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KNOWLEDGE TRANSFERRING PROCESS IN EARTHWORK CONTRACTING FIRMS

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Abstract: Firms with the best information management is more likely to be successful in today's highly competitive business environment. It is a challenge for earthwork contracting firms to capture information and transform it into knowledge that is available for sharing. This study involves a survey on determining the level of implementation of knowledge transferring (KT) process by earthwork contracting firms. Questionnaire forms were distributed to 120 relevant contracting firms in Johor Bahru and Kuala Lumpur. The results reveal that all earthwork contracting firms being studied have implemented KT, even though the level of implementation is different. It is found that contractors of higher class are more willing to implement KT than the lower ones. In so far, the benefits of KT are only moderately agreeable in terms of problem solving and customer relationship.

Keywords: *Knowledge transfer; Contracting firm; Earthwork.*

1.0 Introduction

Many knowledge-intensive firms have achieved spectacular successes in recent years. The size of a firm's industrial premises or administration places can no longer be used as a reliable measure of its capability. Only those, which manage knowledge, can always get ahead of others. According to Davenport and Prusak (1998), knowledge is becoming the primary production factor in producing an output. That is why leading management firms consider that it is more profitable to invest in knowledge assets than on material assets.

The Fourth Prime Minister of Malaysia had emphasized the importance of knowledge in the previous monetary plan by saying that, "all must, and can partake in greater utilization of knowledge" (8th Malaysian Plan Report, 2001). Every aspects of knowledge in all economic areas like manufacturing, agricultural, fishery, consultancy or government sector must be strengthened for future use.

Knowledge is always important and valuable in earthwork contracting process. A good earthwork-contracting firm must utilize related knowledge to fulfill the required specification and quality. There are many individuals and parties involve in earthwork contracting process, so that the methods of transferring knowledge to others become the topic of concern. However, before executing any intensive transfer of knowledge, everyone must be given awareness of its importance and impact. They have to work fast because most knowledge is hold by the individual worker in the organization. Selen (2000) stated that individuals hold much of the key knowledge, unless there are some structures to retain it within the organization memory; because when a person leaves the organization a mass of knowledge goes right out the door with that person.

2.0 Background

Although many firms realize the importance of knowledge as a core of their organizations, they are still unable to transfer and manage the knowledge successfully. Many are still in the dark about what areas of knowledge are vital to their commercial success. At the same time, they are losing knowledge every time they lose knowledgeable and experience workers. Even big international firms might lose sight of their internal competencies and knowledge assets in certain important area. Since valuable knowledge assets may go unnoticed, the managers may not know whether the firm has internal experts on a specific subject. Time will be lost through re-inventing the wheel, because they do not know that a solution has already exists among them. As such, KT process must be facilitated and started as soon as possible.

The purpose of the study is to identify the KT process in earthwork contracting firms. The study will look into the level of implementation of KT process by earthwork contracting firms. It will enable the earthwork contracting firms to know the extent of knowledge transfer that occurs in their organization and start to consider it seriously. The most important issue is to prevent lost of knowledge through any staff of various level that leaves the organization. The objectives of this study are:

i. To determine the implementation level of KT in earthwork contracting firms.
ii. To compare the level of KT implementation between different classes of earthwork contracting firms.
iii. To figure out the benefits obtained by earthwork contracting firms from KT implementation.

This study focuses on the influences, processes and methods of KT in earthwork contracting firms located within Johor Bahru and Kuala Lumpur. It involves several classes of earthwork contracting firms, especially of Class A, B, and C.

2.1 Concepts of Knowledge

Knowledge refers to the understanding and information on a particular subject, which has been acquired, analyzed and understood through experience and training. Understanding information provides a degree of comprehension of both static and dynamic relationships between objects or data, the ability to model structure and the past (and future) behavior of objects (Edward, 2003). This knowledge can be kept in individuals mind or stored in computers, documents, databases, among others.

