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From the Editorial Board:

The Journal of Japanese Management (JJM) was first published in 2000 as an international journal in the field of management, publishing only English papers. In order to start this journal, significant contributions were made by Dr. Fangqi Xu, the first Editor-in-Chief, former professor of Kindai University, as well as directors of the Japan Federation of Management related Academies (JFMA); their contributions have been well-recognized and deeply appreciated.

We acknowledge that the publication of English journals is crucial and almost unavoidable to communicate with the academic community across the world. Over the long history of management studies in Japan, many papers would have made more extensive contributions toward developing management theories worldwide if they had been published in English. However, no matter how exceptional the papers are, the academic community outside Japan would have very few opportunities to access them if they are available only in Japanese.

Although some academic societies affiliated to the JFMA periodically allow their members to submit English papers, others have continued to publish papers only in Japanese, since they face certain challenges in establishing an appropriate review system. Therefore, this international journal is crucial for such academic societies, and accordingly, it has been positioned as one of the essential activities of JFMA.

This journal includes papers submitted by members of academic societies participating in JFMA or papers recommended by these societies. Although the submission process is somewhat different, both types of papers are accepted through a rigorous review process, and their quality is ensured.

The contributions of authors and reviewers of papers are indispensable for any academic journal. Specifically, a steady review process is made possible only with the dedicated support of anonymous reviewers. The outstanding contribution of these reviewers is greatly appreciated.

Finally, we hope that all the papers in this journal offer intellectual stimuli to our readers and contribute to developing various fields of management theory.

Editor-in-Chief, Journal of Japanese Management
Yutaka Ueda, Ph. D.
Professor of Management, Seikei University

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Improvement and Validation of a Model for Tourism Destination Brand Equity in Japan

Masaki Toyama
Shukutoku University
Japan Foundation for International Tourism
E-mail: toyama.masaki.sy@alumni.tsukuba.ac.jp

Abstract

As tourism is expected to be a driving force for the revitalization of local economies, tourism destinations are facing a severely competitive environment in attracting tourists. In this situation, increasing the brand equity of a destination is an effective strategy. To achieve this, it is important to compare the brand equity of a tourism destination with that of its own region. However, few brand equity models can be applied to different types of tourism destinations. Therefore, this study aimed to develop and validate an improved model for measuring tourism destination brand equity, which is intended to be applicable to different types of tourism destinations. We developed a destination brand equity model consisting of four factors: brand awareness, brand image, brand quality, and brand loyalty. The major improvement was in measuring the image of novelty so that brand image could be discriminated from brand quality. The results of the confirmatory factor analysis of data from a web-based questionnaire survey confirmed that the model fit the data well. We conducted a measurement invariance test using data on three types of destinations: beach destinations (Ishigaki Island), city destinations (Osaka), and hot spring destinations (Hakone). The results of the measurement invariance test for the three types of destinations confirmed that the model developed in this study showed partial metric invariance. In other words, the model developed in this study was found to have a factor structure applicable to multiple types of destinations.

Keywords: brand equity; destination marketing; novelty; measurement invariance; confirmatory factor analysis

(1) Introduction

Tourism is an activity related to a wide range of industries such as agriculture and fishery, as well as service industries such as transportation, accommodation, and food and beverage; therefore, consumption activities through tourism have a large economic impact. In 2019, tourism consumption in Japan was estimated to be 29.2 trillion yen, and the value-added effect generated by this was estimated to be 28.4 trillion yen, a figure equivalent to 5.3% of Japan's gross domestic product (GDP) of 561.3 trillion yen in 2019 (Japan Tourism Agency, 2021a).

Consumption activities through tourism also create new jobs. The estimates using the input-output table show that the data for 2019 indicated that tourism consumption would induce 4.56 million jobs on a nationwide scale (Japan Tourism Agency, 2021a). Against this background, tourism has been seen as a driving force for revitalizing local economies. In fact, many tourism destinations in Japan have been promoting initiatives to attract tourists. This indicates that the tourism business environment is highly competitive.

However, the tourism business was seriously damaged by the COVID-19 pandemic that occurred in 2020. According to the Japan Tourism Agency (2021b), Japan's tourism consumption in 2020 decreased by more than 60% compared to the previous year. Nevertheless, after the end of the pandemic, the tourism industry is expected to recover. Many experts at the United Nations World Tourism Organization (UNWTO) see international tourist numbers recovering to 2019 levels in 2024 or later (UNWTO, 2021). The tourism business in Japan is expected to recover to 2019 levels after 2023 under the most optimistic scenario (Phocuswright Research, 2021). In light of this, it can be seen that Japan's tourism destinations will continue to face a highly competitive environment in terms of attracting tourists.

