INDONESIAN CONTRACTORS' PERFORMANCE IN MANAGING IT: CRITICAL SUCCESS FACTORS, ASSESSMENT MODEL, AND BENCHMARKING SYSTEM

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ABSTRACT: Indonesian contractors have entered the information age by adopting information technologies (IT) to improve the efficiency and effectiveness of their business processes. Yet many contractors that have adopted IT face problems related to how to get the best of the adoption and how to reap benefits from the investment. The problem lays in the poor management of IT by contractors including strategic planning, design, implementation, maintenance, evaluation and human resource management processes. This paper discusses three studies conducted to measure the performance of contractors in managing IT. Critical success factors in managing IT were identified from a survey of large contractors and an assessment model was developed based on these factors and implemented by the same contractors. The results of the assessment showed that, in practice, IT is still used merely as supporting tools and there are many limitations to its current usage in contractors' environment. A benchmarking tool for Indonesian contractors to improve their performance in managing IT investments was further developed. A benchmarking case study is discussed in this paper as a real example of the benefit that a contractor can get from the three studies related to measurement of Indonesian contractors' performance in managing IT.

KEYWORDS: assessment, benchmarking, critical success factors, IT management, performance.

1 INTRODUCTION

Indonesian contractors have entered the globalization era as the Indonesian government joined the AFTA and construction services became one of the open markets in Indonesia. Therefore, Indonesian contractors are now facing many challenges as the forces to continually adapt to the changes in the competitive construction market increase. Many big infrastructure projects in Indonesia have already called for foreign investors' as well as contractors' participations. There are 134 foreign construction firms operating in Indonesia nowadays. Even though foreign contractors are still obliged to have local partners in doing business in Indonesia, yet this still means more competitive and challenging market for Indonesian contractors. On the other hand, the challenge is amplified further since the Indonesian contractors have to compete with each other in their national market as the number of contractors registered for doing business in Indonesia is quite high. It has been identified by the Indonesian Construction Industry Development Board that there are almost 120,000 contractors registered (LPJK 2006).

Meanwhile, Indonesian contractors, as well as majority of contractors in any country, still struggle with their problems of delivering their products efficiently (Alwi et. al. 2002). It is a well-known phenomenon that the construction industry, as well as the Indonesian construction industry, still faces problem of inefficiencies in their business processes. The construction industry is considered as an industry that contributes significantly to the growth of the economic of a country, e.g., in 2004, the Indonesian construction industry's growth reached 8.17% and it was higher than the growth of Indonesian GDP, i.e., 6.17% (Abidin et. al. 2004). It means that the construction industry could contribute more to the growth of the country's economic and prosperity if the inefficiencies could be reduced. Any solution to the inefficiency problems will then be the key to the success of Indonesian contractors in answering the globalization challenges.

One of strategies that is believed can answer the challenges is to improve efficiency and effectiveness of business processes by adopting information technologies (IT). Many scholars and practitioners in the field of IT applications in construction have mentioned benefits construction people will gain in adopting IT. Brochner (1990) stated that IT adoption will improve coordination, inspection, and communication in an organization. Furthermore, Betts et al. (1991) mentioned that IT will give a new opportunity as a strategic weapon for gaining competitive advantage, improving productivity and performances, giving new way of managing and organizing, and opening a new business. Moreover, Ahmad (1996) stated that adoption of IT in construction can be implemented in the process of managing construction project since the process is dynamic, complex, team-work activity, and full of uncertainty.

2 NEEDS FOR MANAGEMENT OF INFORMATION TECHNOLOGY

The construction industry has entered the information age by using IT in a variety of ways. Yet many construction firms that have adopted IT face many problems related to how to get the best of IT adoption into their business processes and how to reap benefits of their investment in IT. Some efforts to measure the performance of IT adoption in construction have been conducted in some countries, e.g. Scandinavian, Saudi Arabia, Hong Kong, and Canada. Based on results of their efforts, recommendations can be drawn in conducting further researches and actions to improve the performance of the construction industry in adopting IT. Yet the construction industry still cannot really reap benefits that IT is supposed to provide.

