

A STUDY ON THE SELECTION CRITERIA OF DELIVERY SYSTEM BY TYPES OF THE PUBLIC CONSTRUCTION PROJECTS

Eun-A Choi¹, Su-Man Choi², Jai-Dong Koo³, Nam-Gi Lim⁴ and Sang-Beom Lee⁵

¹ Staff, Heerim Architects & Planners Co., Ltd, Seoul, Korea

² Principal, Heerim Architects & Planners Co., Ltd, Seoul, Korea

³ Principal Research Fellow, Korea Institute of Construction Technology(KICT), Goyang, Korea

⁴ Professor, Department of Architectural Engineering, Tong-myong University, Busan, Korea

⁵ Professor, Department of Architectural Engineering, Dong-eui University, Busan, Korea

Correspond to lsb929@deu.ac.kr

ABSTRACT: Clients demands have been changed by construction circumstances such as high-technology, mega-projects, and the complexity of construction. Advanced foreign nations have already introduced and applied new project delivery systems (i.e, CM, DB, etc.) to deal with the change of such that. Korea has also promoted variation of the delivery systems for the progressive measure to the rapid changeable situation. Even though government has made his efforts as stated above, some clients have uniformly used those to public construction projects. That is because there are not selection criteria of project delivery system for clients.

Therefore, this study presented the selection criteria of project delivery system based on project types in the public large construction projects. In addition, the study has verified the viability of the presented models through consultation with professionals and experts.

Keywords: Project delivery systems; Project types; Project characteristics; Selection criteria; AHP(Analytic Hierarchy Process)

1. INTRODUCTION

1.1 Background and Purpose of Study

We have recognized that the delivery systems have a considerable influence upon the relevant construction performances through the final findings of the relevant studies and that appropriate selection of delivery systems would be decisive elements for the successive construction performances. However, it seems that the best delivery system will be recommended for the applicable requirements of the construction types and project features for respective cases.

Advanced foreign nations in the construction sectors have already introduced various delivery systems and applied to the practical project for the effective meeting to various construction environments and Korea has also promoted variation of the delivery systems for the progressive measure to the rapid changeable situation. With the establishment of “96 Turnkey Construction Activation Plan” and “97 Construction Technology Promotion Basic Plan”, etc., the relevant governmental authorities have broken from the traditional Design-Bid-Build of planning from construction and selected Design-Build as the newly developed delivery systems. In addition, the Ministry of Strategy & Finance of Korean government is making much effort to improve the delivery system by making the domestic construction delivery systems more variable through amendments of

the enforcement ordinance of the relevant law of the contract on which the nation would be one of the contract parties (October 10, 2007).

However, despite the continuous efforts and intent of Korean government, some public clients have applied the traditional specific delivery systems to the public construction projects due to the various kinds of situations of excessive business affairs, supervision, poor cooperation with other sections, and lack of experts and expertise without consideration of the special features and characteristics of the relevant construction projects.

Thus, this study has derived some problems that can be developed during the delivery system application of construction projects through thorough grasping of the practical situation of the construction projects ordered by public organization and analysis of the relevant situation and investigation of the questionnaires of the related situations and the study has presented the selection criteria of types of the construction projects that have been developed through objective processes to be objectively used by the public client for the improved ideas for advanced delivery system by the construction projects as improved methods for the presented problems.

1.2 Scope and Method of Study

Scope of the study was largely focused on the large-scale public construction projects and the study was made chiefly on the ordering case of the large-scale

construction projects with the contract amount of 100 billion KRW made by the city of OO.

The performing summary of this study is as follows.

- (1) Examination of the related documents and seizing of definition of the delivery system and arrangement of the features of the delivery system by types on basis of the relevant laws.
- (2) Presentation of the problems related with the selection and application of the delivery systems through delivery system application of large public construction projects and investigation of the questionnaires with consideration of the example of the city of OO.
- (3) Derivation of the selection criteria of delivery system investigated in the advanced study and classification of the appropriate project types after calculation of the valuable weight of the derived selection criteria through the given questionnaires.
- (4) Proposal of the selection criteria of delivery systems by public construction projects.
- (5) Approval of the practical availability of the selection criteria of delivery systems through consultation with experts.

2. LITERATURE REVIEW

2.1 Definition of Delivery System

Definition of Delivery System has been variable according to the researchers and institutes domestic and overseas and the contents can be arranged as follows.

