

Valuation of Benefits from the Adoption of Project Information Management System

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ABSTRACT: In the construction industry, IT has been an alternative for the enhancement of productivity and technical advances through a paradigm shift. While it has been recognized that the IT system will have a substantial influence on the industry, a quantitative valuation has been very limited. This paper has chosen EVMS (Earned Value Management System), which supports the integrated management of cost and schedule by utilizing IT tools, and which is the largest trend in the construction IT industry in Korea, in order to suggest an analysis model for the valuation of IT. The CVM (Contingent Valuation Method) is used to quantitatively measure intangible value of IT application. Then, a valuation and analysis model were suggested for the quantitative valuation of the effect of IT adoption. In terms of willingness to pay for EVMS, the expected benefits from the adoption of EVMS were US\$ 584.52 per man annually. This research should be helpful for construction companies evaluating their investment to Project Management Information System.

Keywords: Construction; Project Information Management System; Intangible Value; Contingent Valuation Method; Quantitative analysis

1. INTRODUCTION

New technology in information system is increasingly broadening its contribution to the effectiveness of the organization as a whole (Money et al. 1988). As a result, Information system may create not only tangible benefits but also intangible ones. A tangible benefit means one that directly improves the performance of the firm such as reducing costs, an improvement in profits. An intangible benefit is one that might improve the general circumstances in an organization, but will not directly lead to identifiable effects on the organization's bottom line (company accounts). The tangible benefit is easy to identify and to quantify its value. The intangible benefit, however, is difficult to quantify their financial value. Remenyi *et al.*, (2005) points out one of the major problems with IT benefit measurement and management is an intangible benefit. The traditional cost benefit approaches to evaluating effectiveness are now generally regarded as inadequate, especially when a holistic view of the firm is required (Remenyi, D. *et al.*, 2005). This paper

aims to suggest a more systematic approach to put a financial estimate to an intangible benefit of IT systems.

This paper utilizes CVM (Contingent Valuation Method), which is a method to measure intangible value, to provide a valuation and analysis model for measuring the intangible significance of IT adoption. CVM has been well recognized in measuring the value of goods and services with an unfixed market price. EVMS was chosen as a sample to be evaluated. EVMS, which provides an integrated management environment for construction projects, reflects the biggest IT trend in Korean construction industry recently.

2. CVM (Contingent Valuation Method)

For tangible goods and services, the fair market price is the value. For intangible assets or public goods (ex: patents, new technology, the environment), however, prices cannot be determined in the market. Therefore, special techniques are required to measure the value. There are several methods to measure intangible value such as the HPM (Hedonic Price Method), TCM (Travel

Cost Method), and CVM (Contingent Valuation Method). Of these, CVM has been in the widest use recently.

CVM is a method measuring willingness-to-pay (WTP) based on a hypothetical, not a real, market. In other words, contingent valuation is a survey-based economic technique for evaluating non-market resources through questionnaires, measuring WTP to protect the goods and the willingness to accept compensation for the loss of the resource. The questionnaires use various methods of elicitation for CVM such as open-ended / direct questions, payment cards, bidding games, dichotomous choices (take-it-or-leave-it offer), and so forth. However, CVM may lead to hypothetical bias. Because the willingness to pay / accept is asked directly through use of the questionnaire, there is a possibility of bias. Bias is the difference between the actual value and the answer on the questionnaire. When CVM is used, therefore, special attention should be paid to the design of the questionnaire to minimize possible bias.

The CVM was first suggested by Ciriacy-Wantrup (1947) and actively promoted by Davis (1963). Mitchell and Carson (1989) found that CVM is useful in encouraging WTP in environmental goods both theoretically and methodologically. In the U.S. the Water Resources Council (1979, 1983) published "Principles and Standards for Water and Related Land Resources Planning." This set forth the guidelines for federal participation in project evaluation, which specified that CVM was acceptable for use in determining project benefits. In 1986, the U.S. Department of State allowed CVM as a method to measure the benefits and losses of CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act, 1980, 1986). The most famous case in the use of CVM was the Exxon Valdez oil spill in Alaska. The CVM was used to estimate the economic damages of the oil spill. Although there was some controversy over the use of CVM, it was concluded to be the most reliable method to assess the damages. In fact, the Exxon Valdez oil spill put CVM in the spotlight. As a result, CVM has been widely used for assessing the value of non-market resources.