In a competitive environment, increasing tourism destination brand equity is an effective strategy because strong brands with positive brand equity have the advantage of forming consumer preferences and the purchase intentions of consumers (Buil, de Chernatony and Martinez, 2008). Brands are also powerful differentiation tools (Boo, Busser and Baloglu, 2009). Based on Kotler and Keller (2006), whereby differentiation is a strategy for maintaining competitive advantage, it can be expected that increasing brand equity will increase the probability of triumphing in the competition to attract tourists.

It is important to measure the current performance of a tourism destination to increase destination brand equity. Measuring destination brand equity using consumers' subjective evaluations has become mainstream (Hyun and Kim, 2020). Research up to now has viewed brand equity as a concept divided into multiple components, such as "awareness," "image," or "quality" (Boo et al., 2009; Hyun and Kim, 2020; Konecnik and Gartner, 2007; Tasci, 2021). In other words, the brand equity of a certain tourism destination can be understood as an aggregate of consumers' evaluations of each component. Previous studies have attempted to identify the components of destination brand equity and elucidate the structural relationships among the components (Tasci, 2021). However, as discussed below, there are no established components of the destination brand equity.

Considering the nature of tourism destinations, they can be divided into several types based on their core tourism resources, such as nature and culture (Lin et al., 2007). A model for measuring destination brand equity that is applicable across different types of tourism destinations would allow the organization responsible for marketing tourism destinations (hereinafter referred to as DMO, which stands for Destination

Marketing Organization) to analyze the current performance of their brand equity in more detail through relative comparisons. However, very few studies have examined the measurement models of destination brand equity that can be applied to various types of tourism destinations. It is important from an academic perspective to examine this point, as it will confirm the scope of the application of the destination brand equity model.

Therefore, this study aims to develop and validate an improved model for measuring tourism destination brand equity applicable to different types of tourism destinations. The remainder of this paper is organized as follows. First, after reviewing previous studies, we present the tourism destination brand equity model used in this study. Next, we test the validity of the model for three types of tourism destinations using data from a web-based questionnaire survey. Finally, the discussion and conclusions of the study are presented.

(2) Literature review and improved model development

1. Destination brand equity model

To date, various definitions of brand equity have been proposed. The most representative definition is from Aaker (1991, p. 15): "a set of brand assets and liabilities linked to a brand, its name, and symbol, that add to or subtract from the value provided by a product or service to a firm and/or to that firm's customers." Keller (1993, p. 8) defines brand equity as "the differential effect of brand knowledge on consumer response to the marketing of the brand." Both definitions present brand equity as a value added to a brand through marketing activities. Specifically, Keller's (1993) definition emphasizes that a consumer's knowledge is the source of value. This study uses Aaker's (1991) definition of brand equity as a reference for the definition of destination brand equity because Aaker's (1991) definition is the most comprehensive and acceptable definitions of brand equity (Nyadzayo, Matanda and Ewing, 2016). In this study, destination brand equity refers to a set of brand assets and liabilities linked to a destination brand, its name, and symbol, that add to or subtract from the value provided by a destination to a firm and/or to that firm's customers.

Many concepts have been proposed as components of destination brand equity (Dedeoğlu et al., 2019; Tasci, 2021). Konecnik and Gartner (2007) proposed a model consisting of four components: brand awareness, brand image, brand quality, and brand loyalty. Boo et al. (2009) proposed another model comprising four components: brand awareness, brand experience, brand value, and brand loyalty. Dedeoğlu et al. (2019) proposed a model comprising six components: brand awareness, brand quality, brand value, brand trust, brand satisfaction, and brand loyalty.

However, there is no consensus regarding which components are appropriate. Within this context, this study proceeded in its investigation using the evaluation model of Konecnik and Gartner (2007), who were the first to use empirical research to measure destination brand equity. This is because Konecnik and Gartner's (2007) model is the most valid, as has been shown in subsequent studies (Ruzzier, Antoncic and Ruzier, 2014; Veríssimo et al., 2017; Yuwo, Ford and Purwanegara, 2013), to be applicable to other destinations. Nevertheless, it should be noted that the applicability to multiple types of destinations has not been examined.

As indicated earlier, Konecnik and Gartner (2007) stated that destination brand equity is composed of four dimensions: brand awareness, brand image, brand quality, and brand loyalty. These dimensions were also employed in this study. However, this study attempts to make improvements to clarify the difference in meaning between brand image and brand quality, which as described below is unclear.

