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BASIC RESEARCH OF SUB-PACKAGE PROBLEM IN KOREAN CONSTRUCTION INDUSTRY

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ABSTRACT: In the building construction, the specialist contractors play the important roles in the point of the quality securing. Therefore, it is very important for the construction industry to study the sub-package problem. The sub-package problem includes two problems which should be solved. One is to decide the scope of works of each specialist contractor, and another one is to decide the particular specialist contractor which carries out the work. However, the sub-package problem in Korea is not clarified yet, although the circumstance around it has changed rapidly. Many factors influence to the sub-package problem regardless of internal factors or external factors of the project. The general contractor usually decides the sub-package under considering the project conditions. In case of the internal factors, each general contractor manages the organization and materials. But the external factors are relatively more difficult to control and predict than internal ones. But out of the external factors, the legal system has very close relationship with a sub-package problem especially in Korean construction system. So, this paper clarifies relationship between the legal system relating subcontracting and the state of sub-package.

Keywords: Subcontracting System, Sub-Package problem, Construction Management, Subcontractor, Korea

1. INTRODUCTION

1.1 An intro

In its initial developmental stages, the Korean construction system was influenced by the Japanese system. Japan's construction system, which has been used as a model for developing countries, has advanced centered on general contractors who possess a high level of self-control. Since the end of the Korean War, the Korean economy has been improving under government-centered policy. Similarly, in the construction industry, the government has had a strong influence, both restricting and supporting the industry. For example, until the revision of construction law in May 2007, the Korean government had been able to acquire the licenses both of general construction and special construction from one company. Furthermore, with massive revisions of construction law, government restrictions have been appeased but also in some cases eliminated.

While the Korean construction system closely resembled the Japanese system in its initial stages, its developmental process has been different from Japan's. Currently, the Korean construction system has begun to allow private construction companies to exercise self-control.

The Korean construction industry is a divided and specialized work system that involves complex and large-

scale projects. A construction organization, which directly impacts project success, consists of a general contractor who manages the overall project and a sub-contractor who performs the actual construction tasks. In general, the general contractor distributes the construction work, which is contracted from a client to special contractors who act as proper sub-contractors. This process is referred to as the sub-package problem. How to make a sub-package is related to project quality, but the criterion relies on the experience of those in charge, such as the site manager. Accordingly, the basis and evaluation standards of sub-packaging are indistinct. Therefore, this paper examines and clarifies the sub-package problem in Korea. The specific objectives of this paper are as follows:

- To analyze the social conditions and legal system as they pertain to the sub-package problem in the Korean construction industry.
- To identify the main contributor (i.e., group) to the sub-package problem in the project delivery system.
- To identify the actual condition of the sub-package problem through hearings and questionnaire surveys.
- To clarify the characteristics of the sub-package problem.

1.2 Literature review

There are several previous studies that address the sub-package problem. Sasaki (1988) clarified the actual condition of organization regarding the sub-package problem in Japan's construction industry. This study also explicated the relationship between the sub-package problem and construction project characteristics such as conditions, materials, and etc. Additionally, Furusaka (1990) defined the sub-package matrix, consisting of units of work on a horizontal axis and a work breakdown on a vertical axis, for explain the sub-package problem. According to Endo, on the other hand, project characteristics can be classified as having an external, semi-external, or internal limitation. He clarified the relation between each boundary and the sub-package problem and attempted to quantify these relations through modeling.

Furthermore, almost all of the related research in Korea focuses on the legal system, as it has a strong influence on the Korean construction industry. Notably, a considerable amount of these studies focus on restrictive articles, many claiming that unessential restrictive articles must be mitigated or eliminated.

On the other, this paper focuses on the real situation of sub-package problem in Korea to clarify the construction system from the view of the site. And it reorganizes the sub-package matrix to suit on the Korean construction industry.

