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Differences in Processes and Outcomes between Starting from In-House Industrial Designers and Starting from R&D Engineers in Design-Driven Innovation

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ABSTRACT

This research aims to clarify influence of the differences in the design-driven innovation (DDI) origin on process and post-launch performance, based on two cases of DDI in Japanese electric manufactures, one starting from in-house industrial designers (IID) and the other starting from R&D engineers (RDE). Our results showed that there were big differences in the development processes, new product outlines, post-launch results, and subsequent ripple effects between two cases. Though IID played a strategic role in the product planning stage in both cases, the main actor in idea generation was different. This novel qualitative study not only contributes to the accumulation of DDI process research on new product development (NPD), but also provides new insights on how to utilize IID and RDE to perform DDI more effectively.

Keywords: Design-driven innovation (DDI), In-house industrial designers (IID), New product development (NPD), R&D engineers (RDE), Mature products

INTRODUCTION

The importance of design for gaining a competitive advantage is well documented in many countries with a strong tradition of industrial design (Borja de Mozota, 2003; Best, 2006; Utterback, Vedin, Alvarez, Ekman, Sanderson, Tether & Verganti, 2006), such as Italy (Verganti, 2003; 2009), Sweden (Aydin & Erkarslan, 2019), Turkish (Ünsal, 2018), and Japan (Kanno & Shibata, 2013). Verganti (2009) proposed a third approach to innovation based on design in addition to the traditional technology push and market pull strategies for product innovation. He introduced how the concept of DDI has been developed based on the analysis of more than 50 case studies, mainly from the manufacturing industry (Verganti, 2009). Initially, the novelty of innovation assumed by DDI is that "...knowledge of the signs that can be used to deliver messages to users and the socio-cultural context in which users give meaning to those signs." (Verganti 2003; 2006).

Therefore, the leadership of industrial designers is expected in the practice of DDI. Moreover, DDI described design as a process of "making sense of things" (Norman & Verganti, 2014). In recent years, DDI has also been recognized as the equivalent of value creation in NPD (De Goey, Hilletofth & Eriksson, 2019). In other words, the strategy of DDI, namely meaning innovation, focuses on understanding, anticipating, and influencing the meaning of new products that have not yet appeared (Conti & Chiarini, 2021). Hence, this study aims to address these identified to provide a more practical understanding of the DDI process in NPD. In particular, it tries to identify whether IID are the only actors who can be the starting point for DDI process, or whether R&D engineers (RDE) have the potential to do so. Specifically, this study adopts a qualitative approach to analyze the Japanese home appliances cases, and from findings analysis a development process of high-end model electric fans. On top of this, this paper also focuses on two high-end model fans with contrasting appearances that were launched by major electronics companies after Dyson's entry into the Japanese fan market. And after reviewing the frame of DDI theory in previous studies, this paper will contrast these two NPD cases and discuss them based on the findings in relation to the purpose of this study, and finally, future research topics will be discussed.

THEORETICAL FRAMEWORK

Products characterized by new meanings and innovating function do not arise from market requests (Verganti, 2003; 2009). Initially, Verganti (2009) proposed DDI that emphasized on communication with external interpreters in what he called design discourse to create new meaning. The argument for using design discourse as a starting point for DDI was derived from an analysis of case studies in Italy, focusing on the manufacturing industry. Therefore, there has been progress in research on how companies in different countries are practicing the origin of DDI and whether there really is such a thing as design discourse.

In Japan, through a case study of NTT Docomo's i-Mode development, it is suggested that the starting point for implementing DDI should be to consider new applications for existing products (Sugino, 2013). In addition, an exploratory case study of five creative companies in Indonesia suggests that the starting point should be the prediction of future trends (Kembaren, Simatupang, Larso & Wiyancoko, 2014). In contrast, Goto & Ishida (2014), who analyzed the DDI process based on the upstream development of Panasonic's TVs, argued that DDI is an interaction process between technology research and design research. Furthermore, Goto (2017) clarified through a case study of a new product by DDI of a prosthetic limb that the participation of industrial designers in the development of the product is essential for the creation and communication of new meanings.

Verganti (2017) modified his advocacy by stating that the origin of DDI is the process of expressing the inner thought of an individual, which is characterized by moving from inside to outside through interaction with the people around. One of the reasons for this argument is the existence of a

"radical circle" consisted of informal members discovered during the process of developing Microsoft's Xbox game console (Verganti & Shani, 2016). Concerning the origin of DDI, although many case studies mainly for Italian firms clarified that industrial designers were origin of DDI (Verganti, 2009), few DDI originating from RDEs were reported. Also, several studies on the DDI practice process have been published recently, such as Conti & Chiarini (2021), empirical studies focusing on the difference in processes and outcomes between the DDI process starting with IID and RDE are still rare.

