The task distribution of design teams in the Japanese architectural projects comparison with the United Kingdom and the United States

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ABSTRACT
This paper examines the task distribution of design teams in the Japanese architectural projects by comparing them to the equivalent projects in the U.K. and the U.S. The research is divided into two stages. First, architectural projects are analyzed to see how design tasks are distributed among specialized design teams, such as architects, engineers, and a variety of specialized experts. In the U.K./U.S., many consultants are called upon to the project based on their highly segmented specialization. In Japan, by contrast, fewer consultants are involved. The segmentation of the specialization is unclear. To fulfill the role of consultants, subcontractors tend to offer their product design information free of charge, under the notion of “Unofficial Design Assist (Sekkai Kyoryoku)” (UDA) in the hopes of their products being specified and installed in the construction. Second, the details of the UDA were further researched with the focus on the elevator subcontractors. Unlike the U.K./U.S., the vertical transportation consultant was not established as a profession in Japan. The subcontractors shall not be directly liable to the client for the design information, such as drawings, specifications, and analysis results. As a result, the design information’s location of responsibility is unclear from the clients’ perspective.

1. Introduction
In architectural projects, the design work is carried out under the task distribution among architects and engineers, as well as a variety of specialized experts. Task distribution in the design work is shared and recognized worldwide, though their definition heavily depends on the regions. The available materials, construction methods, regulations, resources, and local practices dictate the design process. These days, the awareness of the contractors’ information’s front-loading is raised, which is essential for the effective design process of BIM. However, it is not always easy for architects and engineers to obtain the contractors’ information before the construction contract. The condition of information gathering is highly dependent on the regions.

In this study, the author selected the U.K./U.S. as the comparative countries with Japan. Many countries around the world have adopted English as the common language for the business transaction. While executing international architectural projects, the AIA and RIBA guidelines are a common source of references. As the design process in both U.K./U.S. is considered a standard framework, comparing these standards with the Japanese would highlight the difference more precisely.

The author assumes that the high quality of design and construction in the Japanese construction industry is due to UDA practice for construction integration. However, no papers have investigated the details of UDA in Japan and published in English. This paper aims to clarify how the task distribution is extended in Japan’s architectural projects compared to the U.K./U.S. This paper focuses on the importance of Unofficial Design Assist (UDA), which is not always clearly quantified. Comparing to the U.K./U.S., which tend to clarify roles and responsibilities bound to contracts, Japan has less clear task distribution in practice.

2. Terminology
In this paper, “task distribution” refers to the division of the design work into several specialized tasks, in which specialized experts engaged. “Specialized profession” is defined as a position in which a person of specialized knowledge provides a paid design work. Therefore, it is not limited to outsourced consultants and includes in-house architects and engineers within a design firm. CAD operator, who is involved in Japan’s typical projects, is not regarded as a “specialized profession.” “Subcontractor” refers to a specialized fabricator, supplier, and manufacturer inclusively. “Subcontractor” is equivalent to the trade contractor who retains knowledge and skill for a specific element of a construction project. It has both in-house design and construction teams.

Figure 1 indicates a “design organization” coordinated for a project in the design phase. Once the
construction phase starts, the formation of “design organization” is modified and reconstructed as the “design team” of contractors are invited to join. A “design team” is defined as a single unit of specialized experts, such as architects, structural engineers, mechanical engineers, electrical engineers, a “design team” as a specialized consultant, and a “design team” in a subcontractor. Since some large design firms possess several specialized experts internally, the “design team” can be either internal or external to the design firm. “Design organization” is defined as a collection of “design teams” coordinated for the design work to accomplish a specific architectural project. The “design organization” does not include users, or government officials, as they are not primarily responsible for the design work.