(3) Defining terms

This paper is based on the Korean construction industry. Therefore, the key words used are drawn from the Korean construction law system and traditional terminology. According to Korean construction law, this paper classifies [a construction industry] as an industry that includes whole types of business related to construction engineering and [a building industry] as an industry that includes all business conducted by building contractors. A building contractor is classified with general contractor and sub-contractor. As previously stated, Korean construction law has restricted the acquisition of both licenses for the same company. Until 2007, each building contractor has been able to act as only one side of building contractors; general contractor or sub-contractor. It eliminated such acquisition in 2007. However, this paper focuses on the period before this elimination. Therefore, in this paper, [general contractor] and [sub-contractor] refer to a main business of each company as well as a project role of it.

While setting the construction plan, the construction team organizer should investigate the method of construction and determine the construction schedule. The sub-package problem refers to the process of dividing special works according to the possible works and the allotment of sub-contractors who suit the project's objectives.

Sub-package planning cannot be independent of diverse project conditions. According to Endo, project conditions can be divided into three categories in accordance with controllability: external, semi-external, and internal

conditions. Based on this classification, this paper classifies two boundaries for general contractors in charge of organization at a company level. These limitations are as follows.

- 1) External condition: It is impossible to control generally (e.g., a law system, a custom, a labor or material condition, and etc.).
- 2) Internal condition: It is impossible to control at a project level but can be controlled at a company level (e.g., an internal organization, internal standards, Hyupryukupche, and etc.)

Hyupryukupche is the construction company who joins the group organized under a general contractor. The group of Hyupryukupche consists of sub-contractors. The Korean construction law system includes articles which recommend that general contractors operate with Hyupryukupche.

2. THE LEGAL SYSTEM AND THE SUB-PACKAGE PROBLEM IN KOREA

The Korean construction law system is very complicated and consists of many complex laws. [Construction industry law] is a fundamental law. Qualified architects are managed with [Architect laws]. Building regulations are prescribed with [Building laws], and the guidelines for different types of quality management or supervision work are provided in [Construction technical management laws]. These laws are not independent but are significantly inter-related with each other.

The law related to the sub-package problem has been continually revised according to changes in Korea's construction industry. The [Construction industry law] is most related to the sub-package problem. Based on this law, the following articles directly impact the sub-package problem.

Construction license system
 Construction business boundary system
 Multi license restriction
 Business bounds restriction
 Direct constructing obligation
 The upper limit of subcontracting
 The minimum ratio of subcontracting obligation
 Interrelationship among construction companies system
 Qualification of a contractor
 Cooperating contracting obligation by regional groups
 Construction participant system

From now on, we refer to the transition of the construction business boundary system, which is the basic law related to the sub-package problem. This transition can be divided into three stages: (1) the introduction stage, (2) the specialization stage, and (3) the adjustment stage.

The introduction stage is from 1958, when [Construction law] was first enacted, to 1976. In this initial stage, the unit of construction works was focused on civil engineering. This stage includes the Korean government's attempts to improve and service an

insufficient structure, after just finishing a war. In this state, the basic structure of the construction law system was forged; however, the reorientation of the construction law system was without consistency due to lack of experience and the immaturity of the construction industry.

In 1976, the specialization stage began with overseas expansion and the unit of works being segmented. Most significantly, in this stage, the building industry established the division of two specialized groups: general contractors and sub-contractors. As well, in this stage, the associations related to each specialized group were published.

Then, in 1997, the adjustment stage started with the massive revisions of [Construction industry law]. In this stage, specializations were fixed and the special units of work were adjusted.

Since 2007, although the multi-acquisition of building industry licenses has been permitted, Korean construction law still has a strongly restrictive character.

3. The real condition of the sub-package problem in Korea

3.1 What is the sub-package matrix?

The sub-package matrix is a methodology that presents the allotment scope of special construction works. It consists of a unit of works on a horizontal axis and a work breakdown on a vertical axis.

