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What factors influence companies' design performance?

— Panel data analysis on Japanese electronics companies —

Keywords: design performance, technological capabilities, tenure

Abstract While the importance of design is highly focused on in today's international competition, the weakness of design in Japanese companies is seen as a problem. Although there has been much discussion in previous studies about how creating sophisticated design improves corporate performance, it has not been sufficiently clear what Japanese companies should do to create sophisticated design. Therefore, this paper uses the Good Design Awards as an indicator of good design and analyzes what elements of a company lead to the creation of good design. The analysis was based on a panel data analysis using 20 years of data from 14 companies that sell household electrical appliances to consumers. The results showed that up to a certain level, the higher the technological capabilities, the lower the design performance, but when the technological capabilities exceed a certain level, the design performance also increases. This study provides important insights into the relationship between design and technological development for Japanese companies to produce sophisticated designs and gain international competitiveness. 6263 words

1. Introduction

Nowadays the design of products is becoming increasingly important for companies. This study defines design as "the set of properties of an artifact, consisting of the discrete properties of the form (i.e., the aesthetics of the tangible good and | or service) and the function (i.e., its capabilities) together with the holistic properties of the integrated form and function (Luchs & Swan, 2011, p.338)." As industries become more sophisticated and internationalized, an increasing number of studies focus on design in various areas of business administration due to the fact there is a great chance for it to differentiate products towards customers (Hara & Tatsumoto, 2018).

However, it has been indicated that Japanese companies have fallen far behind in international competition in design (Washida, 2015). In the past, Japanese companies were highly competitive internationally owing to their successful integrated management of product development and production technology. In contrast, they have failed to shift to integrated management of design and design development which is currently necessary to enhance customer satisfaction (Nobeoka, 2015). In addition, designers are neglected in Japan, as opposed to the USA and China, hindering the realization of innovation (Washida, 2021).

To deal with this situation, based on discussions at the ‘Study Group on Industrial Competitiveness and Design’ held in 2017, the Ministry of Economy, Trade and Industry and the Japan Patent Office issued a 'design management' declaration in 2018, and in recent years the need to emphasize design in Japanese companies has begun to be recognized and well known. In fact, there are some companies switching their focus onto design; for example, Sony has been shifting its management policy to a “return to design” since 2014 (Nobeoka, 2015).

In response to this tendency, researches on design targeting Japanese companies have also been conducted (Morinaga, 2016). In such research, it has been clarified how they should manage their companies for creating marvelous designs (Kato, Kano, & Hosoi, 2021). However, few existing studies have explained what kind of companies can produce sophisticated design in terms of firm-level variables (Hara & Tatsumoto, 2018). Although it has been argued that design should be emphasized to improve company performance, at least in Japanese companies, there are not many studies that have quantitatively examined which characteristics enable companies to produce great designs.

This study, therefore, analyzes 20 years of panel data on Japanese companies to identify what kind of Japanese companies can produce great designs. Specifically, we

analyzed panel data from 14 companies selling consumer-oriented household electrical appliances, with the number of Good Design Awards received as the dependent variable. In particular, this study focuses on the factors that have been cited as leading Japanese companies to neglect design, such as the 'tendency to focus on technological capabilities' and 'inertia derived from past successful experiences' (e.g. Zhao & Sekine, 2018), to determine how these factors affect the design performance of the companies. The practical goal of this study is to clarify the direction that Japanese companies, which are said to be lagging behind in international design competition, should aim for, and to provide guidelines for them to raise international competitiveness.

The structure of this study is as follows. In the next section, we organize the research on design and existing research on the design of Japanese companies, leading to sharing the awareness of the issue this study tackles on. In the third section, hypotheses are developed on factors affecting the design performance of Japanese companies, based on the factors that are said to cause Japanese companies to neglect design. The fourth section explains the methodology and the fifth section describes the results of it. In the end, the sixth section provides a discussion, implications, and future tasks.