Architects and Engineers base their design work on readily available documents such as catalogs and construction guidelines for building components. However, if they intend to design by using a custom-made product instead of a ready-made product, it is necessary to ask for a specialized subcontractor for the design information such as drawings, estimates, and verification, because it is not possible to obtain sufficient design information on the detailed specifications, construction limits, and costs of building parts and components. “Unofficial Design Assist (Sekkei Kyoryoku)” (UDA) is defined as the design team in the subcontractor to provide the project-specific design information, such as drawings, specifications, and analysis results, free of charge before the construction contract. The distribution of ready-made products’ data by subcontractors for promotional purposes is not regarded as the UDA. Although the subcontractor’s design team has the specialized knowledge, they do not perform paid design work with responsibility as a consultant; therefore, they are not classified as the “specialized profession.” In the construction phase, the subcontractor’s fee is determined based on the lump sum method, which combines the cost of materials, construction work, and finalization of the design. The interaction between designers and contractors accelerates in the RFI (required for information) and Shop drawings approval process. It is not regarded as UDA because it is already under the construction contract. In the U.K./U.S., the “Design Assist” is regarded as the procurement method by which subcontractors are retained before completing the design to assist the architect, engineer, or construction manager in developing the design and construction documents. At that moment, a construction contract may be awarded, or the service fee is paid for the subcontractors.

3. Literature review
3.1. Collaborate on a project

Collaboration is the key to the successful projects. For design team members to appreciate the multidisciplinary collaboration, there is a need for transparency and a shared understanding of the process (Zanni, Soetanto, and Ruikar 2017). Collaboration improves when individual team members’ roles are clearly defined and well understood (Gratton and Erickson 2007). Collaborative help beyond simple workload sharing is the key to realize innovative organization (Amabile, Fisher, and Pillemer 2014).

To realize the collaborative environment, an appropriate task distribution should be planned under the consideration of how the distributed tasks are going to be integrated. Traditionally the design process is divided between the silos of professions, having architects in one silo and engineers in another silo. In the conventional silo design process, the architect designs the building first, and the engineers then equip it with systems (Landgren et al. 2019). In the management of the design process, it is essential to be sure about when, who, and
what is to be done (Eynon 2013). Many decisions are made in the early design stage to optimize the design process (Landgren and Jensen 2018). Design tasks shall be subdivided into works based on the Work Breakdown Structure (The Project Management Institute 2013), and the responsible person for the deliverables should be predetermined. In the latest RIBA Plan of Work 2020 (RIBA 2020), many consultants are assigned their tasks based on the pre-specified Project Roles Tables. Modularity is one of the criteria to see the distribution of the design tasks. Modularity has shown great potential in the manufacturing industry, reducing order lead time, and creating variety with limited resources (Bekdik et al., 2018). To explain the regional differences, the different pattern of regional modularity between the United States and Japan was verified by introducing the task structure matrix (Yu et al. 2015). The notion of modularity was applied in a design team of architects (Ogasawara, Yoshida, and Yashiro 2016).

### 3.2. Specialized profession in Japan

Design organization is formed as a collection of design teams composed of architects, engineers, and a variety of specialized experts. For the comparative study of the task distribution of design teams, it is essential to understand how the profession is established in Japan compared to the U.K./U.S. Some publications are analyzing the establishment of the profession from a sociological point of view. In the medical field, doctors gained social status and a monopoly on the market and built up a Profession (Larson 1977). The specialized knowledge and skill establish Profession (Freidson 2001), and the legal system has been supporting the monopoly of the profession in the U.S. (Freidson 1986).

The history of the establishment of architects in Japan is quite different from that of the U.K./U.S. Even contractors can obtain an architect license in Japan if they retain the required engineering skill and knowledge. It was caused by the need to raise the buildings’ quality at the beginning of the enactment of the Architect Law in 1950 (Sakomizu 2011). On the other hand, the establishment of the U.K./U.S. Architects are supported by the profession’s concept back to the 18th century (Takahashi and Furusaka 2000). In addition to the architects and engineers, various consultants have been established as a specialized profession. The research categorized the diversification of specialized consultants in Japan into seven types (Miyai et al. 2010). The establishment of consultants is quite different in countries. For example, a façade engineer’s exact role has not been established yet in Japan (Inoue, Matsumura, and Seike 2003).