Additionally, these four dimensions are similar to the brand equity model proposed by Aaker (1991). Aaker's (1991) model consists of five dimensions: brand awareness, brand association, perceived quality, brand loyalty, and other proprietary brand assets. Of these, the concepts of perceived quality and brand quality are the same, except that the names are slightly different. Brand association refers to the meaning of a brand to consumers, which is associated with the brand in their memory (Aaker, 1991). In previous studies (e.g., Bose, Roy and Tiwari, 2016; Jeon and Yoo, 2021), brand image and brand association are often regarded as almost the same concept. In summary, the baseline model of this study can be positioned as the model of Aaker (1991), excluding "other proprietary brand assets."

The following section reviews previous studies relating to dimensions contained in the model.

2. Brand awareness

Aaker (1991) stated that brand awareness is the combination of storage of the brand in the memory of a consumer and their ability to recover the memory of that particular brand. This study adopts this definition. In addition, brand awareness can be seen as a concept reflecting that brand characteristics remain in the minds of consumers (Aaker, 1996).

In the field of tourism research, awareness is considered one factor in a consumer's choice of tourism destination (Woodside and Lysonski, 1989). For example, to attract tourists to a tourism destination, it is first necessary to make consumers aware of the destination (Milman and Pizam, 1995). When consumers select a tourism destination, it is said that they often compile candidate destinations from which to choose (Sirakaya and Woodside, 2005), and in order to become a candidate the name and basic characteristics of the destination must be stored in the consumer's memory.

3. Brand image

Brand image refers to the feelings and perceptions linking consumers and brands (Keller, 2003). This study adopts this definition. Cai (2002) states that brand image is a critical element in the construction of a tourism destination brand. In research that measures destination brand equity, image evaluation has become indispensable. The concept of image is a major research theme in tourism studies. Since the 1970s, an enormous number of studies have been conducted on destination images (Pike, 2002). For destination brand equity measurement, a destination can be considered a type of brand, so destination image can be thought of as a concept similar to brand image.

In previous research (such as Boo et al., 2009; Konecnik and Gartner, 2007, etc.), brand image has been measured by consumers' subjective evaluations of various aspects of a destination. When attempting to measure evaluations of tourism resources and services provided at destinations, the risk exists that the distinction will be lost between brand image and brand quality, which will be reviewed in the next section. This is because brand quality is mainly measured as an evaluation of the experiences provided at the destination (Konecnik and Gartner, 2007). In fact, image and quality items are very similar in the model used by Konecnik and Gartner (2007).

To solve the above problem, this study does not evaluate concrete aspects such as tourism attractions and services; instead, it evaluates more abstract aspects. Specifically, it focuses on novelty, which indicates the extent to which the consumer has not yet experienced the destination. Novelty is one of the major motivations for travel, and it is also considered to be deeply associated with visiting specific destinations (Gitelson and Crompton, 1984; Goossens, 2000). Thus, the improvement of novelty has a positive impact on destination brands in terms of increased probability of visitation, and therefore, it was selected as a measurement component for brand image.

4. Brand quality

Brand quality refers to the quality of various aspects of a brand as perceived by the consumer (Boo et al., 2009; Keller, 2003). This study adopts this definition. Keller (2003) identified seven evaluation dimensions of brand quality: performance, features, conformation quality, reliability, durability, serviceability, and style and design. However, these classifications are put in place as brand evaluation concepts for general products and services. The concept of quality comes up even in the field of tourism research and is specifically interpreted as an evaluation of tourism resources located inside the destination and services experienced by tourists. For example, in a study by Chen and Tsai (2007) of resorts in Taiwan, the quality measurement items included restaurants, transportation, and beaches. To develop a model that can be applied to different types of tourism destinations, this study does not address the evaluation of natural and cultural tourism resources. Instead, we will measure the evaluation of service experiences, such as accommodation, food and beverage, and transportation, as elements common to all tourim destinations.

5. Brand loyalty

Brand loyalty refers to the frequency of repeat purchases of a brand or a consumer's attachment to the brand (Aaker, 1991; Pike and Bianchi, 2016). The former type of loyalty is called behavioral loyalty, while the latter type of loyalty is called attitudinal loyalty (Pike and Bianchi, 2016). In this study, brand loyalty is conceptualized as attitudinal loyalty.

Brand loyalty is considered a core element of brand equity (Aaker, 1991; Keller, 2003). Although up to the 2000s in the field of tourism research, little attention was paid to loyalty to tourism destinations (Konecnik and Gartner, 2007; Oppermann, 2000), it is currently considered a major component of destination brand equity (Boo et al., 2009; Dedeoğlu et al., 2019; Hyun and Kim 2020; Konecnik and Gartner, 2007, etc.). However, among the types of loyalty indicated above, the mainstream approach in previous studies is to measure attitudinal loyalty. Specifically, the main measurement item was the intention to revisit the destination under evaluation.