In Korea, CVM has been used in the Assessment of the Environmental Value of Cheongcho Lake (Park 2001), the Assessment of Benefits from the Adoption of the Express Subway (Ko 1999), and the Assessment of the Economic Value of the Cheonggyecheon (Stream) Restoration (Yoon 2004).

3. EVMS

EVMS is "a performance-based management system through criteria setting and the measurement of the progress of project cost, schedule, and goal (OMB: the Office of Management and Budget, 1997)." In other words, it is a management technique to estimate the rate of progress, profit & loss, and future business schedule & cost by analyzing the progress and cost input in light of the original plan based on process planning and management. Recently, a PIMS (Project Information Management System) which aims to support EVMS has been adopted in several public and private sectors

(especially in the construction sector) in Korea. This paper has investigated "K" corporation, as a case to assess the value of the IT system, which adopted EVMS as a PIMS.

4. DESIGN OF CONTINGENT VALUATION SCENARIO

4.1 Definition of Object Material to Measure

This paper presents the results of an investigation of the adoption of EVMS in Korea construction industry. Specifically, the investigation was conducted to assess the value of the intangible benefits resulting from the adoption of EVMS, such as improved quality of decision-making based on improved quality of information, data accessibility, improved decision-making capability of an individual, improved image of the company, etc. In order to make the target material in a hypothetical market clearly recognized, a questionnaire survey was conducted for the employees of "K" corporation, which in turn increased the reliability of the value assessment.

4.2 Design of the WTP Encouragement Method and the Price

In terms of the method for encouraging the willingness-to-pay, a take-it-or-leave-it offer was used. Under this method, a respondent was asked to answer only "YES" or "NO" for the randomly suggested price. In this way, the bias which is found in open-ended questions or bidding games can be overcome (Cameron 1994). In order to implement the take-it-or-leave-it method, an initial bid price should be set. Therefore, a questionnaire survey was administered to the primary professionals through open-ended questions. Based on the result, then, the amount at 20%, 40%, 60%, and 80% in a cumulative distribution of WTP as shown in Table 1 was set as the bid price for the 2nd questionnaire survey.

Table 1. Design of Bid Price

Cumulative Distribution	Bid Price
20%	US\$ 10.47
40%	US\$ 20.93
60%	US\$ 41.86
80%	US\$ 104.66

Note : (US\$ 1 = ₩ 955.51(KRW) , Average exchange rate in 2006)

4.3 Structure of Questionnaire

In order to acquire the data needed for this study, the questionnaire included general information, how much they are interested in project management techniques, how much awareness of EVMS is, how much EVMS contributed when adopted, the advantages and disadvantages of EVMS, and WTP. General information on EVMS and a full description of WTP were added for a better understanding on the part of the respondent.

4.4 Revision of Questionnaire

In order to remove the bias from CVM, the questionnaire was revised with easy words and simple

structure on the advice of an expert. Furthermore, by accepting the feedback from the 1st questionnaire for the professional group, the result was reviewed and the bid price was analyzed. The price was set as the bid price of this questionnaire.

5. ANALYSIS OF RESPONDENT AND WTP

For the study, the population and sample were chosen from the employees of “K” corporation. The profile of the sample is designed to reflect the profile of the population in terms of job roles. A total of 140 questionnaires were distributed and one hundred surveys (71.4%) were returned. The questionnaire was distributed via the intranet of “K” and collected through e-mail. If any questions about the questionnaire arose, they were explained by telephone or e-mail. The 1st questionnaire survey was performed from Jan. 15 through Jan. 22, 2006 (8 days) and the 2nd survey was conducted from Feb. 1 through Feb. 13 (2 weeks).

The response on WTP can be affected by a person’s position and responsibilities in the company. Therefore, each respondent’s personal information was investigated before empirical analysis. In terms of distribution by job title, assistant managers (30%) and section chiefs (39%) were the highest in the sample, followed by deputy general managers, staff, general managers, and branch office managers (Table 2).

Table 2. Characteristics of Respondent

Job Title	Frequency	Percentage	Cumulative Percentage
Staff	8	8.0	8.0
Assistant Manager	30	30.0	38.0
Section Chief	39	39.0	77.0
Deputy General Manager	16	16.0	93.0
General Manager	6	6.0	99.0
Branch Office Manager	1	1.0	100.0
Total	100	100.0	

For the question ‘Are you willing to pay for the intangible benefits from EVMS application?’, 88 respondents (88%) said ‘yes’ and 12 persons (12%) responded ‘no’ (Table 3).

Table 3. Are you willing to pay?