### 3.3. Unofficial design assist in Japan

It is essential to investigate the condition of contractors in the Japanese context to understand UDA. Japan’s construction industry has a multi-layered subcontracting structure with involvement of a variety of contractors (Kanisawa 2007). The specific techniques and skills for building construction are mainly possessed not by general contractors, but by subcontractors (Imae and Ando 2007). There is a hierarchical affiliation structure between the general contractor and subcontractor (Furusaka and Kaneta 2000). A Japanese construction industry characteristic is based on informal and sales-driven cooperation (Nagashima and Ando 1999).

To some extent, it is not a unique situation for architects to prepare design documents by obtaining information from a contractor. If the architect wants to receive information from the subcontractor, the subcontractor should be nominated by the client or the general contractor based on a contract in advance. In the U.K., the BSI has a Code of Practice that allows architects and contractors to work together to design (British Standards Institution 2015). In Japan, there is no such code of practice. A subcontractor is formally selected through an order placed on the construction stage, so the collaborating subcontractor may not always receive the order (Minemasa and Furusaka 2001).

A collaboration between architects and contractors will improve the design’s perfection, ensure the physical quality, keep the schedule, and manage the construction cost. Decades ago, when the contractual regulation was not as strict as they are today, the traditional method of achieving a cooperative relationship has been to implement high-quality construction projects based on a strong relationship of trust and interdependence between the clients, architects, and contractors (Nishino et al. 2011). The involvement of the design work is sometimes effective for the contractors. Not only architects and engineers but also many construction companies are keen to improve the quality of design services (Hadidi 2016).

### 4. Methods

The research is divided into two stages to illustrate the difference in the task distribution of the Japanese architectural projects comparing to the U.K./U.S. First, the relatively conventional and simplified projects are collected. Each project was selected based on the following criteria.

- Completed

The projects should be actual completed projects to confirm the conditions of task distribution in the design organizations. Unbuilt and ongoing projects were excluded.

- Design-Bid-Build
This research focuses on the conventional Design-Bid-Build project delivery process, in which architects design from Schematic Design to the Construction Document phase. Design-Build projects, in which the general contractor involves a much earlier design phase, were avoided.

- **Domestic**

The projects should be carried out the conventional way of task distribution in each country. In order to avoid the mixture of different ways of task distribution, international projects were excluded.

- **Single-functional building**

In order to focus on identifying precise task distribution, large complexes and urban development projects were excluded.

- **Design firms**

The projects should be designed by the established design firms in business for more than 30 years. The author focus on the middle/large-sized design firms over 50 architects. Since small and new design firms may have their uncommon task distribution methods, such scaled firms were excluded. Additionally, to avoid complicated design team formation and decision-making process, the projects based on the collaboration of design firms were eliminated. The author identified the design team’s conditions, whether they are in the contractual relationship or UDA. For the Japanese cases, in-person surveys were conducted in 2013–2016. In the U.K./U.S. cases, in-person surveys and follow up by email were conducted during 2014–2020. Nine projects from five design firms in Japan, seven projects from five design firms in the U.K., and the 10 projects from five design firms in the U.S. were collected as cases. The practice of UDA shall be confirmed in these architectural projects.

Second, the details of UDA in Japan were further researched. Since the vertical transportation consultants were not established as a specialized profession in Japan, elevator subcontractors were interviewed as typical UDA examples. The top five vertical transportation subcontractors, who account for more than 90% of the Japanese market, were surveyed in 2016. The 12 cases of the UDA were corrected.

### 5. Evaluation and findings

#### 5.1. Task distribution among specialized profession

#### 5.1.1. Japanese cases

Table 1 shows the results of a survey in Japan regarding the task distribution in design organizations. The columns show actual projects collected by the survey. The vertical axis shows the design teams based on the specialized profession or the UDA.

