
MIMOS	Malaysian Institute of Microelectronic Systems

MMR	Mixed Methods Research
MoF	Ministry of Finance
MP	Malaysia Plan
MSC	Multimedia Super Corridor
NETi	National e-tendering Initiatives
NITA	National Information Technology Agenda
NITC	National Information Technology Council
OECD	Organisation for Economic Co-operation and Development
OED	The Oxford University Dictionary
PAM	Pertubuhan Akitek Malaysia
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
POs	Purchase orders
QUAL	Qualitative
QUAN	Quantitative
REHDA	Real Estate Housing Developers Association
RFB	Request for Bids
RFP	Request for Proposals
RFQ	Requests for Quotations
RICS	Royal Institution of Chartered Surveyors
SC	Supply Chain
SCM	Supply Chain Management
SEMM	Sequential Explanatory Mixed Method
SHEDA	Sarawak Housing Developers Association
SHERADA	Sabah Housing and Real Estate Developers Association
SME	Small and Medium Enterprises
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Program
WB	World Bank
WCCI	Web-Based Communication in the Construction Industry
WCMM	Web-based construction material management
WDMS	Web-based document management systems
Wi-Fi	Wireless Fidelity
WPMS	Web-Based Project Management Systems
WWW	World Wide Web
XML	Extensible Mark-up Language

PERMULAAN DAN PENERIMAAN PEMEROLEHAN ELETRONIK DI DALAM INDUSTRI PEMBINAAN.

ABSTRAK

Penyelidikan ini bertujuan mengenal pasti faktor-faktor penting yang memberi kesan terhadap pengenalan dan penerimaan pemerolehan elektronik (electronic procurement, EP) dalam industri pembinaan Malaysia. Suatu kajian eksplanatori berjujukan kaedah-bercampur digunakan untuk mengenal pasti faktor tersebut dalam empat kumpulan pembinaan, iaitu klien, kontraktor, perunding / konsultan, dan pembekal.

Dalam kajian kuantitatif, tumpuan diberikan terhadap pengenalpastian faktor-faktor penting yang memberi kesan terhadap pengenalan dan penerimaan EP dalam industri pembinaan Malaysia. Analisis faktor eksploratori (exploratory factor analysis, EFA) digunakan untuk mengenal pasti faktor tersebut, yang dikelompok berdasarkan keterkaitannya.

Data dikumpul secara pos dan sistem kajian berdasarkan sesawang (web-based survey systems) (N=528). Kadar respons keseluruhan adalah 54.15% dan data dianalisis dengan menggunakan statistik deskriptif, ANOVA, dan EFA.

Melalui penggunaan EPA, enam faktor ditemui dalam dua fasa yang berbeza (fasa pengenalan dan fasa penerimaan). Dua faktor ditemui dalam fasa pengenalan tahap kematangan teknologi maklumat (information technology, IT) dan kesedaran tentang pemerolehan inovasi. Sementara itu, empat faktor ditemui dalam fasa penerimaan: kesediaan organisasi, halangan e-pemerolehan, kepentingan e-pemerolehan dan kepercayaan terhadap e-pemerolehan.

Dalam kajian kualitatif, empat kes paling kaya maklumat dan prinsip variasi maksimum dipilih. Satu kes daripada setiap kumpulan pembinaan (klien, kontraktor, perunding dan pembekal) yang mempengaruhi proses pemerolehan turut dipilih. Hasil daripada fasa kuantitatif dan data dikumpul daripada pelbagai sumber.

Pengekodan terbuka (open-coding) dan analisis data teks dilaksanakan dengan MAXQDA 10. Lapan tema berkaitan pengenalan dan proses penerimaan EP dalam kumpulan pembinaan wujud dalam analisis bertema daripada setiap kes dan merentasi semua kes. Tema tersebut termasuk integrasi teknologi internet, penggunaan teknologi e-pemerolehan, perkongsian ilmu / pengetahuan, prosedur bukan standard, penglibatan pihak pengurusan atasan, *interoperability issue*, isu perundangan, dan kesedaran tentang perubahan (inovasi).

Tema daripada setiap kes berbeza dari segi bilangan dan kesamaan kategori. Lebih banyak kesamaan diperhati dalam kalangan peserta dari sudut integrasi teknologi internet berbanding dengan penggunaan teknologi e-pemerolehan dan faktor yang berkaitan dengan ilmu / pengetahuan. Integrasi teknologi internet dan penggunaan teknologi e-pemerolehan adalah tema yang paling banyak dibincangkan. Kedua-dua tema atau faktor ini boleh membantutkan atau mengganggu kesempurnaan fasa pengenalan dan kelanjutan fasa penerimaan.

The interpretation phase integrated the results of the quantitative and qualitative phases to present the outcomes of the entire study Interpretasi fasa mengintegrasikan atau menyepadukan hasil daripada fasa kuantitatif dan kualitatif untuk memberikan

natijah (outcome) daripada keseluruhan kajian. Dua daripada tema yang wujud dalam fasa 1 adalah sama (penglibatan pihak pengurusan atasan dan kesedaran tentang perubahan atau 'inovasi'). Walaupun, beberapa faktor mengungkapkan nilai yang sama dalam fasa kuantitatif, namun tahap kepentingan daripada faktor-faktor tersebut dapat ditentukan daripada dapatan temu bual. Kesamaan dalam makna membantu penggabungan sesetengah daripada tema ini dengan faktor terdahulu atau yang sedia ada. Justeru, satu model dibangunkan bagi faktor penting yang memberi kesan terhadap pengenalan dan penerimaan EP dalam kumpulan pembinaan.

