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A STUDY ON INTANGIBLE ASSET EVALUATION MODELING FOR CONSTRUCTION MANAGEMENT EFFICIENCY

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ABSTRACT: With overall opening of global construction market by World Trade Organization (WTO) agreements, importance of management efficiency of construction industry which considers both tangible and intangible assets is recently being recognized in our nation. That is, efforts for reinforcement of competitiveness must be placed through maximization of values of internal and external intangible assets of construction industry such as management innovation, information, investment in technology and R&D and intellectual property. Accordingly in this study, evaluation criteria for intangible assets of construction industry were investigated and classified. Using such criteria, evaluation index and model were established based on the degree of importance of each criterion. The purpose of this study is to review importance of intangible assets in terms of competitiveness and management efficiency of construction industry and to provide basic data for establishment of intangible assets and revitalization of investment.

Keywords: Construction management, intangible asset, corporate value, evaluation index, evaluation model

1. INTRODUCTION

With national financial crisis and dullness of domestic economy, Korean construction market is experience a huge difficulty with continued deterioration of management status. Corporations that showed external growth through low price orders and reckless expansion without consideration on profitability are falling behind the changes in domestic and international conditions and environment, adding to the difficulty. Efforts must be placed to reinforce the competitiveness of such construction companies through maximized internal and external intangible asset values such as management innovation, information, investment in technology and R&D and intellectual property by breaking away from quantitative growth. Creation of competitive advantage using intangible assets operates as a more important factor for corporations in the present because our society has moved from industrial era to knowledge and information society. The weight of importance of intangible assets in growth of construction companies is expected to show continued growth. Such intangible assets can be defined and classified using intangible factors that create added values within the value chain of corporations, and intangible assets have not yet been accurately measured and managed compared to importance due to the difficulty and abstraction of measurement and evaluation.

Accordingly, the purpose of this study is to review importance of intangible assets in terms of competitiveness and management efficiency of construction industry and to provide basic data for establishment of intangible assets and revitalization of investment. Evaluation index and model for intangible assets will be constructed through classification of evaluation criteria internalized throughout the construction industry.

This study first approached recognition on the value of intangible assets for management efficiency of domestic construction companies and performed theoretical discussion on definition, classification and method of measuring the value of intangible assets. Survey was conducted on construction management experts to deduce the degree of importance for each criterion and provide evaluation criteria, quantitative evaluation procedure and evaluation model.

First, intangible asset evaluation criteria were classified and selected through domestic and international literature review and expert brainstorming, and existing evaluation methods were examined.

Second, interviews and survey were conducted on construction and management experts to evaluate the degree of importance of intangible asset evaluation

criteria and to test feasibility of analysis by measuring reliability.

Third, intangible asset evaluation index and model were constructed for management efficiency evaluation of construction industry.

Overall flow of this study is as shown in Fig. 1.

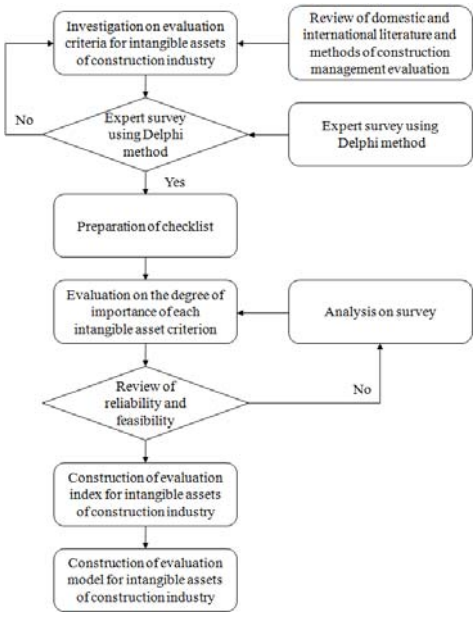

Fig. 1. Study Flowchart

2. THEORETICAL CONSIDERATION OF INTANGIBLE ASSET

2.1 Definition of Intangible Asset and Necessity of Measurement

Corporate assets can be divided based on resource into tangible and intangible assets. While tangible assets have actual form and thus can be measured, intangible assets do not have physical forms and cause extreme difficulty in measurement. However, studies on intangible assets are being conducted from various sides because intangible assets are expected to have possibility for creation of profit in the future (Hyun, Joon-Sik, 2002). Also, tangible assets accompany risks of piracy by competitors through relatively easy imitation, but intangible assets can continuously produce competitiveness of corresponding corporation because they cannot easily be copied (Robert et al, 2004).

