R&D Staff Perception Leading to Product Innovation: Case Study on Carbohydrate-Free Saké

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Abstract. This paper examines the development process of carbohydrate-free saké, namely, *Gekkeikan zero carbohydrate saké*, as a case study in order to help enhance the success rate of innovation by enabling readers to understand the pattern of innovation for its efficient management in the development process. The concept of *effectuation* was applied to this case and explained using *activity theory*. Here we report that, to inspire innovation in product development, organizations should develop prototypes of products containing technology seeds based on the intrinsic motivation of R&D staff and should further begin small test marketing without hesitation from fear of failure.

Keywords: Research & development · Intelligence · Sensemaking · Effectuation · Activity theory

1 Introduction

We examine the development process of carbohydrate-free saké—an innovation—using *Gekkeikan zero carbohydrate saké* as our case study. According to Schumpeter, "innovation" is that a new effort (e.g., implementation of new methods, provision of new products and services that did not exist in the market before, or development of new businesses) on the production side (supply) first, is beneficial to production, and second, creates new customers. Finally, this process leads to the creation of new added value to society [1].

Traditional concepts of service management and design emphasize person to person interactions and this approach focuses on the *touch points* or *encounters* where the service is delivered to the customer. However, it deemphasizes activities or processes that are invisible to the customer. In order to understand the service management system, Teboul divided "service" into two stages. One is the *frontstage* which represents the interaction the customer has with the service, and the other is the *backstage* which is the part of the service value chain that the customer can't see [2]. In this study, as well as the service, the approach which focuses on *backstage* where activities or processes are invisible to the customer is applied to production and manufacturing.

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It is commonly held that successful innovation is merely a result because it is difficult to lead it through intended implementation. However, through our case study, we help to enhance the success rate of innovation by enabling readers to understand the pattern of innovation for its efficient management by examining the backstage phenomenon in the development process based on a business administration approach.

2 The Management of Innovation Process in Product Development

2.1 Interpretation from the Ansoff Matrix

In order to grasp the patterns of innovation in the product development process, the Ansoff Matrix is considered to be a good model for this case. The Ansoff Matrix was developed by Ansoff [3] and summarized in Fig. 1.

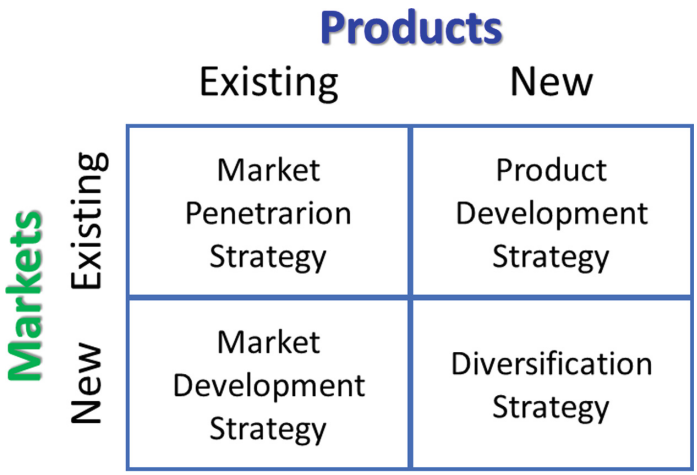

Fig. 1. The Ansoff Matrix adapted from Ansoff [3]. It suggests that there were effectively only two approaches to developing a growth strategy; through varying what is sold (product growth) and who it is sold to (market growth).

As shown in Fig. 1, first, selling its existing products into existing markets is the lowest risk strategy for a company, termed *Market Penetration*. Second, developing new products for existing markets (customers) termed *Product Development* is a higher risk strategy than *Market Penetration*. The success of this strategy is dependent on whether the organization effectively conducts research and insight into their customer and market needs in addition to their own internal capabilities and competencies for driving innovation. Third, taking existing products into new markets termed *Market Development* is also considered to be riskier than *Market Penetration*, because it can be difficult to realize new markets or new target segments beyond conventional rationale. Finally, *Diversification*, developing new products for new markets is considered the

riskiest strategy in the Ansoff Matrix. However, this risk can be mitigated by undertaking 'related' diversification, and it could have the potential to gain the highest returns.

While, it is true that the Ansoff Matrix is a strategic planning tool that provides a framework to help *managers and marketers* decide strategies for future growth, it is insufficient to account for the management of innovations when we aim to help enhance the success rate of innovation in product development. When a marketer and/or R&D staff intend to move into new markets and/or create new products, various factors such as the challenges and risks for changes of business-as-usual activities, and furthermore whether they possess transferable skills, flexible organizations, and agreeable stakeholders must be taken into account.

Therefore, the management of technology (MOT) perspective is considered to be more useful for enhancing the success rate of innovation in product development. It is often said that there are three main barriers that must be overcome to successfully develop a viable new business through technology-based innovation, commonly referred to as the "Devil's River," the "Valley of Death," and the "Darwinian Sea" [4–7]. Some competencies are required for overcoming these barriers. Therefore, we sought to interpret the innovation process in product development based on the intelligence frame.

2.2 Interpretation from the Intelligence Frame

Intelligence Cross. Chesbrough (2007) states that "technology itself has no inherent value, but only when combined with a business model, it creates value" [8]. The following equation can express this statement:

$$\text{Technology} + \text{Business model} \rightarrow \text{Value} \tag{1}$$

Because the business model is realized by "Market needs" and "Product development process involving organizations" it is assigned to (1):

$$\begin{aligned}&\text{Technologies (with the feasibility to achieve significant value)} + \text{Market needs (with a}\\&\text{new value prospect, even customers have not yet recognized)} + \text{Product development}\\&\text{process involving organizations(by using communication skills with members}\\&\text{of other departments)} \rightarrow \text{Value}\end{aligned} \tag{2}$$

(2) is redefined in terms of the ability (intelligence) dimension that generates each situation:

$$\text{TI} + \text{MI} + \text{BI} \rightarrow \text{Innovation} \tag{3}$$

TI, MI, and BI from formula (3) are shown in Fig. 2 below using the framework by Misawa and Hattori [9]. In addition to concrete measures to create differentiated

products for innovation as the competency [10], like an underwater iceberg that does not appear on the surface, it is important to generate each "intelligence cross" (TI × MI × BI).