THE ELECTRONIC PROCUREMENT INITIATION AND ADOPTION IN THE CONSTRUCTION INDUSTRY

ABSTRACT

This research aims to identify the essential factors that affect the initiation and the adoption of electronic procurement (EP) in the Malaysian construction industry. A mixed-methods sequential explanatory study was used to identify these factors in four different construction groups, namely, client, contractor, consultant, and supplier groups.

In the quantitative study, the research focused on identifying the essential factors that affect the initiation and the adoption of EP in the Malaysian construction industry. Exploratory factor analysis (EFA) was used to identify these factors, which were grouped according to relatedness.

Data were collected via postal and Web-based survey systems (N=528). The overall response rate was 54.15%. The participants answered the survey questions, and the data were analyzed with descriptive statistics, ANOVA, and EFA.

EFA identified six different factors that affected the initiation and the adoption of EP in the four construction groups at two separate phases. Two factors were identified in the initiation phase: IT maturity level and awareness of procurement innovation. Meanwhile, four factors were identified in the adoption phase: organizational readiness, e-procurement barriers, perceived benefit of e-procurement, and perceived trust of e-procurement.

In the qualitative study, four different cases that had the richest information and the maximal variation principle were selected. One case each from the four different types of construction groups (client, contractor, consultant, and supplier groups) that influenced the procurement process was selected. Results from the quantitative phase and the data collected from multiple sources added depth to the analysis.

Open-coding and text data analyses were performed with MAXQDA 10. Eight themes related to the EP initiation and adoption processes in the construction groups emerged in the thematic analysis of each case and across all cases. These themes included the integration of Internet technologies, e-procurement technology usage, knowledge sharing, non-standardized procedures, top management involvement, interoperability issues, legality issues, and awareness of changes (innovations).

The themes comprising each case differed in number and similarity of categories. More similarities were observed among the participants in terms of integration of Internet technologies than in terms of e-procurement technology usage and knowledge-related factors. Integration of Internet technologies and e-procurement technology usage under the procurement process were the most discussed themes. The factors integration of Internet technologies and level of e-procurement technology usage jeopardized the completeness of the initiation phase and prolonged the adoption phase.

The interpretation phase integrated the results of the quantitative and qualitative phases to present the outcomes of the entire study. Two emerging themes were

similar across the factors identified in phase 1 (top management involvement and awareness of changes or “innovations”). Moreover, some factors expressed equal values in the quantitative phase, but the transcribed interviews determined the level of importance of these factors. Similarities in meaning helped merge some of these themes with those of previous factors. Therefore, a preliminary model was developed on the essential factors that affect the initiation and the adoption of EP in construction groups.

CHAPTER I – INTRODUCTION

1.1 Introduction

The present research deals with an electronic procurement platform initiation and the current system within construction innovation that utilizes IT tools. The overall purpose of this research is to identify the essential factors that affect the initiation and adoption of the electronic procurement (EP) in the Malaysian construction industry.

Two different phases and an evaluation show how the development of information technology (IT) and Internet technology platform manipulations has transformed the sedentary procurement process in the construction project for both production and process efficiently and effectively.

IT enables companies to track projects, realize results faster, reduce risk, trust collaboration, foster online discussions, and hold parties accountable for their actions. The benefits of IT adoption include an enhanced quality of documents produced, increased work speed, better financial control and communications simpler and faster access to common data, and decreased number in documentation errors (Nitithamyong & Skibniewski, 2006).

Indeed, Web-based applications greatly help in solving the problems caused by geographic fragmentation. According to Zhu et al. (2001) the Internet and Web-related technologies penetrated the daily operation of project construction in the early and mid-1990s (Wright 1993; Setzer 1994; Angelo 1995; Shearer 1995 cited in (Zhu *et al.*, 2001).

Using a Web-based database as a centralized repository of project information has several distinct advantages, such as reduced manual distribution costs, integration of

project information, simple management of access rights, document storage and archiving, continuous access to project information, and minimal software requirement (Construct IT, 2000).

This chapter introduces the subject matter and explores the impetus for change needed in the construction industry. The research problem addressed in this study as well as the scope of the research and its relevance to the industry will be discussed. The chapter also includes the overall structure of this thesis.

1.2 Background

The construction industry has been criticized for its poor performance in both the demand and supply sides as observed in the fragmentation of its task execution. Hence, a call for drastic change is essential to establish an environment that fosters innovation, clarifies communication, and integrates the design, manufacturing, and construction processes. On the supply side, the Latham Report states that the industry's reputation for poor quality stems from the low barriers to entry, general contracting, and low levels of investment in training (Latham, 1994). On the demand side, the major glaring weaknesses include undue emphasis placed on the price and time by clients, poor approach to supplier selection, and fluctuation in overall demand, which also occurs in different sectors of the industry (Cox & Townsend, 1998).

One of the major activities that links both the demand and supply side of the industry is construction procurement. It is known to have played an influential role in the past few decades in the areas of industry relationships, client expectation, quality, and overall cost of the construction project. The procurement process itself involves the purchase of all or a part of the project through bidding, negotiation, or other means.

It may include the selection of the construction contractor, subcontractors, suppliers of major building equipment or systems, and other specialty consultants such as project managers, schedulers, and cost estimators. However, the main actors of this process from inception to handover are the clients (public and private), consultants (i.e., architect, engineers, and quantity surveyors), and contractors (sub-contractors). Hence selecting an appropriate method that can handle the flow of information and material delivery efficiently and effectively is very critical. Research has found that material procurement accounted for 40%–45% of the cost of all construction work (Andraw *et al.*, 1998); (Construction Industry Institute, 1987)). Cagno *et al.* (2004). Figure 1.1 illustrates the relationship of the most involved part of the construction procurement process in both demand and supply sides.