2. Theoretical Background

2-1. Design Research in Business Administration

Research about design began in the 1980s. Design is beginning to be seen as a way to gain a sustainable competitive advantage (Kotler & Rath, 1984), in recent years, design was also taken into account as the source of innovation and a means of branding in the intensifying international competition in the Fourth Industrial Revolution (e.g. Marsili & Salter, 2006).

Under this background, empirical research regarding design has been conducted in two directions. Firstly, the empirical research between design and its effect. This field demonstrates evidence on how design influences a company's financial performance and consumers. For instance, Hertenstein, Platt, & Veryzer (2005) found a positive relationship between effective industrial design and financial performance, and Chiva & Alegre (2009) clarified that investment in design will improve the company's financial performance. Besides, Design Council (2004) and Walsh & Roy (1985) have found certain effects, such as higher growth rates and stock price indices for companies that attach more importance to design compared to those that didn't pay so much attention to design. On the other hand, research mainly targeting consumers confirmed that product appearance could influence customer valuations (Yamamoto &

Lambert, 1994), and design would arouse consumers' expectations towards functions (Hoegg & Alba, 2011). The study mentioned demonstrated design was taken into consideration during the consumers' decision-making process. In addition, it was also found that novelty, typicality, and functionality have a positive effect (Mugge & Schoormans, 2012: Page & Herr, 2002: Veryzer & Hutchinson, 1998).

Another direction is empirical research on how management creates a great design. For example, Kotler & Rath (1984) suggested that designers should be involved from the earlier stages of product development. In addition, Lorenz (1990) indicates the need for heavy use of designers and design departments, as management should be more involved in design and allow design departments to play an active role.

2-2. Design Research in Japanese Companies

Such design studies have also been conducted on Japanese companies in recent years. Past studies have provided specific indications which are rooted in the unique circumstances of Japanese companies. It is said that Japanese companies originally tend to neglect design (Morinaga, 2005). Under these circumstances, there also have been discussions on how to produce sophisticated designs so far among Japanese companies. For instance, to produce impactful design, in addition to technology

development, the collaboration between designers and technicians is also effective (Akiike & Yoshioka, 2015), and in order to create innovative and unified design, it is effective to establish independence and autonomy of the design department, as well as to ensure that designers communicate mutually in diverse ways (Kanno, 2012).

However, despite these discussions, the tendency of Japanese companies to neglect design has remained constant until recent years. For example, Washida (2021) indicated that there is still a tendency in Japanese companies to disregard design, and this situation has to be changed. Similarly, Nobeoka (2015) indicates that new thinking is needed in product development, saying that the importance of enhancing product value should be reaffirmed by utilizing the design value perspective.

In order to resolve these issues, it is necessary to analyze what kind of Japanese companies can produce sophisticated designs and high design performance. Despite this, there is little quantitative research on what kind of companies can generate good designs (Hara & Tatsumoto, 2018). Even when limited to Japanese companies, there are studies that have clarified individual design processes, but few studies have dealt with and analyzed firm-level variables. In addition, there are many qualitative studies that focus on individual cases, and few studies that examine

quantitative factors. Therefore, the reality is that there has been little empirical research on the factors that lead to a company's ability to achieve design performance.

Based on the limitations of these existing studies, this study will conduct a quantitative analysis with the research question, "What kind of Japanese companies can improve their design performance?" By conducting this analysis, we aim to contribute to design research not only on existing Japanese companies but also on design research that is not confined to the context of Japanese companies.

3. Hypothesis Development

This study identifies the factors that Japanese companies need to improve their design performance. Then, this study will utilize the "problems of Japanese companies", indicated by existing research, as clues. These are the 'tendency to emphasize technological capabilities' and 'interia from past successful experiences'.

Many studies suggest that the reason why Japanese companies have come to neglect design is that they placed too much emphasis on their technological capabilities and engineering labor as they gained international competitiveness through rapid technological innovation after the period of high economic growth (e.g. Washida, 2021). Hatamura and Yoshikawa (2012) also indicate that Japanese companies have lost

competitiveness by relying on technological capabilities and giving top priority to technological aspects in product development, neglecting investment in other areas, including design. Considering these studies, it is possible that the more technology-oriented a company is, the more it neglects design, resulting in lower design performance.