3.2 Project delivery system and the main body of sub-package problem

Usually, a general contractor organizes a sub-package under the general contractor delivery method or the turn-key delivery method. In the case of the general contractor method, a client contracts separately with the general contractor and the architectural engineer. Therefore, sub-package planning is commenced after design works are finished. In Korea, according to the [Architect law], it is prohibited for the same company to perform simultaneously building construction business and architecture design work in the same project. So, the usual design-build delivery method is not used very often. In the case of the turn-key method, a general contractor establishes a contract with an architectural engineering office before bidding. Then, after a bid is accepted, the client can demand a few changes to the consortium. Consequently, architectural engineers and clients cannot influence the sub-package problem.

A client plans sub-package problems by himself/herself during the multi-prime delivery method and the construction management-for-fee method. As well, in public projects, it is prohibited to use the multi-prime method, and almost all large-scale private projects are performed by the general contractor method or the turn-key method. The construction manager organizes the construction management method with the GMP (Guaranteed Maximum Price). In this method, the construction manager functions as a general contractor. However, it is prohibited for the same company to

perform construction management work and general contractor work in the same project.

3.3 The real condition of the sub-package problem in regard to structure work

General contractors are the group that is most influential on the sub-package problem. Therefore, to investigate the characteristics of the Korean sub-package problem, we conducted interviews with general contractors currently conducting a project in order to grasp the ways in which they are organized, and their

common tendencies in regard to the sub-package issue. Beyond examining unit of works, we focused on structure work including earthwork, scaffolding work, temporary facilities work, formwork, reinforcement bar work, steel beam work, and rented machinery work. The target projects are mansions because that is the most common building project in Korea.

(1)[A] project

[A] project is located on the outskirts of Seoul, Korea. This project is performed by the build-and-lease method, which is an unusual case.

In this project, the general contractor performs all of the management/control work, while each sub-contractor contracting a unit of work is responsible for shop drawing work. Earthwork and scaffolding work is packaged, and formwork, concrete work, and reinforced beam work is packaged. However, the general contractor is in charge of material procurement work for concrete and reinforced beams. Steel beam work and rented machinery work is sub-contracted separately.

[α] company does not tend to extend the sub-contracting scope, but abridges the number of sub-contracts as is possible in order to minimize control efforts and management costs. As well, in this project, according to the common tendency, [α] company sub-contracts by packaging: [earth work, scaffolding work, formwork] and [concrete work and reinforced beam work]. Meanwhile, management/control work is the responsibility of the general contractor because of the low management/control level of sub-contractors. In regard to a material-labor work package, α company establishes packages on earth work, temporary work, formwork, steel beam work, and it sub-contracts separately on concrete work and reinforced bar work. Concrete and reinforced beam procurement is performed separately due to the high variability of the material cost. [α] company regards that almost all sub-contractors cannot owe the risk because they are small or medium. For the order of sub-package planning, α company first decides the package of works and then selects the proper sub-contractors for the whole unit of works(Table 1.).

Table 1. The sub-package matrix of [A] project

	①	②	③	④	⑤	⑥	⑦
Schedule Management/control	GC	GC	GC	GC	GC	GC	GC
Quality management/control	GC	GC	GC	GC	GC	GC	GC

Shop drawing	SCa	SCa	SCb	SCb	SCb	SCc	
Work force on site	SCa	SCa	SCb	SCb	SCb	SCc	SCd
Material procurement	SCa	SCa	SCb	GC	GC	SCc	SCd
Temporary facilities and machinery	SCa	SCa	SCb	SCb	SCb	SCc	SCd

※GC : General Contractor; SCa,SCb... : Sub-Contractor[a], Sub-Contractor[b]...

①Earth works; ②Prefabricated form and flying shore; ③Cast-in-place; ④Concrete; ⑤Reinforced bar; ⑥Steel beam; ⑦Crane

(2)[B] project

[B] project is located in a satellite city of Seoul city. Two general contractors formed a consortium, but they divided the site into two zones and proceeded with each zone individually. In [B] project, both general contractors join their Hyupryukupche group and bid together. This is a very unique case in Korea.