Knowledge management refers to the identification and analysis of available and required knowledge, and also the subsequent planning and control actions to develop knowledge assets to fulfill organizational objectives. KT is about the mechanism for distribution of packaged knowledge from a central coordinating point. According to Probst et al. (1999), KT is either a centrally directed process of distributing knowledge among a particular group of employees, or the transfer of knowledge between individuals, teams or working groups.

An earthwork process typically includes site clearing, excavation, loading, hauling, dumping or spreading, compacting, grading, and finishing works to the soil. Soil investigation must be carried out before actual construction to check soil strength and suitability. If any unsuitable soil (e.g. organic, marine clay) was found, the soil must be treated or discarded, and refilled with suitable soil.

2.2 Data, Information and Knowledge

In order to start KT process, the first step is to examine the differences between data, information and knowledge. Different people have different ideas about the nature of knowledge. Hence, it is important to share the concepts, which are central to KT. It starts with drawing the distinctions between symbols, data, information and knowledge as shown in Figure 1. Movement between these levels are often describes as enrichment process. A symbol is a sign, mark or object looked upon as representing something. When rules of syntax are applied to symbols, they become data.

According to Edward (2003), data is individual observation, measurement, and primitive messages from lower level. Data are capable of interpretation within a particular context, thus providing the receiver with information. In other words, information refers to sets of organized data. The organization process may include sorting, classifying, or indexing and linking data to place data elements in relational context for subsequent searching and analysis. When information is placed in a network, it can be used in a particular field of activity, and may be called knowledge. Gooijer (2000) defined knowledge as the understanding, awareness or familiarity acquired through study, investigation or experience over the course of time.

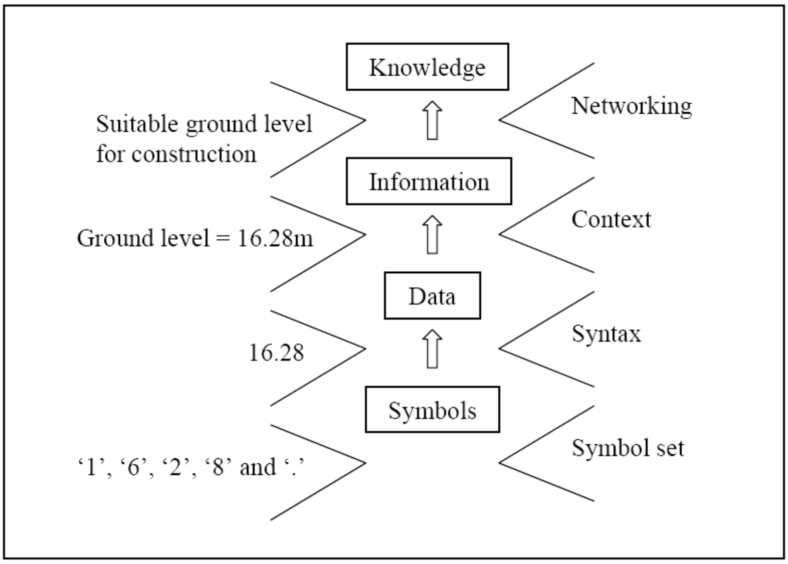

Figure 1: Relationships and levels in conceptual hierarchy of knowledge (Probst et al., 1999).

2.3 Types of Knowledge

In general, knowledge can be divided into two types, namely, explicit and tacit knowledge. Each type has different meaning and sources. Tacit knowledge is the unarticulated knowledge in a person's mind, which is difficult to describe, transfer, and capture. It is embedded in a firm's practices and in the people within an organization. Thus, it is highly personalized and very difficult to measure. This type of knowledge includes lessons learned, know-how, judgment, rules of thumb, and intuition (Mary, 2001). Besides, tacit knowledge is automatic, requires little time or thought, and helps to determine how organizations make decision and influence the collective behavior of their members (Peter, 1994).

Explicit knowledge refers to the knowledge that exists in a given collection of data and rules in a reasonable time (Peter, 1994). According to Civi (2000), explicit knowledge can be expressed in words and numbers, shared in the form of data, scientific formulae and manuals, migrated into community, and made accessible to other people. Compared to tacit knowledge, explicit knowledge is clearly formulated and easily expressed without ambiguity. It is normally stored in databases after it has been codified. The database can be accessed by relevant people and used to solve typical problems in the future.