(3) Methodology

1. Study areas

This study examines a destination brand equity model applicable to multiple types of tourism destinations. Therefore, in this study, three typical destination types were considered: beach, city, and hot spring. To make it easier to collect responses, specific destinations that see a certain number of tourists were selected. The numbers of tourists were based on figures from the "Overnight Travel Statistics Survey" (Japan Tourism Agency, 2021c).

As a result, Ishigaki Island (Ishigaki City, Okinawa Prefecture) was selected as the beach destination, Osaka (Osaka City, Osaka Prefecture) was selected as the city destination, and Hakone (Hakone Town, Kanagawa Prefecture) was selected as the hot spring destination. Ishigaki Island is a remote island located in Okinawa Prefecture that features beautiful beaches. In 2021, the annual number of overnight guests on Ishigaki Island was 362,973 (Japan Tourism Agency 2021c). Osaka is the largest city in the Kansai area and is a popular destination for foreign tourists. In 2021, the annual number of overnight guests in Osaka was 7,782,125 (Japan Tourism Agency 2021c). Hakone is blessed with natural resources, such as hot springs and mountains, and is one of the leading hot spring destinations in Japan. In 2021, the annual number of overnight guests in Hakone was 1,189,135 (Japan Tourism Agency 2021c).

2. Data collection and sample

The data for this study were collected using a consumer panel provided by an Internet survey company. The survey was conducted in December 2021. The survey respondents were people aged 20 years or older who had visited Ishigaki, Osaka, or Hakone at least once in the past, for purposes other than returning home or on a business trip, and for a length of at least one night. There were 550 respondents for each destination, for a total of 1650. In other words, 550 respondents answered about Ishigaki, 550 about Osaka, and 550 about Hakone.

3. Questionnaire development

In this study, all components of the brand equity measurement model were used as constructs. Each construct was a latent variable and was assumed to be measurable using multiple indicators (observed variables) with measurement errors.

Questions regarding brand awareness were created using Boo et al. (2009) and Konecnik and Gartner (2007) as references. A total of three items were scored on a 7-point Likert scale (7 = *Agree* to 1 = *Disagree*). Questions regarding brand image were created with reference to Albaity and Melhem (2017), for which a total of three items were scored on a 7-point Likert scale (7 = *Agree* to 1 = *Disagree*). Questions regarding brand quality were created based on Chen and Tsai (2007) and Konecnik and Gartner (2007), for which a total of four items were scored on a 7-point Likert scale (7 = *Agree* to 1 = *Disagree*). Questions regarding brand loyalty were created with reference to Konecnik and Gartner (2007) and Pike and Bianchi (2016), for which a total of three items were scored on a 7-point Likert scale (7 = *Agree* to 1 = *Disagree*). See Table 6 for details of the above questions.

(4) Results and discussion

1. Profile of sample

Table 1 shows the attributes of the respondents. Regarding gender, there were more males than females for all destinations, while regarding age, the largest percentage of respondents were in their 60s or older for all destinations, and the smallest percentage was in their 20s. Regarding the number of visits, the largest percentage of respondents were once for Ishigaki and Hakone. However, the largest percentage of respondents were "10 or more" for Osaka.

2. Test of reliability and validity

The reliability and validity of each construct of the destination brand equity model were examined. In this study, all

Table 1 Respondent attributes

		Ishigaki Island (*N* = 550)		Osaka (*N* = 550)		Hakone (*N* = 550)	
		Number of Respondents	Composition Ratio	Number of Respondents	Composition Ratio	Number of Respondents	Composition Ratio
Gender	Male	374	68.00%	364	66.20%	418	76.00%
	Female	176	32.00%	186	33.80%	132	24.00%
Age	20 to 29	41	7.50%	23	4.20%	9	1.60%
	30 to 39	78	14.20%	69	12.50%	25	4.50%
	40 to 49	82	14.90%	118	21.50%	78	14.20%
	50 to 59	129	23.50%	182	33.10%	142	25.80%
	over 60s	220	40.00%	158	28.70%	296	53.80%
Number of visits	1	315	57.30%	127	23.10%	125	22.70%
	2	102	18.50%	92	16.70%	112	20.40%
	3	64	11.60%	82	14.90%	80	14.50%
	4	18	3.30%	24	4.40%	24	4.40%
	5	14	2.50%	32	5.80%	58	10.50%
	6~9	9	1.60%	41	7.50%	48	8.70%
	10 or more	28	5.10%	152	27.60%	103	18.70%

subsequent analyses were conducted using R version 4.1.2 and the packages "lavaan" and "semTools".