In Indonesia, a research conducted by Pamulu et al. (2003) showed that about 55% of large Indonesian contractors have adopted IT for their business purposes by investing about 1-5% of their annual budget on IT. Only 32% of them have managed to invest about 6-10% of their annual budgets for IT. The research also showed some arguments that Indonesian contractors put on why they did not want to invest their money on IT. It was shown that about 40% of the Indonesian contractors still think that investment on IT is difficult to prove in term of money they can gain. This is merely because contractors cannot really feel benefits from their investment on IT.

Abduh and Hikmawati (2003) made a premise that the root problem may lay on poor management of IT by contractors, i.e. in strategic planning, design, implementation, maintenance, evaluation and human resource processes. In other words, the investment on IT does not stop at spending money merely in purchasing computers and software, it is a strategic management process that a contractor should commit to in order to adopt IT successfully.

3 CONTRACTORS' CRITICAL SUCCESS FACTORS IN MANAGING IT

IT can function effectively if it is supported by appropriate management of processes related to IT investment. Abduh and Hikmawati (2003), based on literature research, have compiled phases and components of IT management which include planning, design, implementation, evaluation and maintenance processes. Hikmawati (2004) developed factors from each phase and component of the IT management that should be considered to the success of IT investment. Since construction's culture, business processes and environment are considered different from other industries, the way contractors manage their IT would be different as well compared to others. Therefore, there is a need to get picture and also contractors' opinions on the way they manage their IT, and which factors that they think and have experienced to be the success factors of managing IT in their environment.

Hikmawati (2004) designed a survey to collect contractors' opinions on which factors that could be the success factors of managing IT based on several factors that were identified from some literatures that could affect the performance of IT management in any organization. The premise made on this research was that contractors' organization culture and environment will produce different results compared to if it were conducted to other type of organization. For gaining sound validity of the survey, the respondent was a representative person of a contractor that is knowledgeable in construction processes as well as in managing IT. The survey was conducted by distributing questionnaire to 107 contractors, asking for their opinions on the importance of each identified factor (as tabulated in Table 1) to the success of its associated phase of managing IT. With a response rate of 20.6% (22 respondents out of 107 contractors), the survey showed that the criteria for respondents were achieved to make sure that the survey was answered by competent persons. About 60% of the respondents have been working in their firms more than 10 years and have positions in a middle-level management.

The survey then classified the identified success factors into three categories, i.e. critical, modest, and not critical. Categorization of the identified success factors was made based on rating given by respondents for each factor using statistical measures, i.e., combination of mean, modes and standard deviation. Based on this categorization, it was found that, from 47 identified success factors, there are 38 success factors that were categorized as critical success factors. Those that were categorized into modest and not critical success factors are factors that relate to planning of IT investment and implementation of IT, such as relationship between IT usage and the organization's politic, suitability of IT investment and the organization's as well as the country's economic condition, selection of supplier for procuring hardware and software, physical facilities to support IT, IT training programs, and implementation scheme.

Based on the survey's findings, the most critical success factors identified from contractors seemed to follow general practices in any organization, except success factors in planning and implementation phases of IT management where numbers of identified critical success factors were less and tended to diverge from common practices. The differences are due to the nature of contractors' business processes and environment which enable contractor to utilize IT merely for supporting activities. This phenomenon could be well described by the strategic grid for IT model (Cash et. al. 1992) where contractors are belong to the support grid which means that IT has little relevance to the organization and simply supports existing processes (see Figure 1). Yet this conclusion still need more proves, therefore an assessment model to measure practices of contractors in managing IT is needed to reveal more indicators of the aforementioned conclusion regarding position of contractors in adopting IT.

Table 1. Identified Success Factors of Managing IT (Hikmawati 2004).