Figure 2 displays the four modes of knowledge conversion, which are:

- Socialization: from tacit knowledge to tacit knowledge,
- Externalization: from tacit knowledge to explicit knowledge,

- Combination: from explicit knowledge to explicit knowledge, and
- Internalization: from explicit knowledge to tacit knowledge.

From \ To	Tacit Knowledge	Explicit Knowledge
Tacit Knowledge	Socialization	Externalization
Explicit Knowledge	Internalization	Combination

Figure 2: Modes of knowledge conversion (Nonaka and Takeuchi, 1995).

Socialization is a process of sharing information with others. This is more than just talking, which involves sharing internal knowledge and insights in a structured manner. This is how an apprentice learns from the master craftsmen. Externalization is the key process in knowledge conversion. In this process, new tacit knowledge and explicit designs are born. It refers to a knowledge creation process where tacit knowledge becomes explicit, taking the shapes of metaphors, analogies, concepts, hypotheses or models. Combination is a process of creation explicit knowledge by bringing together explicit knowledge from a number of sources. Individuals can exchange and combine their explicit knowledge through telephone conversations, meetings, memos, and others. New knowledge can also be created through the restructuring of existing information by sorting, adding, combining and categorizing explicit knowledge. Finally, internalization is a process of embodying explicit knowledge into tacit knowledge, internalizing the experiences gained through other modes of knowledge creation into individual's tacit knowledge, in the form of shared mental models or work practices.

2.4 KT Process

KT means distribution of acquired, created and developed knowledge throughout the organization, so that the knowledge can be exploited at the organizational level (Webb, 1998). Tacit KT process includes the sharing of experience, collaboration, stories, demonstrations, and hands-on training. Explicit KT occurred through mathematical, graphical, and textual representations, from magazines and textbooks to electronic media. According to Mary (2001), KT requires a delicate coordination of people, processes, and supporting technologies to achieve the enterprise objectives of security, stability, and growth in a dynamic world.

There are five stages that can be described in process terms before coming to the KT stage as shown in Figure 3:

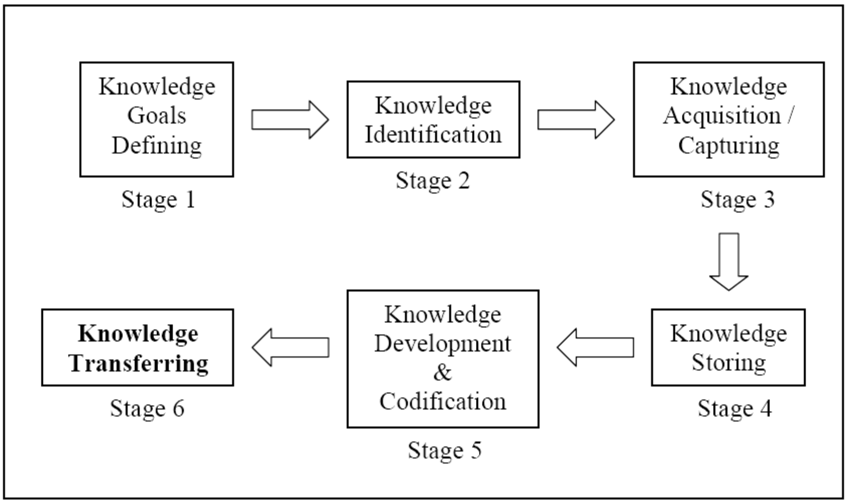

Figure 3: Stages in KT (Edward, 2003)

Stage 1 – Knowledge Goals Defining: One of the core tasks of management is to define goals, which will give direction to a firm's essential processes. It also provides the basis for implementation and monitoring to a firm.

Stage 2 – Knowledge Identification: The stage that describes and analyzes the firm's knowledge status or environment. It must have a level of transparency, which permits individuals within an organization to find their bearings and gain better access to the internal and external knowledge environment to make everyone clear about his or her role in the organization.