Reliability was tested using Cronbach's alpha and composite reliability (CR) values. Cronbach's alpha was calculated for the combined data of respondents from all destinations; all constructs exceeded the threshold of 0.7 (Hair et al., 2014) (see Table 2). CR was calculated by confirmatory factor analysis on the combined data of respondents from all destinations. The assumption for conducting confirmatory factor analysis was the multivariate normality of the data. Multivariate normality can be conveniently tested by checking the skewness and kurtosis of observed variables (Weston and Gore, 2006). The values of skewness and kurtosis of the observed variables were below the thresholds (absolute values of skewness > 3, absolute values of kurtosis > 10) for criteria of departure from normality (Weston and Gore, 2006). As a result of confirmatory factor analysis, the CR values for all constructs exceeded the desirable value of 0.6 (Bagozzi and Yi, 1988) (see Table 2). The above results confirmed the reliability of the constructs.

Table 2 Values of Cronbach's Alpha and CR

	Cronbach's alpha	CR
Brand awareness	0.834	0.844
Brand image	0.938	0.939
Brand quality	0.851	0.853
Brand loyalty	0.855	0.867

Next, two types of validity were tested: convergent and discriminant validity. The convergent validity of the constructs was tested by conducting a confirmatory factor analysis of the combined data of respondents from all destinations. Specifically, the factor loadings from each latent variable to the observed variables and the average variance extracted (AVE) were examined. The standardized factor loadings from each latent variable to the observed variables all exceeded the criterial value of 0.5 (Hair et al., 2014). In addition, the AVE of all latent variables exceeded the criterial value of 0.5 (Fornell and Larcker, 1981; Hair et al., 2014) (see Table 3). The above results confirmed the convergent validity of the constructs was. Furthermore, the criterion was satisfied that the value of AVE for each latent variable should be greater than the squared correlation coefficient between the constructs (Fornell and Larcker, 1981; Hair et al., 2014)

Table 3 Values of AVE and correlation coefficients

	Brand awareness	Brand image	Brand quality	Brand loyalty
Brand awareness	**0.645**			
Brand image	0.582	**0.838**		
Brand quality	0.581	0.733	**0.594**	
Brand loyalty	0.474	0.713	0.724	**0.688**

Note: Bold text indicates values of AVE.

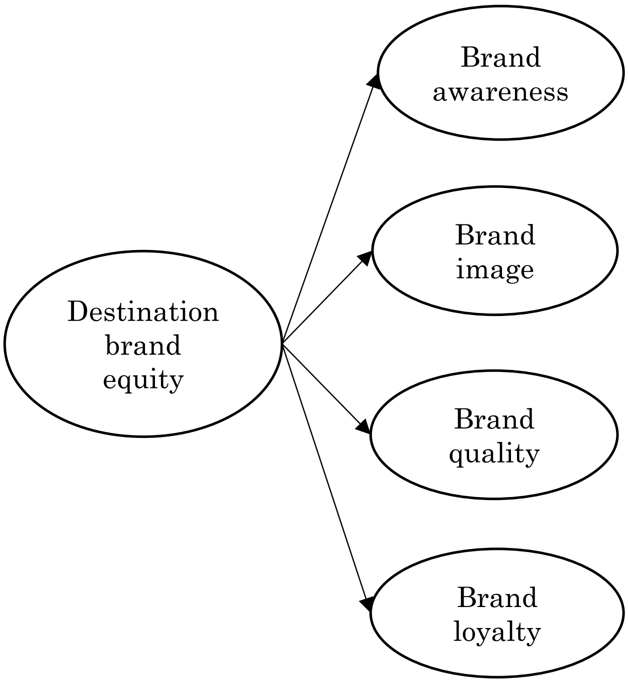

Figure 1 Higher-order factor model

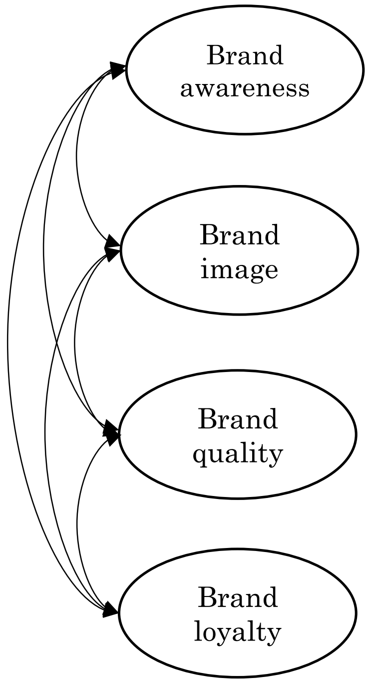

Figure 2 Four-factor model

Table 4 Comparison of the results of the two models

	χ^2	df	CFI	RMSEA	TLI	AIC
Higher-order factor model	698.577	59	0.957	0.081	0.945	55030.634
Four-factor model	726.612	61	0.959	0.081	0.945	55006.582