| Specialized Profession | Architect | Structural | Mechanical (incl. Plumbing) | Cost | Interior Space Planning, Material Finish | Landscape | Curtain-wall, Building Envelop | Acoustics, Audio, Visual | Sign, Graphic | Fire, Life Safety | Environmental Assessment | Theater | Unofficial Design Assist | Vertical Transportation, Elevator | Curtain-wall, Building Envelope | Acoustics, Audio, Visual | Sign, Graphic | Security | Furnishing | Steel Stair | Multistory Parking | IT | EXPJ | Vertical damp proof barrier | Furniture | Partition | Equipments |
|------------------------|-----------|------------|-----------------------------|------|------------------------------------------|-----------|-----------------------------------|--------------------------|----------------|-----------------|-------------------------|---------|---------------------------|---------------------------------|---------------------------------|-----------------------------|----------------|---------|-----------|------------|----------------|---|-------|------------------------|----------------|----------------|------------|
| Building Type          | A         | B          | C                           | D    | E                                        |           |                                   |                          |                |                 |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |
| Office                 | 2002      | 2004       | 2009                        | 2014 | 2013                                     | 2008      | 2008                             | 2016                      | 2016            | 2011            |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |
| A                       |           |            |                             |      |                                          |           |                                   |                          |                |                 |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |
| B                       |           |            |                             |      |                                          |           |                                   |                          |                |                 |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |
| C                       |           |            |                             |      |                                          |           |                                   |                          |                |                 |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |
| D                       |           |            |                             |      |                                          |           |                                   |                          |                |                 |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |
| E                       |           |            |                             |      |                                          |           |                                   |                          |                |                 |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |
| Total Floor Area(sqm)  | 20,000    | 90,000     | 3,000                       | 4,000 | 7,000                                    | 7,000     | 3,000                             | 10,000                    | 10,000          | 10,000          |                         |         |                           |                                   |                                 |                             |               |         |           |             |               |   |   |

Table 1. Task distribution in Japanese architectural projects.

● in-house ○: outsourced
Table 2. Task distribution in the U.K. architectural projects.

| Design Firm               | A   | B   | C   | D   | E   |
|---------------------------|-----|-----|-----|-----|-----|
| Building Type             | Council Office | Civic Centre | Hospital | Art Gallery | Opera House | Residential Office |
| Year of Completion        | 2009 | 2013 | 2015 | 2011 | 2018 | 2017 | 2019 |
| Total Floor Area(sqm)     | 1,513,300 | 40,255 | 1,300 | 3,100 | 5,000 | 22,000 | 10,000 |

| Specialized Profession | Architect | Structural | Mechanical | Electrical | Plumbing | Specification | Interior Space Planning, Material Finish | Building Permit, Planning | Quantity Surveyor (Cost) | Acoustics, Audio, Visual | Lighting | Landscape | Furniture | Sign, Graphic | Vertical Transportation, Elevator | BIM (Revit, ArchiCAD) | Communications, IT, Data Cabling | Environmental Assessment | Sustainable (LEED, BREEAM, etc) | Civil, Traffic and Parking | Security | Geotechnical | Fire, Life Safety | Equipment | Food Service | Commissioning | Townscape, Heritage | Archaeological | Party Wall | Maintenance | Lab Planner | UDA | Curtain-wall, Building Envelope | Hardware |
|------------------------|-----------|------------|------------|------------|----------|--------------|------------------------------------------|--------------------------|--------------------------|-------------------------|-----------|------------|-----------|----------------|-------------------------------|------------------------|--------------------------------|--------------------------|----------------------------------|--------------------------|---------------|-------------|--------------|-----------|--------|----------------|----------|
|                        | ●         | ●         | ●         | ●          | ●        | ●            | ●                                       | ●                        | ●                        | ●                       | ●                      | ●          | ●          |●         | ●            | ●                            | ●                      | ●                                            | ●                        | ●                                 | ●                        |●               |●            |●             |●          |●      |●            |●         |
|                        | ●         | ●         | ●         | ●          | ●        | ●            | ●                                       | ●                        | ●                        | ●                       | ●                      | ●          | ●          |●         | ●            | ●                            | ●                      | ●                                            | ●                        | ●                                 | ●                        |●               |●            |●             |●          |●      |●            |●         |
|                        | ●         | ●         | ●         | ●          | ●        | ●            | ●                                       | ●                        | ●                        | ●                       | ●                      | ●          | ●          |●         | ●            | ●                            | ●                      | ●                                            | ●                        | ●                                 | ●                        |●               |●            |●             |●          |●      |●            |●         |
|                        | ●         | ●         | ●         | ●          | ●        | ●            | ●                                       | ●                        | ●                        | ●                       | ●                      | ●          | ●          |●         | ●            | ●                            | ●                      | ●                                            | ●                        | ●                                 | ●                        |●               |●            |●             |●          |●      |●            |●         |
|                        | ●         | ●         | ●         | ●          | ●        | ●            | ●                                       | ●                        | ●                        | ●                       | ●                      | ●          | ●          |●         | ●            | ●                            | ●                      | ●                                            | ●                        | ●                                 | ●                        |●               |●            |●             |●          |●      |●            |●         |
|                        | ●         | ●         | ●         | ●          | ●        | ●            | ●                                       | ●                        | ●                        | ●                       | ●                      | ●          | ●          |●         | ●            | ●                            | ●                      | ●                                            | ●                        | ●                                 | ●                        |●               |●            |●             |●          |●      |●            |●         |

