KEY FACTORS INFLUENCING ON VIETNAMESE CONSTRUCTION PERFORMANCE

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ABSTRACT

Together with the economic development, Vietnamese construction industry also develops very fast and occupies a large portion in economics. However, there are still many problems such as wastes, loses, low quality or low productivity relating to construction activities need to be improved. This paper aims at finding out the factors that influence on the performance of construction sites. A survey was carried out and found out 25 key factors that influence on the performance of construction sites. These factors are divided into six groups such as management, human resources, technology, finance, material/equipment and design after factor analysis. By ranking the importance of factors, this paper helps the contractors to focus on the most important factors to upgrade their competency.

Keywords: construction performance, key factors, Multiple Linear Regressions, cost and time, Vietnam.

Introduction

In the present competitive environment, Vietnamese contractors face with the demand on improving their competency, especially on construction performance. This demand does not only caused by the domestic contractors but the international contractors that have been joining into the Vietnamese construction industry. In other to acquire it, they need to improve their management skill, technology, human resources, finance, …

The study on the factors that influence on the construction performance can help the contractors to focus on the most important factors to upgrade their competency. However, there is very few study conducted so far in Vietnam. To meet the above demand on studying the factors affecting on performance of construction projects, this paper focuses on the following objectives:

- To review preliminary factors affecting project performance in construction phase in Vietnam.
- To determine key factors affecting performance of construction sites in Vietnam.

- To recommend appropriate solutions for improving performance of construction sites in Vietnam.

Literature review

Iyer and Jha (2003) conducted a research to identify factors affecting cost performance of construction project in India. The research pointed out 55 success and failure attributes relating to the cost performance of construction projects. After doing factor analysis, these attributes were extracted into seven critical success factors which are project manager's competence; top management support; project manager's coordinating and leadership skill; monitoring and feedback by the participants; coordination among project participants; and owners competence and favourable climatic condition. Concurrently, this research also identified factors adversely affecting the cost performance of projects. They are: conflict among project participants; ignorance and lack of knowledge; presence of poor project specific attributes and non existence of cooperation; hostile socioeconomic and climatic condition; reluctance in timely decision; aggressive competition at tender stage; and short bid preparation time. In order to improve cost performance of construction projects, contractors should not only maximize success factors but also minimize the impact of failure factors.

Alwi (2003) identified the key factors affecting construction productivity and their causes influenced by three issues: (1) characteristics of contractors; (2) inadequate management strategy; and (3) organization's focus. He focused on analyzing factors which were related to the waste and value adding of construction projects. By identifying and eliminating waste during construction process, he believed that the performance of projects would be increased.

Makulsawatudom et al. (2004) carried out a survey on 34 project managers working in construction industry in Thailand and found out 23 factors affecting construction performance. Among these 23 factors, the authors suggested concentrating on the ten most significant factors to improve construction performance in Thailand. They are lack of material, incomplete drawings, incompetent supervisors, lack of tools and equipments, absenteeism, poor communication, instruction time, poor site layout, inspection delay and re-work.

With the effort of developing a project improvement system, Mojahed (2005) analyzed 36 factors affecting construction performance. After analyzing, the top five ones were skills and experience of workforce, job planning, worker motivation, management, and shortage of skilled labour. He also found that the type of construction contracts became the driver of performance. Each type of contract was suitable for a certain approach.

Enshassi et al. (2007) conducted a research to identify factors affecting construction performance in Palestine. This research analyzed 45 factors divided into 10 groups: manpower, leadership, motivation, time, materials/tools, supervision, project, safety, quality, and external factors.

Nguyen (2007) suggested 10 factors affecting to cost overrun and time delayed including lack of experience of project management team, lack of capital ability of investor, supervision and organization at site, lack of capital ability of contractor, changes of design, fluctuation of constructional material price, difference between designed condition and actual condition, inadequate cost estimate and contingency amount, mistakes from design process, and late payment for the finished items.

Tran (2007) confirmed 12 similar factors affecting to cost performance such as: compensation and design changed by owner; lack of experience and accountability, mistake in survey and mistake in design of consultant; mistake in construction, lack of capital ability, lack of experience in management, inadequate bidding price, inadequate bill of quantity from the contractor; and fluctuation of constructional material price and improper implementation time.

