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A Study on BIM Performance Assessment Framework for Architecture Firm

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Abstract. Design phase, where the key decisions are made, creates the greatest value through BIM adoption. However, utilization of Building Information Modeling (BIM) is still at the initial level, despite the aggressive movement for adopting it. The main reason for this is the failure to realize BIM benefit and investment profitability. To allow the creation of value and competitiveness in architecture firm by utilizing BIM, this study suggests IT BSC (Balanced Scorecard)-based BIM performance assessment framework, which could measure and evaluate BIM performance in realistic and systematic perspective.

Keywords: Building Information Modeling (BIM), BIM Performance, Performance Management System (PMS), Balanced Scorecard (BSC)

1 Introduction

In many countries including the UK, Singapore and Korea, governments have announced the mandates to implement BIM in public construction projects to achieve greater work productivity and quality. However, utilization of BIM is still in initial level, and BIM tends to be perceived as a visualization tool. In this situation, where BIM adoption is compulsory but its benefit is unclear [1], management of BIM performance provides the maximization of investment effect and the contribution of right decision-making [2]. Expanding upon previous research [3] conducted by authors, this paper focuses on BIM performance index to evaluate BIM benefit in design phase, where key decision and the greatest value could be created by BIM. The purpose of this study is to develop BIM performance assessment framework, which provides the reliable information by visualizing BIM performance and status of firm.

2 BIM Performance and Measurement System

BIM performance, as an IT investment of architecture firm, has the similar characteristics to the IT investment performance. IT investment performance means the value of the overall behaviors and relationships based on IT, from ensuring competitiveness to level of connection between business strategy and each corporate

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activities [4]. In this paper, BIM performance is defined as the financial, non-financial, quantitative and qualitative effect made by utilizing BIM, which substantially contributes to achieve the corporate goal [3].

BIM performance assessment systems have mainly been developed in US, Australia and Netherland. As measurement system at project level, NBIMS ICMM [5] and bimSCORE [6] have been developed. In addition, BIM QuickScan [7] and BIm3 [8] have been developed as measurement system at organizational level. These systems show the following characteristics: 1) Ambiguity of measurement criteria; 2) Limitation on integrated measurement of financial and non-financial value; 3) Limitation on measurement in practice. The multilateral and macroscopic assessment about BIM performance in the corporate level is considered as necessary in the situation of lacking of the system for assessing various value from utilizing BIM.

3 Development of BIM Performance Assessment Framework

This study has utilized the result of preceding research [3], which suggests the IT BSC (Balanced Scorecard)1-based BIM performance assessment model. It is based on BIM guides, related researches, opinions of BIM practitioners and statistical verification using linear regression. The 4 Perspectives and 16 Critical Success Factors (CSF) have been set as a model of BIM performance assessment framework.

3.1 Establishment of Key Performance Indicators of BIM

This study has developed 22 Key Performance Indicators (KPI) under the assessment model, as indexes to assess BIM performance. These are shown in Table 1. To develop measurable, valid and comparable indicators, research has been conducted in three steps. First, preliminary KPIs have been extracted from researches which are related to BIM performance measurement and management. Second, final indicators have been selected according to the result analysis of three advisory councils with five BIM experts who have more than 10-year experience. Third, qualitative and quantitative measurement methods of each indicators on 4 Perspectives have been suggested by reflecting the extracted issues of prior chapter. The qualitative BIM performance is designed to be measured using the 5-point Likert scale.

3.2 Verification of BIM Performance Assessment Framework

The case application has been conducted to verify the suggested 22 KPIs in following aspects: 1) Measurability; 2) Comparability of measured results; 3) Possibility of description on status of firm.