Stage 3 – Knowledge Acquisition / Capturing: The process that captures knowledge by accumulating data through human observations and experiences or technical sensing and measurement.

Stage 4 – Knowledge Storing: Acquired explicit knowledge in a standard form, which could be organized and stored for subsequent analysis and application in digital databases. The advantages are that this type of knowledge is stored in digital storage media which is easy to edit, use, and distribute.

Stage 5 – Knowledge Development and Codification: The acquired knowledge cannot be used directly before it has been fully developed and codified.

Stage 6 – Knowledge Transferring: A centrally directed process of knowledge distribution among a particular group of employees, or between individuals, within teams or working groups. The supported systems for this purpose are the Internet, intranets and other groupware systems such as video-conferencing, document management system, bulletin boards, shared databases, electronic mail system, etc.

2.5 Earthwork Contracting

Earthwork contracting is a combination of activities, which turns basic resources into a finished product (construction site) that will be sent back to client for further construction. This can range from organization of the materials, labor and other resources on the site activities, which control the flows of information and finance (Webb, 1998). In order to achieve the quality needed, earthwork-contracting firm must concentrate on understanding the whole system of earthwork and ensuring that it focuses on the production aims of the site operations.

To accomplish the fundamental activities, earthwork-contracting practices can be divided into the seven sub-processes:

- Policies, procedures and site arrangements: for management techniques and systems.
- Management, supervision and administration of sites: correspondence, minutes, labor allocations, payroll, progress reporting, notices or claims, instruction, drawing register and technical information.
- Commercial management: estimating, valuations, sub-contracting, payment, variations, day works, cost-value reconciliation, final accounts and cash flow.
- Legal, health and safety: management of requirements on sites, safety policy, insurance, building regulations, British Standards and Codes of Practices.
- Planning, monitoring and control: project planning and scheduling, typically Gantt charts, network analyses, method statements, resource leveling, progress and exception reports.
- Delivery and material handling: including requisitions and purchase orders.
- Production on-site and off-site: plans and report; contract terms drawings, specifications, setting-out and measurements.

These seven sub-processes can be expressed through a schematic diagram, namely data flow diagram (DFD). Figure 4 simply explains the basic relationship between earthwork contracting firm and client where they are relating through earthwork contracting process. It also gives an overview of basic activities involved between parties at the lowest level (Level 0).

Figure 5 shows the details of earthwork contracting process in Level 1. The system comprises two terminators, contractor and client. These two parties have the right to do either execution or elimination of the system. There are nine sub-processes, namely planning or scheduling, site preliminary, project team selection, material supply, equipment selection, earthwork process, working progress, quality control, and account department. This system employs five storages or databases, which are planning database, equipment store, inventory, specification and standard database, and work progress file.