RESEARCH OBJECTIVES

As explained in the previous section, though practical DDI process has made progress, little empirical research on the starting point of DDI has been performed. In particular, as far as we know, there is no case study on the NPD by the DDI started from RDE. Therefore, this study has the following three objectives. (1) to discover NPD cases by the DDI originated from RDE, (2) to examine the differences in the DDI process between starting from IID and RDE, and (3) to reveal influence of the differences in the DDI origin on the performance after launch and subsequent ripple effects.

METHODOLOGY

Research Design

This study adopted a qualitative approach using Yin's methodology (Yin, 1994; 2018) and selected two cases related to high-end model electric fans launched by two Japanese major electronics companies in the "electric fan" market, which is a mature market. The "electric fan", which is the subject of this study, has been priced low for many years in home appliances field, and major manufacturers have hardly devoted any manpower to its development. Therefore, it was regarded as a commoditized item, and the major home appliance companies were gradually losing market share in this mature market. However, in Apr. 2010, Dyson in the UK (in the global market since Nov. 2009) launched high-end model electric fans in the Japanese market that have a price difference of 7 to 10 times compared to conventional electric fans. As a result, major Japanese electronics companies entered the high-end model electric fan market one after another, and by FY2016, the value composition of high-end models in the living electric fan market had increased to account for about half of the market[*1]. Therefore, this paper seeks to examine the case of two high-end electric fans developed by; Company T and Company P, which have contrasting appearances among several electric appliance manufacturers that developed high-end model fans in the Japanese fan market after Dyson's entry.

Data Collection

In both cases, information on the development process were collected mainly through the use of authenticated secondary sources, augmented in part by direct interviews. Descriptions illustrating the development story of Company T is based on web articles interviewed with several developers who

joined the NPD process[*2, *3]. Because one of the authors worked for the organization, the descriptions of the case of Company P is based on the perspective of participant observation including direct interviews with the developers (Implementation Date: April 12, 2016), and are supplemented by web articles on the product development[*4]. In both cases, the overviews of the new products were based on each product catalog, and the post-launch results were analyzed based on POS data (Available from: Growth from Knowledge (GfK) Japan). In addition, open documents related to the awarding of the Good Design Award, one of the oldest design awards in Japan, are also taken into reference[*5, *6].

CASE ANALYSIS AND FINDINGS

Company T: "SIENT" F-DLN100

Company T is a well-established company in the fan business in Japan, having developed Japan's first electric fan in 1894. Over 100 years of manufacturing and selling electric fans, Company T was having a difficult time in 2007 as the size of the Japanese electric fan market had bottomed out. In order to deliver a breeze that can be used in combination with an air conditioner, Company T installed a function in the electric fan that automatically adjusts the airflow according to changes in the temperature and humidity of the room and rotates the blades as slowly as possible. In this way, Company T was the first in the market to emphasize the fact that it could deliver "wind that can be used with air conditioners" as the design language of its electric fans. The engineers at Company T recognized that a DC motor would be suitable for the task of creating a slower, gentler breeze, as the AC motors that had been used for years were overloaded and limited. However, they had given up on using DC motors for inexpensive electric fans because the cost of motor parts was about 10 times higher than AC motors at that time. Following the success in the Japanese market of high-end electric fans from Dyson, which were launched in April 2010 and cost 30k to 40k yen in actual sales, Company T was given the go-ahead to develop electric fans with DC motors in the summer of 2010. In the development of the DC motor electric fan "SIENT F-DLN100" of Company T, the IID (Head Office Design Center) took the lead even before the official kick-off, and the concept was being studied from the initial stage. In addition, in Sep. 2010, the IID had completed the idea sketches and were working on the design work in a short time so that the basic design could be advanced and incorporated into the commercialization decision plan. Their concern was that the product would look cheap and not worth the higher price. In order to prevent this, before making the product catalog, IID took the ownership in creating a handmade booklet to visualize the concept of this product, what kind of space it would be placed in, and what it would be selling. The booklet was distributed to the people concerned to share the design concept. Furthermore, SIENT has changed the blades from 4 to 7, which Company T has always persistently used. The reason for this change was that it would not be appealing from a planning point of view to have the same blades as the previous model, which is an important element of a conventional electric fan, even though the product is installed

with the new technology of DC inverter motor. As for why the number of blades was decided to be 7, it was discovered that 7 blades happened to be the best among several prototypes. In other words, the feel of the wind hitting the skin was natural, and the thickness of the blades could be slimmed down, which resulted in the seven blades being appropriate. Despite the new effects described above, the new product ("SIENT") was not much different from conventional fans in terms of appearance and functionality, except that it had seven blades. The expectations of top management may have been for something that would surpass Dyson, but as a well-established electric fan manufacturer, to keep up with the high-end fan market pioneered by Dyson, IID took the leadership in focusing on speed and was able to launch the product in May 2011.

