

A STEP FORWARD TO MANAGEMENT DRIVEN CONSTRUCTION QUALITY

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Abstract: The automobile design in "the Chain of Quality" is finished completely in design phase. On the other hand, in construction projects, the design activity for keeping quality is extended into construction phase after design phase activities. The actual condition in construction industry is carried out not in design phases, but in the construction phase, such as color of materials, and determination of settlement. It is, therefore, both "conformance check business" and "management business" are needed for every product phases in construction projects in order to secure Total Product Quality. This paper is based on the comparative study of the differences of quality control system between construction industry and car manufacturing industry from the viewpoint of production process, and also makes some suggestions to introduce new type management system, like heavyweight project manager in car manufacturing industry, into the Japanese construction industry in order to achieve high quality.

Keywords: Quality, Construction Management, Project Management, Product process

1. Introduction

In Japan, the reliability of construction industry has lost by the recent construction scandal that some developers and contractors sold defective condominiums and economy hotels with structural calculation sheets fudged by the first-class architect. The problems are as follows: 1) lack of total project management through specialization and subdivision, 2) lack of compliance mechanism in the Japanese construction industry, 3) lack of information disclosure and transparency in construction projects.

Fujimoto (2001) shows the definition of quality of car manufacturing industry as following elements; 1) Performance, 2) Reliability, 3) Conformance, 4) Durability, 5) Serviceability, 6) Aesthetics, 7) Features, 8) Perceived quality. These concepts are named generically as "Total Product Quality" (TPQ). The main problem of the construction scandal is to lack of 'Reliability' and 'Aesthetics' of TPQ into the Japanese construction industry.

The car manufacturing production process is divided into two elements, 'Design Quality' and 'Conformance Quality'. Design Quality is the function of product and the product meant, performance, appearance, etc. in the design phase process, and Design Quality is "the quality aimed at as the target of manufacture", or "the product function which the customer was promised beforehand." On the other hand, 'Conformance Quality' shows that the project manager checks the conformance between product design (product information) and product itself. That is "the Chain of Quality" which combined these two types' quality concepts in car manufacturing industry.

In construction projects, the design activity for keeping quality is extended into construction phase after design phase activities. On the other hand, the automobile design as

Toyota Production System (TPS) in "the Chain of Quality" is finished completely in design phase. In the Japanese construction projects, the actual condition is carried out not in design phases, but in the construction phase, such as color of materials, and determination of settlement. It is, therefore, conformance check and management are needed for every product phases in construction projects in order to secure TPQ.

Since the management business was defined as IDEF (Input and output relation), it is decided to analyze deliverables in each phase, such as client requirements, design information, product information, middle products and final products. In construction projects, each deliverables are not completed in each phase. As the result of it, the structure of production system in car manufacturing industry is simple rather than that of construction industry. One of the causes of this is that the Japanese construction industry lacks heavyweight project manager like TPS.

This paper is based on the comparative study of the differences of quality control system between construction industry and car manufacturing industry from the viewpoint of production process, and also makes some suggestions to introduce procurement selection to keep high quality.

2. The product process and the procurement method

The product process is defined, and how "Conformance business of the design documents and products (The intermediate product is included)" provided by the architect law executed will be analyzed. Figure 1 shows conceptual arrangement of the process of an architectural project. It was general to understand each project as a phase (stage) like the design phase and the order stage, etc. , and assumed the analysis from the approval of the management business in

the relation between Input and Output by Deliverables (Here, client demand, basic design information, detailed design information, production information, intermediate product, and final product). In this paper, it is Input for Deliverable in the former stage to invent Deliverable in the next stage. Business (Activity) at each stage is developed based on the Input element. It classifies from the relation of Deliverables into the one (assembly="Management" area of information and the product) to give Deliverables the influence management on business and either whether simply executed the adaptability conformance on business (agreement conformance ="Adaptability conformance" area of information and the product) between elements.