Similar to [A] project, β company is responsible for management/control work and material procurement of concrete and reinforced bars. β company usually contracts out earthwork, scaffolding work, formwork, and steel beam work through material-labor packaging. Reinforced bar work is contracted out separately, while concrete work changes from case to case. The contracting process for earthwork and scaffolding work first fixes sub-contractors, then sub-packages. β company tends to extend the scope of contracting-out. Its difference with [A] project is the state of shop drawing work. β company performs the shop drawing work of scaffolding work and concrete work. In the interview, β company responded that they sub-contract separately, not by packaging. In regard to the interchange of Hyupryukupche groups, there was a 3 to 4 percent cost reduction. Yet, it is unclear if this reduction resulted from the interchange of Hyupryukupche groups or the large-scale contract(Table 2.).

Table 2. The sub-package matrix of [B] project

	①	②	③	④	⑤	⑥	⑦
Schedule Management/control	GC	GC	GC	GC	GC	GC	GC
Quality management/control	GC	GC	GC	GC	GC	GC	GC
Shop drawing	SCa	GC	GC+SCc	GC	SCe	SCg	
Work force on site	SCa	SCb	SCc	SCd	SCf	SCg	SCh
Material procurement	SCa	SCb	SCc	GC	GC	SCg	SCh
Temporary facilities and machinery	SCa	SCb	SCc	SCd	SCf	SCg	SCh

※GC : General Contractor; SCa,SCb... : Sub-Contractor[a], Sub-Contractor[b]...

①Earth works; ②Prefabricated form and flying shore; ③Cast-in-place; ④Concrete; ⑤Reinforced bar; ⑥Steel beam; ⑦Crane

(3)[C] project

[C] project is a residential-commercial complex building located in the midtown area of Seoul city. In [C] project, γ company uses various methods, which have little precedent, such as the S.P.S method.

By itself, γ company performed the labor work of earthwork, scaffolding work, and steel beam work. As well, in the common case, γ company tends to contract out by packaging in order to enhance work efficiency as much as possible. However, this project deviates from the common tendency. It is assumed that this is a result of using a method with little precedence. For example, earthwork, scaffolding work, and steel beam work related to the S.P.S method are almost always not contracted out. And γ company usually procures the material of reinforced bar and concrete, but in this project, this work is contracted out to the sub-contractor. These unusual characteristics make this project a special case for γ company(Table 3.).

Table 3. The sub-package matrix of [C] project

	①	②	③	④	⑤	⑥	⑦
Schedule Management/control	GC	GC	GC	GC	GC	GC	GC
Quality management/control	GC	GC	GC	GC	GC	GC	GC
Shop drawing	GC	GC	GC		SCd	SCe	
Work force on site	GC	GC	GC	SCb	SCd	GC	
Material procurement	GC	GC	GC	SCc			
Temporary facilities and machinery	SCa	GC	GC	GC			

※GC : General Contractor; SCa,SCb... : Sub-Contractor[a], Sub-Contractor[b]...

①Earth works; ②Prefabricated form and flying shore; ③Cast-in-place; ④Concrete; ⑤Reinforced bar; ⑥Steel beam; ⑦Crane

4. THE SUB-PACKAGING PROCESS IN KOREA

4.1 The main decision-making group

The main group that makes sub-package decisions is the general contractor group. A general contractor consists of the main office and the site office that is temporarily organized for every project. According to the interviews conducted, every company plans sub-packages in the main office. In the past, site managers had strong influence on the selection of sub-contractors. However, almost all general contractors have shifted to the main office-centered system. The site manager still retains the right to make recommendations; however, he/she is limited in the acquisition of a bid. On the other hand, while the authority of the sub-package problem is entrusted to the main office, the responsibility of the site control is still on the site manager.

