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ORIGINAL ARTICLE

Proposal of Maintenance and Repair Works Focusing on Specialized Contractors

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***Abstract*:** According to the Construction Industry Act, constructors are classified into comprehensive constructors and specialized constructors. In this study, the authors surveyed the actual situations regarding the increase in demand for the maintenance and repair of deteriorated social infrastructure, the number of orders for maintenance and repair and the contract amount received by constructors in each capital range, based on statistical data analysis, questionnaires, and interviews. Then, it was found that most of general maintenance and repair works are undertaken by specialized constructors with a capital of 10 to 50 million yen. The authors also mentioned that it is desirable that (1) specialized constructors take central roles in maintenance and repair works, according to the government and public office demand law, (2) with this, it is possible to reduce the incompleteness of maintenance and repair works, and (3) design and construction are ordered together. On the other hand, it was pointed out that specialized constructors are required to possess not only technical expertise, but also the ability to manage all construction processes.

Keywords: specialized constructors, maintenance and repair works, the Law for Assuring Small to Medium Sized Companies Access to Public Sector Demand Orders, infrastructure management

1. INTRODUCTION

All construction works related to infrastructure are categorized as either “new construction” or “maintenance and repair works”. The “new construction” category covers the new construction of structures and facilities, as well as their extension and improvement. It also includes improvement and restoration works, as well as removal and demolition works that are necessitated by disaster. “Maintenance and repair works”, on the other hand, refer to construction work other than the new construction, and involves works that are carried out in order to maintain the original performance of existing structures and facilities, including recurring repair work, renovations, relocation work, disaster recovery work. Construction works that include both new construction and maintenance and repair works can be categorized appropriately depending on their primary purpose. Further, under the Construction Industry Act, construction companies that are contracted to undertake these works are categorized into general contractors and specialized contractors (subcontractors).

Maintenance and repair works, which are based on the structural characteristics, history of use,

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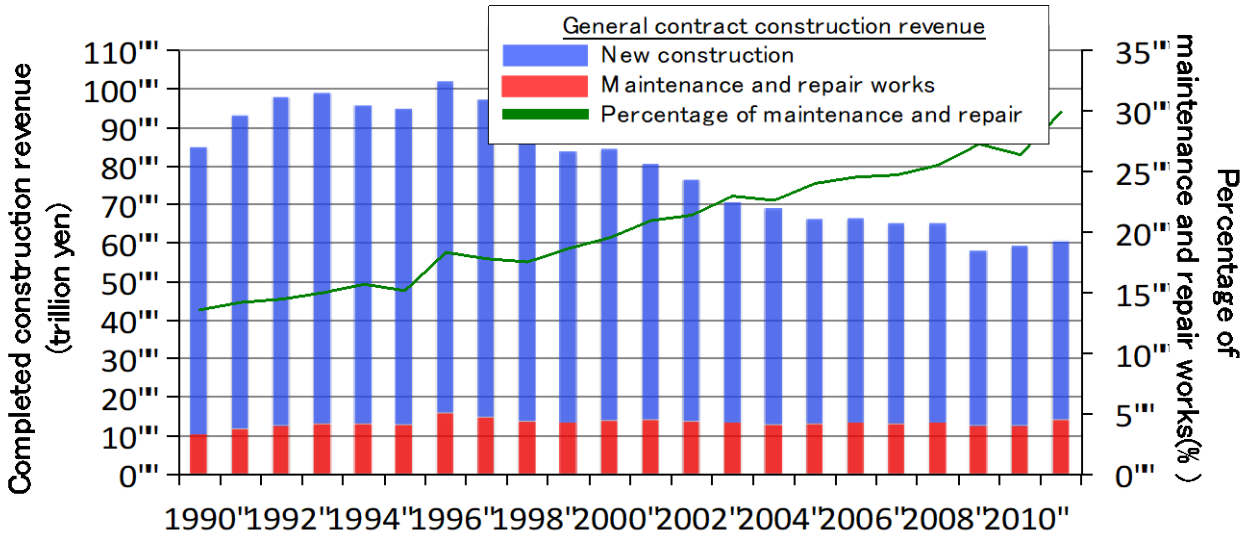
and environmental conditions of the infrastructure, and which take advantage of the experience and expertise of the contractor, call for skills and techniques that are different from those used on new constructions. For example, depending on the conditions of use and importance of the infrastructure, it is not uncommon in maintenance and repair works for live-line construction, where construction continues under its service, to be required. In light of these circumstances, and considering the urgency of recovery work in the wake of accidents or disasters, and the fact that, unlike new construction, maintenance and repair works are carried out on a small-scale decentralized basis, it can be anticipated that locally based small to medium sized companies, such as specialized contractors possessing a higher level of technique and skill, will play a central role in the implementation of maintenance and repair works going forward.