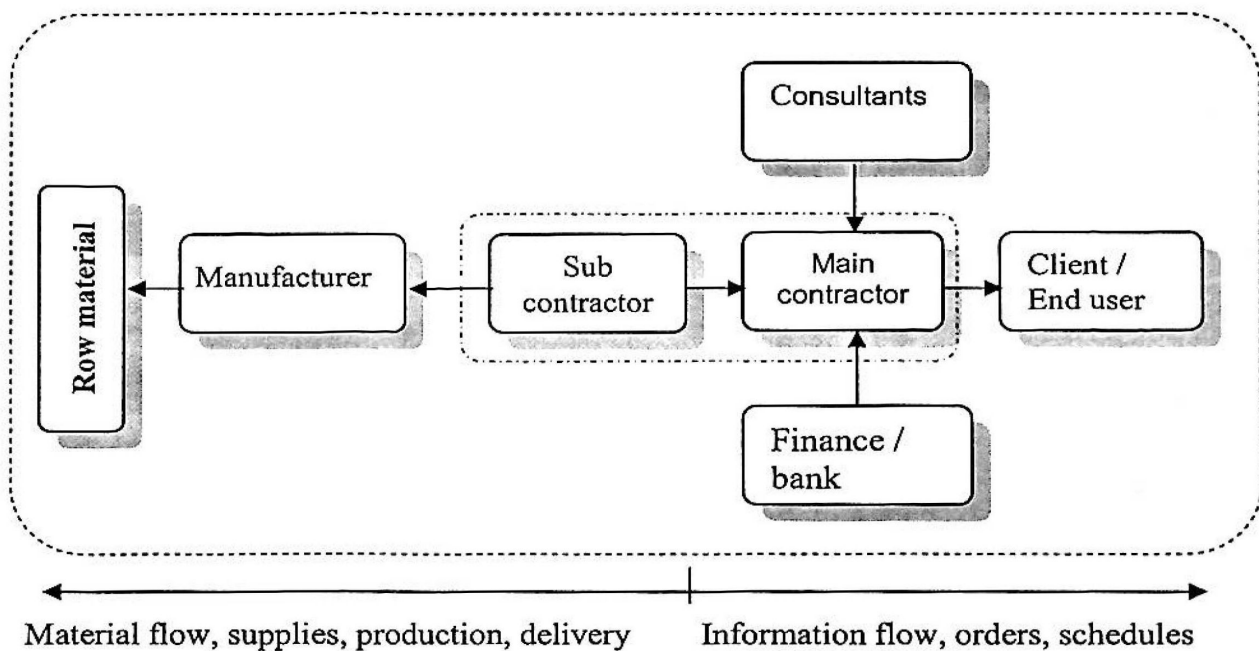


Figure 1.1 Demand and supply, adapted (Duncan Cartlidge, 2009)

Nonetheless, the different orientations and high demands of construction clients have made generalizing and adopting a single method of procurement systems for both long-term and short-term purposes in project delivery chains with their own budget,

time requirements, and obligatory quality standards difficult. Moreover, 93% of construction clients are not from the construction industry ((Newcombe *et al.*, 1990); (A.C.E, 1999)). Love et al. (1998) argued that not one procurement method likely to be better than the others for any project, whereas Gordon (1994) suggested that the selection of an appropriate procurement method could reduce construction project costs by an average of 5%. Thus, the appropriate procurement system may enhance the probability of project success ; (Bennett & Grice, 1990; Luu *et al.*, 2005; Noam, 1994); . However, Masterman (1996) emphasized that the failure to select an appropriate procurement approach is the primary cause of project dissatisfaction.

Overall, the construction procurement cycle is an unresolved task in both organizational boundaries and project scope because of the nature of the industry (CIDB, 2006; Egan, 1998; Latham, 1994 ; NAO, 2001) however as Anumba et al. (2000) found, competitive pressures from within the construction industry as well as external political, economic, and other considerations are forcing the industry to re-examine and improve its performance.

1.3 Problem Statement

As globalization trends, client demands and use of IT virtually created one unified market and community, the construction industry has responded in varied ways too. Chun (1997) has found that the industry involvement included use of as internet technology and broadband networks, multimedia, telecommuting, and technical standards. Some of the current procurement practices are seeing industry stakeholders and academia employing procurement systems ranging from traditional, management, alliance, integrated, partnership, and online procurement materials. The IT has provided the potential for inducing drastic changes in the use of data,

information and knowledge sharing, and online platforms in the construction industry.

However, those were the very notions that are central to the industry problems. The traditional procurement processes have created massive efforts in overlapping work for both staff and management. As most activities are paper-based then the system of circulating the documents among project partners is time consuming. When new information needed to be obtained, the process could be difficult given who is authorized to keep the information and to divulge it. Over time, the probability of errors increases as information is transcribed continuously while using multiple channels makes both the internal and external processes confusing (Kong *et al.*, 2004). Another difficulty is in sourcing materials which have the legacy of depending on paper-based catalogues. In large complex projects, that would mean having to manage papers into large storage areas and setting priorities. At worst, these paper materials also become outdated very quickly, making searching and comparison of prices and quality an unstable task.

Therefore, the traditional procurement practice is potentially inefficient and can lead to costly delays, loss of profit, and possible litigation or as defined by (Udeaja & Tah, 2002) demonstrating low accuracy, time consumption, labor consumption, loss of data and high uncertainty level. Moreover, the fragmented nature of the design and construction; poor communication, inadequacy in dealing with the changing human, technological and organizational conditions; economic changes (e.g., inflation and recession); obstacles placed on innovation by architects/engineers or contractors; and shortfalls in performance expectations are some other problems faced by the construction procurement industry.