However, on the other hand, it has also been shown that the relationship between the two could be positive. Adomako et al. (2021) indicate that investment in R&D is linked to high new product performance. With regard to product design, since the design of products that are widely accepted in an industry is determined by the accumulation of innovations (Abernathy and Utterback,1978: Clark and Fujimoto, 1990), it is also noted that highly regarded designs that become the industry standard are achieved through high technical capabilities. It has also been pointed out that a highly regarded design that becomes an industry standard is achieved through high technological capabilities (Ravasi and Ileana Stigliani, 2012). Indeed, Dyson, which is recognized for its design excellence, is committed to research and development and has publicly stated that it spends £7 million on research and development every week.

These conflicting results suggest the problem of a half-hearted technological orientation. In general, a tendency for design to be neglected as a result of the

emphasis on technology can be observed in Japanese companies. However, it has been suggested that if a company can truly focus on technology and create industry-leading innovations, it may also be able to produce designs that are highly valued as a result. Based on this idea, although technological competence reduces design performance up to a certain level, advanced technological competence conversely increases the likelihood of producing superior design. Therefore, we can make the following hypotheses.

H1: The relationship between a company's technological capability and design performance is U-shaped. The two are negatively related up to a certain level of technological capability, but they become positively correlated above that level.

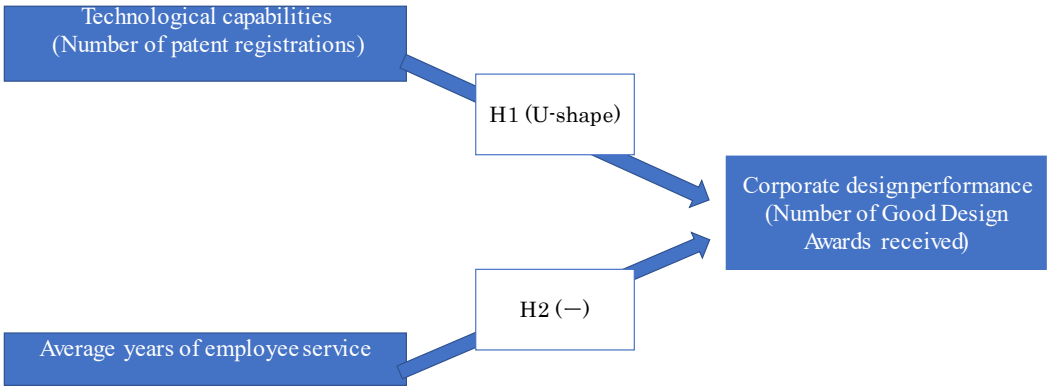
On the other hand, we focus on 'interia from past successful experiences', one of the factors that contribute to creating inertia in Japanese companies is lifetime employment and seniority systems (Okamoto, 2010). In addition, employees in Japanese companies tend to have a longer length of service than their counterparts overseas (Japan Institute for Labour Policy and Training, 2018). Employees who have long years of service experience are more likely to be averse to change (Iverson, 1996),

and then there is high risk for companies losing flexibility. In terms of the design argument, the original design-neglected culture of Japanese companies may become more fixed the longer employees have been with the company, making it more difficult for them to recognize its importance. Indeed, many managers reject innovation ideas proposed by designers and are often particularly reluctant to make decisions on things like design investments whose effects are difficult to measure in numbers (Washida, 2021). Furthermore, diversity is attracting attention as a source of new innovation (Ostergaard, Timmermans, & Kristinsson, 2011), but the long tenure of employees means that they are not hiring many mid-career employees, which implies that metabolism is not on progress. In other words, it is highly likely that long tenure leads to the disadvantage in terms of diversity and contributes to the difficulty in producing excellent designs. The following hypotheses can therefore be formulated.

