

The Effectiveness and Limitations of the PFI for a Water Utility: Case Study of the Kawai Purification Plant Reconstruction Project in Japan

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Abstract

This study investigates the reconstruction of the Kawai purification plant that supplies water treatment for the city of Yokohama in Japan. The purpose is to clarify the effectiveness and limitations of the so-called Private Finance Initiative (PFI) method, as applied to a water utility. The PFI method is said to demonstrate higher efficiency compared with traditional utility maintenance methods. The primary conclusion is that the use of the PFI method at the Kawai purification plant has not achieved a large cost reduction or value for money (VFM) as expected compared with other PFI water service projects in general or other PFI projects in Yokohama specifically. In other words, future bidders should bear in mind that excessive cost reductions are expected. The effectiveness of the PFI approach should, instead, be measured against the usefulness of the technical and management knowledge of the business partner, such as membrane filtration technology or the continuous operation of older facilities during the transition to new facilities and equipment.

Keywords: PFI method, Water Utility, Privatization methods

(1) Introduction

Water utility projects across Japan face many challenges, and several studies¹ have claimed that the introduction of the waterworks private finance initiative (PFI) approach can help address these (Amano, 2017; Kume et al., 2015; Takizawa, 2015; Hashimoto & Murata,

2017; Yoshimoto, 2018. The (PFI) method²— here, the "waterworks PFI method"— is said to offer greater efficiency compared with the conventional approach to public utility development projects, where local governments provide administrative services directly. This paper is an investigation and a clarification of

¹ Amano (2017), Kume et al. (2015), Takizawa (2015), Hashimoto & Murata (2017), Yoshimoto (2018).

² Defined by the Japanese Cabinet Office's Public Private Partnership/Private Finance Initiative (2017), the PFI method is "a method

of providing the same stand-ard of services at a lesser price or a higher quality of services for the same price through the application of private funding, management capability, and technical competence to public utility construction, operation & maintenance, and management."

the effectiveness and limitations of the PFI method, using the Yokohama City Kawai Water Treatment Plant Renovation Project (hereinafter referred to as the Kawai Project), the first project in Japan to adopt the PFI method, as a case study.

In 2006, the city of Yokohama formulated its "Long-Term Vision for the Yokohama Waterworks: A 10-Year Plan," with the "Yokohama City Waterworks Project Medium-Term Plan" dividing the longer term plan into three stages. The goal of the medium-term plan is sustainable waterworks management that utilizes the technical abilities and knowledge available to the city of Yokohama, based on societal trends and various needs of civic life (Kume et al., 2015)³. However, as its Kawai purification plant was faced with many issues⁴, Yokohama chose not to use the traditional utility maintenance approach but instead introduced the PFI method, which relies on business partners.

Existing research on the privatization and management of water services has looked at many of the issues facing the industry. Takizawa (2015) summarizes the issues local Japanese governments are facing in terms of their waterworks as well as the initiatives underway to address these. There have been a series of studies that examine the pros and cons, efficacy, and challenges of using privatization in resolving these issues, including the PFI approach (e.g., Obayashi, 2018; Kishimoto et al., 2018; Nakajima, 2018; Hashimoto & Murata, 2017; Watanabe, 2018). Like Hashimoto and Murata (2017), Kume (2014), Kume et al. (2015),

and Amano (2017) have also showcased case studies of the cities Yokohama and Yubari that applied the PFI approach to their waterworks. Thus, existing studies have summarized the various issues facing water service projects, examined multiple privatization methods, and spotlighted case studies.