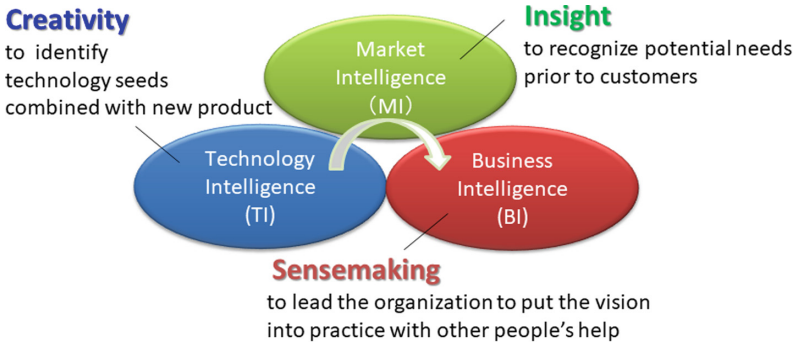

Fig. 2. TI × MI × BI cross based on Misawa and Hattori [9]. R&D staff should fulfill the TI × MI × BI cross to create differentiated products for innovation. TI, MI and BI show the ability (intelligence) dimension that generates each situation concerning Technologies, Market needs and Product development process involving organizations, respectively. TI, MI and BI represent *Creativity*, *Insight* and *Sensemaking*, respectively.

Uncertainties in the Management of R&D and Commercialization. As Chesbrough (2007) has noted, technology development has a long span, whereas marketing information has a short span. Hence, the technology and the market are characterized by uncertainty (Fig. 3). To that end, engineers need to communicate the "technical information" of the technology developments that they have independently interpreted, as the engineers are appropriately managed. It is also important for "knowledge management" that engineers do not focus excessively on technology development for product realization, but at the same time, conduct exploratory research to improve TI.

Two Methods of Evaluating Technologies in the Commercialization Process. As shown in Fig. 4, there are two evaluation systems that minimize the false-positive error toward the existing market and that minimizes the false negative error toward the new market. Conventional product development in existing markets can be compared to "chess thinking," where experience is effective, and once it becomes stronger, failure to develop new products is not an option. On the other hand, innovation in a new market can be compared to "poker thinking," which may result in unintended value creation due to licensing and spin-off among technologies that cannot be realized by businesses and products.

Fig. 3. Uncertainties in the management of R&D and commercialization adapted from Chesbrough 2007. Businesses related to the technology and the market differ in span, orientation, and mission.

In conventional product development, the manner of conducting R&D using an evaluation system that minimizes false-positive errors has been permeating toward existing markets. That is, acquired market research information is applied directly to product development. As shown in Fig. 3 above, the mission of marketers and developers is product development. As a procedure, they first discover and conceive their needs, and then ask researchers and engineers whether there are corresponding technology seeds. The technology is evaluated by minimizing the false-positive error (Fig. 4). Therefore, in many cases, marketers and developers continue to focus on minimizing false-positive errors even toward new markets and are unaware of the importance of the evaluation system that minimizes false-negative errors toward new markets. Whether innovation in a new market succeeds or fails depends on their "unique interpretation" that leads to "intuition" and their insight. MI toward a new market is defined as the recognition of potential needs prior to customers. Therefore, MI needs not only to analyze the current market (customer), but also continue to ask what the future market (customer) should be.

On the other hand, the mission of researchers and engineers is technology development. They are required to assume potential market needs from independent interpretation based on existing market information. They must then proceed with technological development while determining where technology seeds can be used. Thereafter, the technology is evaluated by minimizing the false negative error (Fig. 4). Whether innovation succeeds or fails depends on "the sense of the potential of technology expansion where the acquired seeds through independent interpretation and insight can be used generally for technology development when it applies to a product." TI toward new market is defined as the identification of technology seeds

combined with new product. Therefore, TI needs not only to create new technologies, but also to continue to search for "how the technologies can be used in the future."

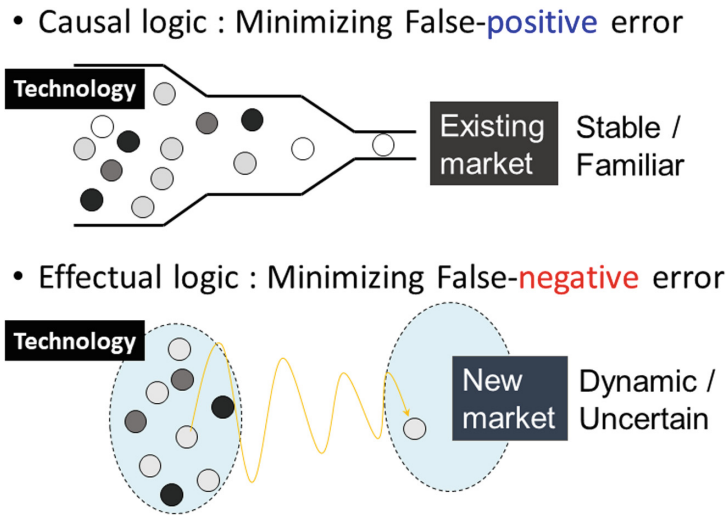

Fig. 4. Two methods of evaluating technologies in the commercialization process toward the existing market and the new market adapted from Chesbrough (2007). The technologies in the commercialization process toward the existing market and the new market were evaluated by causal logic and effectual logic, respectively

The Ability to Convey the Vision and Concept of the Future. In addition to MI and TI, to make it easy to create differentiated products for innovation, R&D staff gains trust in the organization, has multiple patterns of communicating with the surroundings, and has an accurate presentation method (catchphrase, catch copy, etc.). BI is the ability to convey the vision and concept of the future which has been obtained implicitly (not yet acquired) to the surroundings through the cross between TI and MI in a concise and clear manner, and the ability to lead the organization to put it into practice with other people's help.