Saqib et al. (2008) conducted a research to access critical success factors (CSFs) for construction projects in Pakistan. They have carried out a comprehensive study and identify a lot of factors relating to most of stakeholder of a construction project. They have pointed out seven groups of factors which have a tendency to impact on the success of the construction projects in Pakistan. After analyzing data, they have identified the top five CSFs are (1) Contractor-related factors, (2) Project manager-related factors, (3) Procurement-related factors, (4) Design team-related factors and (5) Project management factors. However, their research can only define the CSFs but cannot measure the key performance indicators (KPIs). So, this is only a qualitative research.

Razak et al. (2009) carried out a research to identify the work environment factors which affect to the performance of project managers within a construction firm. And the consequence of this performance will influence to the success of the project being taken. They applied Friedman test – a kind of non parameter test to rank the 12 factors. This research considered the role of the project manager as the core of the problem to impose the success of a project.

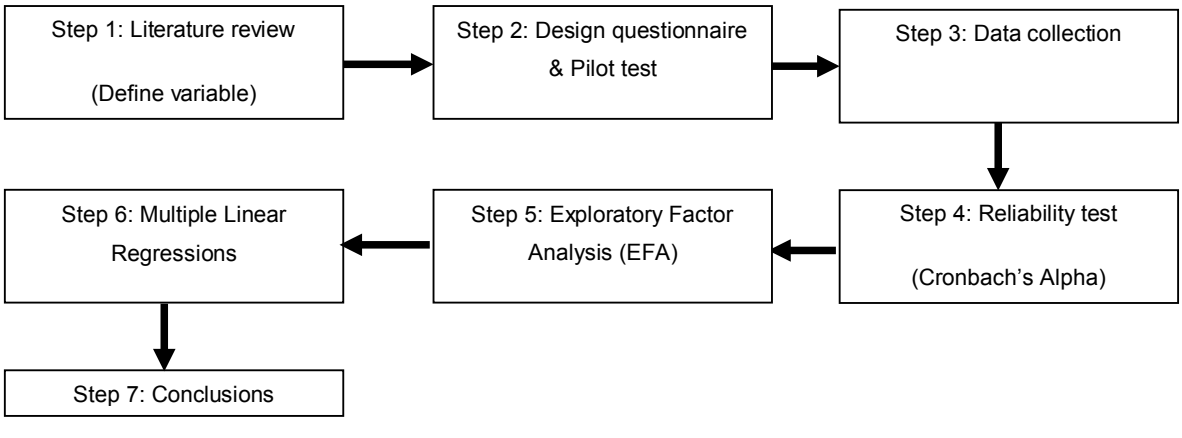
Masrom (2010) developed a model to measure the performance of construction projects. This research depicted two key elements to access the contractor satisfaction (Co-S) level of performance attributes. According to this research, the performance of construction projects is measured through two key components:

Direct attributes: they are performance attributes which consist of some elements such as participants' performance (service quality), project performance, business performance, and external factors.

Indirect attributes: they are also known as contractor characteristics that include some elements such as knowledge, size of the organization, experience and culture.

Research procedure

Figure 1. Research procedure



After doing literature review, pilot test and interviewing the five experts, 30 factors were taken into consideration for research. These factors were divided into eight groups: management, technology, human resource, communication, design, financial capability, material/ equipment, location.

Data collection

Data were collected in four cities/ provinces in which construction industry has been considered as the top development in Vietnam. There were 220 questionnaires sent out, however, there were only 155 feedbacks. After filtrating data carefully, there were 147 answers can be used to analyze. Data were described as follow:

Position of respondents: Among 147 items collected from this survey, there are nine top managers equivalent to 6.1% of the sample size, 46 functional/ project managers equivalent to 31.3% of the sample size, 62 engineers equivalent to 42.2% of the sample size and 30 other type of staffs equivalent to 20.4% of the sample size.

Experience of respondent: This survey includes 53 respondents who have less than five years experience equivalent to 36.1%, 49 respondents who have from five to 10 years experience equivalent to 33.3%, and 45 respondents who have more than 10 years experience equivalent to 30.6% of the sample size.

Type of related party: This survey includes 10 respondents who work for Owners equivalent to 6.8% of the sample size, 68 respondents who work for Designers/Consultants equivalent to 46.3% of the sample size, 68 respondents who work for Contractors equivalent to 46.3% of the sample size and one respondent who works for other type of related party equivalent to 0.7% of the sample size.

Scale of projects ever done by respondents: In this survey, there are 90 respondents who have carried out the projects from 1 million – 5 million USD equivalent to 61.2% of the sample size, 37 respondents who have carried out the projects from VND 5 million – 25 million USD equivalent to 25.2% of the sample size, and 20 respondents who have carried out the projects more than 5 million USD equivalent to 13.6% of the sample size.