However, most of the existing studies focus on pointing out problems, enlightenment by government officials, or only provide an overview of the project. In contrast to previous studies, this study is based on evidence and investigates the effectiveness of waterworks PFI implementation and the challenges associated with it. Specifically, it took up the Kawai project as Japan's first case study of PFI for waterworks, and investigated the outline of services and cost reductions that can realistically be expected through the PFI method. The analysis covered data and materials published by the City of Yokohama and the Ministry of Health, Labor and Welfare, as well as internal data and materials that are not available on the internet. Specifically, these are internal documents and data, including materials from the public hearing (Sep. 19, 2018, 13:30 to 15:30, Kawai Purification Plant). As Japan's first application of the PFI method to a waterworks project, the Kawai project has been positioned as cutting-edge by both Japan's Cabinet Office and its Ministry of Health, Labour and Welfare.

The rest of the paper is organized as follows. Section 2 provides an overview of the Kawai project, the background of the city of Yokohama's water services, and the differences

³ Kume et al. (2015).

⁴ Kume et al. (2015) and Watanabe et al. (2010) identified the issues as the degradation of water treatment capability due to facility

deterioration, declining efficiency from processing untreated water from different sources at a single filtration plant, and the need for facility earthquake-proofing.

between the traditional utility maintenance approach and the PFI method. Section 3 examines the effectiveness and limitations of the waterworks PFI method. Section 4 summarizes the results of the case study.

(2) Background: The Kawai project and the PFI method

1.The Yokohama waterworks projects and the Kawai purification plant⁵

Yokohama's water purification operations purify water at four locations: the Kawai, Tsurugamine, and Nishiya purification plants, which all use gravity flow systems, with the Doshi River and Lake Sagami as water sources; and the Kosuzume purification plant, which is pump-based. These facilities prioritize the use of water from gravity flow systems to minimize environmental impact and the cost of water intake, transportation, and purification, with minimal usage of pump-based systems.

However, all water from the gravity flow systems cannot be used because the facilities and equipment are deteriorating, thereby reducing their purification ability. Factors such as changes in water source quality also pose efficiency issues for processing untreated water from different sources at the same plant.

The Kawai purification plant is the oldest rapid filtration plant in Yokohama, with the Doshi River as its water source. The system has been in operation for 50 years, and during this time it has deteriorated. Prior to the plant's renovation, the facility used chemical clarification and rapid sand filtration methods. The water from the Doshi River is too clean and the amount of suspended matter too small to operate a flocculating clarifier; thus, the

system's ability to form sufficient flocculation for settling and removal is problematic. Additionally, seismic analysis has identified issues with the earthquake resilience of the primary equipment—the distribution reservoirs, the sedimentation basins, and filtration pools—pointing to the need for drastic renovations to the entire plant.

Against this backdrop, a plan was drafted for the complete renovation of the Kawai purification plant, introducing a membrane filtration system capable of processing the entire Doshi River system through effective use of water pressure. The facility would be reconstructed to contribute to the stable and continuous provision of good quality water. At the same time, a decision was made to eliminate unnecessary equipment and simplify operation and maintenance within the plant. The PFI water service method was chosen based on the need for greater capabilities to handle these updates, maintenance operations, and initiatives.

The target operations for the Kawai project were the filtration facility reconstruction – installing new equipment and removing old equipment—as well as facility operations and maintenance⁶(Kume et al., 2015). The project chose the build, transfer, operate (BTO) approach where business partners would construct and install new equipment, then operate and maintain it after the transfer of ownership to the city. The total project duration would be from April 2009 to the end of March 2033. Specifically, Stage 1 construction (removal of old equipment and installation of new equipment at each facility) lasted from April 2009 to March 2014; Stage 2 construction

⁵ Kume et al. (2015).

⁶ Yokohama Waterworks Bureau (2007).

(removal of old equipment and installation of new equipment at each facility) lasts from April 2014 to March 2017; and an operation and maintenance period from April 2014 to March 2033. The contract was valued at about 27.6 billion yen, with facility and equipment installation accounting for about 18.0 billion. Payment would be handled via the service transfer method, with the contract price distributed proportionately according to the work conducted throughout the project period.

The entire Kawai project, from planning and construction to operation and maintenance, was consigned to a given business partner in accordance with performance-based stipulations dependent on quantitative evaluations. The expectation was that this approach would reduce Yokohama's financial burden by 7% compared with commissioning work for individual projects piecemeal (Kume et al., 2015)⁷.