Here, sensemaking is required for engineers and marketers who are located upstream from the commercialization decision and have the role of providing judgment materials. The sensemaking theory was advocated by Weick *et al.* [11], and, until now, there has been a tendency to grasp it as "the power of the humanities" that is a different dimension from business and management, similar to human-dependent ability and spirit theory. However, it is now being recognized as a management theory supported by management scholars [12]. R&D is future-oriented and characterized by risk. Hence, both engineers and managers need entrepreneurship and "conscientious" skills. By using BI to communicate and trust, engineers and managers are connected by empathy. In this way, a relationship is established that surpasses myopic short-term profits and shares value, allowing investment and commercialization decisions.

3 Case Study

3.1 Sales of Gekkeikan Zero Carbohydrate Saké

The Japanese domestic saké market is fiercely competitive. Observers have noted that the war of attrition within this market has been shrinking. Within this environment, Gekkeikan Sake Company, Ltd. (hereon, Gekkeikan) released Gekkeikan zero carbohydrate saké in September 2008. At the time, it was the first carbohydrate-free saké in the industry. In the market, annual sales of over ¥100 mn is considered a success—the Gekkeikan zero carbohydrate saké sales volume increased to ¥500 mn in the first sales year alone. Since then, this product has continued to sell well and become established as a product in a new category of saké (Fig. 5). Its share in the category carton of sake targeted for health-conscious customers grew, allowing it to occupy 55.4% of the market in 2013 compared with 11.4% in 2008 when it was first released. As of 2018, the saké category targeting health-conscious customers is worth more than ¥4 bn, where Gekkeikan zero carbohydrate saké has a 65% share.

In this case, Gekkeikan zero carbohydrate saké is innovative because it overcame the technical challenge of developing a carbohydrate-free saké. It was the first to be released in the market and has consistently recorded stable profits. Though the product was developed by a team of experts, for the purpose of our study, we focus on two individuals—Researcher *I* and Marketer *S*—as the sources of intelligence.

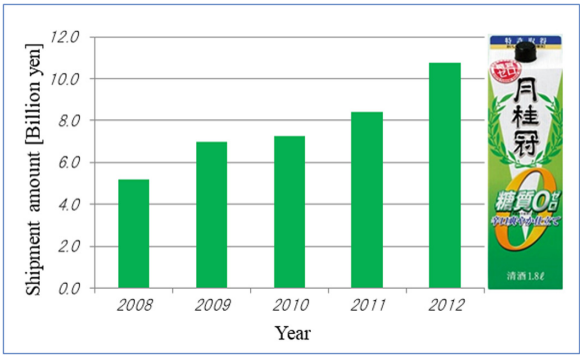

Fig. 5. Annual change in shipment amount of Gekkeikan zero carbohydrate saké for 5 years from 2008 when it was released to 2012.

3.2 Two Challenges for Product Development

Carbohydrate-free mixed beverages are developed by substituting *saccharides* (i.e., the organic compound forming carbohydrates). In this process, there is little to no technical challenge. Similarly, eliminating saccharides from alcoholic beverages such as low-malt beer and liqueurs is also easy allowing for efficient product realization. However, saké is made from rice, which is predominantly a carbohydrate, and have a high alcohol content. The challenge was to develop carbohydrate-free saké while still using the original raw material and also adhering to the manufacturing method defined by the Japanese

Liquor Tax Act[1]. Therefore, there was still great concern about the influence of high carbohydrate and alcohol contents on yeast in the alcoholic fermentation process for carbohydrate-free saké. These technical challenges made it difficult to realize such a product in an ordinary saké brewery.

Because saké is a nonessential grocery product, its quality is evaluated based on its taste. However, without the source of umami and sweetness from the carbohydrate, this type of saké is light-tasting. In fact, a common Google search shows that searching for "Gekkeikan carbohydrate-free" also leads to suggestions for "Gekkeikan carbohydrate-free bad taste." Thus, a substantial number of consumers have evaluated this product as bad-tasting. To develop technology that can help commercialize carbohydrate-free saké, Gekkeikan had to solve numerous problems, such as how to interpret and judge the quality of saké.

3.3 Researcher *I*: Developing the Brewing Technology for Carbohydrate-Free Saké

Researcher *I*, a member of the research department, led the development team of low-carbohydrate saké. Before releasing the final product, he discussed its development with junior researchers during the trial production and tasting stage. Researcher *I* states that:

> "The ultra-light taste of low-carbohydrate saké is good to consume with meals. I believe many people will also agree it tastes good. As I get used to drinking it, I have realized that reducing carbohydrate is refreshing."

To informally test the product, Researcher *I* brought a low-carbohydrate prototype to the year-end party—the peak season for saké brewing—of the product development department in December 2006, approximately one year and nine months before the official release of Gekkeikan zero carbohydrate saké. Upon tasting the prototype, one member of the department stated that "The low-carbohydrate saké certainly goes well with the hot pot dish." Note that, at this point, developing carbohydrate-free saké was not decided by the parent company, but the commercialization of carbohydrate-free saké was a goal set by Researcher *I*. Thus, no reliable method had yet existed to develop such a product. Based on the feedback from the informal testing, Researcher I set out to develop a fully carbohydrate-free saké.