In addition, public works, such as the maintenance and repair of infrastructure, can also stimulate the economy. In fact, when carrying out maintenance and repair works, administrators have been applying the Law for Assuring Small to Medium Sized Companies Access to Public Sector Demand Orders (hereinafter, “Public Sector Demand Law”) in an effort to ensure that small to medium sized general and specialized construction companies are given the opportunity to successfully bid for orders. For example, by subdividing construction orders and stratifying these subdivided orders to match various levels of construction company capital, the administrators can allow a wider range of companies to have more fair opportunity when public bidding for projects. With the demand for maintenance and repair works being predicted to rise in the future, it can be anticipated that, out of all the small to medium scale local construction companies, it will be those specialized contractors that demonstrate the most outstanding skill and technique that will carry out the bulk of actual construction work. However, as far as the authors know, no previous study has dealt with the actual status and role of specialized contractors, or with the design of a system for implementing maintenance and repair works under the Public Sector Demand Law. In light of the above problems, this study shall examine specialized contractors to investigate the role they play in infrastructure maintenance and repair works, and the design of a system that supports their activities. Specifically, in addition to analyzing statistical survey data on the number and value of contracts for maintenance and repair works received by various construction companies divided according to their level of capital, the authors have conducted a fact-finding survey using questionnaires and interviews. Further, together with an investigation into the business structure of specialized contractors and the role they can be anticipated to play in maintenance and repair works, the authors will discuss what conditions and contract systems need to be put in place to enable specialized contractors to play a central role.

2. TRASITION FROM NEW CONSTRUCTION TO MAINTENANCE AND REPAIR WORKS

The Ministry of Land, Infrastructure and Transport (MLIT) has released figures estimating the future costs of infrastructure maintenance and repair works, which indicate that reconstruction costs in the fifty years between 2011 and 2060 will reach a total of 190 trillion yen. By contrast, Figure 1 shows changes in the actual expenditure on new constructions and on maintenance and repair works between 1990 and 2011. The figures in red indicate new constructions, and those in blue indicate maintenance and repair works, and it should be noted that both sets of figures reflect revenues from completed contracts with general contractors (i.e.

Figure 1. Revenues from completed contracts with general contractors, and changes in the percentage of maintenance and repair works



they do not for the most part include revenue from contracts undertaken by the specialized contractors that are the focus of this study). In addition, the Figure also shows what percentage of total revenue that general contractors received from completed contracts came from maintenance and repair works. In this paper, it is noted that the price is not fixed price but current one. Domestic investment in construction peaked at 82.8 trillion yen in 1996 before starting a steady decline, and is anticipated to drop to 50 trillion by FY 2013 (of which approximately 22 trillion represents public investment in construction). In addition, it can be seen that the percentage of general contractor revenue from completed contracts for maintenance and repair works reached 14% in FY 1990, 18% in FY 1998, 26% in FY 2008, and 30% in FY 2011. To relieve small to medium sized construction companies whose business has been hurt by the shrinking of the construction market, the MLIT has been supporting their expansion into the maintenance and repair market. In view of the important role these small to medium sized companies play in stimulating and strengthening the domestic economy, the Public Sector Demand Law has been devised with the aim of increasing the opportunities that small to medium sized companies have to win contracts for governmental and other projects. This is supported by the fact that contract values for maintenance and repair works increased about 0.5% annually until FY 1995 to reach 16 trillion yen in FY 1996, and thereafter, even in the midst of a decline in contract values for new construction, managed to hold at values ranging from 13 to 14 trillion yen. Further, while this will be discussed in more detail later, small to medium sized construction companies receive a higher proportion of their revenue from completed public works contracts for maintenance and repair works. If the authors take a look at the percentage of completed contract revenue that came from construction and maintenance/repair works in FY 2008, compared to the 15% of completed maintenance and repair works contracts that were worth more than 50 billion yen, the percentage of completed maintenance and repair works contracts worth less than 100 million was, at 49%, relatively high. Based on this kind of factual evidence, this research shall investigate the role that specialized contractors are set to play in maintenance and repair works, and the design of a system that will facilitate their anticipated role. As far as the authors know, no previous research has discussed

infrastructure maintenance and repair works with a focus on specialized contractors.