There have been progress and development where researchers have attempted to develop different alternatives in computer-based and Web-based procurement systems in the construction procurement industry, as shown in Table 1.1. These were noteworthy efforts but at the same time may suggest approaches blindly adopting innovation, such as new management techniques, construction techniques, and IT (Egan (1998) as a means to improve construction productivity.

Table 1.1 Online Procurement Systems

Online-based procurement Systems	Researchers
E-tendering and e-bidding	(Kamoto, 2005); e-bidding (Arslan <i>et al.</i> , 2006)
Intranet-based cost control system	(Abudayyeh <i>et al.</i> , 2001)
Internet-based construction material procurement	(Hadikusumo <i>et al.</i> , 2005; Heng <i>et al.</i> , 2003; Kong <i>et al.</i> , 2001a; Kong <i>et al.</i> , 2001b; Kong <i>et al.</i> , 2004; Ugwu <i>et al.</i> , 2002)
Agent-based supporting procurement	(Dzeng & Lin, 2004; Udeaja & Tah, 2002)
Web-based project management	(Ahmad <i>et al.</i> , 2002); (Sriprasert & Dawood, 2002a); (Alshawi & Ingirige, 2003) (Skibniewski & Abduh, 2000); (Nitithamyong & Skibniewski, 2004; Nitithamyong & Skibniewski, 2006; O'Brien, 2000)
Web-based document management system	(Björk, 2006a; Björk, 2002; Forcada <i>et al.</i> , 2007; Matheu, 2005)
E-construct	(Stephens <i>et al.</i> , 2002)
Online collaboration	(Anumba & Duke, 1997; Deng <i>et al.</i> , 2001; Mitev <i>et al.</i> , 1996),(Taylor & Bjornsson, 1999)
APRON	(Obonyo <i>et al.</i> , 2005)

Source: Author

While the environment, such as the MCI in enabling the innovation is ready through: the government policy of ITC adoption in CI; the need to reduce fragmentation and the advocacy of promoting a paperless environment, yet the leverage of IT in the construction industry lags behind that in other industries, and the adoption rate of advanced internet technologies is low. Therefore based on the premises discussed above, this study seeks to understand the basis to developing the most suitable

practice for EP platform in the CI to improve the current procurement process system.

1.4 Purpose of the Study

The objectives of this thesis are as follows:

1. To investigate the current internet and web based technology usage the current procurement process in the MCI.
2. To examine the relationship between the internet and web-based technology usage and the initiation phase for the electronic procurement in the MCI.
3. To identify the electronic procurement technologies currently used in MCI.
4. To study the main benefits and barriers in the initiation and adoption of e procurement in MCI.
5. To examine the initiation and adoption factors related to the practical usage of the Internet and of Web-based technologies of EP in MCI.
6. To determine the factors that affect initiation and adoption of EP in MCI?

1.5 Research Questions

Based on the objectives mentioned above, there is one key question guiding this research which in turn is supported by five smaller questions:

Key Question:

- 1 What are the essential factors affecting the initiation and adoption of an EP platform in the MCI?

Sub Question:

- 1 What are the current internet and web-based technologies that use the current procurement process in the MCI?

- 2 What is the relationship between the internet and web-based technology usage and the initiation phase for the electronic procurement in the MCI?
- 3 What are the electronic procurement technologies that are currently used in MCI?
- 4 What are the main benefits and barriers in the initiation and adoption of e procurement in MCI?
- 5 How do the initiation and adoption factors relate to the practical usage of the Internet and of Web-based technologies of EP in MCI?

1.6 Research Design

In order to answer the research questions and meet the objectives of the study, the researcher has adopted the Mixed Method approach which relies on both quantitative and qualitative methods (see p.139 para 2). While quantitative methods tend to be dominant in construction management research (see Andre, 2008); Mixed Method Research (MMR) has prevailed in social and behavioral studies (Creswell, 2003; Tashakkori & Teddlie, 2003). However, the current research setting as defined by the key questions has made the use of MMR inevitable. The first phase denoted the quantitative study which identified the critical factors affecting the initiation and adoption of EP platform in MCI and which offered the purposeful selection of informants (see. p. 147). These informants represented the selected case study organizations, who the researcher has conducted semi-structured interviews to probe into deeper issues and to validate the factors that have been found earlier (see p.148). The sequence of the methods in the research design is significant because it belongs to its own classification called the Mixed Method Sequential Explanatory Design.

The findings were resolved and interpreted through the analysis of the results that have been integrated from both methods (see p.142).

1.7 Motivation for the Research

Malaysia plans to leapfrog into the post-industrial age by leveraging ICT as a strategic lever for national development and global positioning (Accenture, 2001). The construction industry (CI) is one of the major catalysts for achieving the 2020 vision in that the government has initiated different projects for ICT usage in the CI. Several electronic channels have already been initiated by the government to automate traditional procurement process in both the public and private sectors. ICT tools ensure that a project can be delivered on time for better budget management and better quality. Unfortunately, paper-based procurement does not fulfill all the requirements due to its bureaucratic nature, lack of information, time misuse, delay of orders, and rework issues.

Advances in technology are widely regarded as major sources of improvement in the competitive position of firms and industries as well as major factors in the increased national economic growth and standards of living (Adler, 1989; Porter, 1985 ; Rosenberg, 1982).