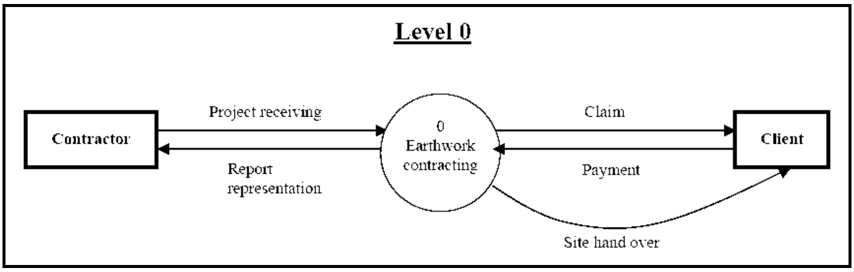

Figure 4: DFD for earthwork contracting firm Level 0

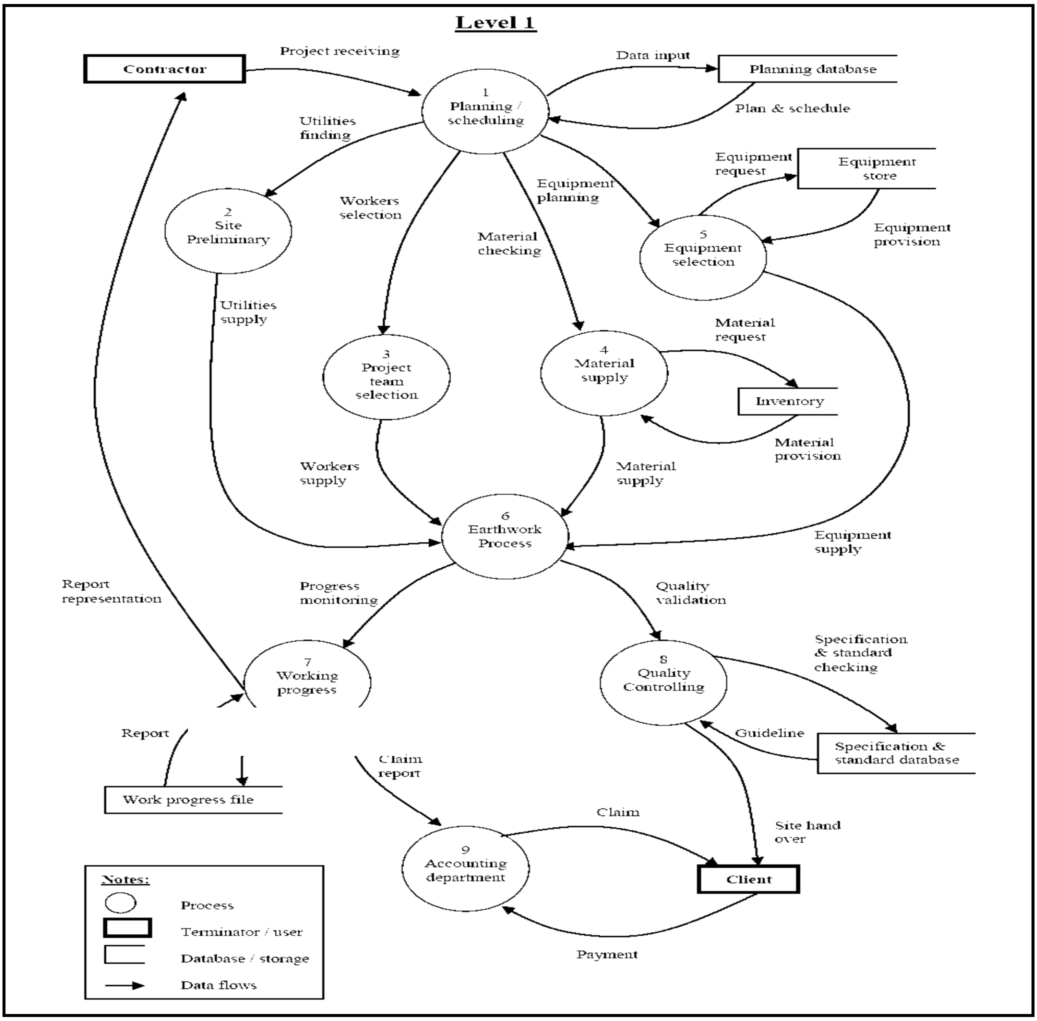

Figure 5: DFD for earthwork contracting firm Level 1

2.6 KT as A Competitive Tool

A competitive tool refers to accessories which gives a competitive edge in the bid to achieve a goal. Competitive advantage can be defined as the difference in any firms attribute or dimension that allows one firm to better serve the customers than others and hence create better customer value (Hutchins, 1991). As shown in Figure 6, a conceptual model of KT and competitive tool is proposed. The model outlined is significant because it offers an opportunity to fill a void in understanding how organization might successfully develop a competitive advantage based on KT. The tool can be used to achieve superior performance and greater benefits.