Phase	Process	Success Factors
Planning	▪ Organization Analysis	▪ IT adoption is aligned with organization needs, culture, and politics ▪ Type and characteristic of IT for each organization level, SOPs, and vision and mission of the organization
	▪ Economic Environmental Analysis	▪ Feasible investment on IT
	▪ Analysis of Existing IT	▪ Identify hardware, software, and telecommunication system
	▪ Identification Business Processes and Information Flow	▪ Identify activities and work flows that need IT supports ▪ Integration between information flow of each activity and the use of IT
	▪ Resources Identification for IT Procurement	▪ Resources procured for IT utilization is suitable and feasible for the organization
	▪ Assessing *Business Value*	▪ Additional values gained ▪ Fulfillment of user's satisfactions and organization's goal
	▪ Feasibility Study	▪ Use of feasibility study on IT development and investment
Design	▪ Logical design ▪ Physical design	▪ Logical design reflects the needs of IT adoption ▪ Physical design reflects the logical design
Implementation	▪ Socialization	▪ Users are involved and get informed
	▪ Procurement of IT hardware	▪ Specification and suppliers of hardware
	▪ Procurement of IT software	▪ Specification and suppliers of software
	▪ Database Development	▪ Data and information analysis of each level of organization ▪ Control of quality, security and integrity of data ▪ Recording procedures to avoid data duplication
	▪ Physical Facility	▪ Physical facility is suitable for IT needs
	▪ Training	▪ Training modules are prepared based on the needs of IT implementation ▪ Schedule of training program is aligned with implementation ▪ Qualification of trainee and trainer
	▪ Conversion scheme	▪ Chosen conversion system is suitable for the organization and IT adoption
Evaluation	▪ Evaluating System Flow	▪ Flow of information as expected and designed ▪ Procedures are followed
	▪ Simulating with Sampling Data and Real Data	▪ Operation follows system logic ▪ Results are valid
Maintenance	▪ Correcting errors/noises	▪ Identified errors and noises ▪ Frequency of correction
	▪ Updated System	▪ Update data ▪ Necessary modification
	▪ Improving System	▪ Optimal improvement of hardware and software as needed
	▪ Data Back-up	▪ System for data back-up

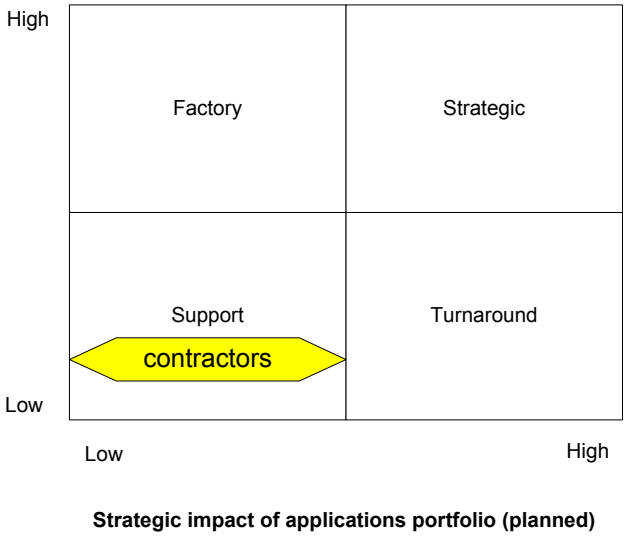

Figure 1. Contractors' Position in the Strategic Grid for IT (based on Cash et. al. 1992).

4 ASSESSMENT MODEL IN MEASURING IT MANAGEMENT PERFORMANCE

Based on the need of an assessment model identified by Hikmawati (2004), Yasak (2005) developed variables or indicators based on the critical success factors of managing IT as the most important part of the assessment model to measure the performance of contractors in managing IT. Based on 38 critical success factors, Yasak (2005) generated 82 performance indicators of managing IT included in the assessment model based on some interviews with several practitioners in construction and IT industries. Qualitative rating method using 'bad', 'fair' and 'good' scales and an additive mathematical multi-criteria approach were used in the assessment model. The qualitative ratings were then transferred to quantitative scales, i.e., 1 = bad, 2 = fair, and 3 = good. A questionnaire was then developed to be used as an implementation tool of the assessment model.