thus confirming discriminant validity (see Table 3).

3. Comparison of the higher-order factor model and four-factor model

The destination brand equity model proposed in this study can be theoretically expressed in two ways: the first is a model in which destination brand equity is set as a higher-order factor and brand awareness, brand image, brand quality, and brand loyalty are sub-factors (hereinafter referred to as the higher-order factor model). The second is a model in which the four sub-factors are interrelated (hereinafter referred to as the four-factor model). Figure 1 shows the higher-order factor model, and Figure 2 shows the four-factor model. In this study, confirmatory factor analysis of the combined data of respondents from all destinations was conducted on these two models to determine which model fit the data more adequately. The fit indices used to evaluate the model were χ^2 statistic, comparative fit index (CFI), root mean square error of approximation (RMSEA), and Tucker-lewis index (TLI), based on the recommendations of previous studies (Hair et al., 2014; Steenkamp and Baumgartner, 1998). We also used the Akaike information criterion (AIC) for multiple model comparisons (Weston and Gore, 2006).

Table 4 shows the results of confirmatory factor analysis for the two models. The results of the likelihood ratio test suggest that the four-factor model fits the data better than the higher-order factor model ($\Delta\chi^2$ (2) = 28.036, $p < 0.001$). In both models, the value of CFI was above 0.9, which is considered a good goodness-of-fit threshold (Hair et al., 2014). Comparing the two models, the four-factor model had a higher CFI value than the higher-order factor model. A higher CFI value indicates a higher goodness of fit, suggesting that the four-factor model fits the data better.

In both models, the RMSEA value was above 0.05, which is considered a high goodness-of-fit threshold (Hair et al., 2014). However, it was below 0.1, which may indicate a serious problem (Kline, 2016). Comparing the two models, the values of RMSEA were the same. In addition, the values of TLI were above 0.9, which is considered a good goodness-of-fit threshold (Hair et al., 2014). The values of TLI were the same in both the models.

Finally, the AIC values showed that the four-factor model was lower than the higher-order factor model. A lower AIC value indicates a higher goodness of fit. Additionally, a difference in AIC values of 10 or more indicates that the difference is significant (Taylor et al., 2014). In this study, the difference in the AIC between the two models was greater than 10. These results suggest that the four-factor model better fits the data.

From the above results, it was confirmed that the four-factor model fit the data better than the higher-order factor model. Therefore, the four-factor model was adopted for subsequent analyses. Since the higher-order factor model can exist when correlations between sub-factors are high (Dombrowski and Watkins, 2013), the better fit of the four-factor model to the data suggests that not all components of destination brand equity are highly correlated.

4. Test of measurement invariance

We tested measurement invariance to examine whether the destination brand equity model could be applied across different types of tourism destinations. Specifically, we conducted a multigroup confirmatory factor analysis of the four-factor model.

To compare the values of factor means across different populations, the following three criteria need to be met (Steenkamp and Baumgartner, 1998; Wang et al., 2018). The first is configural variance, which refers to the number of factors and their loading pattern being equal across populations (Wang et al., 2018). The second is metric invariance, which refers to the number of factors and loading pattern, as well as the factor loadings from latent variables to observed variables across populations that are also equal (Wang et al., 2018). The third is scalar invariance, which refers to the fact that the intercept of the observed variable is also equal across populations, in addition to metric invariance (Wang et al., 2018). If full metric invariance or scalar invariance is not possible, partial invariance is acceptable (Steenkamp and Baumgartner, 1998; Wang et al., 2018). Specifically, it is necessary that

Table 5 Results of measurement invariance analysis

	χ^2	df	CFI	RMSEA	TLI	AIC
Configural invariance model	809.870	177	0.960	0.081	0.947	53856.382
Metric invariance model	856.755	195	0.958	0.079	0.950	53867.353
Partial metric invariance model	822.602	189	0.960	0.078	0.950	53845.137
Partial scalar invariance model	1096.051	201	0.943	0.090	0.934	54095.084

at least two items of each latent variable have metric invariance or scalar invariance (Steenkamp and Baumgartner, 1998).