In the public sector, the Malaysian government started to purchase all services and goods electronically in October 2000. E- Perolehan is part of a wider electronic government project implemented by the Malaysian government. In the construction sector, CIDB was launched (NETi). NETi is a national initiative that integrates and bridges every process and component of the entire construction tendering supply chain using an electronic or digital medium in the hope of transcending geographical,

time, economic, and people-based errors and inefficiency barriers, making the chain faster, more efficient, and more profitable for all the players in the industry.

The Malaysian government has invested heavily in world-class infrastructure. Malaysia's Multimedia Super Corridor (MSC) was designed to create an ideal environment for ICT-related production as well as to provide the backbone for an information superhighway (see Table 1.1). The network contains a high-speed link (10 GB/s network) that connects the MSC to Japan, ASEAN, the US, and Europe. It is capable of supporting extensive public administration, education, and business applications (Accenture, 2001).

Table 1.2 Malaysia's E-readiness (O. Ranking) and the Asia Pacific Region

Yr/ Rank	2006/68	2005/65	2004/64	Country	2006/16	2005/16	2004/16
Country							
Denmark	1	1	1	Australia	1	2	3
Singapore	13	11	7	Hong Kong	2	1	2
S.Korea	18	18	14	Singapore	3	3	1
Japan	21	21	25	S.Korea	4	5	4
Taiwan	23	22	20	Taiwan	7	7	6
Malaysia	37	35	33	Malaysia	8	8	8
Thailand	47	44	43	Thailand	7	9	9
India	53	49	46	Philippines	11	11	11
China	57	54	52	China	12	12	12

Source: (Economic Intelligence Unit, 2008)

The other factors that contribute to the diffusion of internet technology usage in the different sectors are as follows:

1. Internet accessibility of the whole Malaysian region (from dialup to Wi-Fi)
2. Strategies of governments, both regional and federal, to obtain ICT benefits and 2020 goals
3. Rates of internet charges either for monthly charges or internet cafés
4. Organizational competitions for both local and global tasks

1.7 Significance of the Study

EP is a new phenomenon that concerns both public and private organizations in terms of cost and time saving. Hence, the present study can contribute to Malaysia's Vision 2020 and open a new direction in the local CI in determining its level of internet technology usage. There is a strong advocacy at the government level for the uptake of e-procurement of the construction sector. Furthermore, many state governments (i.e., Selangor and Penang) have realized the importance of an electronic system in the construction procurement process.

The current research is significant to construction boards that are willing to initiate or scan the local environment for both IT use and their future status of adopting online business transactions.

Moreover, this study yields valuable results due to the mixed method research design. This research investigated the IT management of the local CI, starting from computer knowledge to advanced technologies, such as Web-based activities, e-commerce, online negotiation, and EP.

The findings of this research have both academic and practical values in the areas of IT adoption, e-procurement, and CI research.

As such, the current study is significant to four groups:

1. Government bodies promoting the e-procurement initiation and adoption of the CI
2. Industry institutions considering the uptake of e-procurement
3. Organizational level of process enhancement
4. IT in construction research

1.9 Thesis Outline

The organization of the present research is so structured that each chapter can be read and understood on its own (Fig 1.1). Each chapter encapsulates elements of the design process that fulfill the aim and objectives of this research, indicating an understanding of the research processes from the introduction to the summary of results based on analysis and acquired knowledge. Each chapter begins with an introduction and ends with the summary of research discussed in the chapter.

Chapter 1 introduces the research background of the current problem of the construction procurement process and the impetus of ICT for change in the CI. Based on this research background, the research problem, aim, and objectives are formulated. This chapter also presents a brief overview of the research motivation and significance.

Chapter 2 presents a review of the literature related to the traditional procurement systems in the CI. It reviews the procurement categories, selection process, industry transformation through the innovation technologies, and construction innovation.

Chapter 3 presents a review of the literature related to IT in the CI in three different levels: applications, internet technologies, and combination of application and the Internet. The current use of Web-based technologies, which involve process-related activities in the CI, is also considered. This chapter also reviews in detail EP in general and e-procurement in the CI. Finally, the chapter draws the theoretical perspective of EP initiation and adoption factors.

Chapter 4 presents the details of the research method, which addresses the key issues relating to the research approach, research design, and relevant analytical techniques adopted in this study. Specifically, the chapter describes the procedures in a mixed method research (MMR) design integrated under a single research design. Furthermore, we provide our justification for the relevance of MMR in construction management research.

Chapter 5 details the quantitative design, analysis, and findings in a technical manner and reports the results of the quantitative study, giving more emphasis to the critical factors in both the initiation and adoption phases. This chapter also presents the summary of one published paper (see appendix D) regarding the evaluation of the current usage of ICT in the MCI. These papers are the take-off point of this thesis. Data were collected and analyzed before the pilot study of the quantitative part.

Chapter 6 presents six case studies purposefully selected from four different disciplines of the most influential parts of the construction procurement process. The double selection of these two disciplines, that is, contractors and clients, was based on their awareness of the industry requirements and the development in internet technology usage.

Chapter 7 presents the overall findings from both the quantitative and qualitative parts by drawing the conclusions based on the results. It also identifies the implications for EP initiation and adoption in the construction organization.

1.10 Summary

This chapter discussed the basic premise of this thesis as well as introduced the research background and inputs of IT in the CI. The research aim and objectives were also established. An overview of the research process was briefly discussed as well as the research motivation and significance. The outline of the thesis structure was also presented. Moreover, this chapter gave a detailed discussion on the research process. The next chapter will present the background of the traditional procurement process in the CI.