2. Differences between conventional public utility development methods and the PFI method

The city of Yokohama considered whether to employ a conventional public utility development method or the PFI method for the Kawai project. According to the Yokohama Waterworks Bureau (2008), the PFI method was chosen after a qualitative assessment's determined that project operations could be stabilized via optimal operations and maintenance service assessments and the identification of risk allocation. Moreover,

stability would continue to increase and government spending would eventually level out⁸.

Table 1 details the major features of each method in terms of implementation and bidding. For specific business activities, according to the Cabinet office, when the total costs of the service transfer fees paid to the business partner by the government are lower than the hypothesized total costs and quantified risks accompanying conventional public utility development methods, the PFI method offers value for money (VFM)⁹. If VFM is anticipated, then using the PFI method promotes ingenuity on the part of the business partner, blanket ordering, and the sharing of risk between the government and the business, reducing the public's financial responsibilities.

(3) Assessment results: effectiveness and limitations of the water service PFI method

In this chapter, the expected effectiveness and limitations of the PFI approach compared to traditional utility development methods are examined in three categories: cost reduction, service quality improvement, and risk allocation.

1. Cost reduction

The total Kawai project was consigned to a single business partner long-term in an integrated manner. The use of blanket ordering and performance ordering was expected to yield reductions in cost. In fact, a cost reduction of

⁷ Kume et al. (2015).

⁸ Yokohama Waterworks Bureau (2008).

⁹ Cabinet Office (2001) considers VFM to be

"the provision of services for the optimal value: payment ratio."

Table 1 *Conventional public utility development methods vs. the PFI method*

Method	Public utility	PFI
Implementation	The design, construction, operation & maintenance, and management of the facility are consigned piecemeal to private entities or undertaken directly by the public.	The design, construction, operation & maintenance, and management of the facility are handled in an integrated manner by the PFI firm over the long term. The public sector monitors and approves the master plan, imposes conditions, and monitors operations.
Bidding	Bidding by stage or work item: Bidding is divided by work stage or construction area; work is divided and ordered by item (civil engineering, construction, installation, etc.) Ordered to spec: The public sector drafts and presents a specification document detailing the construction method, materials, etc.	Blanket ordering: An integrated order for operation & maintenance, management, etc., is placed; work items are not divided between vendors. Performance ordering: The public sector presents basic performance targets for the facility, etc., and the business creates a plan and constructs the facility to fulfill these.
Business selection	Price-based bidding as a general rule.	Comprehensive assessment, taking price and proposal content into account.
Risk allocation	Determined upon consultation whenever risk is incurred, but fundamentally borne by the public sector.	Defined at time of contract; shared between the public and private sectors.
Funding	The public sector supplies funding via municipal bonds, subsidies, etc.	The private sector supplies funding from the market (the project financing method).

Source: Kume et al. (2015, p. 18), partially amended for clarity.

about 7% was expected for the Kawai project, Table 1: Public utility development methods vs. the PFI method with the total price of the

project estimated at 26,531,579,000 yen; representing a cost savings of about 1.1 billion yen (City of Yokohama, 2008a; Yokohama

Waterworks Bureau, 2008)¹⁰.

In the PFI method, project funding is supplied not through taxes or public funding, such as government securities, as with public utility development methods, but rather by the business partner. Under this arrangement, Yokohama merely makes regular service transfer fee payments to the business as predetermined compensation for the project. Therefore, the city does not need to issue bonds to install the new facility, leading to a leveling-off in government spending (Kume et al., 2015)¹¹. As Kume et al. (2015) point out, the reconstruction of the Kawai plant and the consequent closure of the Tsurugamine plant have produced a reduction in fixed administrative costs as well¹². This approach allows for the issuing of government grants through the BTO method with no property taxes levied¹³.