Corporate Accounting Standards currently defines intangible assets as 'a non-monetary asset without physical body that can be distinguished', and such definition was referred from definition on intangible assets of Clause 38 of International Accounting Standards that an intangible asset is 'a non-monetary asset without actual physical body that can be controlled as a result of past transactions and is expected to bring economic profit in the future (IAS 38.8)'. Though such definition reflects the flow of change from hardware based era to software based era, limitations of evaluating intangible assets only through traditional accounting methods are appearing with deepening of price difference in market and accounting. For example, the main intangible asset of construction companies would be the ability to perform complicated projects, but evaluation method that only reflects accounting factors grants values to assets that definitely show contribution to corporate projects, leading to failure in sufficiently considering diverse intangible assets.

Moreover, the size of intangible assets of top 100 domestic corporations listed in KOSPI was recently compared to that of global corporations (top 100 of S&P) and was found to be 3.2% (Seoul Economy 2008), suggesting the necessity for domestic corporations to actively invest in intangible assets to increase the value of brand and image. Subjective measurement of intangible assets can provide an upright direction also in management of intangible assets after investment and allow easy and accurate understanding on competitive power of each corporation. In addition, measurement of intangible assets is related to evaluation of how deeply corporate strategies are connected with its assets. In other words, if corporate strategies are closely linked with intangible assets, investment of capital in intangible assets will directly lead to profit. If they are not related or there is a problem in strategy, the corporation will fail to create profit (Robert et al, 2004). Based on such study, evaluation results on intangible assets can be used to concentrate the investment on fields linked to profit and maximize expectation effects of intangible assets. As such, values and decision making of corporations are increasingly being evaluated and decided using intangible assets instead of tangible assets.

2.2 Existing Measurement Method and Problems

Evaluation methods for intangible assets include indirect evaluation method and direct evaluation method. Indirect method is the accounting method mentioned above used to evaluate assets of a corporation using financial statements and examples include excess asset return rate method, capital market premium approach and real option model. On the other hand, direct evaluation method is based on evaluation of non-financial elements of a corporation and examples include balanced scorecard (called BSC hereafter), Skandia Navigator Model and intangible assets monitor (called IAM hereafter) (Son, Young-Chan, 2002). This study aims to devise an evaluation model using direct evaluation method for intangible assets of construction companies.

The three direct evaluation methods above have similar structures, though classifications of intangible assets are slightly different. First, BSC is an evaluation method was designed by Dr. Norton from a consulting company Renaissance Solution and Professor Kaplan at Harvard University for the purpose of work evaluation in the short term and corporate survival in the long term. BSC classified intangible assets largely into financial perspective, customer perspective, internal process perspective and learning and growth perspective. Skandia Navigator was designed by Lief Edcinsson at insurance and financial company Skandia AFS based on BSC to systematically manage non-financial information within a group. Intangible assets were classified into financial, customers, process, renewal and development, and human

foci. Lastly, IAM was designed by Professor Sveiby at University of Queensland of Australia by classifying intangible assets into external structure, internal structure and employee competence. This method is most appropriate for the objective of measuring intangible assets because financial perspective was entirely excluded.

Christopher et al. (2008) provided problems that may occur during evaluation of intangible assets using existing direct evaluation methods in their study on the course of evaluation methods and problems of accomplishment index for intangible assets. First, most of evaluation methods do not focus on corporate strategy of a specific field. While corporations must select an evaluation method after finding the cause and effect relationship of which factors are directly linked with profit, simple application of general evaluation systems like BSC may bring problems of insufficient reflection of corporate characteristics. Second, there may be difficulty in finding the evaluation criteria that allow production of long term profit. Though hypothesis must first be formulated and then tested in order to examine the relationship between criteria, many officials devise a method based on their own experiences and prejudice, preventing accurate evaluation on intangible assets. Last, measurement methods themselves may not be able to demonstrate reliability and feasibility due to insufficient accuracy. Making use of a simple 5 point scale for convenience of evaluation results in failure to guarantee reliability and feasibility. Also, problems occur when the subject of measurement is ambiguous or measurement methods between departments do not accord. In response to such problems, the objective of this study is to design an intangible asset evaluation method which reflects characteristics of construction industry and opinions of actual construction managers.