In addition to small-scale brewing tests (up to 10 kg of white rice) at the laboratory, Researcher *I* routinely visited the site of the brewery to work with frontline workers engaged in commercial brewery (up to 80 ton. of white rice). Despite being part of R&D and experimentation, he often worked at the site of the brewery, eventually becoming the "hub specialist between the brewer and the researcher." As a result, the process of product development involved serious collaboration between the brewery site and the laboratory for solving technical challenges and determining the scope of implementing theoretical ideas. Researcher *I* states that "You cannot do something impossible, but you can do it with accumulation of a little effort." Assessing the feasibility of the brewery

[1] Saké is characterized by the specific ingredients that are used to make it. First, it must only be made using rice and a "rubbing" process is necessary as stipulated in Article 3-7 of the Japanese Liquor Tax Law.

section allowed him to gain progress in new product development through technology development and field testing. Researcher *I*'s skills in, for instance, repairing and constructing experimental equipment also exemplified his overarching role in product development and research, giving him the moniker of "building firm" by colleagues. Efficient communication with other researchers during repairs allowed the proper monitoring of the project. Any experimental ideas were also researched as "underground research," though not included in the official reports. Despite inter-organizational barriers between the research site and the brewing site, Researcher *I* was able to overcome these challenges. In addition to having a unique career and high skill as a craftsman, he was highly regarded in the manufacturing headquarters.

3.4 Marketer *S*: Insights on Releasing Carbohydrate-Free Saké as a Successful Product

At the forefront of sales, the appearance of more differentiated products incorporating Gekkeikan original technology was eagerly awaited. At this point, Marketer *S* conducted market research on the highly differentiated product of carbohydrate-free saké from its preceding counterpart, low-carbohydrate products. In addition to the part of the product planning and advertising department, Marketer *S*, a business graduate, became the central figure conducting the market research survey for Gekkeikan. This market research yielded positive responses, confirming the existence of customers who would positively evaluate the super-light taste of carbohydrate-free saké, though some respondents did reject the taste. These findings convinced him that carbohydrate-free saké could become a successful selling product if it were released. He noted that the quality of "sense" in qualitative research interviews was important in market research. That is,

> "Qualitative survey helps us understand whether our sense and touch of the customer is 'just a false belief' or 'what the customer actually feels.' It makes a hypothesis from the marketer's point of view, that is, it makes it possible to see the value customers have and to predict customer's taste preferences. Through the information input process, we can understand the key points of customer value, and we can move on to the test marketing stage, figuring out how many customers have such value through subsequent quantitative surveys."

Marketer *S* further states that:

> "Other large manufacturers in other industries are gathering data from interview surveys of customers for so-called 'higher-ups in the company.' They then make 'in-place decision-making by inputting customer information.' I would like to create a system to increase the number of employees who have a customer perspective, besides customer perspective management."

Marketer *S*, with new product planning achievements, gained the trust of the sales department. He brought a different perspective of the commercialization of carbohydrate-free saké, which complemented Researcher *I*'s research-based approaches.

3.5 Decision to Commercialize Carbohydrate-Free Saké

Gap Between Sales Side and Manufacturing Side. In April 2007, a routine meeting was held between the technical development and product planning sides. Researcher *I*

and Marketer *S* aimed to overlap their work from their respective standpoints to develop carbohydrate-free saké. However, the company feedback was highly varied. At the forefront of the business, a salesperson desired carbohydrate-free saké because carbohydrate-free beer-based beverages were already existing in the market: "We want a new product that will become a weapon for our sales."

Though carbohydrate-free saké is markedly different from the products of other companies, it is a product that negates the "common sense" of the saké industry in terms of taste. Therefore, it would be difficult to secure the expected quality, especially for the manufacturing side, which is responsible for ensuring higher quality and taste, as well as the executive side. The in-house evaluations of the prototypes brought up issues such as "whether such a too light and poor taste is acceptable to customers" or if there is a "risk of damaging the Gekkeikan brand when this product is released."

However, the development of the product did not halt because the management attitude embraced the challenge of creating a carbohydrate-free saké; that is, the firm exhibited a strong spirit of "creativity."

Gekkeikan's Basic Philosophy. Haruhiko Okura, the current president of Gekkeikan company and the fourteenth head, established Gekkeikan's basic philosophy of "*Quality, Creativity, Humanity*" when he became president in 1997. The firm has always pursued the basic quality of the manufacturer ("*Quality First*") and focused on "providing the world's highest quality products at competitive prices that can always satisfy consumers." For the firm, *Creativity* is "to constantly pursue creativity, promote innovation in management and technology, and continue to take on new challenges." *Humanity* is "to endeavor to improve employee knowledge and abilities, and to help each employee lead a fulfilling life according to their individuality." The management attitude holds that "challenging creates tradition" and "the total human power of each employee leads to the power of the company and leads to a company that can satisfy customers."

Moreover, the development continued because there was no sufficient practical reason to object against the taste of a nonessential grocery product with a strong subjective factor. The commercialization of Gekkeikan zero carbohydrate saké was promoted mainly because both Researcher *I* and Marketer *S* were trusted by their respective headquarters based on their past achievements. The trust in individual promoters and their supporters also being crucial.

3.6 Conflicts Between Researcher *I* and Marketer *S*

Difference Between Technology Development and Product Realization. When technology development for product realization began, Marketer *S* routinely visited the laboratory and brewery site to collaborate with Researcher *I*, who developed the technology. Although few salespeople could be seen in the brewery site, it was rare for sales staff such as Marketer *S* to visit so frequently.

Although Researcher *I* and Marketer *S* had the same vision of product realization and commercialization of Gekkeikan zero carbohydrate saké, the timelines of technology development and product realization differed significantly. Technology development is time-consuming, whereas product realization requires the introduction of differentiated products to the market as soon as possible. From the viewpoint of customers and distribution, Marketer *S* set deadlines for achieving goals on the manufacturing side,

whereas Researcher *I* had to meet technical requirements to realize manufacturing in a limited time. This led to conflicts.

The Insufficient Scale-Up Verification. Saké is different from other Japanese crafts in that it is not made by human hands, but by the action of microorganisms. Hence, the brewer's job is likened to creating a better environment within which microorganisms can function in the making of saké. To reduce the carbohydrate content in saké, it is necessary to prepare an environment where saké yeast can sufficiently *eat* the carbohydrate. Although small-scale technology development in the laboratory was realized and technical elements had already been prepared, the scale-up verification at the commercial level at the brewery site was insufficient.