H2: The longer an employee has been with the company, the lower the design performance.

The conceptual model with our hypothesis is graphically represented in Figure 1.

Figure 1：Conceptual Model



4. Hypothesis Testing（Methodology）

4-1. Data Selection

In testing the hypotheses posed in the previous section, this study focused on the Japanese household electrical equipment industry, and selected 14 companies as the subjects of the study: Panasonic, Sanyo Electric, Hitachi, Toshiba, Mitsubishi Electric, Sharp, Daikin, Sony, Canon, Seiko Epson, Fujitsu General, Casio, Zojirushi, and Fuji Film Holdings. The reason for selecting the household electrical appliance industry is that, although Japanese companies have been able to compete by expanding their functions and have achieved a certain degree of competitiveness, their competitiveness has declined markedly as product life cycles have matured, differentiation by function

has become more difficult, and product design has become more important worldwide. From among them, we selected 14 companies from the Nikkei Kaisha Joho DIGITAL database that sell BtoC products and for which we were able to obtain sufficient variables to test our hypotheses. The period covered was the 20-year period from 2002 to 2021, when the decline in the international position of Japanese companies occurred.

The first variable used was the number of Good Design Awards received as a numerical indicator of the evaluation of a company's design. The Good Design Awards is an award that recognizes and honors the quality of designs that fulfill some ideal or purpose, regardless of whether they have a form or not, and that improve our lives and society through design. This award data was collected from the materials published by the Japan Institute of Design Promotion, a public interest incorporated foundation that manages the awards, from its homepage (link?). Of the independent and control variables used, those related to corporate information were collected from securities reports, and those related to the number of patent, trademark, and design registrations were collected from the patent information platform J-PlatPat.

The analysis was a panel data analysis to capture the relationship between company characteristics and design creation over time and to determine what factors

in a company influence the creation of excellent designs. The panel data analysis is another important originality of this study, since, as mentioned earlier, existing studies have not also conducted quantitative analysis over time. In addition, the final number of observations is 263.

4-2. Dependent Variable

The dependent variable of this study is the total number of Good Design Awards won by each research target company over the past 20 years from 2002-2021. Two indicators that are sometimes used in research as a numerical measure of a company's design reputation are the number of design registrations and the number of design awards received.

According to Filitz, Henkel, and Tether (2015) and Yoshioka -Kobayashi, Watanabe (2016), design registration could be used as an indicator of innovation. However, there is a significant bias in the propensity of companies to apply for design, and many companies do not apply for it at all. On the other hand, design awards have a smaller bias in application propensity than designs, and are considered to be useful as an indicator of innovation (Kobayashi -Yoshioka and Akiike, 2017). Notably, a large

amount of data has been accumulated over the long time Japanese companies have applied. Moreover, not only does the judging committee consist of designers, but it also takes diverse data related to design activities with no limitation on the single product itself, which enables the judgment to be objective. Additionally, there is a system of recommendation by the judging committee, and awards are smaller than those for applications only. For these reasons, the Good Design Awards is considered useful for design-related innovation research (Hara, Yoshioka-Kobayashi, & Ashizawa, 2019). In addition, the Japan Institute of Design Promotion, which administers the Good Design Awards, officially publishes the data, making it highly reliable.

4-3. Independent Variable

Based on the hypotheses, the independent variables used in this study are "number of patents obtained" per company and year as a variable of technological capabilities and "average years of employee service" as a variable of firm inertia.

The number of patents is often used as a proxy indicator of technological capabilities (Natalicchio et al, 2022). Based on such studies, this study obtained the number of patents obtained in the previous year.

4-4. Control Variable

The natural logarithm of the number of employees, ROA, R&D intensity (R&D expenditures divided by sales), and the number of design registrations was used as control variables. The number of employees was input to control for the size of the firm, ROA for the firm's ability to generate profits, R&D intensity for the firm's ability to generate profits, and the number of design registrations for the firm's investment in design.