No intangible asset evaluation method is effective at all situations. In other words, it is necessary to use multilateral evaluation methods especially designed for each field, and necessity of study on intangible assets is being emphasized further by higher rate of return for stocks of corporations that make use of diverse evaluation methods (Christopher, 2003). With the need to specialize evaluation methods according to the industry of use, construction industry must also conduct studies on evaluation methods of intangible assets for efficient corporate management.

2.3 Investigation on Current Status and Recognition of Intangible Assets

Prior to this study, a survey was conducted for investigation on current status and recognition of intangible assets at construction companies. Most of respondents showed positive attitude towards establishment of intangible assets by construction companies (positive: 42%, very positive: 16%) and domestic and international utilization of data on intangible assets (positive: 58%, very positive: 4%). They also answered that the influence of intangible assets on efficient corporate management is large (large: 73%, very large: 4%). However in contrast to such positive recognition by respondents, construction companies showed noncommittal attitude towards creation of intangible assets (neutral: 50%, negative: 12%). Through this investigation, urgent need of studies on intangible studies was examined. Fig. 2 shows the response for each question.

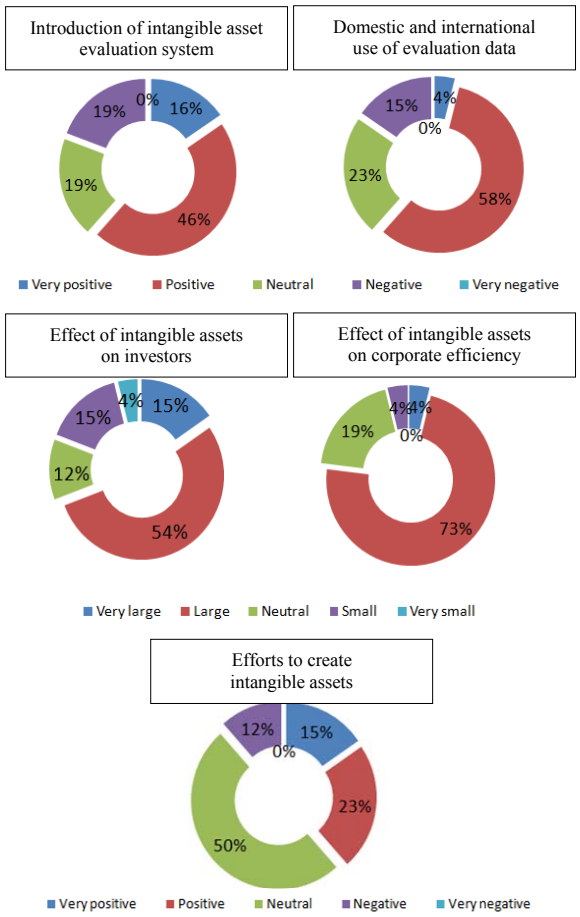

Fig. 2. Investigation on Status of Intangible Asset

3. INTANGIBLE ASSET EVALUATION MODELING

With change of modern society from industrial society to information society, importance of intangible assets is increasing. In order to use a direct method of evaluating intangible assets of construction companies, evaluation criteria in this study were deduced based on criteria extracted from existing studies and corporations. Analytic hierarchy process (called AHP hereafter) was used to compute weighted values of evaluation criteria and such values were used to create an evaluation model for intangible assets. AHP is a method of computing the degree of importance of each alternative by dividing the objective values into a hierarchical system. AHP is based on one on one comparison instead of absolute evaluation, allows consideration of both qualitative and quantitative elements, and can infer consistency of evaluation.