4.2 The order

Generally, the main office first fixes the contracting-out scope and then shifts to the phase of choosing a sub-contractor. There are cases in which a sub-contractor is chosen based on the possession of material, but these cases are few. On the other hand, some companies choose sub-contractors first for the sustainable relationship that could be developed. For example, a general contractor who owns a subsidiary company, which procures

materials such as concrete and reinforced bar, may be chosen solely to establish a continuous relationship.

4.3 The scope of the contracting-out

According to the interviews, in terms of the scope of contracting-out, it is the common view that general contractors should perform management/control work, while sub-contractors should perform labor work. The interviews also indicated that the self-control level of sub-contractors is more improved, although this level is still not high enough. In regard to material procurement, almost all general contractors agreed that they procure the main materials, while sub-contractors are responsible for procuring others. Furthermore, most of the respondents agreed that the general contractor should be responsible for the shop drawing work. However, because the quality of these drawings is often insufficient in terms of buildability, sub-contractors often have to do the work again, thus repeating a work phase. In regard to the ratio of the contracting-out scope, most of the respondents agreed that the general contractors extend the ratio of it, except from management/control work to allocate the risk.

4.4 The factors involved in selecting a sub-contractor

The main factor of choosing a sub-contractor is whether the candidate company is a member of the Hyupryukupche group or not. Accordingly, the process of selecting a sub-contractor is as follows.

The standard of choosing a Hyupryukupche is based on each company's contracting out company estimation chart. The actual result is the most important factor; thus, are few changes in members. After registration, a general contractor estimates technology, actual result and so on (Fig. 1.).

5. THE PROJECT CONDITION ASSOCIATED WITH THE SUB-PACKAGE PROBLEM

5.1 External Conditions

The construction law system has influenced the unilateral responsibility of general contractors and the strict division between general contractors and sub-contractors. In the Korean construction industry, other project participants are not involved in the sub-package problem because of strict legal restrictions and client insufficiency of management/control ability. Furthermore, although the turn-key delivery system is established to develop the management techniques of general contractors, it also means that general contractors are entrusted with sub-package problem planning.

Another external condition, the minimum ratio of the subcontracting obligation system, which was abolished for the self-planning of general contractors in project planning, has contributed to the division between general contractors and sub-contractors and has caused the scope of contracting-out to grow. Moreover, building facilities work, such as electrical work, must be contracted by multiple-prime delivery though client does not want to do it.

As well, Hyupryukupche-based selection in the sub-contractor system is supposedly caused by the cooperating contracting obligation system. Relationships with sub-contractors are evaluated by bids in the turn-key system.

Cost-centered sub-package planning is supposed to be influenced by the lowest price bid system. Even in public projects, the ratio of projects performed by the lowest price bid system is increasing and the government plans to further increase this ratio.

5.2 Internal Conditions

General contractors focus on cost reduction resulting from a decrease in the amount of orders received, and they tend to concentrate on management/control work by compacting organization. Through compacting, companies extend the scope of contracting-out and material-labor contract packaging in order to cut down charges and maintenance costs. The main office-centered enterprise aims at transparency in cost breakdowns, which is enabled by the development of information technology. For risk management, general contractors shift from the policy of contracting-out work to taking responsibility for the procurement of main materials.

Furthermore, almost all general contractors choose sub-contractors from the Hyupryukupche group. Registration for the Hyupryukupche is operated annually; however, it is difficult to become a new member, as registration is based on actual contract results.

6. THE EXPANSION OF THE SUB-PACKAGE PROBLEM

Following recent revisions to construction law, several shifts are expected to occur in the construction industry.

For example, a decrease in the amount of orders received will result in a shift toward other types of businesses. However, almost all sub-contractors do not have sufficient ability to control the whole construction work and have a few precedent of general contracting. Because of these factors, it is difficult for sub-contractors to enter into new business: general contractor work. In this case, the large sub-contractors may enter into a merger or acquisition with the middle or small general contractors possessing the appropriate management/control ability for entry into the market. Furthermore, the middle-sized general contractors may extend their vertical business scope and attempt to improve work efficiency to survive the competition established by contracts.