Based on the above criteria, we first examined whether configural invariance can be established among the three types of tourism destinations. The confirmatory factor analysis found that the values of CFI and TLI were above 0.9 while that of RMSEA was below 0.1, indicating that the goodness of fit index was acceptable (see Table 5). Next, we compared the configural invariance model with the metric invariance model. In the metric invariance model, the RMSEA value was lower than the configural invariance model, and the TLI value was higher than the configural invariance model (see Table 5). However, the CFI value was lower than the configural invariance model, and the AIC value was higher than the configural invariance model (see Table 5). The results of the likelihood ratio test also suggested that the configural invariance model was a better fit ($\Delta\chi^2$ (18) = 46.885, $p < 0.001$). To summarize these results, three of the five indices suggested that the configural invariance model fits the data better. Therefore, we concluded that the configural invariance model fits the data better than the metric variance model.

In light of the above decision, based on the method adopted by Steenkamp and Baumgartner (1998), we examined the observed variables to release the equality constraint of factor loadings with reference to the modification indices. As a result, we set up a partial metric invariance model that released the equality constraints for one item of brand awareness, one item of brand quality, and one item of brand loyalty (see Table 6).

We then compared the configural invariance model with the partial metric invariance model. In the partial metric invariance model, the TLI value was higher than the configural invariance model, and the CFI value was the same as the configural invariance model (see Table 5). Additionally, the partial metric variance model had lower values of RMSEA and AIC than the configural invariance model (see Table 5). The results of the likelihood ratio test also suggested that the partial metric invariance model fit the data better ($\Delta\chi^2$ (12) = 12.732, p = 0.389). To summarize these results, four of the five indices suggested that the partial metric invariance model fits the data better. Therefore, we concluded that the partial metric invariance model fits the data better than the configural variance model.

In addition, we compared the partial metric invariance model with the partial scalar invariance model, which releases the

Table 6 Factor loadings in the partial metric invariance model

Item	Unstandardized factor loadings		
	Ishigaki Island (beach destination)	Osaka (city destination)	Hakone (hot spring destination)
Brand awareness (3 items)			
(Name of destination) is well known as a travel destination	**0.838**	**0.988**	**0.763**
(Name of destination) has a good reputation as a travel destination	0.959	0.959	0.959
Characteristics of (name of destination) not found in any other countries come to mind	0.837	0.837	0.837
Brand image (3 items)			
I can experience new things in (name of destination) no matter how many times I visit	1.112	1.112	1.112
I can make new discoveries in (name of destination) no matter how many times I visit	1.163	1.163	1.163
(Name of destination) still feels fresh no matter how many times I visit	1.119	1.119	1.119
Brand quality (4 items)			
The quality of accommodations in (name of destination) is generally high.	**1.020**	**0.896**	**0.870**
The quality of restaurants in (name of destination) is generally high.	0.986	0.986	0.986
The quality of tourist facilities in (name of destination) is generally high.	1.048	1.048	1.048
(Name of destination) is easy to transport within the region.	0.873	0.873	0.873
Brand loyalty (3 items)			
(Name of destination) will always be my first candidate when planning a leisure trip	**1.203**	**1.295**	**1.154**
I want to visit (name of destination), even if the travel costs are somewhat high	1.176	1.176	1.176
I want to visit (name of destination) in the near future	0.905	0.905	0.905

Note: Bold text indicates items whose equality constraints are released.

equality constraint on the intercept of observed variables in the same way as the partial metric invariance model. The partial scalar invariance model resulted in lower values of CFI and TLI, and higher values of RMSEA and AIC than the partial metric invariance model (see Table 5). The results of the likelihood ratio test also suggested that partial metric invariance fits the data better ($\Delta\chi^2$ (12) = 273.449, $p < 0.001$).

Based on the results so far, it was confirmed that the model developed in this study was established up to partial metric invariance. Table 6 shows the factor loadings of the observed variables from each latent variable in the partial metric invariance model. The factor structure of the model developed in this study can be applied to all three types of destinations. In other words, regardless of the type of destination, destination brand equity may consist of four factors: brand awareness, brand image, brand quality, and brand loyalty. On the other hand, it is suggested that the model developed in this study is not suitable for comparing factor means among types of destinations.