Although the commercialization schedule was preplanned, the scale of actual production did not always match the small-scale production, and then it was still uncertain whether the carbohydrate content was reduced to zero as the fermentation progressed. In fact, even after its release, it remained difficult to control its production. On the other hand, the new Gekkeikan zero carbohydrate saké, where fermentation is difficult to manage, showed higher sales than expected, leading to tight supply of stocks.

Risks Behind Successful Release. Marketer *S* recalls:

> "It is impressive that there was a crisis of shortage of stock at the time of release. Sales have been stronger than expected since it was released, so we urgently needed to increase production. However, the factory was about to enter the maintenance period, and the employees working there were also scheduled to be absent. We could not run out of new products by any means. I repeatedly negotiated with related departments to operationalize the brewery site and factory. Thanks to the cooperation of many people, it was possible to increase production on a tight schedule. As a result, Gekkeikan zero carbohydrate saké has been steadily sold without any shortage and continues to perform well. I felt once again strongly that our company had a corporate culture that enabled the entire company to work together even during difficult challenges. I still have a strong impression of this time."

The production of Gekkeikan zero carbohydrate saké faced a crisis for a while, despite its successful release, because it was already adopted by major convenience store chains. If it ran out of stock, the distribution side would then impose a penalty, such as suspension of trade.

3.7 The Customer's Needs and the New Technology Seeds

Technology seeds are not a complete form of technological development. Innovative product development was not realized even after all technical elements were completed. In fact, Gekkeikan zero carbohydrate saké was created by what Researcher *I* called the "accumulation of a little bit of effort."

Regarding customer needs, Marketer *S* described the elation from being accepted in the market. It was motivating that the hypothesis derived from objective data analysis applied successfully to the market. This was a challenging process:

> "We conducted qualitative surveys to understand customer awareness and behavior, but collecting and organizing the data after the surveys requires an enormous amount of time and labor. I found it worthwhile to use this data to identify customer needs. With the product that I

oversaw, it was rewarding to see even the product development become a hot topic in the market. The sales are now going well, so I feel satisfied."

For his future goal, Marketer *S* states:

"I would like to translate the advanced technology (seeds), which is the strong point of Gekkeikan, into products and to create products that customers can enjoy for a long time."

As a marketer, he is also exploring ways to utilize technology seeds.

4 Case Analysis

4.1 Case Analysis by Using Intelligence Frame

Key to Success for Good Sales. The survey results in 2013 showed why Gekkeikan zero carbohydrate saké, which was first evaluated as having "bad taste," continued to have good sales [13]. The poor evaluation of carbohydrate-free saké came from existing customers who preferred traditional saké, whereas a new customer cluster was formed that was health-conscious, which purchased the product. In other words, because saké is a nonessential grocery product, the taste continued to be recognized as the basic measure of quality because of the provider's cognitive bias. However, the new customer segment which did not belong to the same segment as the provider, formed a large part of the potential market the provider had not yet discovered. On the other hand, this provider's cognitive bias led to the competitors delaying the discovery of this new customer segment. Thus, similar products took longer to develop, and, as a result, Gekkeikan zero carbohydrate saké dominated sales, with the company taking up the top market share in the saké category targeting health-conscious customers. Gekkeikan zero carbohydrate saké was expected to be as if that means "zero risk of health damage" from the number "zero" on the product package by the health-conscious customers. Furthermore, the biggest barrier to entry for competitors due to business customs and allocation of shelves at the sales floor was that this product was first released in the saké industry. From this point, it is necessary to bring products with new value to the market as soon as possible. To do this, it is necessary to overcome both technical challenges and uncertainties in introducing products with a distinctive feature into the market.

Independent Interpretation (Hypothetical Thinking) of the Potential Markets and Technologies. Gekkeikan zero carbohydrate saké was the first carbohydrate-free saké released in the saké industry. Before its release, the target was a potential market, not an existing market. It was shown that, for successful product development that responds to potential market needs with a new value prospect, R&D staff such as Researcher *I* and Marketer *S* need to not only pay attention to an existing market, but also independently interpret (hypothetical thinking) the potential markets and technologies based on their missions. Their interpretations (hypothetical thinking) led to greater intrinsic motivation, which became the driving force for product development. Researcher *I* had a belief (in *the creation of innovation*) and sought to "develop a technology that can reduce the carbohydrate content of saké to zero" which was a technical issue. On the other hand, Marketer *S* had a belief (in *the spread of innovation*) and sought to release

carbohydrate-free saké as a successful selling product without any reluctance for introducing products with a distinctive feature into the market.

The Implementation of the Product Development Process Involving Organizations. Both Researcher *I* and Marketer *S* combined their mission with the needs of a customer segment that had not yet become apparent at that time and with the seeds of technological development that had not yet been perfected, respectively. Furthermore, organizational trust in them played a key role in product development. This organization's involvement led to commercialization without the executive departments freezing development. Thus, a product with a new value was born.

As shown in Fig. 6, intelligences in this case study on carbohydrate-free saké are summarized by using the intelligence frame. TI, MI, and BI, which are required for an innovation in product development in terms of the ability (intelligence) dimension, were divided into two individuals, Researcher *I* and Marketer *S*.

The success of Gekkeikan zero carbohydrate saké can be mostly attributed to the fact that the product was realized with normal organizational functions including existing facilities, even if the target was a potential customer. However, when a product is commercialized by organizational actions within a company, such as the creation of a new business, the innovative ideas of internal entrepreneurs face fierce resistance from those who act on existing common sense. Because the production of new products within a company often involves many irregular events, it is essential to obtain an understanding of other departments, especially the manufacturing department.