Additionally, the transition from traditional rapid filtration to the membrane filtration method reduces the amount of power used to treat each m³ of untreated water from 0.040 kWh to 0.024 kWh, lowering annual power costs from about 34 million yen to about 21 million yen¹⁴. The amount of condensing agent used per 1 m³ of untreated water fell from 0.0255 L to 0.0164 L, with annual chemical costs dropping from about 42 million to 27 million yen (City of Yokohama, 2016)¹⁵.

However, achieving these cost reductions reveals two major issues. First, while these utility and chemical cost reductions are expected to achieve a 7% overall VFM, the

adoption of the PFI method has other hidden costs. For example, with public utility development methods, funding is raised through municipal bonds, issued at an interest rate lower than the market rate or other sources of project funding, such as taxes. However, the PFI method incurs higher interest rates than municipal bonds, taxation, or other public funding options, as funds are raised by the partner by borrowing from financial institutions or others. Specifically, special purpose companies (SPC), such as banks or major corporations, lend funding at certain profitable interest rates. As the nature of the PFI method is private, details on the Kawai project funding are not available. However, if the business conducts fundraising, it is highly probable that it does so at an interest rate far higher than one that taxes or public fundraising would incur. Limiting the scope to operations and maintenance in the Kawai project, a "publicly built, privately owned" model applies, whereas, in a design-build-operate (DBO) system or a designated management system, Yokohama would undertake the "hardware" part of the project, such as facility and equipment installation, while the "software" side, such as operation and maintenance, would be entrusted to private enterprise. However, by consigning the project as a whole to private business, Yokohama expects fixed fundraising costs and a high VFM. Second, by evading the need to issue public bonds, the belief is that the negative impact on various financial indices¹⁶ applied to local governments throughout Japan, including

¹⁰ City of Yokohama (2008a) and Yokohama Waterworks Bureau (2008).

¹¹ Kume et al. (2015).

¹² Ibid.

¹³ Ibid.

¹⁴ City of Yokohama (2016).

¹⁵ Ibid.

¹⁶ When local governments issue municipal bonds allocated to public enterprises, their consolidated real deficit ratios, real debt service

Yokohama, would be avoided.

Although the PFI method has been shown to reduce certain costs, based on the overall Kawai water production costs post-project, it is difficult to say whether an overall reduction in costs was actually achieved. As a result of examining four water systems: the Sagami Lake system, the Ba'nyu River system, the Doshi River system (which encompasses the Kawai and Nishiya plants), and the district as a whole, the following was found. Specifically, according to Yokohama (2019), in the 2018 fiscal year, the cost of producing 1 m³ of treated water was 159.321 yen for the Doshi River system, 147.59 yen for the Lake Sagami system, 143.88 yen for the Ba'nyu River system, and 193.17 for the district overall, with an average of 170.51 yen. Chemical costs per 1 m³ of treated water were 0.61 yen for the Doshi River system, 1.81 yen for the Lake Sagami system, 1.78 yen for the Ba'nyu River system, and 0.04 yen for the district overall, for an average of 0.79 yen. However, commission costs were 20.8 yen per 1 m³ of treated water for the Doshi River system, 15.53 yen for the Lake Sagami system, 13.06 yen for the Ba'nyu River system, and 11.26 yen for the district as a whole, for an average of 13.76 yen. Interest paid totaled 11.54 yen per 1 m³ for the Doshi River system, 7.44 yen for the Lake Sagami system, 7.71 yen for the Ba'nyu River system, and 6.19 yen for the district, for an average of 7.44 yen.

In other words, for the Doshi River system (which encompasses the Kawai plant), chemical costs were less than for other systems, but commission payments and interest expenses were more. This result is associated with the

ratio, and future burden ratios as stipulated by the Fiscal Reconstruction Act suffer.

¹⁷ Cabinet Office (2001) considers VFM to be "the provision of services for the optimal value:

PFI method of consignment of specific duties to the private sector and the aforementioned higher interest rates incurred as the business needs to secure its own financing. While water production costs for the Doshi River system are ultimately lower than they are in the district, they are higher than those for the Lake Sagami or Ba'nyu River districts.