3.1 Deduction of Evaluation Criteria

In deduction of evaluation criteria for intangible assets, existing studies and literature were primarily examined to apply them in evaluation. Brainstorming of 10 experts in

construction industry was secondarily conducted to modify and supplement the criteria selected above. Then,

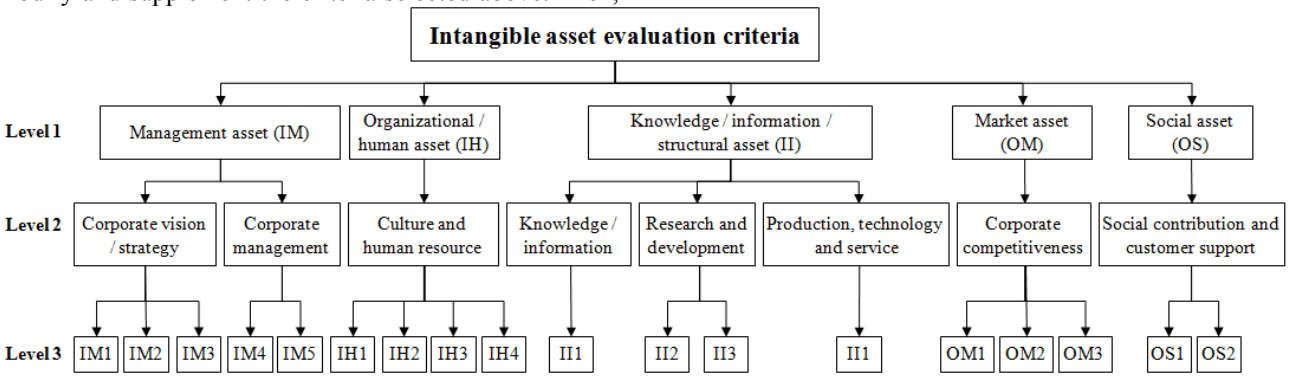

Fig. 3. Hierarchy Diagram for Evaluation of Intangible Assets

evaluation criteria were coded into each field. Fig. 3 is the hierarchy diagram for evaluation criteria of intangible assets. Primary criteria were classified by 1) management asset, 2) organizational / human asset, 3) knowledge / information / structural asset, 4) market asset and 5) social asset. Also, secondary criteria were classified into 8 types including corporate vision / strategy and corporate management for management asset, knowledge / information, R&D, and production, technology and service. Tertiary criteria were coded into 18 detailed items. Table 1 is the list of criteria and details for each code.

3.2 Evaluation on the Degree of Importance

3.2.1 Survey Outline

Survey was conducted in this study to reflect opinions of experts on the degree of importance of evaluation criteria. The survey was composed of questions asking for the degree of importance of each intangible asset criterion, and subjects of survey were selected from managers, investors and financial personnel who are currently participating in management of a construction company. Due to the complexity of AHP survey method, the purpose and course of study was briefly explained through e-mail and survey was conducted through visitation. The number of final respondents was 73.

Table 1. Detailed Intangible Assets for Each Code

Classification	Code	Tertiary Criteria	Details
Corporate vision / strategy	IM1	Future value of corporate vision	□Mid to long term vision and slogan for stepwise creation □Vision for laborers, society and national community
	IM2	Quality of corporate strategy	□Possibility of success for plans and strategies
Corporate management	IM3	Management experience and reliability	□Company history, image and career of managers
	IM4	Leadership of the CEO	□Efforts for rational vision and execution □Leadership for concentration of capabilities and management
	IM5	Utilization of knowledge management	□Knowledge leadership, sharing, strategy and information
Culture and human resource	IH1	Labor welfare environment	□Labor and welfare conditions
	IH2	Knowledge and experience of members	□Employee competence and creativity
	IH3	Education/training programs for cultivation of human resource	□Education/training programs
	IH4	Group technique and teamwork	□Cooperation and community techniques
Knowledge / information	II1	Database and information system	□Construction and use of information system
R&D	II2	Leadership and investment in R&D	□Technological support and investment
	II3	New products and technologies	□Copyright, patent, trademark and design
Production, technology and service	II4	Infrastructure for production, work and service	□Production capability, work and service environment
Competitive-ness	OM1	Brand value and competitiveness	□Brand recognition, loyalty and quality of goods and services
	OM2	Global competitiveness	□International investment, entry and accomplishments
	OM3	Marketing/promotion competitiveness	□Promotion and marketing of domestic projects
Social contribution and customer support	OS1	Social, environmental and welfare policies	□Social contribution and environmental investment
	OS2	Customer satisfaction system	□Customer support for service satisfaction

Geometric mean and weighted arithmetic mean are methods that can be used to summate opinions of many, and geometric mean was used in this study. Expert Choice 11.5 was used to analyze the survey.