(5) Conclusion

This study improved the tourism destination brand equity model in such a way that it can be applied across different tourism destination types and validated the model. With reference to previous studies, we developed a destination brand equity model consisting of four factors: brand awareness, brand image, brand quality, and brand loyalty. The major improvement was in measuring the image of novelty so that brand image could be discriminated from brand quality. The results of the confirmatory factor analysis confirmed that the developed model fits the data well. In addition, measurement invariance was tested for three destination types (beach, hot spring, and city), and it was confirmed that the factor structure of the model was common among the destination types.

The academic implications of this study are as follows. First, the factor structure of the tourism destination brand equity model was shown to be common among different types of destinations. Although there have been studies examining the invariance of the brand equity model for multiple tourism destinations of the same type (Boo et al., 2009), few studies have examined the applicability of the model across multiple types. This study is a new step forward for research on the application of the tourism destination brand equity model. Second, evaluation from a new perspective of novelty was employed to measure brand image, and the suitability of the measurement scale was confirmed. In the case of tourism destinations, measuring novelty as a measure of brand image may be useful.

The following points suggest the potential practical applicability of this study. First, it is important for DMOs to focus on improving the evaluation of the four elements of awareness, image, quality, and loyalty in order to increase the brand equity of their own region. Second, the model developed in this study is not currently suitable for comparing the evaluation scores of different types of tourism destinations, so it should be used to understand the changes in the destination brand equity in one's own region over time. Although it was not possible to examine this in this study, it may be possible to make comparisons among several tourism destinations if they are of the same tourism destination type. Future research is needed to confirm this hypothesis.

Finally, we discuss the limitations and challenges of this study. First, as mentioned earlier, the model developed in this study was not able to ensure scalar invariance. Further improvement of the model is needed in order to be able to compare brand equity ratings among different destination types. One way is to include new factors (e.g., brand trust and brand value) that were not employed in the model of this study. In addition, because of the research design, only three types of destinations were considered in this study. In the future, it will be necessary to examine the validity of the model developed in this study for other types of destinations, such as mountain destinations and historical destinations.

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

Ooshima Makoto
Association of International Arts and Science, Yokohama City University
E-mail:ooshima@yokohama-cu.ac.jp

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 studies[1] 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) method[2]—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 manage-ment."

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 issues[4], 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 degrada-tion 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 plant[5]

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 maintenance[6](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 out[8].

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

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7 Kume et al. (2015).

8 Yokohama Waterworks Bureau (2008).

9 Cabinet Office (2001) considers VFM to be "the provision of services for the op-timal 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 well[12]. This approach allows for the issuing of government grants through the BTO method with no property taxes levied[13].

Additionally, the transition from traditional rapid filtration to the membrane filtration method reduces the amount of power used to treat each m^3 of untreated water from 0.040 kWh to 0.024 kWh, lowering annual power costs from about 34 million yen to about 21 million yen[14]. The amount of condensing agent used per 1 m^3 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 indices[16] 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 m^3 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 m^3 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 m^3 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 m^3 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 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 facilities[17]. 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 follows[18]:

VFM （%） = (PublicutilityprojectLCC −

ratio, and future burden ra-tios as stipulated by the Fiscal Reconstruction Act suffer.

[17] Cabinet Office (2001) considers VFM to be "the provision of services for the op-timal value: 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 Accounting[19] 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 m^3 of city gas and liquefied petroleum gas. Emissions totaled 72,538 t-CO_2 of carbon dioxide, 4,285 DS-t of waste soil from wastewater treatment, and 85,653 m^3 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 energy[22]. 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 Jyousuijou 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 m^3 per day), membrane filtration equipment operation and maintenance (O&M) results (at least 1,000 m^3 per day), membrane chemical scrubbing results (on-site cleansing), distribution reservoir construction results (at least 10,000 m^3 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

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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 Jigyou 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 Act[31]. 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 points[32]

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,

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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 Jigyou 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 (Kasyou) Seibi Jigyou Sinsa Kouhyou* (City of Yokohama High School of Science & Technology Renovation Project Inspection & Review)."

30 See City of Yokohama (2002), " *Totuka Eki Nishiguti Dai 1 Tiku Dai Nisyu Sigaiti Saikaihatu Jigyou Kasetu Tenpo Seibi Tou Jigyou Yusen Kousyoukensya Sentei Ketuka Kouhyou* (Totsuka Station West Entrance District No. 1 Category 2 Urban Development Project Provisional Development Priority Negoti-ator Selection Results Evaluation)."

31 See City of Yokohama (2009), " *Kawai Jyousuijou Sai Seibi Jigyou Nyusatu Setumei Syo Tenpu Shiryou 5 Jigyou Keiyaku Syo* (*An*) (Kawai Purification Plant Renovation Project Bid-ding 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

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[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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