3. FACTUAL INVESTIGATION USING STATISTICAL SURVEY DATA

3.1 Assessing Project Performance and Business Status using Relative Comparison

Until 1959, specialized contractors had supplied labor to general contractors under the direct control construction system that was managed and supervised by the former Ministry of Construction. Later, with the transfer of the direct control management and supervision system from the former Ministry of Construction to general contractors, the work undertaken by specialized contractors came to be divided by industry under the guidance of general contractors. As the nation entered a period of strong economic growth and investment in construction started to expand, large-scale projects such as the Tokyo Olympics and highway construction got underway, and there was also a dramatic surge in the capital investment required for construction work. Specialized contractors responded by greatly expanded their own investments in construction materials and equipment under the direct control of general contractors. As a result, there was a corresponding increase in the percentage of construction investments going to subcontracting revenues and the ratio of subcontracting. The construction system that was made up of both general and specialized contractors (subcontractors), based on the type of contract, gave rise to complex contractual relationships such as the re-subcontracting of work to specialized contractors in order to complete projects following an increase in construction investment. These circumstances helped give rise to the multilayered subcontracting structure that exists today, and there was an increase in the proportion of contracted work that ended up being subcontracted.

Figure 2 shows changes in the percentage of subcontracted construction projects (subcontracted construction revenue and general contract construction revenue are shown in the bar graph). In the 1960s, between 19% and 29% of all construction projects were subcontracted, but the authors can observe that from the second half of the 1970s to the end of the 1980s, this proportion rose to almost 60%. As described above, this rise in the percentage of subcontracted projects was due to the fact that specialized contractors who had undertaken projects responded to increases in the volume of work by re-subcontracting work out to secondary subcontractors. Some of these secondary specialized contractors even chose to further subcontract work out to tertiary specialized contractors. These contractual relationships helped the industry to successfully absorb the hugely increased quantity of public works, and some specialized companies started to re-subcontract the majority of work undertaken to sub-subcontractors, and then devoted themselves exclusively to managing construction projects. As a result of these diverse forms of contracts and construction works, the proportion of work subcontracted to specialized companies continued to increase further still, reaching 69% in 1997. Following a gentle descent post-1997 in response to the drop in general contractor construction revenue (indicated in the graph by a solid blue line), by 2011 this proportion had decreased to 57% (this is the latest available data). The Figure also shows the amount of revenue from subcontracted construction. Overall this follows the same trends as that for general contract revenue, but a greater drop can be seen post-1997 compared to the slight drop in the percentage of subcontracted construction projects. Further, while general contract revenue started to show improvement from 2009, subcontract revenue continued to fall. These facts reveal that, although specialized contractors have

been undertaking an increasing volume of the actual construction labor, this increase has not been reflected in their revenues.

Figure 3 shows an analysis of trends in the profitability of the core business operations of two types of construction company by showing changes in their operating profit margin and average bid acceptance ratio: Level 1 shows construction companies with capital of over 1 billion yen (most of which are general contractors), and Level 2 shows specialized contractors, comprised of mostly subcontractors with capital of between 10 to 50 million yen (Level 2 includes sub-subcontractors). Operating profit margin, which is a profit ratio calculated by dividing operating profit by sales and multiplying by 100, can be used as an indicator to evaluate the profitability of core business. The operating profit margin of companies in Levels 1 and 2 peaked in FY 1991 and 1992 before going into a sudden decline. Since around 2001, the construction industry has undergone a wide range of legal reforms, including the enactment of the Act to Ensure the Quality of Public Works and the Act to Prevent Collusive Bidding, and the strengthening of the Act to Increase Propriety in Public Works Bidding and Contracting, and has developed a bidding system that is founded on the principle of transparent and fair competition. Moreover, in December 2005 the Japan Civil Engineering Contractors Association, together with the Japan Federation of Construction Contractors and the Building Contractors Society, sent a notice in the chairman's name to member companies entitled "On the Promotion of Fair Business Practice", in which it requested full compliance. The Association also resolved to part with old traditions to build a new business model, and in April 2006 it published guidelines entitled, "Toward a Transparent Bidding and Contracting System: Approach and Recommendations for Reform". Through the enforcement of these guidelines, the construction industry transitioned to a bidding system that was based on principles of fair competition. While this did put the industry under severe restraints, despite the sudden drop in the average bid acceptance ratio, the operating profit margin of Level 1 companies (the solid red line in the graph) has continued to rise, albeit slowly after 2002. However, by contrast, the operating profit margin of Level 2 companies (solid green line) remained in a state of steady stagnation or decline, dropping to less than 1.0% after 2008. If the authors look at the difference between the operating profit margins of companies in the two levels, compared to the difference that existed from the era of the bubble economy until 1997, the difference between the operating profit margin of companies in Levels 1 and 2 went on to increase remarkably thereafter. This is mainly because, as a means of increasing their operating profit margin, a dominant trend emerged whereby the general contractors in Level 1 started to select subcontractors based not on their construction expertise, but rather gave greater priority to low prices. In addition, in order to substantially reduce the amount of risk they incurred through undertaking subcontracting orders, it appears that the specialized contractors in Level 2 kept passing projects down the subcontracting hierarchy, thereby managing to barely secure an operating profit. Further, the reasons why the operating profit margins of general contractors showed relatively little fluctuation include the following: (1) Construction companies that operated mainly as general contractors strongly promoted internal control; (2) They selected desirable projects to bid on and made efforts with problematic projects; (3) In response to the soaring cost of labor and construction machinery, they requested that small to medium sized specialized contractors provide discounts that disregarded construction productivity; (4) They organized the centralized purchasing of petroleum products, iron, and construction materials.