3.2.2 Consistency Test for Each Criterion

AHP technique can compute the ratio of inconsistency to review logical consistency. Ratio of inconsistency is the value calculated by dividing inconsistency index by the probability index that corresponds to the size of array N. If the value of inconsistency ratio is close to 0, data is considered to be consistent. Values of 0.1 or below are seen as consistent and values of 0.2 or below are accepted, but anything higher is determined to have low reliability. In this study, survey responses with inconsistency ratio of 0.1 or above were excluded before analysis. Inconsistence ratio for each classification is shown in Table 2.

Table 2. Test of Consistency for Each Hierarchical Element

Classification		IR	Right or False
Primary class		0.03	Right
Secondary class	IM	0	Right
	II	0.00438	Right
Tertiary class	Vision / strategy	0	Right
	Management	0.01	Right
	Human resource	0.02	Right
	R&D	0	Right
	Competitiveness	0.00708	Right
	Social contribution / customer support	0	Right

3.2.3 Weighted Value Analysis on Each Criterion

Weighted values from pair wise comparison of primary criteria such as management asset, organizational / human asset, knowledge / information / structural asset, market asset and social asset are shown in Fig. 4. IM (management asset) and IH (organizational / human asset) were found to be important with weighted values of 0.32 and 0.267, IM being most important. In contrast, OM (market asset) was selected as an unimportant factor with weighted value of 0.112. OS (social asset) was determined to be most unimportant. Such results suggest

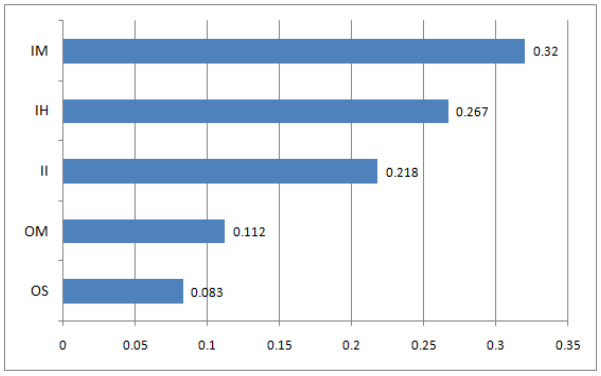

Fig. 4. Weighted Values of Primary Criteria

that corporations consider internal assets like management and organizational / human assets to be more important than external assets like market and social assets.

Weighted values for secondary and tertiary criteria are shown in Table 3. Looking at the weighted values of secondary criteria, corporate vision and strategy shows higher weighted value of 0.528 among items in management asset (Fig. 5). This is a result that reflects importance of corporate management that corresponds to an accurate vision. Among items of knowledge / information / structural asset, R&D was selected to be most important with weighted value of 0.607 (Fig. 6), suggesting that active investment in R&D can lead to creation of future values.

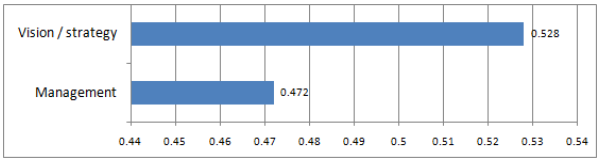

Fig. 5. Weighted Values of IM

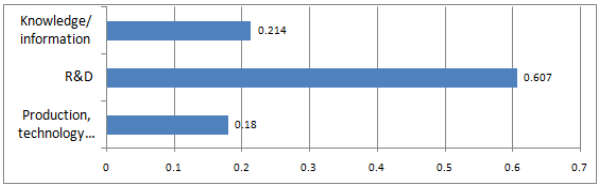

Fig. 6. Weighted Values of II

Looking at the weighted values of tertiary criteria, IM1 (future value of corporate vision) showed highest weighted value of 0.524 in corporate vision / strategy and IM4 (leadership of the CEO) at 0.429 in corporate management, IH1 (labor welfare environment) at 0.316 in organizational culture and human resource, II2 (leadership and investment in R&D) at 0.659 in R&D, OM2 (global competitiveness) at 0.563 in corporate competitiveness, and OS2 (customer satisfaction system)