A survey was conducted to implement the assessment model of Indonesian large contractor firms. Data collection was performed by distributing questionnaires to targeted respondents and following up the answered questionnaire by interviews. The response rate was 39.3% and all of the respondents (23 contractors) were from city of Jakarta and consisted of 9 government's contractors, 8 private contractors, and 6 foreign or joint-operation contractors. Figure 2 shows results of the assessment. The average performance value is 1.878 which is categorized less than 'fair' performance and it is shown also that there is no contractor that has gained value of 3 ('good') on overall performance of managing IT.

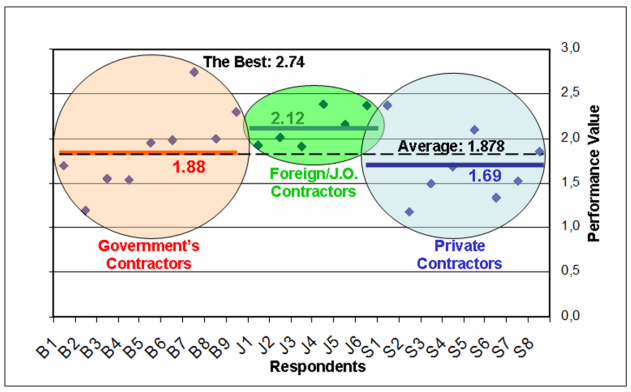

Figure 2. Overall Contractors' Performance in Managing IT (Abduh et. al. 2005).

Even though, the average performance of contractors in managing IT is not considered 'fair' or even 'good' yet, there is one government's contractor that has performance value 2.74 which is more than 'fair' and almost reached 'good' performance. Meanwhile, based on the contractors' status, foreign or joint-operation contractors have the best average overall performance in managing IT (i.e., 2.12) compared to government's contractors (i.e., 1.88) and private contractors (i.e., 1.69) and each foreign contractor has performance value above the average of all contractors (i.e., 1.878). It was very surprising to notice that private contractors have the lowest average overall performance and the highest performer is coming from government's contractor.

The best performer in managing IT is a government's contractor that has been doing its business mostly in EPC projects. It seems that type of business a contractor deals with has forced a need of IT to support the business process. EPC projects are considered more integrated in term of project delivery process if it is compared to a traditional and segmented design-bid-build type of project delivery. With the virtue of this type of organization integration, an EPC contractor is more aware of the need for technological and information integration. Therefore, an EPC contractor tends to put more hope to IT to answer the integration issues. Eventually, this government's construction firm has a special IT division with special IT personnel holding IT related bachelor degree. The best performer predicate is also given to this contractor since its higher level management is very committed to the adoption of IT and, even more, the director of IT division become a champion in the organization to lead IT adoption.

5 WEAKNESSES OF INDONESIAN CONTRACTORS IN MANAGING IT

Based on findings of the assessment as mentioned above, more analysis on detail performance of contractors in managing IT for each phase concluded several weaknesses of Indonesian contractors in managing IT as follows (Abduh et. al. 2005):

- IT utilization is not strategically planned and well defined at the beginning of IT management phases.
- IT is utilized merely for supporting administrative and operational activities.
- Human resource development plan/career is not well defined for IT personnel.
- Maintenance of IT is conditional.

Furthermore, in overall, the only phase of IT management that has more than 'fair' performance is the design phase. The rest phases are considered less than 'fair'. This finding confirmed initial conclusion from Hikmawati (2004) regarding the critical success factors in managing IT. It seems that the contractors tended to put less critical value on the factors that relate to activities in the phases that they have not performed well. Yet the reasons behind this are still to be further studied whether they are caused by natural characteristics of contractors' business processes and environment or other factors.