Testing for measurement scale

After comparing means of collected factors, one factor of "*Communication*" group and three factors of "*Location*" group are deleted because their mean less than 3.6. The remaining seven groups including 26 factors will be tested next steps to evaluate the reliability and relevance of the measurement scale.

Correlation analysis was executed to find out the correlation between the variables within each factor group. Most of the correlation levels are higher than 0.3. According to Hair and Associates (1998), this result proves the relevance of the factor groups for the Factor Analysis next steps. That means all remaining 26 factors are strongly correlated to each other in a group.

Testing Cronbach's Alpha

Cronbach's Alpha (α) is computed by the following formula:

$$\alpha = \frac{k}{k-1} * \left[\frac{1 - \sum S_i^2}{S_t^2} \right] \quad (1)$$

In which:

k: number of individual items.

S_i^2: Variance of the variable k.

S_t^2: Variances of the sum of all items.

The result of Cronbach's Alpha factors are calculated by the software SPSS version 16.0 and shown in the Table 1

Table 1. Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Project management skill of contractors	16.65	4.559	0.619	0.397	0.806
Management capability of key staffs	16.6	4.598	0.59	0.399	0.814
Management capability of supervisors	16.95	4.312	0.681	0.492	0.789
Management capability of consultants	16.8	4.447	0.67	0.483	0.792
Management capability of Owners	17.01	4.404	0.618	0.411	0.807
New technology application of contractors	12.11	2.906	0.671	0.458	0.786
Technology improvement of contractors	12.17	2.813	0.706	0.518	0.77
Opportunity to approach new technology of contractors	12.35	2.778	0.714	0.517	0.766
Mechanization level of contractors	11.96	3.3	0.565	0.324	0.83
Recruitment and training policy of contractors	12.24	2.899	0.585	0.343	0.76
Education level of site management unit members	12.33	2.852	0.582	0.343	0.762
Worker skill	12.08	2.897	0.614	0.398	0.746
Promotion and incentive system of contractors	12.45	2.77	0.661	0.447	0.723
Communication plan of the site management unit	8.52	1.279	0.513	0.268	0.679
Ensuring accurate and timely communication	8.31	1.365	0.511	0.262	0.677
Way of handling communication	8.45	1.455	0.532	0.298	0.647
Quality of the design	8.49	1.457	0.709	0.524	0.717
Professional capability of designers	8.63	1.482	0.708	0.522	0.719
Changing in the design	8.99	1.555	0.609	0.371	0.818
Financial capability of contractors	8.41	1.929	0.663	0.448	0.773
Financial capability of Owners	8.24	1.857	0.714	0.509	0.725
Payment term of the construction contract	8.61	1.72	0.667	0.451	0.774
Material/equipment supply plan	11.77	3.535	0.643	0.45	0.754
Types of material/equipment indicated in the contract	12.18	3.288	0.672	0.491	0.734
Price fluctuation of Material/ equipment	12.09	3.095	0.618	0.409	0.764
Lead time of supplying Material/equipment	12.02	3.417	0.573	0.349	0.781

All Cronbach's Alpha if Item Deleted of the factors are larger than 0.6. In addition, the correlation of every item compared with the total correlation is larger than 0.5. Therefore, all factors will be maintained for next analysis.

Factor analysis

The result from SPSS software shows that KMO = 0.855 > 0.5 and the value Sig. < 0.05. According to Hair and Associates (2006), these factors are relevant for Factor Analysis.

Based on the result of Factor Analysis extracting from SPSS software, there is one item *"Education level of site management unit members"* that has the Communality value less than 0.5. So, this item will be deleted from the data set. And the remaining data set will include only 25 items.

Factor Analysis will be applied again with the remaining data set including 25 items to reduce the number of factors down to a reasonable amount. This time, the Factor Analysis result from SPSS software (Table 2) shows that KMO = 0.853 > 0.5, Sig. < 0.05 and Communalities of all items are more than 0.5.

Table 2. KMO and Bartlett's test (re-calculating with 25 factors)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.853
Bartlett's Test of Sphericity	Approx. Chi-Square	1765.096
	df	300
	Sig.	0

Multiple Linear Regressions

After applying Factor Analysis, the research model is reduced to 25 items. These items were grouped into: *Management, Resources of Contractor, Technology, Finance, Material/Equipment,* and *Design*.