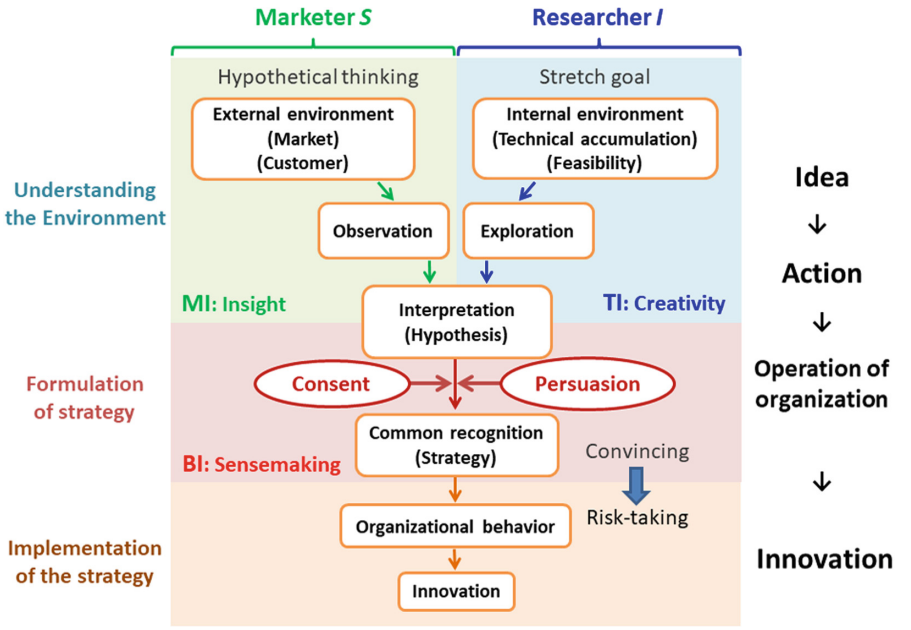

Fig. 6. Relationship between intelligence and the practical process. Intelligence in this case study is summarized by using intelligence frame. TI, MI, and BI needed to inspire innovation in product development, changed over time, was largely into two individuals, Researcher *I* and Marketer *S*.

Analysis According to the Sensemaking Theory. In the "practice" involving organizations, their BIs are analyzed according to the sensemaking theory. Gekkeikan zero carbohydrate saké was a new product that had never been put on the market before. It was in a critical state, wherein the product was introduced to the market before its manufacturing technology was completed. Thus, it was necessary for Researcher *I* and Marketer *S* to "make sense" (1: scanning). Researcher *I* and Marketer *S* are trusted by their respective headquarters and have the element of "more persuasive than accurate." Because Gekkeikan advocates the basic philosophy of "*Quality, Creativity, Humanity*," it was possible to "to align the various interpretations" without substantially changing the broad interpretation (2: interpretation).

Then, the action to place the product on sale before the manufacturing technology was completed can be recognized as "retrospective sensemaking." Thus, innovation is not only achieved through "intuition," but also through "practice." (3: enacting).

4.2 Case Analysis from Extant Entrepreneurship Studies

Need for the Recognition (Bias) Analysis of the R&D Staff - Causation and Effectuation. A case study examining the development process of the Gekkeikan Zero carbohydrate saké used the intelligence frame (see Sects. 2.2 and 4.1). This frame is interpreted as the result of individuals' competencies once the necessary elements of innovation as intelligence are clarified. Each individual's independent interpretation based on intuition is understood from the perspective of identifying potential markets and technologies; that is, from the perspective of *causation*, or *discovery of the market*.

In particular, the implementation of the product development process involving organizations is analyzed by using the sensemaking theory. At this stage, an R&D staff often faces a trade-off relation between speed and accuracy. In order to achieve results in a limited amount of time, sensemaking then becomes crucial to focus on plausibility, consistency, reasonableness, and creativity rather than on accuracy. Therefore, in Sect. 4.1, in order to achieve product realization, Researcher *I* and Marketer *S* as the leader of each department constructed the vision using conceptual skills and communicated the vision to the surroundings highlighting the purpose and goal. As a result, the surroundings were able to embody carbohydrate-free saké products at concrete steps using the company's producing facilities. Therefore, we adopted an analysis based on the concept of *causation*.

However, carbohydrate-free saké products were developed without the pursuit of good taste, which is against the conventional common sense of the saké industry. In addition to the promotion of technology development, there was a high level of uncertainty on how to interpret quality or taste, and thus decide on commercialization. In this respect, the recognition (bias) of the R&D staff of Gekkeikan zero-carbohydrate saké strongly influenced decision-making. Further, in the product development process, the element of *effectuation* ("create a market for") and *causation* (which is common in marketing) exerted influence [14].

Explanation of This Case Using Activity Theory. It is important to effectively use both *causation* and *effectuation* within the company to develop a product that meets the latent needs of the customer. For this reason, *activity theory* can be applied to this case

study—it clarifies the organization's actions to generalize and reproduce this process of innovation in a versatile manner [15].

Figure 7-A illustrates the conventional development of a new regular saké product using activity theory. For the product development of an ordinary nonessential grocery product such as saké, a marketer who is a *Subject* discovers a customer (business opportunity) in an existing market with the help (*Division of labor*) of R&D staff who mainly develop a new product containing the technology seeds created by researchers. The *Outcome* is obtaining *Existing customer's satisfaction* through the taste and *Tools and Signs* is centered on *Marketing research* based on causation.