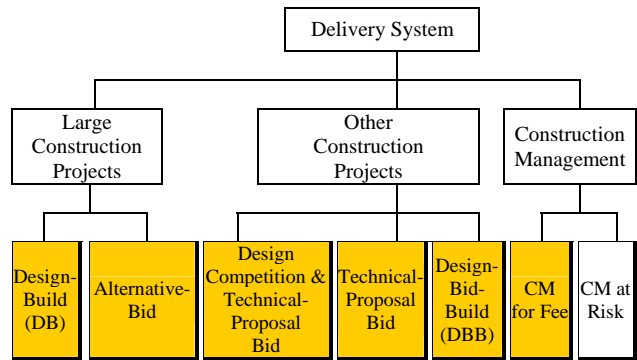
Table 1. Definition of Delivery System

Researcher	Definition
Masterman (1992)	The organizational structure adopted by the client for the management of the design and construction of a building project.
Love et. Al (1998)	Procurement system is an organizational system that assigns specific responsibilities and authorities to people and organizations, and defines the relationships of the various elements in the construction of a project.
Y.C Seo (2003)	The project delivery system as a basic framework to perform construction project conforms to one of the important decision-making items of early stages of construction project, assigns specific authority and responsibility to parties participated in construction project and defines relationships among them.
I. H Yoo (2008)	Comprehensive pre-contract practice including fund raising method, project performance methods, competition methods, bid methods, successful contractor selection methods, etc. shall be available for the definition.

2.2 Classification and Overview of Delivery System

Delivery Systems by the regulation of the large construction contract of the national contract law in Korea shall be Design-Build, Alternative Bid, Design-

Bid-Build, Technical Proposal Bid, Design Competition & Technical Proposal Bid that are introduced newly in 2007, which can be diagrammed as the picture 1.



Picture 1. Classification of Delivery Systems Construction Projects in Korea

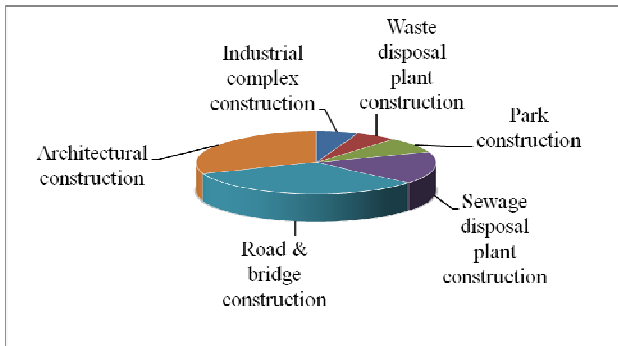
The applicable delivery systems originated from the picture 1 shall be 6 and the institutional overview of them shall be as table 2.

Table 2. Institutional Overview of Delivery System

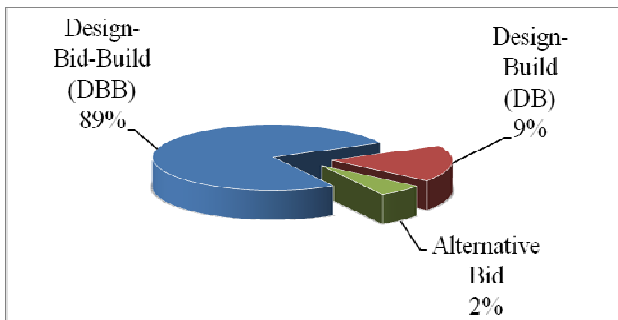
3. ANALYSIS PROBLEMS OF DELIVERY SYSTEM IN PUBLIC CONSTRUCTION PROJECTS

3.1 Analysis of Case Study on OO City Projects

This study has analyzed totally 36 construction projects according to the six patterns of the relevant construction types of architectural construction, road & bridge construction, sewage disposal plant construction, park construction, industrial complex construction, waste disposal plant construction project, etc. on the objects of the large construction projects that were made by the city of OO for the recognition of the delivery systems that were made by the relevant public clients.



Picture 2. Distribution Status of Construction Projects



Picture 3. Application Status of Delivery Systems

Considering the distribution of the large construction projects by the delivery systems that were made by the city of OO as is showed in picture 3, Design-Bid-Build (DBB) cases are showed to be 29 cases (89%), which occupied most of the total cases and then Design-Build (DB) to be 5 cases (9%), and Alternative-Bid to be 2 cases (2%). This fact would explain that various delivery systems have not been applied to the practical construction projects according to the construction patterns and features and uniform delivery systems are being applied to the most of the practical construction projects.