The second issue lies with VFM—the deciding factor in why PFI was chosen over a public utility for the Kawai project. VFM here includes not only the costs associated with the Kawai project's installation, development, operation, and maintenance, but also quality improvements gained from the project, represented in financial terms, as well as the benefits for Yokohama of reducing its risk; as well as the environmental impacts.

VFM is generally considered "the provision of services for the optimal value-to-payment ratio" for administrative services, such as the development, operation and maintenance, and certain facilities¹⁷. When the life cycle cost (LCC) for providing these administrative services is calculated and compared between conventional methods and the PFI approach, the method with the higher value-to-payment ratio is said to have VFM; and the other method is said to lack VFM. Comparing conventional methods with PFI and calculating VFM means examining both approaches to assess whether the public service quality from the project remains the same in both. The specific formula is as follows¹⁸:

$$\text{VFM} (\%) = (\text{Public utility project LCC} - \text{payment ratio})$$

¹⁸ From the Cabinet Office homepage (www8.cao.go.jp/pfi/pfi_jouhou/tebiki/kiso/kiso13_01.html; accessed Feb. 9, 2021).

PFILCC)/PublicutilityprojectLCC × 100
(1)

In formula (1), LCC is defined as income and expenditure over a defined project period, composed of planning and construction costs, operation and maintenance costs, interest, and national and local taxes. If the PFI method equates to lower costs than the conventional one, the PFI method is said to have VFM.

According to the PFI project Guidebook (2003) from the PFI Project Research committee, methods of calculating VFM "should include the quantification of risks not traditionally acknowledged explicitly; the optimization of risk allocation between the public and private sectors; the hedging of risk via insurance; the establishment of an appropriate cost reduction rate achievable by a private entity; a precise understanding of the conditions of loans borrowed from financial institutions; an understanding of issues within the system; and revisions of the system."

The Yokohama Waterworks Bureau (2007) states that the quantitative assessment of VFM for the Kawai project was calculated based on its expected groundbreaking costs, design costs, construction costs, construction administrative costs, operation and maintenance costs, insurance premiums, taxes, and monitoring costs to be borne by the public. The only fundraising approaches listed were bonds, self-financing, and bank loans. However, while operation and maintenance services, risk allocation, safety, and environmental impact as basic project concepts were listed as quantitative assessment items, these were not included in the VFM calculations. Therefore,

while VFM is supposed to be calculated from all items related to project costs, factors such as risk allocation, cutting-edge technology, and environmental impact were not included in its calculation for the PFI method.

In fact, according to part of the 2016 Environmental Accounting¹⁹ initiative, which quantifies environmental challenges as much as possible, not just for the Kawai project but also for waterworks in all of Yokohama, the sum total of waterworks projects in Yokohama in delivering tap water to consumers equated to (consumed) an environmental burden in terms of resources and energy of 132,188,000 kWh of electricity; 195,809 ℓ of fuel oil, gas, and kerosene; and 154,177 m³ of city gas and liquefied petroleum gas. Emissions totaled 72,538 t-CO₂ of carbon dioxide, 4,285 DS-t of waste soil from wastewater treatment, and 85,653 m³ of waste soil from waterworks operations.

To add environmental considerations to the calculation of VFM for the Kawai project, the following method could be used. For the Kawai project, Yokohama (2008b) established the level of performance it sought from its business partner and the level of service required for target operation and maintenance activities. One of the stipulated duties, "environmental consciousness," included "the utilization of unused energy, the adoption of energy conservation plans, recycling, measures to address the 'heat island' effect, and the limitation and reduction of greenhouse gas emissions"²⁰. Theoretically, a monetary amount representing the reduction in greenhouse gas emissions achieved by the

¹⁹ Yokohama Waterworks Bureau (2019), "*Yokohama no Suido 2018*" (Yokohama

Waterworks 2018)."