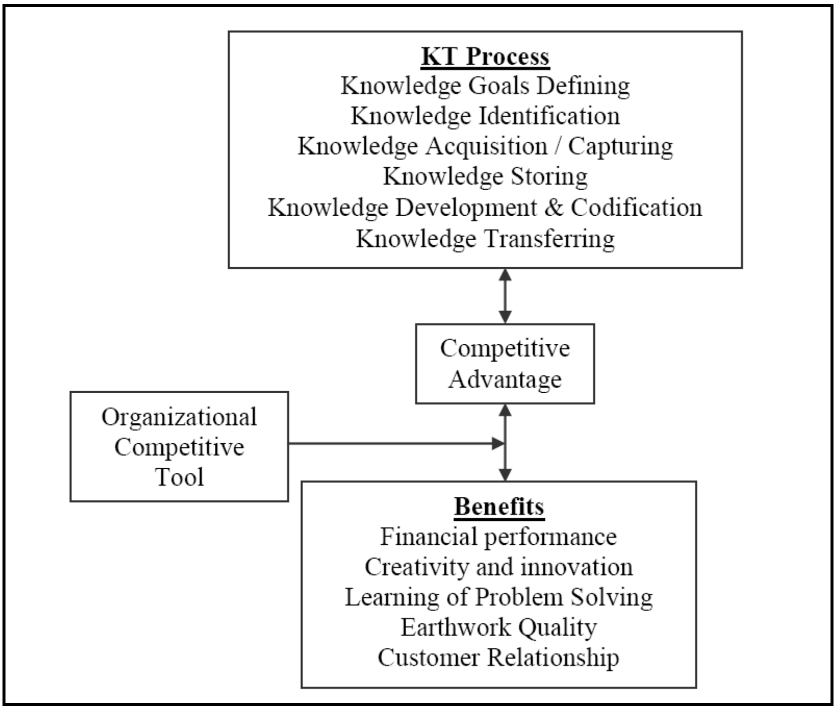

Figure 6: Model of KT as a competitive tool

3.0 Methodology

3.1 Research Design

This study involves multivariable analysis, which means a multidimensional study of more than two variables. The variables of the study consists the six keys of KT process. These six keys are goals defining, identification, acquisition or capturing, storing, development and codification, and transferring of knowledge. Inferential analysis is also used to recognize the differences that occur between the different group of respondents and determining the relationship and the strength of the relationship between the variables.

3.2 Sampling and Respondent

The population consists of contracting firms in the field of earthwork in the surrounding districts of Johor Bahru and Kuala Lumpur. A total of 120 questionnaires were distributed to earthwork contracting firms in both places with 60 questionnaires each, respectively.

3.3 Data Collection

Mail survey method was used to collect primary data. Distribution of questionnaire was done by hand because it is the most effective way to assure delivery. The questionnaire consists of three parts (Part A, B and C), and designed to solicit information about the level of KT implementation among the contractors. Questions in Part A are used to identify respondent's profile and information. It is important to identify the respondent's background because result obtained may influence by this factor. In the Part B, the influence of the six keys of KT process (knowledge goals defining, identification, acquisition or capturing, storing, development and codification, and transferring) towards earthwork contacting firm is identified. From the available data, the most significant processes from the six keys are selected to measure whether an earthwork-contracting firm implements KT. Finally, Part C highlights the benefits obtained by earthwork contracting firm from KT implementation. Analysis is carried out to study the relationship between KT and benefits obtained from KT implementation. The questions in Part C are based on questionnaire from a previous study done by Karagozoglu and Lindell (2000).

Almost all questions are based on Likert scales of measurement (1 = Strongly disagree; 2 = Disagree; 3 = Indifferent; 4 = Agree; 5 = Strongly disagree). Likert scale is used with the assumption that each item has the equal weight and importance.

4.0 Results and Discussion

From a total of 120 questionnaires, 39 were returned successfully (response rate of 32.50%). 14 were from Class A, 12 from Class B, 9 from Class C and 4 from other classes of contractors. The respondents are project managers, site managers, managing directors, quantity surveyors, and others.

4.1 Level of KT Implementation

Table 1 shows the score and indication obtained from the mean of one part in the questionnaire. The mean score of 1 – 2.33 is considered as having no KT implementation in the respective consulting firms. The mean score of 2.34 – 3.66 is considered low while the score of 3.67 – 5.00 is categorized as high level of implementation.