Figure 2. Changes in percentage of completed subcontracted construction projects (and contract revenue)

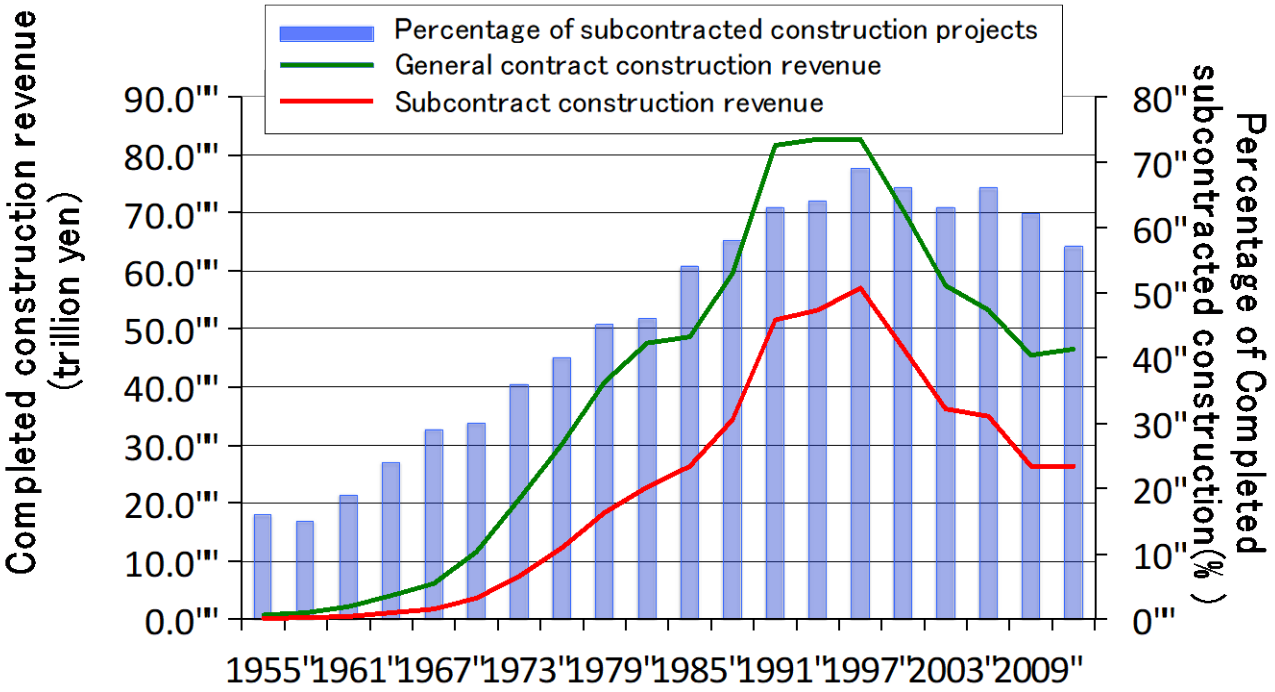
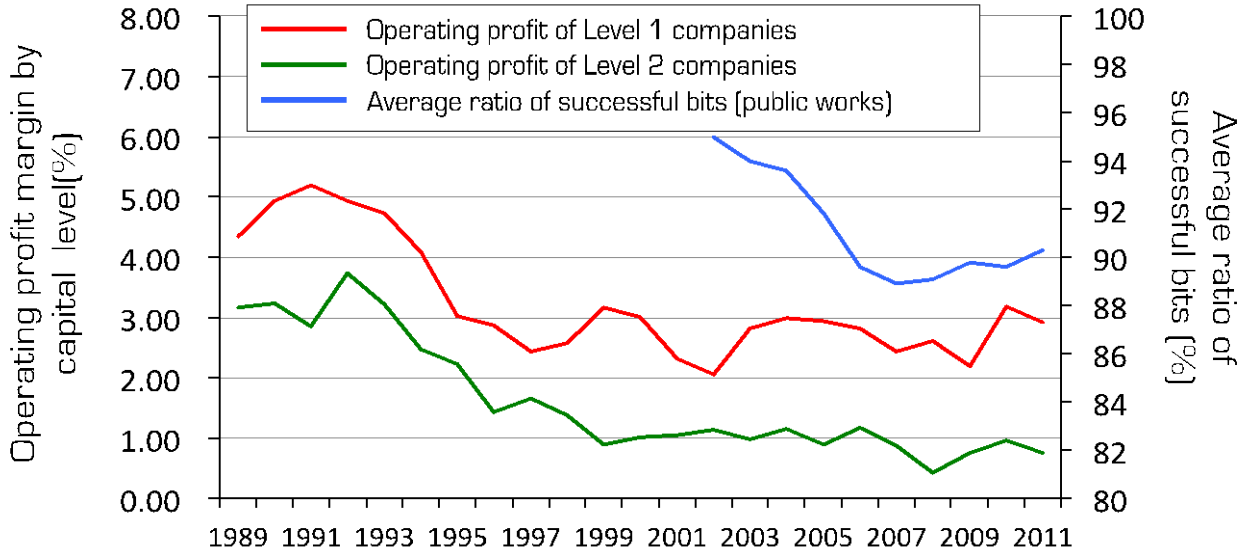