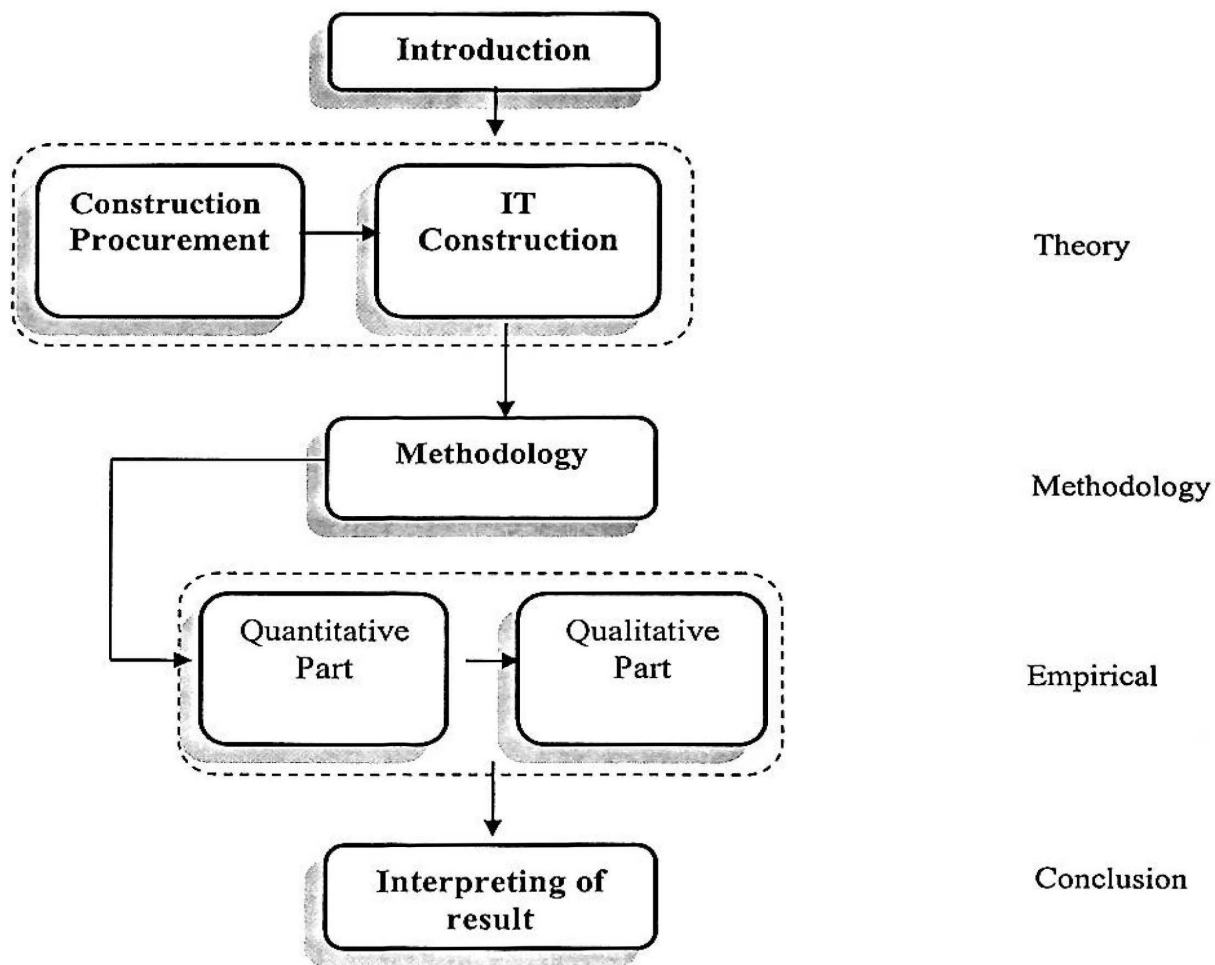


Figure 1.2 Thesis outline

CHAPTER 2 - CONSTRUCTION PROCUREMENT

2.1 Introduction

At present, construction companies undergo the process of restructuring in order to enhance competitiveness in the era of Internet technologies. Information technologies (IT) reduce the fragmentation of the construction industry (CI), which in turn, increases productivity. With the capability of IT to reduce the cost of both tactical and technical strategies, resulting in improved quality and enhanced client satisfaction, integration and more collaborative work have been observed in the last decade.

Given that procurement is one of the more challenging concerns in the CI, the selection of an the appropriate procurement system can facilitate good collaboration and provide sufficient information to all parties. This would allow each component and all the phases of the project to finish the work on time and within the budget as completed through the framework of good quality implementation strategies.

The choice of the appropriate construction procurement strategy varies between clients (public or private sector) and projects (new or refurbishment). The public sector procurement process is a heavily regulated procedure focused on transparency and accountability. On the other hand, the private sector is less regulated and places more emphasis on the result rather than the process itself (Duncan, 2009). For others, efficient implementation of construction work through the choice of the most appropriate procurement method has long been recognized as a main determinant of project success (Bennett & Grice, 1990).

Necombe (1994) has argued that the selection of the procurement path entails more than simply establishing a contractual relation. The selection and use of an appropriate procurement system contributes significantly to the success of a construction project (Naoum, 1994; Rwelamila & Meyer, 1999; Sharif & Morledge, 1994). The following section summarizes published work on the traditional procurement systems and the development of various other types before the emergence of information technologies. The chapter starts with a discussion on the traditional procurement systems, followed by a classification of the procurement systems, including procurement selection process, procurement selection criteria, identifying different categories and variables of procurement systems, factors related to project participant, and the Malaysian procurement scenario.