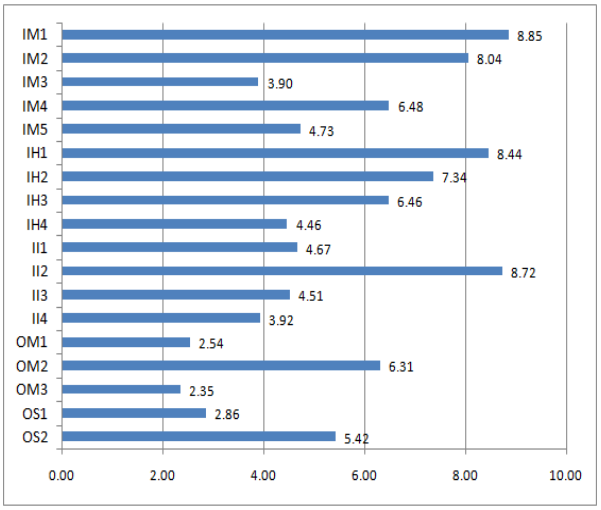

Fig. 7. Weighted Values

at 0.656 in social contribution and customer support.

Looking at Fig. 7 that shows the result of adding weighted values for tertiary criteria with that of primary and secondary criteria, IM1 (future value of corporate vision) was found to be most important with the weighted value of 0.0885. This suggests that establishment of corporate vision is extremely important in management of intangible assets. II2 (leadership and investment in R&D) was the next important element with the value of 0.0872. Creation of new profit and increase in future competitiveness through investment in R&D for new technologies are thought to be important. In contrast, OM1 (brand value and competitiveness) and OM3 (marketing / promotion competitiveness) showed lowest weighted values of 0.0253 and 0.0235, respectively. Weighted values for criteria that reinforce internal competitiveness are higher than those that invest in the external image.

Table 3. Weighted Values for Each Criterion

Primary		Secondary		Details			
Item	Value	Item	Value	Code	Value	Overall (%)	Rank
IM	0.32	Vision / strategy	0.528	IM1	0.524	8.85	1
				IM2	0.476	8.04	4
		Managem-ent	0.472	IM3	0.258	3.90	15
				IM4	0.429	6.48	6
				IM5	0.313	4.73	10
IH	0.267	Culture and human resource	1	IH1	0.316	8.44	3
				IH2	0.275	7.34	5
				IH3	0.242	6.46	7
				IH4	0.167	4.46	13
II	0.218	Knowledge	0.214	II1	1	4.67	11
		R&D	0.607	II2	0.659	8.72	2
				II3	0.341	4.51	12
		Production, technology and service	0.18	II4	1	3.92	14
OM	0.112	Competiti-veness	1	OM1	0.227	2.53	17
				OM2	0.563	6.31	8
				OM3	0.21	2.35	18
OS	0.083	Social contributi-on and customer support	1	OS1	0.344	2.86	16
				OS2	0.656	5.43	9
Total						100	

3.3 Construction of Evaluation Index and Model

3.3.1 Evaluation Model for Intangible Assets

Using the weighted values for each criterion computed above, an evaluation index for intangible assets was composed. Evaluation index was made using MS Excel 2007 for convenience in modification, storage and calculation. Among evaluation grades (A, B, C, D and E) for each criterion, the degree of importance of A was configured as '1', and the degrees for other grades are as shown in Table 4. Once the grade that corresponds to the conditions of a corporation is selected for each criterion, the degree of importance that corresponds to that grade is multiplied to the weighted value of corresponding criterion. Such computed values are added up to evaluate overall status for intangible assets of a corporation as a numeric value. Intangible asset evaluation model proposed in this study is as shown in Fig. 8.