Figure 3. Changes in average ratio of successful bids and operating profit margin by capital level



In this way, general contractors have been able to avail of several administrative options that specialized contractors naturally do not have access to.

3.2 Orders Received by Level of Capital

Figures 4 through 7 compare the number of orders placed, and the contract values, for new construction and maintenance and repair of infrastructure in FY 2011, divided by the companies' level of capital (eight levels). By contrast to the 97,168 orders that were placed for new construction, with a total contract value of 7.0016 trillion yen, 36,263 orders were placed for maintenance and

Figure 4. Number of new construction orders
(FY 2011, by level of capital)

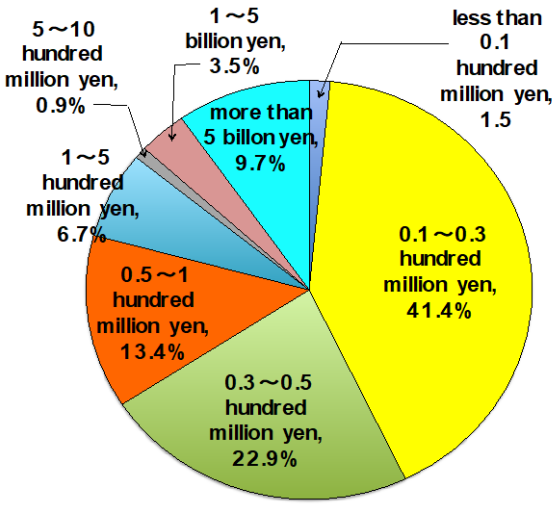


Figure 5. New construction Contract value
(FY 2011, by level of capital)

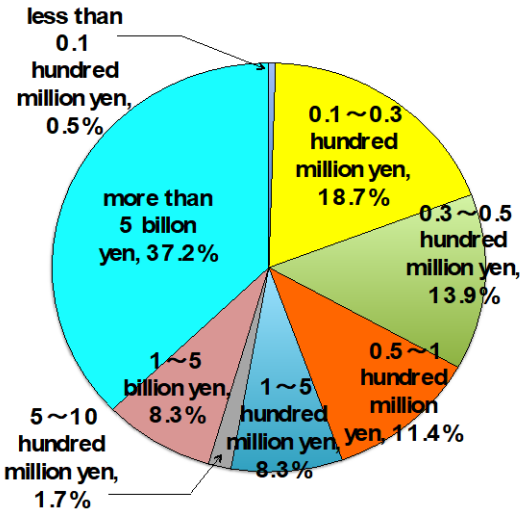


Figure 6. Number of
maintenance and repair works orders
(FY 2011, by level of capital)