On the other hand, as a result of the Korean construction industry becoming open and advancing to the global market, general contractors have to improve their control ability based on building skills in order to compete with global companies. Therefore, they must shift from temporary relationships to partnering based on positive and sustained cooperation. Specifically, general contractors must enhance cooperation with sub-contractors by using the enterprise resource process system, while sub-contractors must positively support this

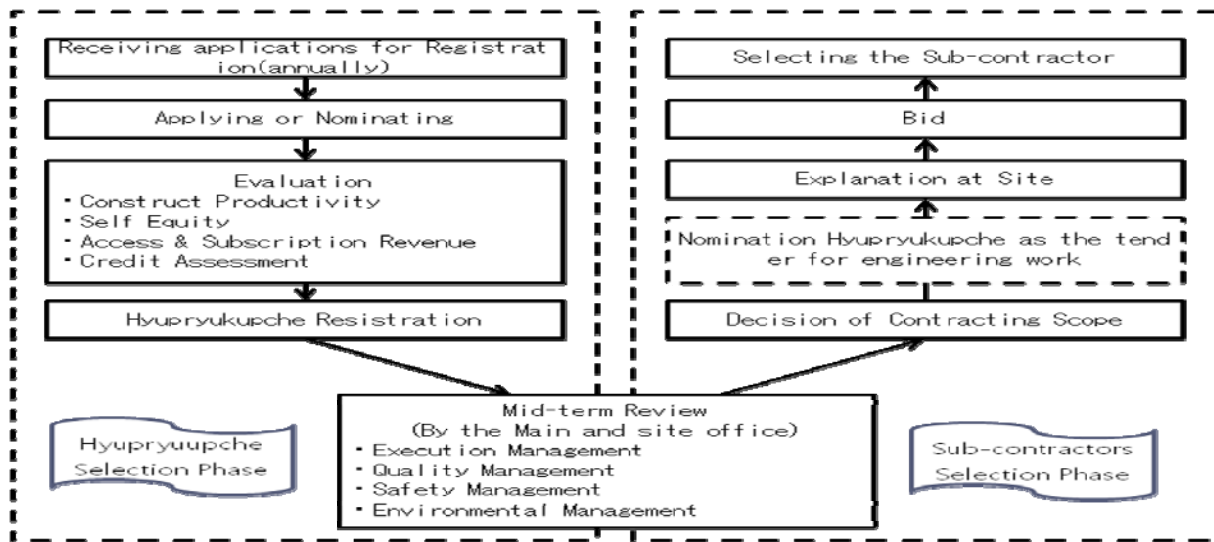
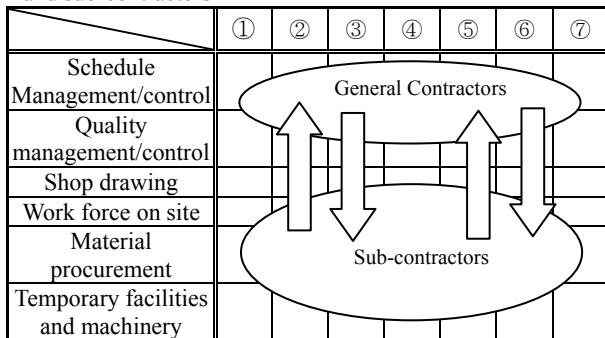


Fig. 1. The Sub-packaging Process in Korea

collaboration in order to build a harmonious construction team(Fig. 2.).