Company P: The Bladeless Air Generator "Q" F-BL25Z

Company P had suspended the development of new fan products since FY2005 because they were less profitable, but they had been seeking to revive the development since around 2009. Mr. O, an engineer in the R&D Center in charge of the fan business at Company P had been warming up to the idea of an "urn-shaped air blower using induced airflow technology" since before Dyson entered the Japanese market. Then, after the successful launch of high-end electric fan called SIENT in May 2011, he proposed some ideas for a new electric fan to the head of the business unit in Dec. 2011. After that, the product planning division in charge of the fan business at that time had many other new product themes in the existing business, and the consideration of launching "urn-shaped fan using induced air technology" was put on hold for a while. Sometime later, in the summer of 2012, the inventor Mr. O set up an informal team to discuss the product concept and detailed design, inviting IID and product planning staff from within the company in order to commercialize the idea that had been postponed. This informal organization is a voluntary activity called for by Mr. O himself, and had nothing to do with the official activities of the R&D organization to which he belonged. Mr. O argued, "To focus on Dyson, pay attention to the circulator," in the discussion and presented the technical prototype of an urn shape with high straight forwardness; he asked for opinions between in-house designers and product planning staff. The IID also accepted his initial idea of an urn shape, recognizing that a breakthrough would not be possible if they were stuck with the traditional design of electric fans. As the discussion progressed, the product planning staff member who did not specialize in electric fans suggested changing the design to a spherical shape (ball) that resembled a soccer ball, which Mr. O initially rejected, arguing that it would lose the appeal of the functional beauty shape of the product using induced airflow technology. Later, in spring of 2013, after receiving the report from the product planning staff who participated in Mr. O's informal gathering, the division manager set the scheduled launch date to Apr. 2015 and decided to accept Mr. O's technical prototype concept based on the customer response and the evaluation of the assumed users. As a result, official NPD in the home appliance fan business unit started in May 2014. The new type of fans (Air Generator

Table 1. DDI process and performance between the two cases.

	Factors	Company T SIENT Launched in May 2011	Company P "Q" Launched in May 2015
DDI process	Originator of DDI	In-house Industrial Designers(IIDs)	R&D Engineers(RDEs)
	Transmission methods of originator's concept	Design language (a booklet summarizing the product concept)	Rapid prototyping (technological prototype)
	Design management style	IIDs take leadership (top-down approach)	RDEs make suggestions (bottom-up approach)
	Collaborative style between IIDs and RDEs	IIDs communicated the verbalized design concept to RDEs, and RDEs implemented IID's design concept with an extension of conventional technology.	RDEs proposed a novel air blower distinct from conventional fans to IIDs using a prototype. IIDs modified the appearance of the prototype from an ergonomic perspective.
	Role of the Product Planning Department	Request of technological development for realizing the product concept	User acceptance survey of product concepts
Performance	Contributed a new category creation	Yes	Yes
	Product appearance	Typical	Novel
	Good Design Award(in Japan)	Received	Received
	CAGR of unit sales in the first three years after launch(Fan market)	**+4.7%** (−13.1%)	**−3.4%** (−0.9%)
	Subsequent progress	SIENT series discontinue in May 2016	Some air blowers based on this technology were launched in 2020

"Q") that is visually and functionally significantly different from conventional fans which is an air generator equipped with hidden blades were shipped Mar. 2015. In the development process, the contribution of IID was to give consideration to human-centered design to improve the usability of technical prototypes.

FINDINGS

The findings from the two cases are summarized in Table 1. with the objectives of this study. The starters of DDI in the case of Company T ("SIENT") and Company P (Air Generator "Q") were IID and RDE, respectively. Differences in DDI starters also influenced the DDI process, management style and role of product planning departments in NPD. In the two cases, those

factors were quite different. The appearance of SIENT started from the IID was typical and the appearance of Air Generator "Q" started from the RDE was novel, however the appearance designs of two products were both praised and received the Good Design Award. With regard to the performance of two high-end model electric fans after launch, Company T succeeded in increasing the shipment value of its own hi-end fans, despite the shrinking electric fan industry Growth in Japan during the same period, though Company P's high-end electric fan was not successful enough from a business point of view. On the other hand, the airflow technology applied to Air Generator "Q" has been applied to other products, contributing to the creation of new businesses for Company P. *7. The details will be discussed in the next section.