From the study it was found also that most of the contractors planned their IT investments due to owners' orders. Idea for IT investment is not coming from the need to improve productivity of their business processes or to be part of their competitive advantages. There is no adequate alignment between IT strategic plan and the firm's vision and mission in the planning phase of IT investment. Therefore, result of IT planning is merely the use of IT for presentation to and communication with the owners whilst internal business processes that have been supported by IT were only administrative and operational activities; only about 30% of standard operating procedures that have been supported by IT.

In the implementation phase of IT management, contractors ignored to invest adequate human resources for IT personnel. It is rare to find a contractor that have IT personnel, or IT group, or even IT division specialized to take care of IT management for its organization. Most of contractors utilized excess capacity of their human resources in other divisions to have their IT investment taken care of. Furthermore, no appropriate and well defined training programs or socializations to their employees for new investment on IT. The most important issue related to the implementation phase is that there is no adequate commitment from higher level management to the implementation of IT investment. Therefore, there is no motivation, i.e., reward and punishment, for the employees to utilize new system or investment on IT.

In the maintenance phase of IT management, contractors tended to conduct maintenance based on crisis they found. Most of the contractors argued that their IT maintenance practice was as such since the existence of IT in supporting their activities is not critical. Therefore, IT maintenance can be done conditionally without harming the operations of their core business processes.

The performances and weaknesses of contractors in managing IT that were found in this study suggested that initial conclusion regarding the position of contractors in strategic grid for IT is confirmed. In other words, the contractors use IT merely for supporting some limited number of their business processes which are not critical and not significant for adding values to customers.

6 BENCHMARKING SYSTEM

One of potential use of an assessment model is for benchmarking. As mentioned by Barber (2004), benchmarking is a systematic process of measuring and comparing an organization's performance against that of other similar organizations in key business activities. The lessons learned from conducting benchmarking are used to establish improvement targets and to promote changes in the organization. In the context of IT management, there is a need that the assessment model that has been developed to be used as a benchmarking tool for Indonesian contractors to improve their way in managing IT, therefore they can reap benefits of IT adoption for their business processes.

A study by Supani (2005) was conducted with an aim to develop a benchmarking system that accommodates the assessment model that had been developed by Yasak (2005). This benchmarking system was used to measure performance of Indonesian contractors in managing IT, to select a benchmark for identifying gaps of a contractor's performance in managing IT, and to suggest improvement efforts to be adopted by a contractor in managing IT. The benchmarking type that was used in this study was a competitive-process benchmarking which compares one organization performance to others and suggest adoption of strategies to improve the organization's business processes. An assumption that was made in developing the benchmarking system was that each attribute or indicator was independent to each other or value of one attribute will not affect values of others.

Furthermore, in this benchmarking system, a gap analysis was performed based on value of each attribute and results of the analysis were used to compare one contractor's performance to a selected benchmark. The gap analysis was not performed only to performance's value of lower-level attributes but also to aggregated attributes. Actually, the gap analysis to the aggregated attributes was conducted first and after that more gap identifications were carried out to the lower-level attributes. For each lower-level attribute that has gap, further analysis was performed to determine an improvement strategy based on four scenarios of improvement, i.e., from 'bad' to 'fair', or from 'bad' to 'good', or from 'fair' to 'good', or from existing performance to a selected benchmark's performance.

For this benchmarking system, a knowledge-based system was then developed using the EXSYS developer version 8.0. A knowledge database was designed based on rules and knowledge acquisition from some experts. The knowledge acquisition was conducted to collect experts' opinions on strategies of improvement in managing IT based on the scenarios of improvement as mentioned before. An expert that was very well involved in the knowledge acquisition was from the best-performer contractor gained from previous study by Yasak (2005).