4-5. Model Specification

To test the hypotheses, this study employed a panel data analysis. This is because the objective of exploring universal factors that improve design performance requires information over time, and the results of the analysis should not be influenced by differences among companies when applied to different companies. To assess the differences between a fixed effects model and a random effects model, we performed a Hausman test and found that the null hypothesis—that no correlations exist between independent variables. and firm-level fixed effects ($p < 0.001$)—were rejected (Wooldridge, 2012). Thus, the fixed effects model was found to be more suitable.

Compared with the random effects model, the fixed effects model is also considered to be more effective in dealing with the potential bias derived from unobserved firm-specific heterogeneity (Halaby, 2004: Wooldridge, 2012). Therefore, we conducted a fixed effects ordinary least squares estimation (using "xtreg, fe" in Stata 15.0). Also, the independent and control variables were lagged by one year to minimize endogeneity issues and an age dummy variable is introduced to control for unexpected increases or decreases in the dependent variable in a particular year.

4-6. Results

The main descriptive statistics of the variables are shown in Table 1. The correlation table for each variable is shown in Table 2, and the empirical results of the fixed effects model are shown in Table 3. As reported in Table 2, the correlation matrix confirms that some of the correlation coefficients among the predictors exceed the threshold value of 0.50. The variance inflation factor values of all the explanatory variables are below the threshold of 5 (Hair et al.,1998), suggesting that multicollinearity is not a critical statistical issue in our sample.

First, Hypothesis 1 is tested. Model 2 shows the relationship between the number of patents and the number of Good Design Awards received, but was rejected

because the p value exceeded 0.05 for the number of patents as an independent variable. However, Model 3, which includes the number of patents and the square of the number of patents as independent variables, is significant because both p values are below 0.05. The coefficient is positive for the number of patent registrations and negative for the square of the number of patent registrations, indicating a U-shaped relationship between the Good Design Awards on the Y axis and the number of patents on the X axis in the first quadrant. This indicates a U-shaped relationship between the Good Design Awards on the Y-axis and the number of patents on the X-axis in the first quadrant. Therefore, Hypothesis 1 is indicated regarding the relationship between a firm's technological capability and design performance.

Next, hypothesis 2 is tested. In Model 4, where the number of years of employee service was included as an independent variable, the p value for the independent variable of years of service exceeded 0.05. Therefore, the relationship between the number of Good Design Awards obtained and the number of years of employee service indicated by this model was not significant. Therefore, Hypothesis 2, which states that longer employee tenure leads to less flexibility for firms to switch to a design focus and lower design performance, is rejected.

Table 1 : Descriptive Statistics

# Variable	Mean	Std. Dev.	Min	Max
1 Number of Good Design Awards received	14.973	19.928	0.000	103.000
2 Number of patent registrations(t-1)	4336.141	3396.730	9.000	13729.000
3 Average years of employee service(t-1)	18.442	2.259	13.900	23.300
4 Number of Employees(log)(t-1)	10.992	1.579	6.770	12.860
5 ROA(t-1)	2.955	4.919	-23.190	15.540
6 R&D intensity (t-1)	4.934	2.008	0.395	9.491
7 Number of registered designs(t-1)	206.692	202.579	0.000	946.000

Table 2 : Correlation Matrix

# Variables	1	2	3	4	5	6	7
1 Number of Good Design Awards received	1.000						
2 Number of patent registrations(t-1)	0.125 *	1.000					
3 Average years of employee service(t-1)	0.503 ***	-0.035	1.000				
4 Number of Employees(log)(t-1)	0.413 ***	0.554 ***	0.348 ***	1.000			
5 ROA(t-1)	-0.140 *	-0.164 **	-0.225 ***	-0.193 **	1.000		
6 R&D intensity (t-1)	0.369 ***	0.478 ***	0.230 ***	0.658 ***	-0.163 **	1.000	
7 Number of registered designs (t-1)	0.250 ***	0.588 ***	0.198 **	0.466 ***	-0.360 ***	0.141 *	1.000