²⁰ City of Yokohama (2008b).

Kawai project, as well as the environment impact of each step of the project, should be added to the numerator of formula (1) used to calculate VFM.

In practice, for an accurate assessment, it is essential to determine the environmental impact of each step of the project via environmental performance indices and then add their economic value to the VFM calculation. Specifically, the differences in environmental performance indices, such as total energy expenditure, greenhouse gas emissions, and output of environmentally harmful substances before the start of the project and after its completion, must be calculated and converted to a monetary value (e.g., calculating the cost of carbon emissions through carbon pricing).

2. Service content

There are four primary elements expected in the Kawai project's service standards. The first is the use of a membrane filtration system in the purification plant (Kume et al., 2015)²¹ (21). This would be difficult for the Yokohama Waterworks Bureau to construct, but possible for a business partner with such technology. A business introducing proprietary membrane filtration technology would make sedimentation basins and filtration ponds unnecessary; additionally, space-saving construction could enable the existing water treatment facilities to remain in operation while renovations were conducted on the current site. (Other rapid filtration systems besides membrane filtration

would make it difficult to keep the existing facilities running during renovations.) The second is the use of potential energy²². Generally, membrane filtration systems require a significant amount of electricity to power the pump used for the high pressure difference at the membrane; however, at the Kawai plant, potential energy can be used due to the difference in elevation at the water supply conduit. The difference in elevation from the junction well along the water supply route (from the intake to the filtration plant) to the plant is 35 m; the water runs through a pipeline, and by the time it arrives at the filtration plant, pressure equivalent to 11.5 m remains. This pressure is used to conduct membrane filtration, whereon the water flows into the distribution reservoir.

The third expectation concerns water quality (Watanabe, 2010)²³. At the Kawai plant, the clean water standards required from the business partner are more severe than those imposed on drinking water. Quality standards for drinking water demand a standard plate count of no more than 100 per mL; no more than 3 mg/L of organic matter; turbidity of no more than 2°; and chromaticity of no more than 5°. However, the Kawai plant clean water quality standards require a general plate count of no more than 1 per mL; no more than 1 mg/L of organic matter; turbidity of no more than 0.01°, and chromaticity of no more than 1°.

The fourth expectation concerns the role of the business partner (City of Yokohama, 2008a)

²¹ Kume et al. (2015).

²² Yokohama Waterworks Bureau, " *Kawai Jyousujou Sai Seibi Jigyou niyoru Kankyou ni Hairyo sita Suido Sisutemu no Jistugen* (Creating an Environmentally-Conscious Water-works System through the Kawai

Purification Plant Renovation)" (Japan River Association homepage, www.japanriver.or.jp/taisyo/oubo_jyusyou/jyusyou_katudou/no17/no17_pdf/yokohama_city.pdf; accessed Feb. 13, 2021)

²³ Watanabe (2010).

²⁴ The city required a business partner for the Kawai project that would ensure that construction would be efficient, with effective new water purification equipment and facilities; a smooth transition to a membrane filtration system; and stable, uninterrupted provision of water, maintaining the required clean water quality standards during the operation and maintenance period. Thus, Yokohama imposed bidding requirements regarding membrane filtration equipment, manufacturing, and construction results (at least 1,000 m³ per day), membrane filtration equipment operation and maintenance (O&M) results (at least 1,000 m³ per day), membrane chemical scrubbing results (on-site cleansing), distribution reservoir construction results (at least 10,000 m³ of reservoir space), and overall ratings for operation inspections.

Furthermore, the Kawai project consigned facility management and operations, including responsibility for complying with Japan's Waterworks Act, to a third party, entrusting all the purification activities at the core of the water supply process to private enterprise. To address potential concerns ²⁵, the project required that the SPC have an internal, first-class water purification manager or a consulting engineer to oversee the water supply technology (City of Yokohama, 2008b; Kume et al., 2015; Watanabe et al., 2010).