There are many specialized design teams which are not confirmed in the Japanese projects. For instance, no Spec Writer was recognized. In other words, specification is not subdivided as a specialized field. In the survey, five out of six design firms possess internally distributed reference materials for preparing specifications. The project architect prepares the specifications by referring to the reference materials that are regarded as the body of knowledge based on the past projects and referring to the prescribed specifications issued by the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT). A certain quality level could be ensured in the Japanese construction industry without consultants’ involvement, such as Spec Writer.

Neither Building Permit Expediter nor Planning Consultant was confirmed. The task to confirm legal compliance was solely in the hands of architects. Under Japan’s Building Standard Law, architects who prepare a design document should have legal responsibility and indicate their name on the building permit application documents. Therefore, a Design Architect who creates the overall concept and manages the design intent is not legally liable as an architect. This shows the characteristics of the Japanese construction industry’s social system that does not make a clear distinction between the Design Architect and Architect of Record.

No sustainability-related consultants, such as Environmental Assessment and Sustainable Consultants, were confirmed in the survey. It implies that there is less social and governmental pressure for green buildings in Japan. Also, no Townscape/Heritage consultant is confirmed. In Japan, regulations to maintain old streetscapes are enacted by each municipality’s ordinances. In the assessment by a review board in the building permit process, the explanatory materials are prepared by architects, who are not necessarily specialists of the townscape and heritage.

The subdivision of mechanical engineers and plumbing engineers are not identified. The design work without separating mechanical and plumbing engineering can realize effective coordination, while the workload of design increases without the division of labor.

The Vertical Transportation Consultant is a clear example of the UDA. The technology and know-how have been accumulated within the elevator subcontractors. Therefore, without their involvement, the architects and engineers cannot design the elevator’s product details. The Building Envelope and Curtain Wall Consultant is quite a similar condition as the
### Table 3. Task distribution in the U.S. architectural projects.

| Design Firm | Building Type | A | B | C | D | E |
|-------------|---------------|---|---|---|---|---|
|             | Office | Hospital | School | Residential | Office | Residential | Laboratory | Hospital | School | Laboratory | Laboratory |
| Year of Completion | 2006 | 2013 | 2011 | 2010 | 2009 | 2014 | 2005 | 2012 | 2008 | 2007 |
| Total Floor Area(sqm) | 1,513,000 | 38,050 | 56,250 | 26,930 | 51,300 | 17,640 | 18,900 | 35,370 | 23,040 | 16,920 |

| Specialized Profession | Architect | Structural | Mechanical | Electrical | Plumbing | Specification | Interior Space Planning, Material Finish | Building Permit | Cost | Acoustics, Audio, Visual | Lighting | Landscape | Sign, Graphic | Vertical Transportation, Elevator | Curtain-wall, Building Envelope | Communications, IT, Data Cabling Technology | Environmental Assessment | Sustainability (LEED) | Civil, Traffic, Parking | Security | Geotechnical | Fire, Life Safety | Equipments | Facilities Programmer | Hardware | Building Maintenance | Restoration | Pool Operation | Toxic Materials | Food Service | Commissioning | Water Proofing | Shoring |
|------------------------|-----------|-----------|-----------|-----------|----------|--------------|------------------------------------------|-----------------|------|-------------------------|----------|-----------|-------------|-----------------|-----------------|----------------|----------------|----------------|-----------------|----------------|----------------|----------------|-----------------
|                        | ●         | ●         | ●         | ●         | ●        | ●            | ●                                        | ●               | ●    | ○                       | ○        | ○         | ○            | ○               | ●               | ○               | ●              | ○               | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |
|                        | ○         | ○         | ○         | ○         | ○        | ○            | ○                                        | ○               | ○    | ○                       | ○        | ○         | ○            | ○               | ○               | ○               | ○              | ○               | ○               | ○               | ○               | ○               | ○               | ○               |