3.2 Survey and Interview with clients

This study has made up some questionnaires and interview on the objects of the persons in charge of the relevant fields of the construction department of the city of OO for the recognition of the derived problems through the practical analysis. According to the result, more than the half of them responded that influence that

Division	Overview of Delivery Systems
Design-Bid-Build (DBB)	The traditional method and design contractor shall be separated from construction contractor and construction drawing shall be executed by design contractor and the contractor shall be selected through competition bid.
Design-Build (DB)	Through this delivery system, the client shall be made in one time contract between design and build contractor
Alternative Bid	The client shall employ the designer to complete the plan and design and contractor has to propose alternative plan when in bid.
Design Competition & Technical Proposal Bid	The successful bidder shall prepare the technical proposal and submit the proposal with the bid after considering the preliminary design documentations and bidding guideline that are prepared and given by the client.
Technical Proposal Bid	According to the execution design documentations and the bidding guideline granted by the client, the bidder shall prepare the technical proposal to submit the proposal with the bid.
Construction Management (CM)	Project plan, design, and construction stages shall be jointly dealt by CMr and through the combined efforts of the relevant staff of the client, designer, and CMr so that all the management of the procedure of the construction project can be integrated and managed effectively.

delivery systems would have on the construction project results would have some close relation and most of the relevant persons recognized that delivery systems should be applied according to the features and characteristics of the projects. However, 71% of them responded that delivery systems were applied to the practical cases without consideration of the project patterns and project features and characteristics.

It was also responded that the performed construction projects were selected due to the size of the project expense and convenient administrative business based on the traditional experiences in order. In addition, though delivery systems should be selected with the consideration of appropriation and transparency of the related project through the progress of the delivery systems, it showed that the judgment of optimized delivery systems of the persons in charge of the relevant construction projects would face considerable difficulties in selection of a delivery system due to the lack of the clear selection criteria, spare time, and concern about the future audit, etc.

Researcher	Selection Criteria of Delivery System
K.I Kim (2000)	coping with complexity, quality assurance, cost reduction, time saving, prevention of claim, applicability of new technologies and construction methods, client's responsibility and work pressure(burden)
University of Seoul (2000)	quality assurance, cost reduction, time saving, project scale, coping with complexity, new technologies and construction methods, prevention of claim & dispute, client's experience, responsibility and administrative burden reduction, participation, condition of regulation & law, market condition, client's ability and policy
S.I Kim (2002)	complexity and scope of project, design, construction plan, design changes in construction phase, time, quality, budget and cash flow of government, usability and ability of in house, regulation & law, client's control and risk sharing, recommendation and experience of other countries
Y.C Seo (2003)	quality, time, cost, control and participation, complexity, uncertainties, innovative technologies, project scale, administrative burdens, experience & ability, claim & dispute, market condition, law & regulation & policy, contractor's profit increasing.
C.T Hyun (2005)	quality, time, cost, control and participation, administration, experience & ability, claim & dispute, communication & mutual trust, project type, risk, fitness, environment
H.S Moon (2008)	experience & ability, claim & dispute, responsibility, quality, time, cost, control and participation, risk, project type, complexity, innovation, flexibility, necessity of Design-Build, market conditions, law & regulation & policy and market competitiveness
I.H You (2008)	cost, time, quality, control and participation, size of project, complexity/degree of difficulty, uncertainties, applicability of advanced technologies, experience, capacity to contract, capacity to bidding, risk/responsibility, policy direction, competitive environment and claim & dispute

3.3 Results of the Actual Condition and Establishment of Improvement Directions

Result deduced from the actual investigation of the ordered constructions by the city of OO and the questionnaires and improvement direction arranged from the result shall be as follows.

1) In case of the constructions ordered by the city of OO, specific delivery systems would be applied to most of them regardless of the intrinsic project patterns. This is originated from the administrative policy by which the delivery systems should be adapted according to the amount of the appropriated project expense.

2) Though the officials in charge of the relevant construction business also recognize the important relation between the delivery systems and project performance & result, the actual delivery systems would be applied improperly to the relevant features of the construction projects due to nonexistence of the available delivery systems.

Therefore, this study has judged that objective and systematical project patterns in simple type are necessary that are proper for the requirements of the clients and the project features and characteristics according to the types or patterns of relevant construction projects.

4. THE SELECTION CRITERIA OF DELEVERY SYSTEM BY TYPES OF PUBLIC CONSTRUCTION PROJECTS

4.1 Examination of Selection Criteria for Delivery System

Seizing of the features by the patterns and types of the applicable projects would be first of all. In this chapter, this study has studied the composing elements that are the selection criteria of the delivery systems on the basis of the preceding investigation findings of the selection criteria of the delivery systems in Korea and the result has been deduced from the weight evaluation on the elements among the relevant elements that the public client would favor by the project types or patterns.