During development of the knowledge database, an issue related to the assumption made in the assessment model raised up and halted the development. The generation of rules cannot be achieved satisfactorily since the assumption of independency of attributes is not valid in real life. It was suggested by the expert that any improvement of performance of one attribute could affect significantly other attributes as well (see Figure 3). Even though the gap analysis has identified gaps on several attributes, the improvement efforts would not be linearly reflected by their gaps' values or number of attributes that have gaps. Therefore, the developed benchmarking system has limitation on this issue. It was suggested that further studies should be conducted and focus on determination of inter-relationships between attributes used in the assessment model, application of multiplicative mathematical model to accommodate dependency of attributes, and incorporation the refined model to the benchmarking system.

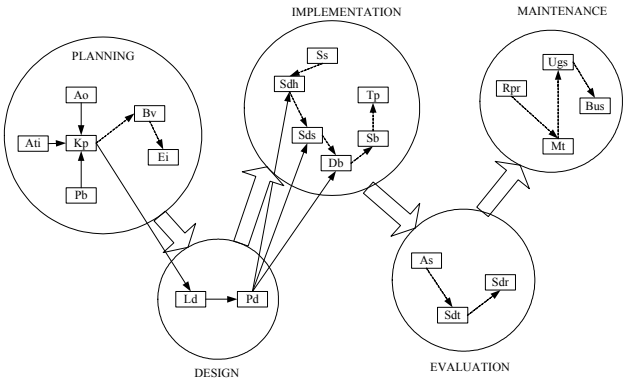

Figure 3. Suggested Inter-relationships between Attributes.

7 CASE STUDY AND RESPONSES FROM INDUSTRY

The aforementioned studies, i.e., the critical success factors (Hikmawati 2004), the assessment model (Yasak 2005), and the benchmarking system (Supani 2005), have been implemented in a case study using real data from practitioners and the Indonesian construction industry. Dissemination of results from those studies have already been done by sending reports to the respondents as well as by publishing results of the studies in a national journal and several seminars to gain industry's attentions and responses.

Two large construction firms, i.e., one government's contractor and one private contractor, have responded and approached the author to follow up results of the studies. The government's contractor has overall performance value of 1.890 and the private contractor has 2.093. In general, both contractors confirmed the positions of each contractor and weaknesses found from the studies in their IT management. Both contractors at the first time were interested to only know who the best performer was. But the government's contractor asked more questions regarding the studies and wanted to validate the results of the assessment, wanted to perform a benchmarking, and wanted to make some necessary improvements. The government's contractor is then further named as 'benchmarker' in this case study; meanwhile the private contractor is named as 'partner' and the best performer as 'best'. Based on Figure 4, performances of these contractors in managing IT were compared using a spider-web diagram to identify gaps of each phase's value in managing IT, i.e., planning, design, implementation, evaluation, maintenance phases. It is shown that the benchmarker had less performance value for all phases of IT management com-

pared to the best performer. If compared to the partner, the benchmarker had three less performance values, i.e., for planning, implementation, and maintenance phases, and two similar performance values, i.e., for design, and evaluation phases. Therefore, alternatives were to improve all benchmarker's identified gaps to the best's or to the partner's performance.

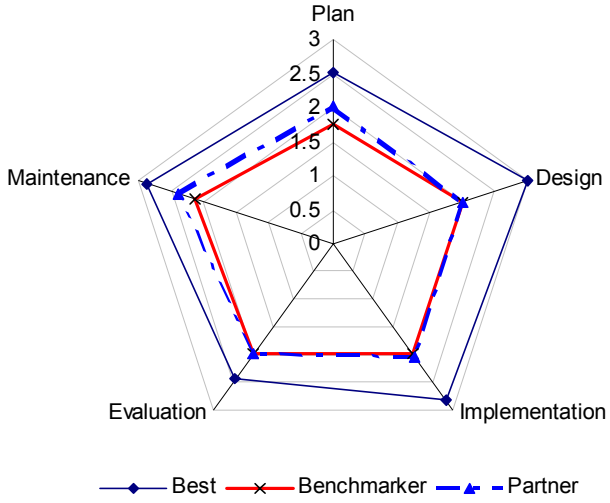

Figure 4. Benchmarking of Three Contractors' Performance in Managing IT.