2.2 Traditional Procurement Systems

Increasing client demand and global competitiveness have made the introduction of new directives and innovations in the current construction procurement process a top priority for most companies. Procurement contributes to profitability in the sense that good procurement practices can increase corporate profitability by taking advantage of quantity discounts, minimizing cash flow problems, and seeking out quality suppliers. The appropriate procurement selection method is important so as to ensure that the expectations of the client and the needs of a project are satisfied in terms of space, aesthetics, quality, time period, and economic price (Ashworth, 1990).

The various forms of procurement can be loosely classified under the following four typologies proposed by (Harris & McCaffer, 1996): separated and cooperative arrangements, management-oriented procurement systems, integrated

arrangements, and discretionary systems. Table (2-1) presents examples of the procurement categories adapted from (Franks, 1998; Harris & McCaffer, 1996).

Table 2.1 Procurement categories

SN	Type	Example
01	Separated	Traditional single-stage and two-stage competitive tendering, and variants of the above
02	Management type	Construction management, management construction, design management
03	Integrated	Design and building construct, design and building finance, package deal, turnkey, all in contracts, variants of the above
04	Discretionary	Partnering, alliance, joint venture, voluntary arrangement, in-house provision

Adopted from (Franks, 1998; Harris & McCaffer, 1996)

2.3 Procurement Definition

The definition of procurement varies considerably from one sector to another but generally have the same element: gathering information on goods/services/works from external sources. The chain process of procurement reflects the relationships and contractual agreement of stakeholders for every project.

The term “procurement” may be defined in various ways. For example, building procurement is a contractual item and a contract is defined as a “mutual agreement between two or more parties that something shall be done...an agreement enforceable by law” (Nahapiet & Nahapiet, 1985).

Different scholars, such as Franks (1984), Ireland (1985), Heldt et al. (1997), Love et al. (1997b), Masterman (1992), Mohsini and Colin (1991) and Ngowi (1997), as well as CIB W92 (1991) have all given relevant definitions of construction procurement. However, the definition of Sinclair (1995) is quite dissimilar because he defines procurement as “the act of obtaining something such as supplies for another organization.” The Oxford University Dictionary (OED) (2004), on the other

hand, defines procurement as “the action of causing, compassing, accomplishing, or bringing about goods, service and work esp. through the instrumentality of an agent; management, arrangement; authorization, instigation; prompting, contrivance.” It also characterizes procurement as “the action or process of obtaining by care or effort; acquisition, attainment, getting, gaining” or “the action or process of procuring equipment and supplies.”

Indeed, CIB labels procurement as “a method of obtaining and organizing the external resources needed to complete a project” (CIB, 1997a, 1997). The basic arguments of the definitions have been driven by the differing points of view regarding the activities inside the organizations. Masterman (1992), (Ireland, 1985), (Love *et al.*, 1997a), and (Ngowi, 1997) mainly emphasize the organizational structure adopted to manage the design and construction activities of a project whereas the definitions by Franks (1984), Mohsini and Davidson (1991) indicate a broader conceptualization, even encompassing the purchase or lease of an existing building.

However, there are still diverse trails of interpretation inside the CI for the word procurement and in different contexts, such as the Procurement Path NEDO (1985), Hibberd (1991), Procurement Form Rowlinson and McDermott (1999), Procurement Method, Naoumand and Mustapha (1994), Ireland (1985), Contractual Arrangements, Nahapiet and Nahapiet (1985), Latham (1994), and Procurement Systems CIB W92, (1991, 1994, 1996, 1997b). The industry has often considered all those terms almost interchangeably.

The definition of CIB W92 in (1991) is the most cited definition that appears sufficiently broad enough and encourages a strategic interpretation of “the framework within which construction is brought about, acquired or obtained.”

McDermott and Jaggar (1991) argue that even among CIB W92 members, there is no common understanding or agreement on the meaning of the term.

The accuracy of selecting a proper procurement method is an important element to ensure that the benefits reach the parties involved, particularly the client. Generally, a procurement method is required to accommodate three main factors, namely, time, cost and quality(Love, 2002). The right selection of method ensures that the project is delivered on time, appropriately priced, and completed to a standard, which follows internationally accepted guidelines of quality control. Generally, any organization has two basic procurement strategies geared toward attaining the objectives. These are depicted in Table 2.2

Table 2.2 Procurement strategies

Corporate procurement strategy:	The relationship of specific procurement actions to the corporate strategy
Project procurement strategy	The relationship of specific procurement actions to the operating environment of project

Source: (Author, 2008)

Procurement must take place in either one of two environments discussed below.

2.3.1 Macro-environment

The macro environment includes the general external variables that can influence how and when procurement is done. These include recessions, inflation, cost of borrowing money, and unemployment.

2.3.2 Micro-environment

The microenvironment refers to the internal environment of the firm, especially the policies and procedures imposed by either the firm or client to guide the way, in

which the procurement will take place. This includes the procurement selection and contracting system, which contains five cycles (Table 2.3). Nevertheless, the PMBOK Guide (PMI, 2004) subdivides procurement management into six processes: planning purchase and acquisitions, planning contract execution, requesting seller responses, selecting sellers, contract administration, and contract closure.

Table 2.3 Five cycles in the procurement selection system

01	Requirement cycle	Definition of the project's boundaries
02	Requisition cycle	Analysis of sources
03	Solicitation cycle	Bidding process
04	Award cycle	Selection and contract awarding
05	Contract administration	Managing the subcontractor until the completion of the contract

Source: (Author, 2008)

In construction procurement, there are different parties involved, namely, the client, consultant, and contractor whose job descriptions are based on the activities they perform. For example, the client is the person who has the money for the building, while the consultant has the expertise in preparing the technical documents and plans for the client's building. The contractor, on the other hand, is responsible for the means and methods to be used in the execution of the project in accordance with the contract stipulations during the construction phase.