The study has arranged the findings of the selection criteria of the delivery systems and influential factors that are presented by the preceding studies in Korea and the contents shall be presented as aforementioned in the table 3. The influential elements have been deduced first on the basis of the related preceding studies.

Table 3. Selection Criteria of Delivery Systems in Former Researcher and Study

4.2 Extraction of Important Selection Criteria

Considering the selection criteria of the preceding studies in Korea, we can recognize that the selection criteria of delivery systems would be classified chiefly into client's requirements, features of the relevant projects, client's characteristics, and external environmental elements, which can be classified into 25 sectional selection elements in details and respective researchers would use the words of the selection criteria and detailed selection criteria as similar ones. On the basis of detailed selection criteria that were applied to more than four times in the preceding studies, this study has removed some similar terms and vague expressions and rearranged them into terms with clear meaning and with high practical application.

Final selection criteria of the delivery systems have been decided according to the project features (complexity/level of difficulty, creativity/innovative technology, uncertainties, project scale), the client's requirements (quality assurance, cost reduction, time

Project Types		Type 1	Type 2	Type 3
Selection Criteria				
Project Features		0.351	0.379	0.326
Client's Requirements		0.425	0.310	0.385
Client's Characteristics		0.072	0.171	0.098
External Elements		0.152	0.140	0.191
Complexity/Level of difficulty		0.281	0.302	0.358
Project selection criteria	Project Types	Type 4	Type 5	Type 6
	Creativity/Innovative technology	0.304	0.277	0.290
Project Features	Project Features	0.310	0.401	0.319
	Uncertainties	0.211	0.290	0.110
Client's requirements	Project Scale	0.309	0.364	0.356
	Quality Assurance	0.204	0.191	0.242
Client's characteristics	Quality Assurance	0.211	0.114	0.216
	Complexity/Level of difficulty	0.361	0.257	0.385
External Elements	Assurance	0.170	0.121	0.109
	Cost Reduction	0.322	0.241	0.136
Client's Requirements	Complexity/Level of difficulty	0.333	0.309	0.241
	Level of difficulty	0.109	0.209	0.177
Project features	Creativity/Innovative technology	0.308	0.308	0.303
	Claim/Dispute	0.326	0.309	0.388
Client's Characteristics	Experience/Ability	0.178	0.178	0.207
	Project Scale	0.235	0.359	0.361
Client's requirements	Administrative Burden	0.439	0.358	0.311
	Cost Reduction	0.195	0.165	0.150
External Elements	Time Saving	0.435	0.187	0.361
	Market Condition	0.375	0.503	0.439
Client's characteristics	Control	0.370	0.236	0.298
	Claim/Dispute	0.370	0.236	0.298
Client's requirements	Experience/Ability	0.300	0.300	0.300
	Administrative Burden	0.321	0.374	0.411
External Elements	Policy	0.617	0.701	0.522
	Market Condition	0.383	0.299	0.299

Table 4. Analysis of Weights of Important Selection Criteria

Type1: architectural construction, Type2: road & bridge construction, Type3: sewage disposal plant construction, Type4: park construction, Type5: industrial complex, construction, Type6: waste disposal plant construction

Table 5. A List of the Selection Criteria by Types of Construction Projects

No	Selection Criteria		
	Project Type1	Project Type2	Project Type3
1	Quality Assurance	Complexity/Level of difficulty	Quality Assurance
2	Cost Reduction	Participation/Control	Complexity/Level of difficulty
3	Creativity/Innovative technology	Uncertainties	Participation/Control
4	Complexity/Level of difficulty	Creativity/Innovative technology	Policy
5	Policy	Quality Assurance	Creativity/Innovative technology
6	Participation/Control	Cost Reduction	Market Condition
7	Uncertainties	Time Saving	Project Scale
8	Project Scale	Market Condition	Time Saving
9	Market Condition	Policy	Cost Reduction
10	Time Saving	Administrative Burden Reduction	Experience/Ability
11	Administrative Burden Reduction	Experience/Ability	Uncertainties
12	Claim/Dispute	Claim/Dispute	Administrative Burden Reduction
13	Experience/Ability	Project Scale	Claim/Dispute

saving, participation and control), client's characteristics (claim & disputes, experience/ability, administrative burden reduction) and the external environmental elements (policy, market condition).

4.3 Priority Analysis of Selection Criteria by Project Types

Comparison of the importance has been practiced through the questionnaires on the objects of the officials of the public organizations and the relevant professionals for the analysis of the importance of the selection criteria by project types.