Linear Multiple Regression will be applied to identify level of influence of each factor group on the performance of construction sites. In this research, the performance of construction sites is evaluated by the two dependent variables Cost and Time difference. The Ordinary Least Square (OLS) regression method is applied to analyze regression.

The factors influencing on the performance of construction site are filtrated and revised to six factor groups. These factor groups will be used as the input of Linear Multiple Regression model of SPSS by Enter method. The result of this Multiple Regression is shown as follows:

$$Y_1 = 19.313 + 1.093X_1 + 0.824X_2 + 0.913X_3 + 0.553X_4 + 1.008X_5 + 0.4X_6 \quad [2]$$

$$Y_2 = 1.871 + 1.608X_1 + 1.304X_2 + 1.319X_3 + 1.072X_4 + 1.283X_5 + 1.045X_6 \quad [3]$$

In which:

Y_1: Cost difference of construction sites.

Y_2: Time difference of construction sites.

X_1: Factors relating to management.

X_2: Factors relating to Resources of Contractor.

X_3: Factors relating to technology.

X_4: Factors relating to finance.

X_5: Factors relating to material/ equipment.

X_6: Factors relating to design.

Relevance testing for the regression model

The relevance of the research model will be evaluated by some methods such as computing R square, F – statistic test, t – statistic test.

Testing the relevance of the regression model by R square.

In the regression model, to explain the influence of factors on the cost and time difference, the R square is 0.301 and 0.762 respectively. This means that six independent variables in the model can explain 30.1% of the variance of the cost difference and 76.2% of the variance of the time difference.

Normally, in social economic research, R square can only explain around 25% of the variance of the dependent variable. So, the R square of this research can be considered rather high.

Testing utility of model

F – Statistic test is carried out by Analysis of Variance (ANOVA) to consider whether the research sample can be generalized for the whole population or not. Based on the ANOVA table of both regression model of Cost and Time difference, the Sig. are less than 0.001, so the hypothesis R square of population = 0 is rejected. Therefore, there is at least one independent variable influencing on the variance of the dependent variables.

Testing the assumption violations of linear regression

The Linear Regression has its statistic meaning when the assumptions are not violated.

Violation of linearity: in order to test this assumption, the Scatter Plot diagram with the Standardized Residuals on vertical axis and Standardized Predicted Value on the horizontal axis can be used. These are shown on the figures below:

Figure 2. Scatter Plot for Cost Difference Regression

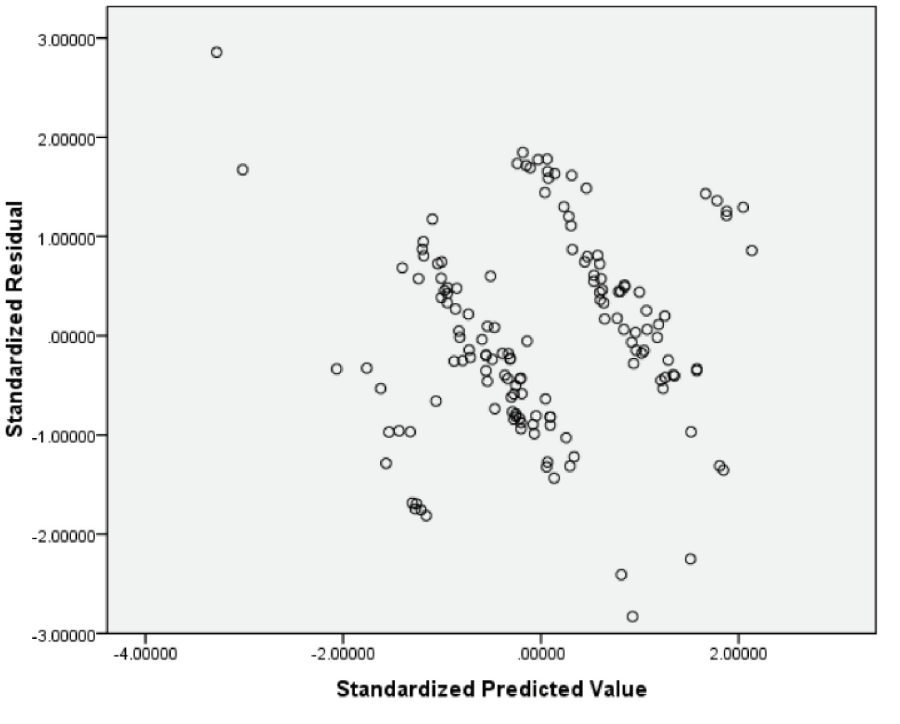
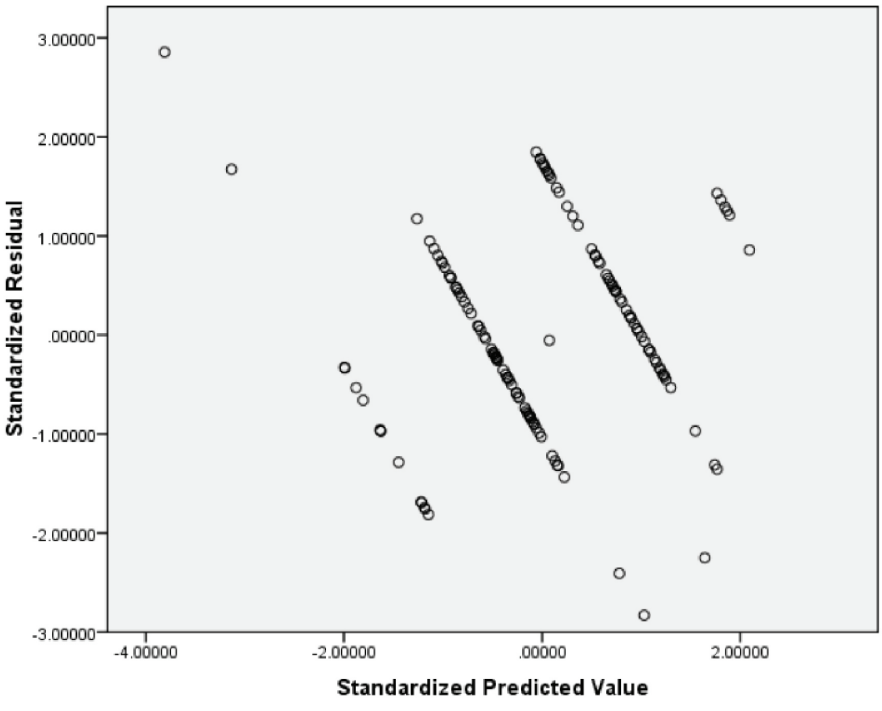