〇: in-house  ●: outsourced
vertical transportation consultant. In this survey, only one case of the Curtain wall consultant was confirmed, which may be an exceptional case in the Japanese construction industry. The design information from the curtain wall was typically obtained through UDA from the curtain wall subcontractors.

Sign making is another example of the UDA. In some cases, architects outsource the design task to the consultant. In the other cases, architects obtain the information from the subcontractors. In some cases, Graphic designers design the sign and sometimes arrange the fabrication of the sign. In other cases, there are Sign subcontractors who provide UDA to architects. Although this was not the case in the current survey, the interviewee mentioned that the design of lighting, acoustics, and landscape are the similar condition in sign making.

The subcontractors who possess unique products in the market are more inclined to offer UDA. For example, a multistory parking system, hardware for expansion system, and vertical damp proof barrier are the products in which only a specialized subcontractor possesses the detailed information. Architects request UDA for the subcontractors even in the early design phase to make their design scheme feasible.

5.1.2. The U.K. and the U.S. cases

Tables 2 and 3 indicate the results of the U.K./U.S. The columns show actual projects collected by the survey. The vertical axis shows the design teams based on the specialized profession or the UDA.

The task distribution in the U.K./U.S. is more segmented than in Japanese cases. Spec Writer was recognized. Building Permit Expediter and Planning Consultant was confirmed. Environmental Assessment and Sustainable Consultants were involved in almost all the projects. Compared to Japan, the social and governmental support for green buildings is expected. Mechanical engineers and plumbing engineers are classified as specialized professionals, and each engineer was independently responsible for their specialization.

Building Envelope and Curtain Wall Consultant was classified as the specialized profession which provides design and support services related to façade design, performance, cost, quality, durability, and project management.

BIM experts confirmed their participation in the project. The creation of design documents using BIM will require BIM experts’ involvement within the architect team until each architect can operate BIM software by themselves without the help. However, in a recent interview, some architects said that there were no designated BIM experts assigned to the project in ongoing projects because of the improvement of the architects’ ability.

One design firm in the U.K. shows cases of the UDA in Curtain Wall and Hardware. Considering the U.K. industry, it may be an exceptional case under the tacit understanding through the long-standing relationship between the design firm and the subcontractor. UDA was not confirmed in the other design firms in the U.K. No UDA was confirmed in the U.S.

There are unique consultants in the U.K. Quantity Surveyor in the U.K. who have a broader task and responsibility than Cost Consultants. Sometimes Quantity Surveyor is appointed by the client even before the architect. Their task is managing the overall cost of the project, and occasionally oversee the decision of Architects. The Cost Consultants, on the other hand, only estimates the cost of the architect’s design. They do not control the entire project from a cost perspective. The Party Wall consultant, a professional who investigates the ownership of the Party Wall between dwelling units in the Row Houses, is also a unique consult only exists in the U.K.

There are unique consultants in the U.S. as well. Pool Operation consultant and Toxic Material consultant were confirmed. The establishment of the unique profession is confirmed in a niche market for the specific building elements.

5.2. Unofficial design assist

5.2.1. Cases in vertical transportation

The UDA details were further researched to clarify the characteristics of the architectural projects’ task distribution in Japan. Additional interviews were conducted with the elevator subcontractors in Japan, which has already been established as a profession as a vertical transportation consultant in the U.K./U.S.

Many departments, such as sales, design, manufacturing, construction, and maintenance, provide consistent services from planning to operation. The elevator design process can be divided into two stages: pre-order and post-order. Before receiving an order, design for sales promotion purposes is mainly conducted by a design team, and manufacturing and construction teams are not involved. The order is undetermined at this pre-order stage, and non-paid UDA does not always lead to an order. Once the order is confirmed, the design for sales promotion was succeeded by the manufacturing team.