In chapter 3, the relevant construction projects are patterned into six project categories of architectural construction, road & bridge construction, sewage disposal plant construction, park construction, industrial complex construction, waste disposal plant construction project. The determinant value of the dual comparison has been acquired through the responding respondents of the questionnaires and the weight value has been calculated according to the AHP analysis method using the Expert Choice Program on the preceding result. As this analysis is a part of the data that would be the objective data for the client to make the final decision, this study would propose to select the optimized delivery system proper for the given project types on the basis of the following selection criteria preferential order.

4.4 Application Approval of the Selection Criteria of Delivery Systems by Construction Project Types

Regarding the practical application ability of the lastly deduced selection criteria of project delivery systems by types of public construction projects, the practical results approved by professionals are as follows ;

(1) The selection criteria can be used as tools of decision making for selection of proper delivery system considering types and purpose of the project by the public organization.

(2) In case the public organizations selects a delivery system, they are recommended to select the upper 7 items preferentially with high weight value among 13 selection criteria of delivery systems and they are apply or reject up to 9th items considering the features of the relevant projects.

(3) The types of public construction projects used in this study are based on the cases of the City of OO and the types are necessary to be variable so that they can be applied to all the other construction projects that are ordered by Korean government and other municipal governments in Korea.

5. CONCLUSIONS AND FUTURE TASKS

The study has derived some problems of delivery system applications in public projects through the practical situation of the construction projects ordered by public organizations and analysis of the relevant situation and investigation of the questionnaires of the related situations and it has presented the selection criteria of delivery systems by types of public construction projects to be objectively used by the public organization for the improved ideas of advanced delivery system by the construction types by using of AHP method. The study had interview with professionals for the approval of the use of the presented selection criteria.

Thus, as the selection criteria of project delivery systems presented in this study was deduced through the objective process using AHP, the result will have high leveled confidence and as the selection criteria has been presented by the project types, the finally recommended delivery systems can be effectively considered and selected if these criteria would be preferentially considered and used for the practical cases.

As the public construction projects presented in this study have been classified on the practical construction cases of some specific public organizations, construction projects ordered by another public organization can be added to the presented ones and they can be classified into more detailed categories for more improved performance.

REFERENCES

[1] K.I Kim, "A Study on the Selection Criteria for Delivery Systems in the Large Public Building Projects",

No	Selection Criteria		
	Project Type4	Project Type5	Project Type6
1	Policy	Creativity/ Innovative technology	Quality Assurance
2	Complexity/ Level of difficulty	Complexity/ Level of difficulty	Participation/ Control
3	Participation/ Control	Cost Reduction	Uncertainties
4	Creativity/ Innovative technology	Quality Assurance	Administrative Burden Reduction
5	Claim/Dispute	Participation/ Control	Project Scale
6	Time Saving	Policy	Complexity/ Level of difficulty
7	Quality Assurance	Time Saving	Time Saving
8	Administrative Burden Reduction	Uncertainties	Claim/Dispute
9	Experience/ Ability	Project Scale	Experience/ Ability
10	Market Condition	Experience/ Ability	Policy
11	Cost Reduction	Administrative Burden Reduction	Cost Reduction
12	Uncertainties	Market Condition	Creativity/ Innovative technology
13	Project Scale	Claim/Dispute	Market Condition

Journal of the Architectural Institute of Korea, Vol. 16 (4), 2000.

[2] S.I Kim, "Diversification of the Governmental Construction Project Delivery System: Reshaping Institutional Arrangements and Enhancing Institutional Capacity", Korea Research Institute for Human Settlements, 2000.

[3] H.S Moon, "The Analysis on the Impact Factors of Delivery Method for Multi-Family Housing Projects", Journal of Korea Institute of Construction Engineering and Management, Vol. 9 (3), 2008.

[4] Y.C Seo, "A Model for Selecting Project Delivery Systems of Public Construction Projects", Ph. D. Dissertation, University of Seoul, 2003

[5] I.H You, "A Selection Model of Suitable Tendering System for Public Construction Projects", Journal of Korea Institute of Construction Engineering and Management, Vol. 9 (3), 2008.

[6] C.T Hyun, "A Plan for Development of Delivery Method Selection Criteria for Public Construction Project", Korea Research Institute for Human Settlements, 2005.

[7] C.T Hyun, "A Method of Selecting Delivery Systems for Public Construction Projects using the Analytic Network Process", Journal of the Architectural Institute of Korea, Vol.19 (47), 2003.

[9] Alhazmi, T., and Mccaffer, R, "Project procurement system selection medel", J.Constr. Eng. Manage, 2000.

[10]. Masterman, J., "An Introduction to Building Procurements Systems", E&FN SPON, 1992.