Response	Frequency	Percentage	Cumulative Percentage
No	12	12.0	12.0
Yes	88	88.0	100.0
Total	100	100.0	

For the question ‘How sure are you that you are willing to pay?’ 94.3% (6.8%: definitely; 46.6%: certainly; 40.9%: likely) responded that they were willing to pay (Table 4). This result is very reliable in terms of WTP.

Table 4. How sure are you that you are willing to pay?

Response	Frequency	Percentage	Cumulative Percentage
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Definitely	6	6.8	6.8
Certainly	41	46.6	53.4
Likely	36	40.9	94.3
Uncertain	5	5.7	100.0
Total	88	100.0	-

For the question ‘Why aren’t you willing to pay?’ 10 respondents (83.3%) said ‘the company will pay’ (Table 5). It seems that even though EVMS is likely to help company business, projects, and individual work, most employees think that the company should be responsible for the related costs. Even though efforts were made to clarify the questions on the questionnaire, some employees were not fully able to understand the virtual market. They thought that the company not employee should pay for the intangible benefits resulting from the application of information system. It was found that it is important to make respondents understand that WTP is not a personal expenditure but a personal assessment of value.

Table 5. Reasons for Unwillingness to Pay

Response	Frequency	Percentage	Cumulative Percentage
Not worth it	1	8.3	8.3
EVMS is not reliable	1	8.3	16.6
The company should be responsible	10	83.4	100.0
Total	12	100.0	-

6. ANALYSIS OF RESULTS

The respondents were questioned about how much interest they have in project management technique and how informed they are concerning EVMS and its contribution to the company, projects, and individual work.

6.1 Interest in Project Management Technique

According to the survey on how much interest respondents have in project management techniques, 87% (24%: somewhat) responded that they are interested in it (Fig. 1).

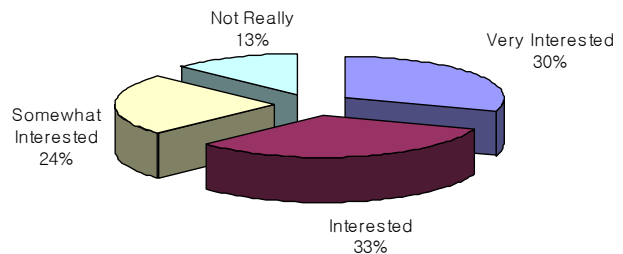


Fig. 1. Interest in Project Management Techniques

6.2 Awareness of EVMS

For the question ‘How aware are you of EVMS?’, almost all respondents (97%) reported having an awareness of EVMS. Most respondents (80%) had some knowledge about EVMS (Fig. 2). It can be said, then, that

the respondents were well aware of EVMS. This was, therefore, a good subject for the survey.

6.3 Contribution and Efficiency of EVMS

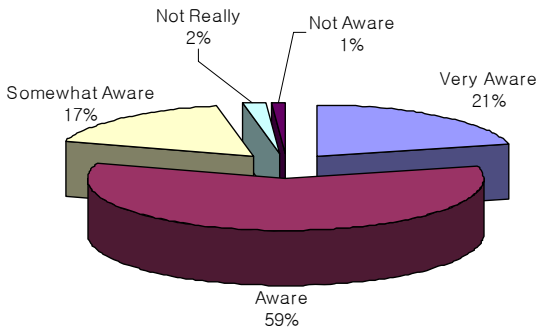


Fig. 2. Awareness of EVMS

When the contribution of EVMS is categorized into company, project management, and individual work, it turns out to be high for company and project management. Eighty-six point seven percent (very helpful: 29.6%; helpful: 57.1%) responded that EVMS is helpful for the company while 88.8% (very helpful: 27.6%; helpful: 61.2%) said that EVMS is helpful in project management. Therefore, in terms of the contribution of EVMS, project management (88.8%) was the highest, followed by company (86.7%) and individual work (59.2%) (Fig. 3).