Walker (1994) and Love (1996) have confirmed that project success is highly dependent on how the project participants (client, contractor, and designer) work together as a team to achieve the common objectives. Hence, these three parties have to work in a proper partnership to ensure that the project is a success from the beginning until completion. Figure (2.1) explains the relationship between the key actors of the procurement process during the construction procurement process.

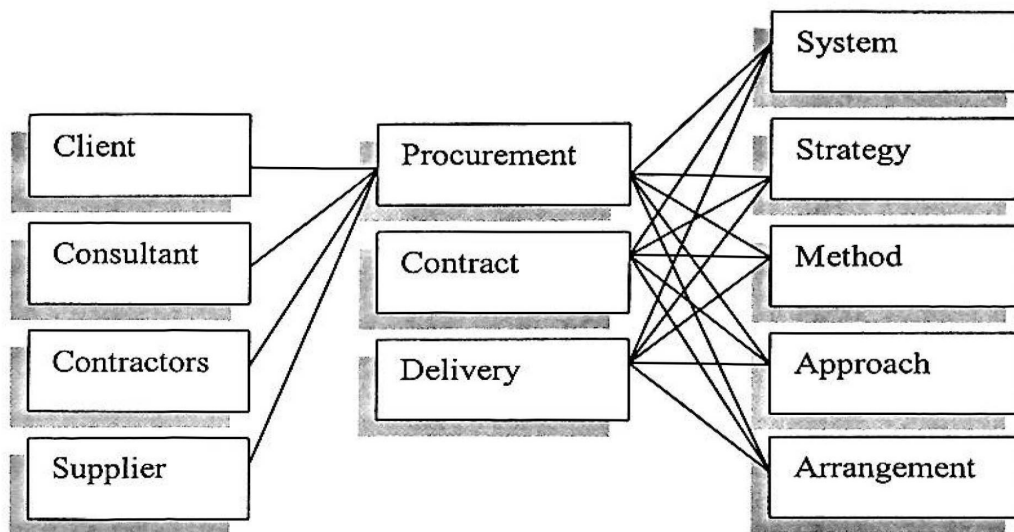


Figure 2.1 The relationship between the key actors of the procurement.

2.4 The Procurement Selection Process

The intensifying competitive environment and demands of clients in the CI has necessitated the creation of a new method of selection for a specific project. Various procurement selection methods have been developed to help the clients choose the most appropriate procurement system for their specific needs (Ireland, 1985; Masterman, 1992; Skitmore & Marsden, 1988).

Through the process of procurement selection, a specific choice is made to match the needs of the client. This is usually done before the design process begins because the array of approach choices may affect the design processes, contracting methods, and construction (Birrell, 1988; Birrell, 1992). Several studies have identified a number of factors influencing the selection of a procurement system in construction. These studies have focused on selection factors in terms of client characteristics, such as Moshini (1993), Masterman and Gameson (1994) and Molenaar (1999); project requirements, such as Gordon (1994), Ambrose and Tucker

(1999), and Rowlinson (1999); and external environment, such as Walker (1994), Hughes (1989), Sheath et al. (1994), Alhazmi and McCaffer (2000), and Kumaraswami and Dissanayake (2001).

Outcomes of the previous studies related to procurement selection reveal that some important parameters are commonly neglected at the macro level. A list of predominant procurement selection parameters have been identified by Luu et al. (2003) under the categories of client characteristics and objectives, project characteristics, and external environment. The procurement process itself is an important consideration for all involved parties from ideation until project completion. Selecting the right process saves costs, reduces the time required to complete the project, and helps maintain the highest standards possible.

Archer and Yuan (2000) have presented the business procurement life cycle as follows:

1. Information gathering;
2. Supplier contact (requests for quotes or RFQ, requests for proposals or RFP, requests for information or RFI, and requests for bids or RFB);
3. Background review, in which references for product/service quality are consulted, requirements for follow-up services (installation, maintenance and warranty) are investigated, and samples of the PIS (product/ service) being considered may be examined or trials may be undertaken;
4. Negotiation (price, availability and customization possibilities, delivery schedules, and complete contract to acquire PIS);
5. Fulfillment (supplier preparation, shipment, delivery, payment, installation, and training may also be included);

6. Consumption, maintenance, and disposal (evaluation of the performance of the PIS and any accompanying service support); and 7. Renewal

Leenders et al. (2002) have determined nine steps in procurement: (1) recognition of need, (2) accurate description of desired commodity or service (RFQ, RFP, RFB), (3) selection of possible sources of supply, (4) determination of price and terms, (5) preparation of purchase order, (6) follow-up and expediting, (7) receipt and inspection of goods/services, (8) clearing of invoice and payment, and (9) maintenance of records.

Meanwhile, Quesada (2004), citing Missouri (2001), has formulated the procurement cycle as follows: (1) recognition of the need, (2) development of requisition, (3) requisition reviews for accuracy and completeness, (4) checking if goods are available in stock or excess (surplus), (5) determination of the method, (6) requesting of quotation through IFM, RFP and RFQ; (7) receipt and tabulation of bid quotations, (8) evaluation of bids and awarding, (9) processing of purchase order, (10) receipt and delivery of order to the requisitioning department, (11) checking and delivery of order to requisitioning department, (12) administering the contract, and (13) recalculation or disposal of surplus, salvage, or scrap.

However, in the CI, the process of selection is usually complex, expensive, and lengthy and more often carried out in a hostile environment. This means that the project teams are formed by some temporary organizations whose members are already frequently unknown to each other (Masterman, 1992). Ashworth (1990) has recommended the selection of procurement according to four stages, as shown in Table 2.7