In the survey, the role and the responsibility in UDA were confirmed. All companies responded that the elevator subcontractor’s name should not be indicated in the drawings and specifications in UDA. Even the elevator design information is indicated on building permit documents, the name of the elevator subcontractor is not shown. It would be necessary to point out that the architects may prepare design drawings without a thorough understanding of the elevator’s details. All interviewees shared that if there were deficiencies in the design drawings or specifications, the responsibility would fall on the architects whose name appears
in the drawings. The information provided by UDA is just informal information without any responsibility.

The contents of the design information prepared by UDA were investigated. The design information provided to architects includes drawings (plan, elevation, cross-section, and detail drawings), specifications, analysis results (consideration of optimal speed, number of units for population, traffic calculations), presentation-related (creation of rendered image drawings), and cost-related (calculation of new construction costs and maintenance costs) materials. There was no predetermined format of design information in the UDA, but the design information was provided upon the architects’ requests. The process of UDA is quite dynamic rather than static. In particular, the analysis and preparation of drawings and specifications were linked to a series of changes. For example, the changes to the floor plan influence the capacity of staying on each floor. The number of the people staying on each floor impacted the shape of the elevator core. The change of the elevator core force to modify the floor plan. It was confirmed that the design information was updated continuously on UDA. Table 4 shows the cases of UDA based on the actual projects. The columns indicate the actual projects, and the vertical rows show the details of the UDA (Table 4).

UDA’s design information is very different depending on whether the product is ready-made with minor modifications or a custom-made. Smaller buildings with fewer floors served by fewer elevators have less uncertainty about how the elevators are utilized. In this case, ready-made products with minor modifications are often applied. The UDA period is short. A few requirements and constraints come from the architects to the subcontractor’s design team at the DD (Design Development) phase. The subcontractor’s feedback to the architects is quite limited until the end of the CD (Construction Document) phase.

On the other hand, custom-made products are often used in large buildings with a high degree of uncertainty about the number of floors and elevators. UDA starts at the early stage of the project like the SD (Schematic Design) phase and continues to the end of the CD. Architects provide various design requirements and constraints, and the design team in the subcontractor has to create and provide a variety of design information as UDA. Particularly in large office buildings, it is necessary to predict people’s movement from an urban perspective rather than a stand-alone building. The elevator subcontractor sometimes oversees the specific design information provided by the traffic consultant in the U.K./U.S. It was confirmed that widely analyzed design information is provided even from the planning stage.

The elevator subcontractor is providing design information generated by the UDA to the architects. Simultaneously, all interviewees confirmed that they were applying the design information obtained through UDA to develop their product. Typically, the elevator subcontractor’s design team does not have the opportunity to directly hear the client’s needs. Especially for the UDA of custom-made elevators, the architect informed the client’s specific needs, which cannot be satisfied by ready-made products. For example, the function to prevent pinching by an infrared sensor instead of a touch sensor, the function to facilitate access from each floor by installing an AED in the cage, the function to speed up operation by a variable speed mechanism, and the function to adjust between floors in a double-deck elevator were all requested by architects and led to product development of the new elevator.

Design information leading to product development may be obtained from the company’s own or an affiliate’s maintenance department as well. For example, feedback from users, such as sound and shaking, led to product improvements. The measures to prevent personal belongings from falling through the gap between the building and the elevator cage led to developing a clearance-less function. The additional batteries were installed for the temporary restoration operation system right after the Hanshin Awaji Earthquake disaster.