DISCUSSION AND CONCLUSION

We have examined two case studies of DDI practices Company T starting from IID and Company P starting from RDE. The results of these case studies are extracted in terms of how the conceptual design that was first imagined was formulated and communicated, the design management style at that time, and the role of the product planning department. The previous literature of DDI theory has assumed that companies that launch innovative products should conduct research regarding several activities forecasting for the target market trend, design research, and technology research. In this study, we revealed that the individual's thought expression as a starting point for DDI is a design language in the case of IID and a technology prototype in the case of RDE. Furthermore, from the results regarding design management style, we understood that in case of starting from IID a top-down approach, while the bottom-up approach is used when the RDE is the starting point. This fact for example evaluates that IIDs can take a leadership role in NPD when the complexity is about the level of home appliances (Fujimoto, 1999). In addition, from the results regarding the role of the product planning department, we observed that the role was to request engineers to develop technology based on the design (language) concept when the IID was the starting point, and to investigate the acceptability of the product to the assumed users when the RDE was the starting point. Therefore, we examined the management difference in the initial stage of the NPD process between the case where the IID is the starting point and the case where the RDE is the starting point. However, IID and RDE appeared in both case studies, differences are also revealed in the relationship between IIDs and RDEs. between the case whereby IID is the starting point and the case whereby RDE is the starting point. We understand the two cases that IID had a few knowledge of technical means and asked the RDEs to develop technologies that fit their own concepts and when RDE proposed technological prototypes, they wanted to ignore the design icons of conventional products and try to adopt new technologies. In other words, this finding seems to be the reason for the differences in the external appearance of the developed products.

In summary, this study was performed to clarify influence of the differences in the DDI origin on process and post-launch performance and subsequent

ripple effects, based on two cases of DDI in Japanese electric manufactures, one starting from IID and the other starting from RDE. We found the development of Air Generator "Q" in Company P as a rare example of DDI starting from RDE. We also confirmed that the DDI processes were different between the IID and RDE origins. Although it is generally known that the DDI process is often led by the IID, when the RDE was the starter of DDI, a bottom-up approach was used to share the ideas generated by the RDE with the technical prototypes. Therefore, this study contributes to the accumulation of DDI process research on NPD. In addition, we revealed influence of the differences in the DDI origin on the performance after launch and subsequent ripple effects. Our results showed that when the RDEs are starter of DDI, however new products may not be sufficiently successful in terms of business due to its novel appearance compared with the conventional products, the new technology used in the new products is later applied to other products and contributes to the creation of new business. Thus, our findings offer several important practical implications for innovation management of existing businesses in mature markets. In general, it is inferred that it takes long time for NPD starting from RDE (e.g., Yadav, Nepal & Jain, 2007). Therefore, it is necessary to manage RDE so that they can be free to propose technological prototypes in the early stage of NPD, and to utilize them in a way differently from the DDI process originating from IID.

Further Studies

We plan to explore the mechanism by which DDIs starting from IID and RDE make a difference not only in the DDI process, but also in post-launch results and subsequent ripple effects through further in-depth case studies.

ENDNOTES

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*2 Pd Web Interview (Summer, 2011) DCimbātāmōtā ni yoru sempūki no saijōi wo mezashite SIENT F-DLN100 no dezain kaihatsu [Design and development of "SIENT" F-DLN100, aiming at the top of the line living fan with DC inverter motor]. Product Design Website: (in Japanese)
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*3 Seido, Keiichi. (July 27, 2012) Kokunai ōtemēkā hatsuno kōkyū sempūki, tōshiba "SIENT" ni himerareta kodawari [The secret mind behind Toshiba's "SIENT", the first high-end fan from a major Japanese manufacturer]. Kaden Watch Website: (in Japanese)
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*6 GOOD DESIGN AWARD (Oct., 2015) "sōfūki" [Panasonic sōfūki "Q"] [The air blower: Panasonic Bladeless Air Generator "Q"]. JDP Website: (in Japanese)
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*7 Panasonic News Release (Nov. 26, 2020) "chōshitsu", "jokin", "kiryū" no gijutsu de, IAQ jigyō wo gurōbaruni kakudai [Global expansion of IAQ (indoor air quality) business with technologies of "humidity control," "sterilization," and "air flow"]. Panasonic Website: (in Japanese)
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