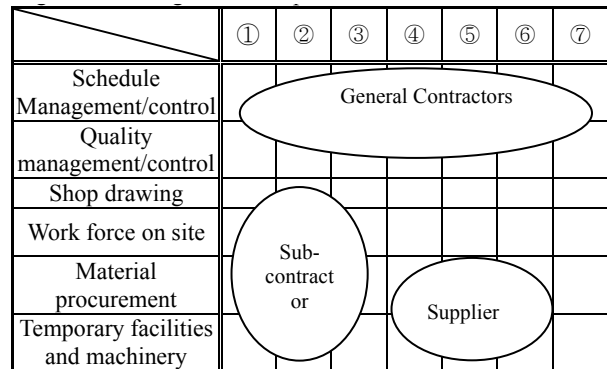
Fig. 2. The Change of collaboration between general contractors and sub-contractors



①Earth works; ②Prefabricated form and flying shore; ③Cast-in-place; ④Concrete; ⑤Reinforced bar; ⑥Steel beam; ⑦Crane

However, under the current stagnation of the Korean construction industry, it has been extremely difficult for general contractors to collaborate with sub-contractors. Although construction policies recommend partnering and collaboration between companies, this has resulted in relationships solely established to satisfy these policies.

Furthermore, it is expected that the entry of different types of business will increase and that contract competition will become fiercer. In this situation, many sub-contractors will likely specialize their core business to increase their competitive power. As well, more sub-contractors that are small, but specialized, are anticipated to enter the market. And in particular, following the extension of material-labor contracts and structure packaging, it is predicted that more companies which are specialized in procurement of concrete and reinforced bar or structure building work will enter the market(Fig. 3.).



①Earth works; ②Prefabricated form and flying shore; ③Cast-in-place; ④Concrete; ⑤Reinforced bar; ⑥Steel beam; ⑦Crane

The Korean government is planning to make progress by inducing the multi-prime delivery system for public projects. However, as the government does not have sufficient planning ability, construction managers will likely have to perform the role of chief planner. Therefore, the recognition of a construction management system is very likely to rise and extend. Yet, although some general contractors have performed construction management work, general contractors feel negatively towards the induction of construction management. As the market of construction management extends and the Korean construction industry gradually opens, general contractors' entry into the business of construction management will increase. As well, following the establishment of construction management, general contractors will be more likely to enter projects as sub-contractors performing management work only on the special units of work(Fig. 4.).

Fig. 4. The entry of general contractors to CM business

[6]Kwon, O., “A Study on Scope Restructuring of General Constructor and Specialty Constructor in Korean Construction Industry”, CERIK, Korea, 2005

	①	②	③	④	⑤	⑥	⑦
Schedule Management/control	GC		GC				
Quality management/control	GC		GC				
Shop drawing							
Work force on site	S	S	S	S	S		
Material procurement	C	C	C	C	C		
Temporary facilities and machinery	S	S	S	S	S		

※GC : General Contractor; SCa,SCb... : Sub-Contractor[a], Sub-Contractor[b]...

①Earth works; ②Prefabricated form and flying shore; ③Cast-in-place; ④Concrete; ⑤Reinforced bar; ⑥Steel beam; ⑦Crane

7. CONCLUSIONS

The Korean construction industry is strongly influenced by Korea’s legal system. Until now, government-centered policies have propelled changes in the construction industry. However, it is likely that because of social changes and changes in the legal system, the construction industry is also likely to rapidly change. Following the mitigation of legal restrictions, the sub-package issue will become more flexible. However, on the other hand, a decrease in the amount of contracts is expected to impede this shift. Nevertheless, a paradigm shift has already started and the relationship between construction companies and business boundaries is likely to become obscure.

In this study, we interviewed construction personnel in order to investigate the expert opinions of general contractors. Based on these interviews, we defined the relationship between the groups and the factors contributing to the sub-package problem. Furthermore, we defined the process related to the sub-package problem and clarified the relationship between this process and project conditions. Because prevalent legal restrictions have resulted in fixing the sub-package problem, there are a few exceptions. From now on, building companies are supposed to innovate in an enterprise system and find new business models for the changing market.

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