"Management business" and "conformance business" are classified as shown Table 1;

The conformance and the process control of "Information" and "chiefly correspond basically to "Conformance business". The process control of "Information" and "Information" is pertinent to "Management business". For instance, the collation of design information and the product (building) is included in "Conformance business".

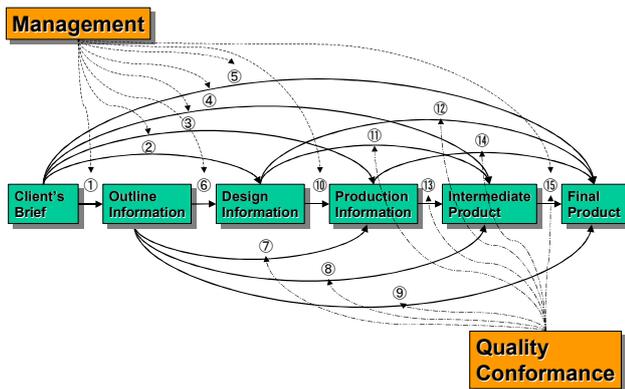


Figure 1. The Definition of Product Process in construction industry –Construction product process-

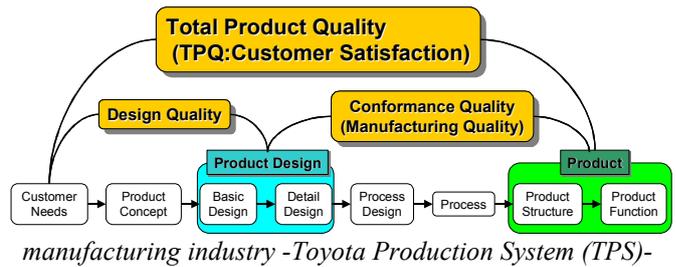
Table 1. Construction services on the production process

The management business
The business ① client request ⇒ general plan information (Business to sublimate to the general plan information based on the brief)
The business ② client request ⇒ detailed design information (Business to sublimate to the detailed design information based on the brief)
The business ③ client request ⇒ production information (Business which corrects production information based on the client request)
The business ④ client request ⇒ intermediate-product (Business which corrects an intermediate-product based on the client request)
The business ⑤ client request ⇒ end-product (Business which corrects an end-product based on the client request)
The business ⑥ general plan information ⇒ detailed design information (Business to sublimate to the detailed design information based on the general plan information)
The business ⑩ detailed design information ⇒ production information (Business to sublimate to the production information based on the detailed design information)
The business ⑮ intermediate-product ⇒ end-product

The conformance business
The business ⑦ general plan information ⇒ production information (Conformance business of the general plan information and the production information)
The business ⑧ general plan information ⇒ intermediate-product (Conformance business of the general plan information and the intermediate-product)
The business ⑨ general plan information ⇒ end-product (Conformance business of the general plan information and the end-product)
The business ⑪ detailed design information ⇒ intermediate-product (Conformance business of the detailed design information and the intermediate-product)
The business ⑫ detailed design information ⇒ end-product (Conformance business of the detailed design information and the end-product)
The business ⑬ production information ⇒ intermediate-product (Conformance business of the production information and the intermediate-product)
The business ⑭ production information ⇒ end-product (Conformance business of the production information and the end-product)

3. The product process of the manufacturing industry

Figure 2. The Definition of Product Process in



Professor Fujimoto [4] defines the product process of automobile manufacturing industry is linear product process as shown figure 2. There are minor design changes at production stage, but management duties do not occur at this stage. Only "conformance activities" activity has been done in principle. In contrast, both "management activities" and "conformance activities" occur at every stage, because product process of a building does not have complete information at each stage. The information of building project has not completed at every construction stage. When reviewing relation between the procurement method and the product process, it is necessary to clarify whether each project participant is implementing these "the management business" or "the conformance business" specifically. Then, "Design Bid Build", "Design Build", and "Construction Management" as a typical procurement method were analyzed to project participants, scope of works.