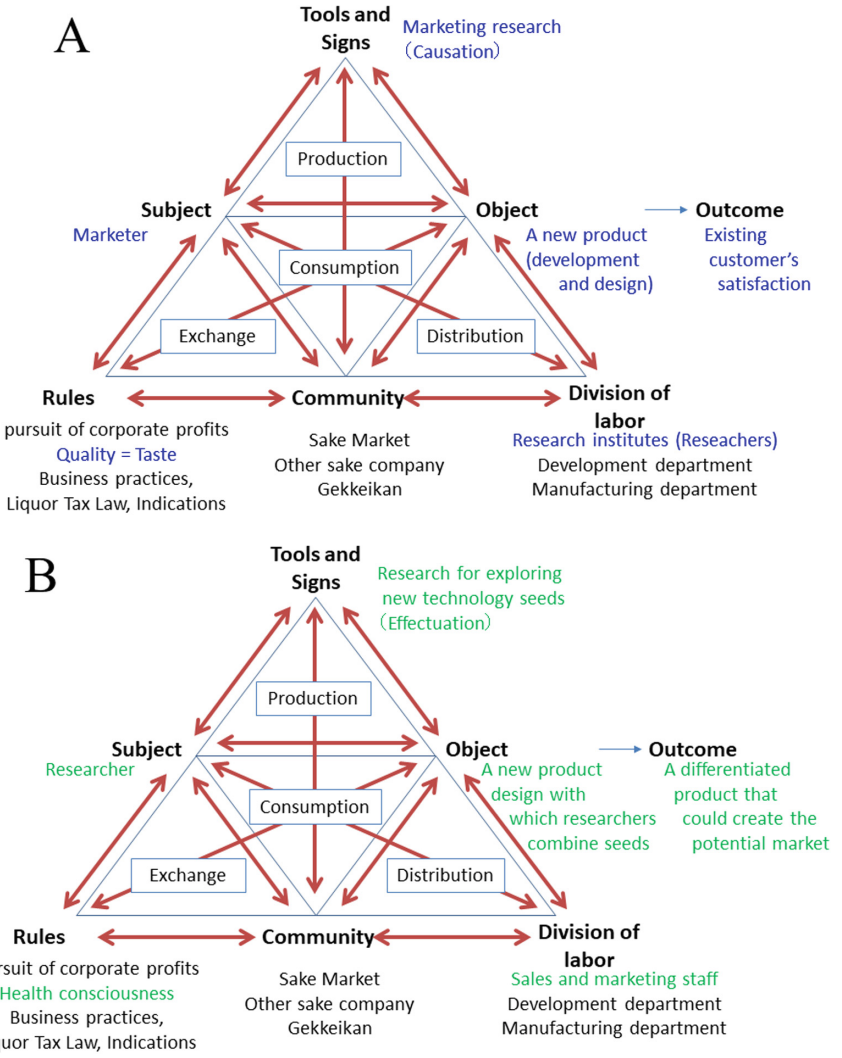

Fig. 7. Activity theory based on Engeström [15]. A: applied to the conventional development of new regular saké products, B: applied to the development of carbohydrate-free saké. The different points between the two figures are shown in blue for A and green for B. (Color figure online)

On the other hand, it is necessary to reconsider the case of product development of carbohydrate-free saké through the effectuation of market creation. This is because the product differentiation by technology seeds and application to the brewery is a product-out type development wherein the decisions and sales are driven by the soft skills of recognition of and trust in the developer.

Figure 7-B illustrates the development of carbohydrate-free saké using activity theory. Here, *Tools and Sign*s is at first set as the effectuation in comparison with Fig. 7-A, to be analyzed by the effectuation element. Effectuation starts with the existence of "*Tools and Signs*" and then proceeds to ask "What can we do with these tools?" By designing the result as much as possible, *Tools and Signs* is defined as *Research for exploring new technology seeds*. The *Subject* is defined as the *Researcher* and the *Object* is *A new product design containing the technology seeds*, respectively.

Application of the Concept of Effectuation to This Case. From the perspective of the lifecycle of an enterprise, effectuation is effective in the *Turn zero into valuable existence (0 to 1)* phase, which is the phase of starting a business. Causation is then effective in the *Increase the amount of what is generated (1 to 10)* phase, which is the management phase. However, the actual new product development process within a company, each in series, does not shift to the causation phase after the effectuation phase. At the start of a startup or new business, there is often scarce capital and few facilities. The only solution is to use the resources already available (principle of "*a bird in the hand*"). Hence, starting with the *Set 0 to 1* phase, the result serially progresses to the *Set 1 to 10* phase by following this principle. On the other hand, regarding the development of new products within a company, the *Set 1 to 10* phase always occurs in the organization due to the large amount of existing capital and facilities available for the production of existing products. The emphasis on efficiency and the reluctance to take risks then lead to only gradual development of new products, which makes it difficult for so-called *Value Innovation* to occur. Under these circumstances, *Research for exploring new technology seeds* has the highest effectuation factor. As determined by activity theory in Fig. 7-B, a researcher designs *A new product containing the technology seeds* using his/her *Research (for exploring new technology seeds)* to achieve *A differentiated product that could create the potential market* even if needs have not yet come up to the surface in the market.

What is the Specific Action to be Taken Next as an Organization? The activity theory diagram in Fig. 7-B does not fully express the details of the development case of carbohydrate-free saké. Here, the roles of R&D are roughly divided into causation (Fig. 7-A) by Marketer *S* and effectuation (Fig. 7-B) by Researcher *I*. In addition to *A new product design with which researchers combine seeds,* the activity of conventional development of a new regular saké product (Fig. 7-A) is necessary to achieve *A differentiated product that could create the potential market*. Thus, it is hypothesized that researchers are the main participants in the commercialization of the seeds-containing product, and these activity theories must occur in parallel. This parallel activity theory also increases the likelihood of the product "not selling well," because there is the gap of the *objects* between *A new product (development and design)* and *A new product design combined the technology seeds with* (in Fig. 7-A and -B, respectively). Here, the effectuation principle, *Affordable Loss* is applied to the development case of

carbohydrate-free saké. Affordable loss involves decision-makers estimating what they might be able to put at risk and determining what they are willing to lose in order to follow a course of action. Applying affordable loss to this case reveals that it is important to *begin product prototyping and sales experiments on a small scale to apply technology seeds and immediately take the next action without fear of failure*. As shown in Sect. 3.3 of this case, a low-carbohydrate saké was informally tested for the taste and whether it goes well with meals by Researcher *I* and members of the product development department in December 2006, approximately one year and nine months before the official release of Gekkeikan zero carbohydrate saké. This is consistent with the evaluation method shown in Fig. 4, which is similar to the evaluation of the commercialization process of technology by *effectual logic*. Thus, a scenario should be created that tolerates failure, in some cases, by adopting an evaluation system that minimizes false-negative errors toward new markets.