Table 1: Score and indication means

Score	Level of KT Implementation
1 – 2.33	No implementation
2.34 – 3.66	Low
3.67 – 5.00	High

The respondents were given a value of 1 to 5 as the degree of their agreement with each statement. There were 18 questions asked, and the total score for these questions was divided equally to get the mean of the data. The mean score is 3.72. This mean falls in the high-level category.

Table 2 shows the mean score of each key question that represents differences of KT process. Key 2 (knowledge identification), Key 3 (knowledge acquisition), Key 4 (knowledge storing) and Key 6 (knowledge transferring) have mean values of within 2.34 – 3.66 (highly implemented by the earthwork contractor firms in Johor Bahru and Kuala Lumpur). However, Key 1 (knowledge goals defining) and Key 5 (knowledge development and codification) are considered in the low level of implementation because their mean values are within 3.67 – 5.00. These results indicate that all the 6 keys were not implemented equally by the earthwork contractor firms.

Table 2: Mean scores of key questions

	N	Minimum	Maximum	Mean	Std. Deviation
Key 1	39	2.00	4.67	3.4701	.57082
Key 2	39	2.33	4.67	3.6923	.54817
Key 3	39	3.00	5.00	3.8974	.50236
Key 4	39	3.00	5.00	3.8291	.55605
Key 5	39	2.33	5.00	3.5897	.55389
Key 6	39	3.00	4.67	3.8547	.45752
Valid N (listwise)	39				

4.2 Classes of Contractor and Components of KT Process

The ANOVA test was used to determine whether there is significant difference between classes of earthwork contractor firm and the components of KT process. From Table 3, contractor Class A has the highest value of level implementation in Key 1, Key 2, Key 3 and Key 6. Contractor Class B has the highest value in Key 4 and Key 5. Other classes of contractor have lowest level implementation in all keys.

Table 3: Mean score of earthwork contractor firms with different classes

Key	Class	N	Mean	Std. Deviation	Std. Error
Key 1	Class A	14	3.6905	.46159	.12336
	Class B	12	3.6667	.44947	.12975
	Class C	9	3.3333	.37268	.12423
	Others class	4	2.4167	.41944	.20972
	Total	39	3.4701	.57082	.09140
Key 2	Class A	14	3.7619	.47911	.12805
	Class B	12	3.7500	.60511	.17468
	Class C	9	3.5926	.66202	.22067
	Others class	4	3.5000	.43033	.21517
	Total	39	3.6923	.54817	.08778
Key 3	Class A	14	4.1905	.50152	.13404
	Class B	12	3.8056	.33207	.09586
	Class C	9	3.8148	.52997	.17666
	Others class	4	3.3333	.27217	.13608
	Total	39	3.8974	.50236	.08044
Key 4	Class A	14	3.8571	.56560	.15116
	Class B	12	3.9444	.58315	.16834
	Class C	9	3.8519	.52997	.17666
	Others class	4	3.3333	.38490	.19245
	Total	39	3.8291	.55605	.08904
Key 5	Class A	14	3.5952	.50937	.13614
	Class B	12	3.6667	.49237	.14213
	Class C	9	3.5926	.61864	.20621
	Others class	4	3.3333	.86066	.43033
	Total	39	3.5897	.55389	.08869
Key 6	Class A	14	4.0476	.41049	.10971
	Class B	12	3.7500	.55277	.15957
	Class C	9	3.8148	.33793	.11264
	Others class	4	3.5833	.41944	.20972
	Total	39	3.8547	.45752	.07326

Table 4: Comparative analysis between classes of earthwork contractor firms and the components of KT process

		Sum of Squares	df	Mean Square	F	Sig.
Key1	Between Groups	5.751	3	1.917	10.118	.000
	Within Groups	6.631	35	.189		
	Total	12.382	38			
Key2	Between Groups	.345	3	.115	.364	.780
	Within Groups	11.074	35	.316		
	Total	11.419	38			
Key3	Between Groups	2.638	3	.879	4.427	.010
	Within Groups	6.952	35	.199		
	Total	9.590	38			
Key4	Between Groups	1.158	3	.386	1.276	.298
	Within Groups	10.591	35	.303		
	Total	11.749	38			
Key5	Between Groups	.334	3	.111	.345	.793
	Within Groups	11.324	35	.324		
	Total	11.658	38			
Key6	Between Groups	.961	3	.320	1.604	.206
	Within Groups	6.993	35	.200		
	Total	7.954	38			