Figure 3. Scatter Plot for Time Difference Regression



The Residuals in both cases are randomly scattered on the diagram. So, the assumption about linearity is not violated.

Violation of constant variance of the errors: based on the Figure 2 and 3 above, the Standardized Residual and Standardized Predicted Value vary differently and randomly. So, this can be concluded that the assumption of constant variance of the errors is not violated.

Violation of independence of the error: to test this assumption, Durbin-Watson (d) value will be calculated. Normally, "d" value will vary from 0 to 4. If there is no serial correlation between Residuals, "d" value will be equivalent to 2. Durbin-Watson value calculated in case dependent variable is cost and dependent variable is time respectively is 1.822 and 2.056. So, it can be considered there is no violation of independence of the error.

Violation of collinearity: in both cases the dependent variable is cost and time, the Variance Inflation Factors are very small. Therefore, this assumption is not violated.

Conclusion

This research has developed and tested a model including 25 items remaining to be considered influencing on the performance of construction sites. These items are divided into 6 groups. They are ranked as following order *management, technology, resources of contractor, material/equipment, finance and design*. The contractors should allocate their limited resources on necessary fields so that they can improve the performance of their construction sites.

Recommendations

- *To improve management capacity*: This study once again confirms the critical role of management knowledge in implementing a construction project successfully. As we know, project management is a kind of team work. It needs a smooth operation of every related provision of every related organization. So, it requires the understanding and implementing by all related members at any levels in a company. It should be started from the highest top managers to the lowest management staffs of. And

this management knowledge even should be updated and upgraded continuously to catch up the development of management science.

- *To optimize limited resources of a contractor*: Resources of a contractor include difference kinds of assets in which, according to this study, the most valuable things are *Human Resource* and *Information*. In many situations, a contractor has to face with the difficulty of lacking of high quality workforce and valuable information. If they don't allocate their resources reasonably, they will cause a lot of waste in using their resources.

- *To invest strongly into technology*: The significant progress of science and technology has influence a lot on the productivity of every industry. Especially, the construction industry is usually deal with many kinds of challenging and complicated tasks. If contractors don't achieve a certain level of technology, it's impossible for them to carry out many jobs in construction works.

- *To maintain healthy financial condition by pushing cash flow turnover*: Operation of construction contractors depends a lot on their financial conditions. If they cannot keep their financial status healthy, they cannot keep their construction sites operated smoothly. In order to this, it requires a proper co-ordination between functional departments in a construction company. It requires a good operation of the project management team to deliver the bill of interim claim in time. Then the accounting department should carry out its job to push the payment under the contract conditions.