Eventually, the benchmarker had already made some improvements and more investments on information system, IT organization and personnel, facilities and IT infrastructure. Some information systems have been developed recently to support several business processes, such as operation and project, accounting, human resource management, procurement and marketing, IT security management, and technical. Yet the information systems that support the core businesses of contractors, i.e., operation and project, procurement, and technical, were not well planned and designed. IT infrastructure and facilities have been adequately provided. Yet the IT personnel of this contractor were recruited from non-IT background personnel and most of IT related developments were outsourced.

Based on the identified gaps and recent conditions of the benchmarker's IT management, an alternative to level the partner's performance, not to level the best, was considered as the most possible and relatively inexpensive strategy. To level the best was considered expensive since the gaps were many and associate with all phases of IT management. It was also realized that the best had more complex business processes to be supported by IT since most of its projects were EPC projects which demand more integrated management in term of organization and technology.

The following suggestions were proposed to the benchmarker in the regard of investing new IS and IT in the future as well as of improving of their existing IT and IS:

- Need analysis for new IT or IS should focus on activities to be supported by IT and IS that are adding-value activities and giving competitive advantages to the firm. For this contractor, the activities are categorized into operation function, such as project management, construction, equipment management, material management, design, and procurement.
- The firm should focus on developing IT and IS that support automation and integration between project's applications (front office) and the firm's organizational function applications (back office).
- The firm should design its IT human resources development aligned with the need of IT adoption and the development of IT and IS. This issue includes whether IT division is needed or not, job specifications, job descriptions, career plan, and IT training programs.
- The firm should identify IT and IS applications that could improve not only the productivity of office works (back office) but also the productivity of in-the-field productivity (front office).
- The development of IT and IS applications for each organizational function or project's activity should not be conducted solely by each function or project without any guideline from a master plan of IT and IS applications of the firm. There should be a good coordination of IT and IS applications' developments from the beginning of the developments. Of course, user's involvement is a must in each IT and IS application development.

Although responses from two contractors have motivated the author to forget the well-known image that contractors are afraid of innovations and laggards in adopting new technology, yet the image is still valid for Indonesian contractors in general. The fact that the private contractor, which had approached the author, had no further interest except knowing who the best performer was described general condition of Indonesian contractors. Even more, the aforementioned government's contractor, which was interested in knowing further results of the studies, have had no further interest when some comments and suggestions on what kind of improvements they need to make were proposed. It can be said that majority of contractors still wait and see when it comes to IT investment. Therefore, the image that describes contractor belongs to the support grid for IT still holds.

8 CONCLUSIONS

Series of studies have been conducted to develop tools for measuring Indonesian contractors' performance in managing IT. The motivation of the studies came from the fact that Indonesian contractors face many challenges from more and ever competitive construction market and they have adopted IT for improving their business processes to gain competitive advantages but they could not reap benefits of their investment on IT yet. The premise was to improve the management of IT. The studies produced the critical success factors in managing IT, the assessment model to measure performance, and a knowledge-based benchmarking system to provide improvement strategies in managing IT by contractors.

Besides the detail of studies' results that give better picture of Indonesian contractors' performance in managing IT, which in average the Indonesian contractors had less than fair performance, the studies also provided general conclusion on characteristics of Indonesian contractors in

IT adoption. It was shown that IT had not been a factor and had not held a strategic role in Indonesian contractors' business processes. IT is still considered as an expensive investment with no visible returns. Even though IT adoption is still ongoing, use of IT is merely to improve productivity of limited business processes and still cannot contribute to gaining competitive advantages.

Yet the motivation is still there since there is a contractor that had put IT as critical and significant tools in doing the business. This best-performer contractor would be useful to be a benchmark and also a champion in improving other contractors' preferences towards IT adoption in Indonesia.

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