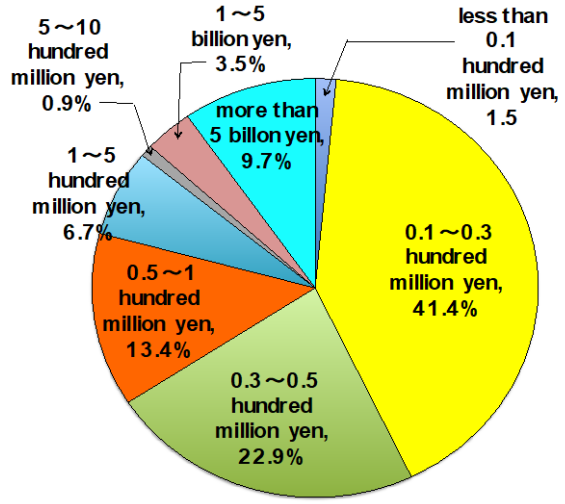
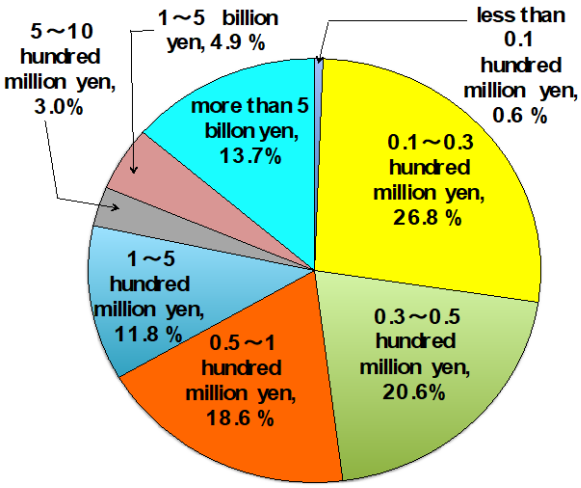


Figure 7. maintenance and repair works orders
Contract value
(FY 2011, by level of capital)



repair works, with a total contract value of 1.0002 trillion yen. When compared according to the companies' level of capital, it can be seen that construction companies with capital of between 10 million and less than 100 million yen received approximately 77% of the total number of orders for new construction, as shown in Figure 4; in particular, construction companies with capital of between 10 and less than 30 million yen received approximately 41% of orders. By contrast, construction companies with capital of over 100 million yen received fewer actual orders, with the highest share of 9.7% going to companies with more than 5 billion yen in capital. As shown in Figure 5, construction companies with capital of between 10 million and less than 100 million yen received approximately 44% of the total value of new construction contracts. Therein, companies with capital ranging from 10 to less than 30 million yen received approximately 19%. Companies with capital of 5 billion yen or more, on

the other hand, claimed approximately 37% of contract value, receiving a much greater share of contract remuneration compared to companies in the other categories. One trend identified in new construction work was that, compared to companies in other categories, construction companies with capital of 5 billion yen or more received a relatively low 10% or so of the total number of orders, but received approximately 37% of the total value of contracts (total contract value of 2.611 trillion yen from 9445 orders). Moreover, the simple average of the contract value per order was approximately 2.7644 billion yen, indicating that most of the projects undertaken were large-scale new constructions.

Turning our attention to trends in order numbers for maintenance and repair works, shown in Figure 6, it can be seen that construction companies with capital of between 10 million and less than 100 million yen received approximately 80% of the total number of orders. In particular, companies with capital ranging from 10 to less than 30 million yen received approximately 41% of orders. Companies with capital of 5 billion yen or more, on the other hand, received no more than approximately 6% of orders. The overall trends appear to be similar to those seen for the number of new construction orders (Figure 4). In terms of the value of maintenance and repair works contracts, shown in Figure 7, companies with capital of between 10 million and less than 100 million yen received approximately 66% of total contract value, with approximately 27% going to companies therein with capital in the range of 10 to 30 million yen. A relatively small percentage went to companies with capital of 500 million or more: companies in the highest range with capital of more than 5 billion yen took approximately 14%, and companies with capital of between 1 and 5 billion yen took approximately 5%. When the authors compare this with the data in Figure 5, it becomes clear that contract values for new construction projects and for maintenance and repair works projects show completely different trends. The simple average contract value per maintenance/repair works project was 64.7 million yen (out of a total contract value of 211.7 billion yen for a total of 2,117 projects). Maintenance and repair works are characterized by the fact that companies with capital of between 10 million and 100 million yen received the greater part of orders in terms of both numbers and value, and of them companies with capital of between 10 and less than 30 million yen were dominant. Needless to say, the majority of the specialized contractors under focus in this study belong to this category.