While the project was appropriately implemented, the following two issues were identified with the service content. The first is in regard to the business envisioned as the city's partner. The Kawai project required that

potential bidders have a past track record with public works in Yokohama, significant expertise in and experience with water filtration projects and the required materials, among other aspects. The Kawai project was Japan's first genuine waterworks PFI project and, as the city of Yokohama was proactively pursuing a number of privatization projects, PFI and otherwise, many businesses were interested. However, despite successful project briefings and 2,710 inquiries from participants and potential partners, ultimately, only one business submitted a bid. Despite the single applicant, the Yokohama PFI Project Review Committee (2008) determined that the successful bidder's seven constituent enterprises had enough experience in the given tasks and gave the bid high marks. However, the experimental VFM factor analysis in Japan conducted by Ueno and Maeno (2010) indicates that many applicants are necessary to activate the competition principle, leading to lower prices and reduced expenses through lower construction costs, thereby achieving higher VFM.

Although, as mentioned, it is difficult to obtain information on PFI projects because they are private projects, there were confirmed the number of applicants and VFM results in the case of PFI water projects comparable to the Kawai project, as follows. For the Otokogawa purification plant renovation project, five groups applied, with VFM at the stage of selecting a business partner at 54.3%²⁶; for the Samukawa Purification & Wastewater Treatment Facility qualified project, three groups applied, with VFM at the stage of

²⁴ City of Yokohama (2008a).

²⁵ City of Yokohama (2008b), Kume et al. (2015); Watanabe et al. (2010).

²⁶ See Okazaki Waterworks Bureau (2012), "

Otokogawa Jyousuijyo Koushin Jigyuu Rakusatusya Ketei (Selecting the Winning Bid for the Otokogawa Purification Plant Renovation Project)."

selecting a business partner at 25.0%²⁷. For the Asaka purification plant and Misono purification plant/power plant renovation projects, as the winning bidder withdrew and the runner-up was awarded the contract, at least two groups applied, with the VFM at the stage of selecting a business partner at 11.2%²⁸; all of these projects with a higher VFM than that for the Kawai project.

In addition, although the targets were different from Kawai's project, VFMs were also confirmed at the stage of selecting a business partner for the following PFI projects in Yokohama City. The City of Yokohama High School of Science and Technology renovation project had seven applicants, with VFM at the stage of selecting a business partner at 40.1%²⁹; for the Totsuka Station west entrance redevelopment / temporary maintenance project, five groups applied, with VFM at the stage of selecting a business partner at 13.8%³⁰. Thus, based on these examples, the implication is that the participation of multiple applicants could have produced VFM beyond the 7% achieved in the Kawai project.

The second issue rests with the improvement

of service standards. While the Kawai project used the PFI method, a third-party consignment format was used to entrust further facility operation and maintenance to private enterprise, including responsibility for compliance with the Waterworks Act³¹. Yokohama also established detailed standards for earthquake-proofing and water quality. However, as project knowledge is key, the city of Yokohama needs to implement a project schema capable of extracting sufficient technology and management know-how from its business partner's creative forces.

The increase in the service transfer fees paid by the city to the business is determined as follows.

Formula: individual payment amount for O&M costs x 0.001 x bonus points³²

In terms of the "bonus points," exactly what constitutes "a significant contribution to the Yokohama waterworks or the city of Yokohama"³³ is not specified. Furthermore, while "the utilization of unused energy, the adoption of energy conservation plans, recycling,

²⁷ Kanagawa Prefectural Government homepage (<https://www.pref.kanagawa.jp/docs/n8g/management/samukawa.html>; accessed Feb. 9, 2021).

²⁸ See Tokyo Metropolitan Government Bureau of Waterworks (2001), "Asaka Jyousuijyou · Misono Jyousuijyou PFI Jigyō ni kakaru Keiyaku no Teiketu nituite (Contract Formation for the Asaka & Misono Purification Plants PFI Projects)."