Note(s): ***p < 0.001, **p < 0.01, *p < 0.05, and † p< 0.1

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Number of Employees(log)(t-1)	23.218	5.491 ***	25.399	5.667 ***	20.970	5.599 ***	23.213	5.508 ***	20.870	5.592 ***
ROA(t-1)	1.533	0.940	1.578	0.938 †	1.479	0.908	1.535	0.946	1.351	0.913
R&D intensity (t-1)	3.256	2.724	3.548	2.723	4.513	2.648	3.272	2.848	3.579	2.747
Number of registered designs(t-1)	-2.331	0.997 *	-1.017	1.326	-1.108	1.285	-2.326	1.031 *	-1.419	1.306
Number of patent registrations(t-1)			-3.186	2.130	-8.484	2.452 **			-9.056	2.491 ***
Number of patent registrations(squared) (t-1)					3.451	0.865 ***			3.792	0.905 ***
Average years of employee service(t-1)							0.025	1.235	-1.568	1.246
R-squared	0.231		0.239		0.289		0.231		0.294	
F-value	2.960***		2.940***		3.650***		2.820***		3.580***	

Note(s):All models include firm effects, year effects.***p<0.001,**p<0.01,*p<0.05,and †p<0.1

Table 3 : Panel Data Analysis Results

Analysis on patent registrations and Average years of employee service

4-7. Additional Analysis

To clarify the robustness of this model, we additionally analyzed ROA as the dependent variable and the number of Good Design Awards received as the independent variable. In general, design performance has been shown to be correlated with company performance (Whyte, Jennifer, et al., 2003). However, there are few studies that quantitatively correlate design performance with corporate performance in Japanese companies, even though companies that have created excellent designs have been taken up as success stories. If design performance is not related to corporate performance, it is possible that Japanese companies are not required to design well in the first place. To confirm the practical value of this study, we checked design performance and company performance.

The results showed that the more Good Design Awards a company had received in the previous year, the higher its ROA (Table 4). Since there was no relationship that the higher the ROA in the previous year, the more Good Design Award can be obtained, it can be seen that the number of Good Design Award received affects ROA, but ROA has no effect on the number of Good Design Award received. Furthermore, this relationship did not emerge in the analysis using the international design awards

IDEA and IF as independent variables, it can be assumed that the Good Design Award was a good indicator of design performance in this study.

Table 4：ROA

	Model 6		Model 7	
	Coef.	Std. Err.	Coef.	Std. Err.
Number of patent registrations(t-1)	0.129	0.896	0.520	0.903
Number of patent registrations(squared) (t-1)	0.315	0.325	0.124	0.332
Average years of employee service(t-1)	-0.697	0.445	-0.613	0.442
Number of Employees(log)(t-1)	-0.844	2.016	-2.563	2.129
R&D intensity (t-1)	-1.802	0.972 †	-1.920	0.964 *
Number of registered designs(t-1)	-1.251	0.469 **	-1.137	0.467 *
Number of Good Design Awards received(t-1)			1.181	0.508 *
R-squared	0.468		0.480	
F-value	7.830***		7.890***	

Note(s):All models include firm effects,year effects and industry effects.***p<0.001,**p<0.01,*p<0.05,and †p<0.

5. Discussion

This study revealed the characteristics of Japanese companies that produce sophisticated designs by the analysis targeting the household electrical appliances industry.

First of all, a U-shaped relationship between technological capability and design performance was found. This result contradicts existing research (Washio, 2021), which has regarded the relationship between them as a simple trade-off. Certainly, an emphasis on technology tends to reduce design performance. However, it can also improve design performance by developing technical ability extremely.

Therefore, the results imply that Japanese companies do not necessarily need to change their technology-oriented attitude. Further refining their technological capabilities may enable them to produce more sophisticated designs including functionality. Furthermore, considering existing research, such as the one that implies the possibility of having an independent design department with a larger budget may lead to sophisticated design (Morinaga, 2018), it is possible that the development of products with sufficiently high functionality by utilizing technological capabilities contributes to creating more room to review and invest in design. This could also be interpreted as. In any case, this suggests a new direction, strengthening rather than weakening technological orientation is a key to good design.