Table 4. Intangible Asset Evaluation Grades

Grade	A	B	C	D	E
Level	Highest	Up to 75% of highest level	Up to 50% of highest level	Up to 25% of highest level	Up to 10% of highest level
Value	1	0.75	0.5	0.25	0.1

Evaluation index for intangible assets of construction companies

Primary criteria		Secondary criteria		Detailed criteria		Overall weighted value (%)	Grade	Evalaution value for each criterion
Item	Weighted value	Item	Weighted value	Code	Weighted value			
Management asset	0.32	Corporate vision / strategy	0.528	IM1	0.524	8.85	B	6.64
				IM2	0.476	8.04	D	2.01
		Corporate management	0.472	IM3	0.258	3.89	D	0.97
				IM4	0.429	6.47	B	4.85
				IM5	0.313	4.73	C	2.36
Organizational / human asset	0.267	Culture and human resource	1	IH1	0.316	8.44	C	4.22
				IH2	0.275	7.34	A	7.34
				IH3	0.242	6.46	C	3.23
				IH4	0.167	4.46		
Knowledge / information / structural asset	0.218	Knowledge / information	0.214	II1	1	4.67		
		R&D	0.607	II2	0.659	8.72		
				II3	0.341	4.51		
		Production, technology and service	0.18	II4	1	3.92		
Market asset	0.112	Corporate competitiveness	1	OM1	0.227	2.54		
				OM2	0.563	6.31		
				OM3	0.21	2.35		
Social asset	0.083	Social contribution and customer	1	OS1	0.344	2.86		
				OS2	0.656	5.44		
				Sum		100.00		31.63

Fig. 8. Intangible Asset Evaluation Model

3.3.2 Method of Utilization and Expected Effects

Such evaluation model can be used as an index by a construction company for evaluating current intangible asset status of that corporation. This can be the element of self evaluation on what kind of intangible asset is insufficient. Selection of subjective evaluation index is expected to bring an appropriate evaluation scale for intangible assets. Also, evaluation on current status using this model can be an index that shows to which intangible asset investment must be concentrated. Corporate managers can use this model as a guideline for making investment in intangible assets.

4. CONCLUSIONS

With movement from industrial era to information era, importance of intangible assets is continuously increasing and many corporations are enforcing investment in intangible assets. However, there is no evaluation standard specialized for construction industry. Accordingly, the purpose of this study was to deduce evaluation criteria for intangible assets, to receive

opinions of experts using AHP and to provide an evaluation model.

The results of this study are as follows.

[1] Five primary criteria, 8 secondary criteria and 18 tertiary criteria were deduced for intangible assets. Officials of construction companies were selected as subjects of survey and the degree of importance of each criterion was computed using only the responses with consistency ratio of 0.1 or below.

[2] As a result of analyzing the survey results using AHP, management asset and organizational / human asset were determined among primary criteria to be important with weighted values of 0.32 and 0.267. In contrast, market asset and social asset were considered to be relatively not important with values of 0.112 and 0.083. In case of construction companies, internal assets such as management asset and organizational/human asset were found to be much more important than external assets such as market and social assets.

[3] Looking at the weighted values of secondary criteria, corporate vision and strategy showed higher value of 0.528 among items of management asset. R&D was selected to be most important with the value of 0.607 in knowledge / information / structural asset. Sufficient consideration must be placed on the course of corporation after establishment of corporate vision and strategy. Active investment in R&D for creation of new profit with research results was deemed important.

[4] Looking at the weighted values of tertiary criteria, 'future value of corporate vision' was at 0.524 in corporate vision / strategy, 'leadership of the CEO' at 0.429 in corporate management, 'labor welfare environment' at 0.316 in culture and human resource, 'leadership and investment in R&D' at 0.659 in R&D, 'global competitiveness' at 0.563 in corporate competitiveness, and 'customer satisfaction system' at 0.656 in social contribution and customer support.

[5] Looking at the overall weighted value that summed all weighed values, 'future value of corporate vision' showed highest weighted value of 0.0885, followed by 'leadership and investment in R&D' at 0.0827.

[6] An intangible asset evaluation model was designed based on the overall weighted value computed using AHP. Selection of an appropriate grade for each criterion allows evaluation of intangible assets by adding the values computed by multiplying the ratio given for each grade with the weighted value of corresponding criterion. Such model can become a guideline for making capital investment in intangible assets.

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