4. INVESTIGATION OF ORDERS RECEIVED BY CONSTRUCTION COMPANIES BY CONTRACT CATEGORY

4.1 Case studies showing number of orders by contract value

In Chapter 3, the authors investigated the number and value of orders for new construction and maintenance/repair of infrastructure originating from local government received by construction companies, which were categorized according to their level of capital. This investigation revealed that the majority of general maintenance and repair works orders (worth in the tens of millions of yen) went to specialized contractors with capital of between 10 and 50 million yen. It was also observed that, in order for major general contractors with capital of over 1 billion yen to assign business value to maintenance and repair works, the individual construction projects need to be larger in scale. The authors will now discuss the case studies the authors carried out in May and June 2013, in which the authors investigated the number of orders received by contract category in the five year period between

FY 2008 and FY 2012 by five companies selected from different ranges of capital, comprised of one major general contractor, one medium scale general contractor, two local general contractors, and one specialized mechanized construction contractor. Moreover, the investigation was limited to the number of orders for governmental public works projects for new constructions and repair and maintenance works, and private civilian projects and design changes to ongoing projects as well as overseas construction projects. Contracts were divided into eight categories according to their value, ranging from “50 million yen and under” to “5 billion yen and over”, and an investigation was done into the orders placed from each category.

4.2 Trends in number of orders received by five construction companies categorized by contract value

As can be seen in Figure 8, orders received by major general contractor Company A were well distributed between the eight contract value categories. However, the company received fewer orders belonging to the under 50 million yen category — as little as 6% — than it did orders from the 5 billion yen and over category. Moreover, these contracts merely covered miscellaneous works related to large-scale construction in central urban areas. At approximately 46%, almost half of its contracts fell into the 500 million to 3 billion yen value range. Similarly to Company A, mid-sized general contractor Company B, illustrated in Figure 9, received orders that were relatively evenly distributed between the eight value ranges, but the bulk of its orders, at approximately 59%, fell into the 100 million to under 1 billion yen range. Just 13% of its contracts were of under 50 million yen in value. Figure 10 reveals that approximately 78% of the contracts received by local general contractor Company C were in the under 50 million yen and 50 to 100 million yen value ranges, with approximately 31% being worth less than 50 million yen. The company received a balanced number of orders in the under 500 million yen ranges for new construction and maintenance/repair of infrastructure in mostly regional cities. Approximately 94% of the orders received by local general contractor Company D, detailed in Figure 11, belonged to the less than 50 million yen and 50 to 300 million yen ranges. At 56%, there was a particularly high number of orders in the 50 to under 100 million yen range. Specialized contractor Company E, shown in Figure 12, is in possession of its own human resources as well as materials and equipment centered around a regional city, and receives orders for new construction and repair/maintenance of infrastructure in its capacity as a subcontractor on a direct construction basis. Approximately 96% of its contracts were in the under 50 million yen and 50 to 300 million yen ranges, with the percentage of contracts in the former category reaching as high as approximately 60%.

This study involved a case study of these five general and specialized contractors. Although the sample was small, it can be considered large enough to grasp trends in order numbers. As has been shown, it is difficult for companies to undertake orders that do not correspond to the company’s scale as indicated by its amount of capital. In addition to the macro-trends seen in Chapter 3, the micro-trends observed in this study of five particular companies also indicate that, while major and mid-sized general contractors tend to receive more high-value contracts for new constructions, local general contractors and specialized contractors receive a greater share of orders for maintenance and repairs valued at less than 100 million yen.