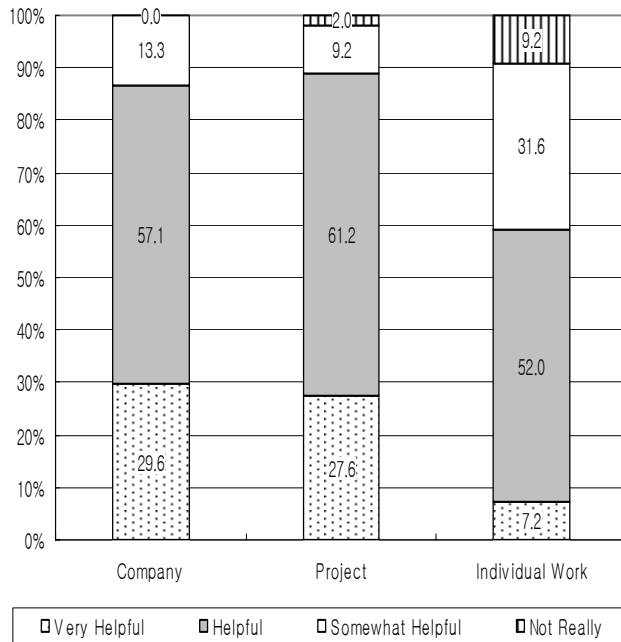


Fig. 3. Contribution of EVMS

6.4 Willingness to Pay

In order to identify the quantitative amount each employee estimate on the value of the intangible benefits resulting from the adoption of EVMS, the respondents were questioned about “Are you willing to pay for the

adoption of EVMS and how much are you willing to pay (WTP) monthly for the intangible benefits?”. In terms of WTP, a slight difference was found between the mean value (US\$ 73.85) and the adjusted mean which trimmed off 5% from the bottom and 5% from the top (US\$ 48.71). The problem with the mean as a measure of central tendency is that it can be greatly influenced by a few extreme values. One very large value can make the mean much larger than it would be if that value were excluded, and similarly for an extremely small value. One way around this problem is to exclude very large and very small values before calculating a mean. The resulting measure of central tendency is called a trimmed mean. To calculate a 5% trimmed mean, we exclude the largest 5% and the smallest 5% the values and calculate the mean of the remaining values. In general, for an x% trimmed mean we exclude the smallest x% and the largest x% of the values and calculate the mean of remaining (100 - 2x)% of the values. Typical values for the percent x excluded from each end are integers from 1 to 15 (Rasmussen 1992). In order to get reliable a WTP, therefore, US\$ 48.71 was chosen, excluding the extremes. The adjusted mean does not greatly differ from the median (US\$ 41.86) (Table 6).

Table 6. Monthly WTP to intangible benefits from EVMS

Statistical Measures		Amount
	Mean	US\$ 73.85
95%	Lower Boundary	US\$ 41.02
Confidence Interval	Upper Boundary	US\$ 106.69
	5% Adjusted Mean	US\$ 48.71
	Median	US\$ 41.86
	Variance	US\$ 24,016.73
	Standard Deviation	US\$ 154.97
	Min.	US\$ 10.47
	Max.	US\$ 1,046.56

Assessing the value of the benefits resulting from the adoption of the EVMS is based on the monthly and personal benefits. Annual company wide value of the adoption of EVMS is as follows. Considering the 550 employees of “K” corporation, the annual value of EVMS can be calculated as US\$ 48.71 x 12 (months) x 550 (persons) = US\$ 321,486. The amount is the annual value of the intangible benefit from the application of EVMS.

That is to say that due to the adoption of EVMS, value of intangible benefits is US\$ 321,486 annually. Therefore, the benefit factor, which has been immeasurable in monetary values, can now be considered as a factor of economic benefit.

7. CONCLUSION

In order to estimate the value of intangible benefits from IT application (EVMS), this study used CVM, which has been utilized in the valuation of environmental

resources, and investigated the WTP for Korean construction companies in which an EVMS-based construction management system is implemented. This study has aimed to determine the value of the expected intangible benefit from EVMS implementation. As a result, it has aimed to make the benefits quantifiable in monetary terms by analyzing the correlation between a respondent's features and WTP. Therefore, the significance of this paper is that the indirect benefits occurring from the adoption of EVMS have been quantified.

Respondents already had some basic knowledge of EVMS. Out of the total respondents, 88% showed a willingness to pay. 94% of those were sure of their willingness-to-pay. Therefore, WTP was reliable. In terms of the contribution to the company and project, 86.7% positively responded. In terms of the contribution to individual work, however, the result turned out relatively low because the workload increased at the early stage that the system was implemented. When analyzed by statistical analysis, the value of EVMS turned out to be US\$ 48.71 per man-month. The value of intangible benefits of EVMS per man turned out to be US\$ 584.52 / year. Lessons learned are the evaluator should be aware that the point in time in which the value of IT application is assessed can have an influence on the value of WTP and it is important to have respondents understand that WTP is not a personal expenditure but a personal assessment of value.

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