The components of the KM process are shown in Table 4, which consist of eight keys and a confidence level of 95% (the accepted significant level is 0.05). The result indicates that the values for Key 2, Key 3, Key 4, Key 5 and Key 6 are more than 0.05, which mean there is no significant difference between contractors of Class A, Class B, Class C and others (classes lower than C). However, Key 1 has a significant difference towards the components of KT process because it has a significant value of less than 0.05. In Key 1, contractor Class A and Class B are categorized as having high level of implementation (its value is more than 3.66); and contractor class C and lower are categorized in low level of implementation.

Table 5: KT implementation among earthwork contracting firms

Class of earthwork contractor		KT Level		Total
		High	Low	
Class A	Count	14	0	14
	% of total	35.90%	0%	35.90%
Class B	Count	11	1	12
	% of total	28.21%	2.56%	30.77%
Class C	Count	5	4	9
	% of total	12.82%	10.26%	23.08%
Others class	Count	0	4	4
	% of total	0%	10.26%	10.26%
Total	Count	30	9	39
	% of total	76.93%	23.08%	100.0%

4.3 Level of KT Implementation

In Table 5, the total percentage indicates the relative composition of the sample (76.93% high KT implementation and 23.08% low KT implementation). All respondents implement KT and more than half of the firms implement KT highly. Contractors Class A is the highest contributor of 35.90%. Only 11 contractors Class B and 5 contractors Class C fall in the same category.

4.4 KT Benefits

The Pearson's product Moment Correlation was used to analyze the linear relationship between KT and benefits obtained by earthwork contracting firms. The benefits studied were related to 5 aspects:

Financial Performance: no significant difference between the level of KT implementation and financial performance achieved. Although the relationship is positive, the Pearson correlation coefficient of 0.214 indicates a weak relationship between level of KT implementation and the financial performance achieved.

Creativity and Innovation: the coefficient is a positive value, but indicates a weak linear relationship of substantial magnitude ($r = 0.201$) and statistically not significant ($p > 0.05$) due to the p value equals to 0.219.

Learning of Problem Solving: a positive value with substantial magnitude of 0.573 and highly significant ($p=0.000$). The Pearson correlation coefficient of 0.573 tends to suggest a moderate region between the KT and the learning of problem solving achieved.

Earthwork Quality: the coefficient is positive but a weak relationship because of the substantial magnitude ($r = 0.244$) and statistically not significant ($p>0.05$) since the p value equals to 0.134.

Customer Relationship: the significant value is less than 0.05 ($p=0.009$). There is significant difference between the level of KT implementation and firm's customer relationship achieved. The Pearson correlation of a value 0.411 is classified as moderate between level of KT implementation and the firm's customer relationship achieved.

5.0 Conclusions

This study presents an effort to integrate KT process into earthwork contracting practices. The need to synthesize KT process was identified by the identification of types of knowledge relevant to earthwork contracting. It is found that earthwork contracting offers a wide range of interesting engineering and management problems to be solved. This conclusions focus on the level of KT implementation, relationship and benefits obtained by earthwork contracting firms. The study identifies that all earthwork-contracting firms have implemented KT. However, it is found that contractors of higher class are more willing to implement KT than the lower class contractors. Although KT is important in the earthwork contracting firms, some of the firms have not put in enough effort to develop sufficient process. Knowledge identification (Key 2), knowledge acquisition (Key 3), knowledge storing (Key 4) and knowledge transferring (Key 6) are implemented at high level by earthwork contracting firms in Johor Bahru and Kuala Lumpur. In general, firms financial performance, creativity and innovation, and earthwork quality have weak relationship with KT. Only the problem solving and customer relationship have moderate relationship with KT.

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