Figure 8. Number of orders received by Company A by contract

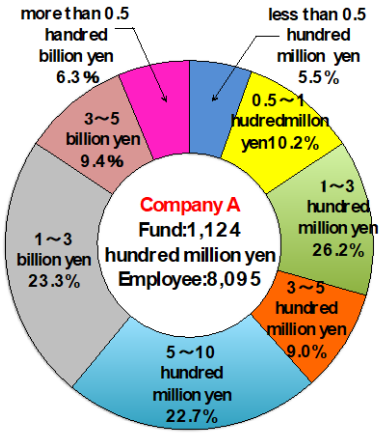


Figure 9. Number of orders received by Company B by contract value

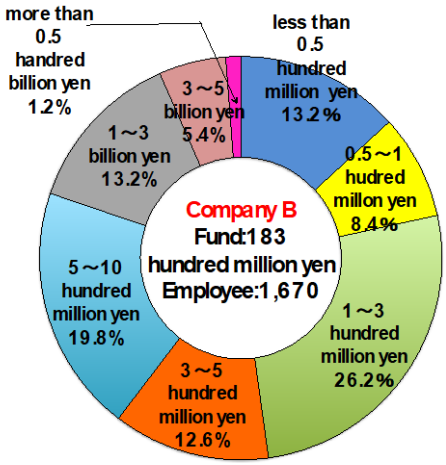


Figure 10. Number of orders received by Company C by contract value

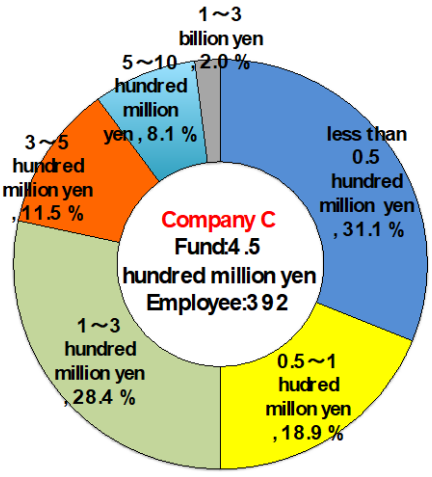


Figure 11. Number of orders received by Company D by contract value

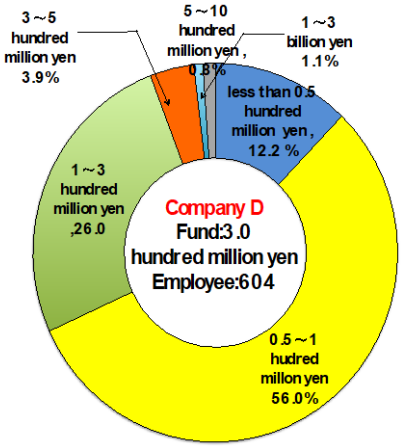
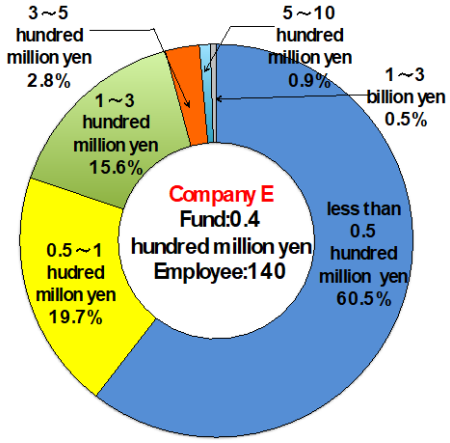


Figure 12. Number of orders received by Company E by contract



4. CONCLUSIONS

Through an investigation of infrastructure maintenance and repair works, with a particular focus on specialized contractors, this research explored the role that specialized contractors ought Figure 8. Number of orders received by large sized construction company by contract value to play going forward, and the design of a system to support that role. To begin, the authors analyzed changes in expenditure on new constructions and

maintenance/repair works, as well as the percentage of all projects that were comprised of maintenance/repair works, and showed that despite the reduction in expenditure on contracts for new constructions and construction investments, the volume of maintenance and repair works has continued to increase. Through statistical survey data analysis and case s Figure 9. Number of orders received by medium sized construction company by contract valuetudies, the authors found that the majority contracts for small-scale and decentralized projects, and that the construction companies that were best able to accommodate these projects were those with capital in the range of 10 to 100 million yen, of which the majority belong to the 10 to 50 million yen capital category. Further, it was pointed out that the application of the Public Sector Demand Law makes it difficult for maintenance and repair works to increase in size. Finally, the authors observed that, when the authors also consider the need to facilitate emergency inspections and repairs, and rapid responses to accidents and disasters, it becomes clear that it is locally based specialized contractors that are best positioned to carry out maintenance and repair works.

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