5.2.2. Unofficial design assist in the Japanese construction industry

The flow of design information and compensation differs depending on the countries. In Japan, the architect’s design information is submitted to the client based on the design service contract. The client submits the design information to the general contractor first and then to the subcontractor through the construction order. At the same time, UDA between the architect and the design team in the subcontractor exists. As a result, the architect gets design information from the subcontractor, such as drawings, specifications, analysis results, and costs, free of charge. In this diagram, there are no clear boundaries between design and construction like in the U.K./U.S. The subcontractor can actively incorporate input from the architect and the client into developing the new products and construction methods both in the design and construction phase. This demonstrates the circulation of design information in the construction industry, rooted in Japanese business practices. (Figure 2)

For comparison, a diagram of the U.K./U.S. is presented in Figure 3. The design information, such as drawing and specification, is submitted from the architect to the client. The architect receives compensation from the client, and the portion of the compensation is transferred to the consultants. Each consultant is a specialized
### Table 4. Cases of unofficial design assist by elevator subcontractors.

| Building Type | Office | Office | Hospital | Office | Office | Office | Office | Office | School | Residential | Residential | Residential | Residential |
|---------------|--------|--------|----------|--------|--------|--------|--------|--------|--------|-------------|-------------|-------------|-------------|
| Landing Floors| 58     | 35     | 17       | 23     | 18     | unknown | unknown | unknown | 15     | 10          | 14          | 5           |
| Number of EV  | 21     | 27     | 10       | 12     | 23     | 5       | unknown | unknown | 2      | 1           | 1           | 1           |
| Custom-made/Ready-made | Custom | Custom | Custom | Custom | Custom | Custom | Custom | Custom | Ready | Ready       | Ready       | Ready       | Ready       |
| New/Refurbishment | New | New | New | New | New | New | New | New | New     | Refurbishment | New | Refurbishment |
| Period of DA | Start  | SD     | CD       | SD     | CD     | CD     | CD     | CD     | CD     | CD          | CD          | CD          |
| Requirements and Constraints provided from Architects | Floor Plan Section | Floor Plan Section | Site Plan | Site Plan | Floor Plan | Floor Plan | Floor Plan | Floor Plan | Floor Plan | Floor Plan | Floor Plan | Floor Plan |
| DA provided to architects | Drawing | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
|                        | Specification | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
|                        | Analysis | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
|                        | Presentation | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
|                        | Cost | 东芝 | 三菱 | 三菱 | 日立 | 日立 | 东芝 | 三菱 | 三菱 | OTIS | OTIS | OTIS | OTIS |
profession and has established an independent status from the subcontractor. There is a clear separation between design and construction, and no close connection between consultant and subcontractor, especially in the design phase. It is a challenge for each consultant to keep up with the latest information on ongoing construction in such circumstances.

6. Conclusions

This paper clarified how the task distribution is extended in Japan’s architectural projects compared to the U.K./U.S. by focusing on UDA. The characteristics of the task distribution in design organizations in Japan are as follows:

- The distribution of tasks among the specialized profession is not as segmented as the U.K. and the U.S.
- Design teams of subcontractors are invited to form a design organization as UDA.

The characteristics of the Unofficial Design Assist in Japan are as follows:

- The design information, such as drawings, specifications, analysis results, and cost, are provided by the design team in a subcontractor to an architect free of charge.
- The subcontractor shall not be directly liable to the client for the provided design information.
- The subcontractor can actively incorporate input from the architect and the client into developing the new products and construction methods.

| Type of Elevator | Custom-made | Minor alteration | Ready-made |
|------------------|-------------|------------------|------------|
| Uncertainty      | high        | low              | none       |
| DA start         | SD          | DD               | none       |
| DA end           | end of CD   | end of CD        | none       |
| Period of DA     | long        | short            | none       |
| Requirements and Constraints provided from Architects | a lot | few | none |
| DA provided to Architects | a lot | few | none |

Figure 2. Flow of design information and compensation of UDA in Japan.

Figure 3. Flow of design information and compensation in the U.K./U.S.
This study confirms the practices of UDA among many subcontractors in Japan. Over the past two decades, many highly skilled construction workers in Japan have been retired, and the quality of newly constructed buildings is declining. Moreover, the utilization of ICT technologies, such as BIM, has been slow. It is essential to introduce ICT technologies, including BIM, and promote construction integration to maintain quality and productivity while practicing UDA. Compared to practices in the U.K. and the U.S., where design is carried out on a strictly contractual basis, Japan may have an advantage of the UDA, facilitating the front-loading design process in BIM. Needless to say, further research is required to verify. A comparative study of how the division of labor differs between CAD-based and BIM-based projects is also recommended.

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