As the result of it, it is understood that the collation of the client demand and the product is mainly developed as contractor's business.

On the other hand, the management business of the design business in a wide meaning including the designer and the construction supervisor has been generated.

The construction manager chiefly takes charge of those construction people's business and roles in the management method. Moreover, the inclusive degree of the business rises by contractors in Design Build procurement, and Design Builder control all phases.

It makes clear both "Management business" and "Conformance business" by analyzing product process, and it is important to examine who fulfill project's responsibility by procurement type.

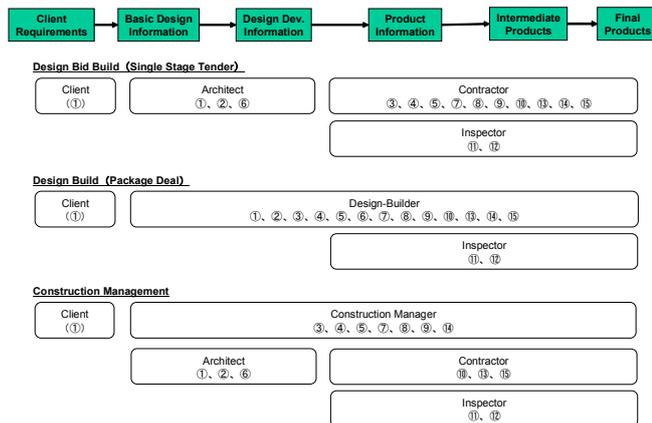


Figure3. Duty of project participants by procurement selection

4. The choice of the procurement method based on the product process (The evaluation axis)

Ability for quality control of each project participant gives choice of a supply method big influence. On the other hand, by choice of a supply method based on a person of ordering demand, ability for quality control is not considered.

A project participant diverges into many branches, but this chapter classifies quality in three kinds to simplify as follows:

- "Ordering quality"; the client requests
- "Design quality"; the general plan information, the detailed design information
- "Building quality"; the production information, the intermediate-product, the end product

Table 2 shows a combination of the pattern that three kinds of quality is high and low pattern.

Table also shows problems and the factors to every pattern.

For example, as for the pattern B, the ordering quality is low and the design quality is high. The building quality is also high.

There is a problem of pattern B in lowness of ordering quality. Non-accuracy of client requirements is a problem. On the basis of these, choice of a supply method to make up for an omission of a client request is demanded. In other words, same as relations between a client demand and procurement selection, ability for quality control of each

project participant accomplishing a project is important as a factor of procurement choice.

Table2. Procurement selection by quality level and problems

	ordering quality	design quality	building quality	problem	factor
A	+	+	+	---	---
B	-	+	+	The ordering quality	Insufficient client requests
C	+	-	+	The design quality	The quality of the design document
D	-	-	+	The ordering quality	Insufficient client requests
E	+	+	-	The building quality	The lack of the ability to build
F	-	+	-	The ordering & building quality	The lack of the ability to build
G	+	-	-	The design quality	The quality of the design document
H	-	-	-	The ordering quality	Insufficient client requests

Project Participant is different every procurement method about the product process and the scope of work, too It is necessary to be settled in a project participant every supply method and the sphere of business so that a choice method to make up for ability for quality control of each project participant is demanded by choice of a supply method based on a product process. It is therefore necessary to make scope of works clear as shown figure 4. It is connected in choice of Design Build (Package Deal) and construction management if the ability of design quality control is low. In addition, the choice of design bid build and construction management are necessary as procurement selection when ability for quality control of client requests is low, which it is not possible for making briefs as client requests. At all events it is important that procurement selection is chosen according to product process, clarifying procurement characteristic. For example, when a client requests "Single Responsibility", procurement selection by client requests should be design build procurement. Furthermore, procurement selection proceeds as ability for quality control of each project participant based on product process. For example, it is compared with the management method that can supply ability for quality control of a designer. In other words it is desirable to weigh the choice of procurement selection on product process against the choice of procurement selection by client requirements.