²⁹ See City of Yokohama PFI Project Review Committee (2005), "Yokohama Siritu Kagaku Gijyutu Koutou Gakou (Kasyō) Seibi Jigyō Sinsa Kouhyō (City of Yokohama High School of Science & Technology Renovation Project Inspection & Review)."

³⁰ See City of Yokohama (2002), "Totsuka Eki Nishiguti Dai 1 Tiku Dai Nisyū Sigaiti Saikaihatsu Jigyō Kasetu Tenpo Seibi Tou Jigyō Yūsen Kōsuyōkensyū Sentei Ketuka Kouhyō (Totsuka Station West Entrance District No. 1 Category 2 Urban Development Project Provisional Development Priority Negotiator Selection Results Evaluation)."

³¹ See City of Yokohama (2009), "Kawai Jyousuijō Sai Seibi Jigyō Nyusatsu Setumei Syō Tenpu Shiryou 5 Jigyō Keiyaku Syō (An) (Kawai Purification Plant Renovation Project Bidding Manual Attachment 5: Project Contract Proposals)."

³² *ibid.*

³³ *ibid.*

measures to address the 'heat island' effect, and the limitation & reduction of greenhouse gas emissions" ³⁴ are cited as potential environmentally conscious measures for the Kawai project, it is unclear how these are measures or assessed, and ultimately, how much the service transfer fee should increase if they are met. Therefore, while Yokohama requires advanced technology, high water quality, and strong project continuity and stability, it needs to specify bonus points that reflect the provision of these services and the method of increasing the service transfer fee calculated thereby.

3. Risk allocation

In a PFI project, the risks of the project (acts of God, etc.) are distributed between the local government commissioning the work and the business submitting the successful bid. For the Kawai project, as with other PFI projects in general, risks for the "soft" and "hard" tasks, involving facility development, O&M, and general management, among others, are distributed between Yokohama and the business partner. Risk is allocated to each constituent based on the concept of "clarification of the hypothesized risk to the greatest extent possible, followed by allocation of the relevant risk to the parties most capable of assuming it"³⁵. "The parties most capable of assuming it" are the parties in charge of executing the task. Therefore, risk is allocated based on the tasks undertaken by each constituent.

However, the allocation of risk for each task is not precise, as water purification projects and

other waterworks projects demand continuity and stability. If a problem occurs, it is the local residents and businesses of Yokohama – the customers—who bear the greatest burden, not the city or its business partner; thus, in this case, culpability is irrelevant. Yokohama makes sure to minimize risk by ensuring a safety net not only through general PFI risk allocation, but also through a third-party outsourcing system for performance and cleanup activity issues at the time of bidding, and through direct contracts between Yokohama and financial institutions.

(4) Conclusion

This paper outlines the background of the introduction of the PFI approach in Japanese waterworks projects, using the Kawai Project as a case study, and discusses the expected benefits and limitations based on the practical evidence.

The key conclusions of this paper are as follows. First, compared with other waterwork PFI projects or other PFI projects undertaken by Yokohama, the Kawai water project has not realized commensurate VFM or cost reduction results. Of course, the content for PFI waterworks projects varies from project to project, and it would be misguided to conduct simplistic comparisons; however, all future bidders should recognize that excessive cost savings are expected. Second, the project demands sufficient utilization of the technological and management expertise that the business partner possesses in endeavors such as installing a membrane filtration system and keeping the old facility operational during the switch to new equipment. Finally, although

³⁴ *ibid.*

³⁵ See Cabinet Office (2000), "*Minkan Sikin Nado no Katuyou niyoru Kou Kyou Sisetu nado no Seibi nado ni kansuru Jigyou no Jisi ni*

kansuru Kihon Houshin (Basic Policy on Constructing Public Facilities by Utilizing Public Funds)."

Yokohama expects its business partner to consider environmental awareness as part of the service content, an assessment that takes this into account, as well as a payment scheme that provides an incentive to partners to achieve these goals, is still required.

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