2014's BIM performances of three architecture firms, a large architecture firm(Firm A), a mid-sized architecture firm(Firm B) and a small & medium-sized architecture firm(Firm C), have been measured by suggested KPIs, and the results are

[1] IT BSC is Multi-Criteria approach of IT investment performance management system. IT BSC is a reorganized model of BSC to reflect the characteristics of the IT organization.

shown in Table 2. The establishment level of BIM work environment, the BIM support level in enterprise aspect and the capability of BIM utilization of three architecture firms have been appropriately measured. It is confirmed that most of the KPIs are measurable, and that the BIM performance according to the size and characteristic of design firm can be represented by KPIs. BIM performance of three design firms can be compared based on the quantified value deducted by objective criteria. In addition, "C201" and "F401", which are only measured in Firm A, have been turned out that serve the role of performance driver.

Table 1. Developed BIM performance assessment framework.

Perspective	CSF	KPI	
		Contents	Measurement Method
Corporate Contribution	C1. Business Contribution	C101. Rate of Sales of BIM project	Total sales of BIM project/Total sales of firm (%)
	C2. Productivity Improvement	C201. Improved rate of BIM project's schedule compliance	Average of compliance of BIM project's schedule over the previous year (%)
	C3. Synergy Effect	C301. Marketing effectiveness	The number of BIM reward results in the year
		C302. BIM contribution	Outsourcing cost/Total cost of BIM project (%)
Operational Excellence	O1. BIM Plan	O101. BIM execution plan	5-point Likert scale
	O2. BIM-based Work Process	O201. Utilization level of BIM	5-point Likert scale
		O202. BIM-based design process	5-point Likert scale
	O3. BIM Supporting Organization	O301. BIM supporting organization	5-point Likert scale
	O4. BIM Resource	O401. BIM S/W retention level	Number of copy of BIM S/W/Number of people in BIM organization (%)
		O402. BIM H/W retention level	Number of BIM H/W/Number of people in BIM organization (%)
	O5. BIM Collaboration	O501. BIM collaboration system	5-point Likert scale
		O502. Data compatibility	5-point Likert scale
	O6. BIM Information	O601. BIM information framework	5-point Likert scale
		O602. BIM library Management	5-point Likert scale
User Orientation	U1. BIM Quality	U101. Quality assurance rate of BIM	Number of qualified BIM project/Total number of BIM project (%)
	U2. Owner's Satisfaction	U201. Satisfaction of owner	5-point Likert scale
	U3. BIM User's Satisfaction	U301. Satisfaction of BIM User	5-point Likert scale
Future Orientation	F1. BIM Education	F101. BIM education program	5-point Likert scale
	F2. BIM User's Capability	F201. BIM manager's capability	5-point Likert scale
		F202. Proficiency of BIM User	5-point Likert scale
	F3. BIM Knowledge	F301. BIM knowledge management system	5-point Likert scale
	F4. BIM R&D	F401. BIM R&D budget	The budget of BIM R&D/The total budget of technology investment (%)

Table 2. Measured BIM performance of 3 firms by BIM performance assessment framework.

KPI	C 101	C 201	C 301	O 101	O 201	O 202	O 301	O 302	O 401	O 402	O 501	O 502	O 601	O 602	U 101	U 201	U 301	F 101	F 201	F 202	F 301	F 401
Firm A	9.8	120	1	4	3	3	4	3.5	295	434	3	2	4	4	100	4.1	3.6	4.1	2.1	3.9	3	1.25
Firm B	4.51	-	0	4	4	3	4	1.1	5000	25	3	2	1	1	100	3.2	3.1	3.4	3.2	3.5	2	-
Firm C	5.4	-	0	2	2	3	3	0.4	9.5	9.5	3	3	1	1	100	4.3	3.8	3.6	3.8	4.3	2	-

4 Conclusion

To solve the problem of reduced productivity, the adoption of BIM on public project and the interest on BIM have gradually been increasing in construction industry. However, BIM utilization is still in initial level, and only a few BIM users create the positive ROI from BIM project. This study suggests the BIM performance assessment framework, as a basic research on BIM performance management system in order to provide better value by utilizing BIM, and accurate information and prediction of corporation. Expanding previous research, this study developed the KPIs for assessing BIM performance and verified its validity. BIM performance of design phase, where key decision of project is made, has been firstly focused in this study. Future study would be conducted to develop BIM performance management system across the whole construction project phase.

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