As for the second hypothesis, the results reject the hypothesis. No significant relationship was found between employee tenure and company design performance, indicating that decision-making flexibility and diversity due to a fluid workforce do not contribute significantly to producing excellent design. It implies that it may not be employee tenure that creates inflexibility in corporate decision-making, but other factors such as the attributes of directors.

Additional analysis in this study also revealed that companies that won more Good Design Awards had higher ROA in the following year. This suggests that an

emphasis on design in Japanese companies may have a positive effect on financial performance.

5-1. Implication

This study has generated a variety of implications. Academically, it has made contributions in three major ways. First, it has provided suggestions on contributing factors to the creation of design on a firm-by-firm basis, something that has been largely unexplored in the accumulation of research on the importance of design in international competition. Second, we examined the discourse on design research in Japan and found that it differs from the prevailing discourse. This study is of unique value in that, while some studies have suggested that the low design performance of Japanese companies is a result of their dependence on technology, they lacked quantitative evidence for this, and the analysis was able to capture the relationship between a certain level of high technological capabilities and the creation of great design. Third, the study demonstrated the desirability of the Good Design Award as an indicator of design performance. As for the design awards, some have questioned their validity, this study shows academically that the Good Design Award has a certain value in response to these opinions (Hara, Yoshioka-Kobayashi, & Ashizawa, 2017). We hope that further research

using the Good Design Award will be promoted from here.

In practical terms, the study has provided two major directions for concrete measures to create excellent design, especially in the manufacturing industry in Japan, which is suffering from weakness in international competitiveness. First, instead of emphasizing technological capabilities in product development and raising only the level of functionality, investment in technological capabilities should be reduced and the amount of investment should be used to invest in designs that consumers will like. Second, rather than giving up on technological capabilities or focusing on technological development half-heartedly, companies should invest in technological development to a level where they can acquire outstanding technological capabilities that will enable them to develop excellent designs.

There are also implications for international business. The first is in terms of research. The U-shaped relationship between technological capabilities and design performance may be a phenomenon unique to Japanese companies. Based on this, research on the uniquely Japanese context in which design is neglected may help to make Western research relative to Japanese research. Second, the study shows the direction of Japanese companies in practical international competition. In refining design for international competitiveness, it is suggested that Japanese companies have their own

way of further improving their technological capabilities, which is different from other innovation creation methods.

5-2. Limitation

Although this study analyzed 14 companies from the household electrical appliance industry on the issue of design performance of Japanese companies, it has not been possible to confirm even whether similar results can actually be obtained in other industries. Therefore, it is necessary to increase the sample size in the future.

In addition, because this study focused its analysis on the factors that cause Japanese companies to neglect design, it was not possible to find any contributing factors other than technical capabilities to how companies can actually improve their design performance. Another relationship that we wanted to examine was the relationship between designers and management, but we could not demonstrate this because there are few such cases in Japanese companies. In the future, it will be necessary to use more multifaceted variables in our analysis.

Furthermore, similar analysis should be conducted for non-Japanese companies. This research on Japanese companies will allow for international comparisons by conducting such research on foreign companies.

6. Conclusion

This study explored, by using the Good Design Award as an indicator of design performance, what strategies should be adopted on a company-by-company basis in order to produce sophisticated design and achieve high international competitiveness, in view of the fact that Japanese companies lag far behind the rest of the world in a situation where design is becoming increasingly important as a source of corporate competitiveness worldwide. The analysis revealed that there are two paths to producing sophisticated design: either to quit the technology-oriented trend or to focus highly more on technology. This study presents an empirical basis for companies that can produce sophisticated product design by using quantitative longitudinal data, from which the need for validation of the general discourse is identified. We hope that this research will lead to the development of design research beyond Japanese companies.

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