- *To prepare a good material supply plan and implement it strictly*: The construction sites cannot be operated without materials. However, it usually takes time for the contractors to prepare and deliver materials at the site. Normally, there is a procedure from catalogues, sample and specifications presentation for the clients and consultant to approve to ordering and delivery the materials at the site. Especially, it takes very long time if materials are imported from foreign countries. Therefore, the contractors need to prepare for the material supply plan very well to cope with any difficulty at the beginning of the project. Otherwise, it will influence extremely to the site progress.

- *To pay much attention to the design*: Obliviously, the design is the guideline for contractor to follow. However, in many circumstances, it makes a lot of trouble for the construction sites. This may happen because of many possible reasons. Usually, the designers are not the one who can understand clearly how an item being constructed at the site. So, their solutions may not be suitable for execution in the reality. It's the contractors who execute the tasks directly will know exactly which is the best option for a job. Thus, the contractors should review and suggest their solution if they can. So the progress of the construction sites will not be influenced by any possible revision of the design.

REFERENCES

[1] Alwi, S. (2003) "Factors influencing construction productivity in the Indonesian context", in: Proceeding of the 5th EASTS Conference, Fukuoka, 2003, Japan.

[2] Cao H. T. (2006), "Critical Success Factors in Project Management – An Analysis of Infrastructure projects in Viet Nam", School of Management, Bangkok, Thailand.

[3] Chan, A. and Chan, A. P. (2004), "Key performance indicators for measuring construction success", *Benchmarking*, *11*(2), pp. 203-221.

[4] Enshassi, A., Mohamed, S., Mustafa, Z. A., and Mayer, P. E. (2007), "Factors affecting labour productivity in building projects in the Gaza Strip", *Journal of Civil Engineering and Management*, 13(4).

[5] Goodrum, P. and Haas, C. (2002), "Partial factor productivity and equipment technology change at activity level in U.S. construction industry", *Journal of Construction Engineering and Management*, 128(6), pp. 463–472.

[6] Goodrum, P. and Haas, C. (2004), "The long – term impact of equipment technology on labour productivity in the U.S. construction industry at the activity level", *Journal of Construction Engineering and Management*. 131(1). pp. 124-133.

[7] Iyer, K.C. and Jha, K.N. (2005), "Factors affecting cost performance: evidence from Indian construction projects", *Int. Journal of Project Management*, 23(4), pp. 283-295.

[8] Makulsawatudom, A., Emsely. M., and Sinthawanarong, K. (2004), "Critical factors influencing construction productivity in Thailand", *Journal of KMITNB*, 14(3).

[9] Masrom, M. A. and Skitmore, M. (2010), "A new approach to assessing Malaysian contractor satisfaction levels", in: *Proceeding of the PM-05 Fifth scientific conference on project management, Crete, May 2010*, Greece: National technical university of Athens – Centre for construction innovation.

[10] Mojahed, S. (2005), "A project improvement system for effective management of construction projects", Published thesis (PhD), Louisiana State University, 155 pages.

[11] Nguyen A. T. (2007), Assessing variations of Cost and Time of Construction Projects by Neuron Network, Thesis (ME), HCM University of Technology, Vietnam.

[12] Nguyen T. M. T. (2009), "Critical Factors Varying Construction Cost", *Journal of Science and Technology Development*, Vol. 12, No. pp. 104-117, Vietnam.

[13] Razak, A., Jaafar, M., Abdullah, S., and Muhammad, S. (2009), "Work environment factors and job performance: The construction project manager's perspective", in: *International conference of construction industry 2009, Padang, August 2009,* Indonesia.

[14] Rojas, E. and Aramvareekul, P. (2003), "Labour productivity drivers and opportunities in the construction industry", *Journal of Management in Engineering*, 19(2), pp. 78-82.

[15] Saqib, M., Farooqui, F., and Lodi, H.S. (2008), "Assessment of critical success factors for construction projects in Pakistan", in: *First International Conference Construction in Developing Countries, Advancing and Integrating Construction Education, Research and Practice, ICCDIC, Karachi, August 2008,* Pakistan: Jointly organised by NED University of Engineering and Technology, Pakistan and Florida International University, USA.

[16] Tran V. T. (2007), Quantifying Risk of Cost of Construction Project by Bayes Belief Network (ANN), Thesis (ME), HCM University of Technology, Vietnam.