Therefore, if saying in the procurement method, here as it makes it up if making a scope of work as shown in the figure clear and the quality control ability of the designer is low temporarily, it connects with the choice of design and construction lump-sum order system (Package Deal) and the construction management method. Also, the quality control ability of the client is low and when the creating of a satisfactory ordering requisition sheet and a brief aren't made, as the procurement method as it helps these, the choice of the design and construction division order method and the construction management method and so on will become necessary.

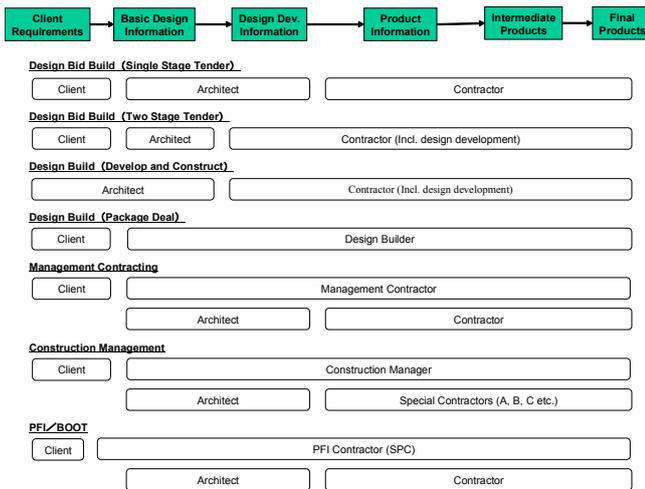


Figure 4. Scope of Services by procurement selection

In any case, to compare with the product process after taking the characteristic of the procurement method and to select an accurate procurement method is important. In client request based on "Single Responsibility" which is the highest evaluation about the design build method for example, each of Project Participant's one that is based on the product process after selecting a following procurement method. It is desirable to do the comparative examination of the selection of the procurement method which accompanies an client requirement and the selection of the procurement method which is based on the product process to do comparative examination with the management method that the choice of the procurement method according to the quality control ability, e.g. the quality control ability of the designer can be complemented, and so on.

It is explained ability for quality control in product process and choice of procurement selection. Procurement selection should be based on replacement of lower quality level by choosing adequate procurement selection, considering the basis of procurement characteristic.

The relationship between procurement selection and product process are shown as follows; A - H of pattern shows combination of quality control.

A client evaluates the ability for quality control of each project participant, and chooses the most suitable procurement based on client demands at project starting point.

Table 3. Procurement Selection by quality level

① Design bid Build procurement

Condition: A designer can secure complete design quality.
Therefore, the choice of the procurement is 『A、B、E、F』 .

② Design Build procurement

Condition: A contractor can secure complete building quality.
Therefore, the choice of the procurement is 『A、B、C、D』 .

③ Construction management procurement

Condition: A client can secure complete ordering quality.
Therefore, the choice of the procurement is 『A、C、E、G』 .

5. Conclusion

This paper shows that the procurement selection is important in diversified procurement method. Procurement selection should be based on both client requirements and product quality on product process. Procurement method of construction projects is diversifying steadily by changing social environment. It affects person of various ordering needs to have many choices, and it comes better factors to improve customer satisfaction to construction industry. In the U.K., it has succeeded in getting the trust that construction industry serves procurement selection to various client demands. In Japan, it is necessary to introduce clear procurement definition and establish procurement selection system based on client requirements and participants' quality level on product process. In addition, Design Build as the typical procurement in Japan should be defined its strength. The Japanese style Design Build has the possibility to get much more overseas' market, which is oriented Customer Satisfaction and technical innovation on product process. It is therefore necessary to develop Japanese procurement selection.

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