As described in Sects. 2.2 and 4.1, an analysis of this case in terms of competencies leads to the conclusion that R&D staff should improve his or her ability in TI, MI, and BI, respectively. However, the organizational action to develop new products that predict potential markets remains unclear. By applying the concept of effectuation to this case while explaining the case in activity theory, the specific action to be taken next as an organization can be derived.

5 Conclusions

5.1 Summary of the Case

This paper examines the development process of carbohydrate-free saké, namely, Gekkeikan zero carbohydrate saké, as a case study. The successful marketing of a so-called innovative product entails the rapid introduction of a product with new value. The product development of carbohydrate-free saké was carried out under high uncertainty, contrary to conventional rationale in the saké industry—that is, there was no pursuit of good taste. Thus, R&D staffs had to overcome the resistance to introduce "products with such a distinctive feature" into the market in addition to "overcoming technical challenges." In fact, the R&D staff's recognition (bias) had a significant impact on their success. The independent interpretation of new products into the future (hypothetical thinking) by R&D staff leads to their internal motivation, which is a driving force in the practical stage of development.

5.2 Contribution

Teboul divided "service" into *frontstage* and *backstage* [2], where the service itself forms the frontstage, but production and manufacturing constitute the backstage. Also, in the development process, customers do not enter the backstage, which conventionally refers to the inside of a factory. In this study, we aimed to help enhance the success rate of innovation in product development by enabling readers to understand the pattern of innovation for its efficient management by examining the phenomenon at

backstage in the development process and by applying some frames to the analysis of the product innovation.

Ansoff Matrix's growth strategy is insufficient to account for the management of the innovations because whether R&D staff \ organization allows for the challenges and risks come from the change of business-as-usual activities and whether possess transferable skills, flexible structures, and agreeable stakeholders must be taken into account. For this purpose, the most notable point is considered to be R&D staff's recognition. We analyzed this based on the intelligence frame from the viewpoint of MOT. The application of the intelligence frame to the case revealed that it is important to generate each "intelligence cross" (TI × MI × BI) and led to the conclusion that each R&D staff member should improve his or her competency in TI, MI, and BI required for innovation.

However, the organizational action to develop new products that capture potential markets remains unclear. Thus, we attempted to identify the specific action to be taken next as an organization by applying the concept of effectuation while explaining the case using activity theory. Here we reported that, in order to create innovation in product development, organizations should develop prototypes of products that apply technology seeds based on the intrinsic motivation of R&D staff and further begin small test marketing without hesitation from fear of failure.

5.3 Implications/Future Directions

In order to create innovation in product development, those who are using the perspective of causation first consider "What should I do?", whereas those who using the perspective of effectuation first consider "What can I do?" Employees of saké manufacturers, including researchers and engineers, are often heavy saké drinkers. They have a fixed belief that "As a saké manufacturer, we should focus on palatability and satisfaction in new product development." Due to restrictions in the production method of saké, health consciousness and taste have not been compatible traits, leading to a trade-off relationship. The employees of saké manufacturers placed excessive emphasis on palatability, thus resisting a new customer segment's value of health consciousness. However, both Researcher *I* and Marketer *S* developed their own interpretation (intuition) by going against the grain, which led to product commercialization.

Researcher *I* took a relativistic approach by focusing on technology and search seeds, including new businesses. Marketer *S*, on the other hand, took a positivistic approach to identifying markets (customer), which can be described as environmental analysis. However, Marketer *S* also exhibited effectuation in addition to causation because he promoted commercialization by realizing the existence of a potential market that did not match up with the available market data.

Intrinsic motivation arising from independent interpretation is an important prerequisite for innovation. This applies not only to Researcher *I*, but also to Marketer *S*. Evidently, both individuals have been a driving force for commercialization. Although attempts to grasp Marketer *S* based on effectuation are meaningful, Marketer *S* also acted from the perspective of causation. Thus, his perspective boundary is not

yet clear. As a result, we should discuss whether Marketer *S discovered* these new customers, or whether he *created* them through product realization. It is reasonable to assume that Marketer *S* had prospects of effectuation because he emphasized not only market data, but also his own interpretations and intuition, taking manufacturing risks with Researcher *I*. However, to generalize this assumption, it is necessary to clarify the *simultaneity* in individuals considering both causation and effectuation.

5.4 Limitations

There are some limitations to this study. First, this study includes locality and context because it conventionally refers to the backstage, inside of a factory, where customers do not enter. Therefore, the viability of results asked for further exploration of the relationships proposed in the model with a large sample size. Secondly, this study deals with R&D staff's recognition, which is intangible soft skill. No matter how detailed we conduct an interview with them and diligently we analyze, there are still some unclear points.

References

1. Schumpeter, J.A.: The Theory of Economic Development: A An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle. Harvard University Press, Cambridge (1912)
2. Teboul, J.: Service Is Front Stage: We Are All in Services… More or Less !. Palgrave Macmillan, London (2006)
3. Ansoff, H.I.: Corporate Strategy: An Analytic Approach to Business Policy for Growth and Expansion. McGraw Hill Inc., New York (1965)
4. Tanii, R.: Possibility of technological innovation to introduce MOT concept breaking down of Devil River and Valley of Death. Bull. Chukyo Gakuin Univ. Manag. Soc. **17**(2), 27–36 (2015)
5. Yoshii, K.: Hi-tech development strategy after the R & D bubble burst. J. Intellect. Asset Creation **11**(5), 80–97 (2003)
6. Inoue, J.: R & D course inventory of the thorough possession technology to found a new market through Valley of Death the first visualization of technical assets. Nikkei Monozukuri **697**, 142–146 (2012)
7. Nobeoka, K.: Introduction to MOT (Technology Management). Nihon Keizai-Shinbunsha, Tokyo (2006)
8. Chesbrough, H., Appleyard, M.M.: Open innovation and strategy. California Manag. Rev. **50**(1), 57–76 (2007)
9. Misawa, K., Hattori, K.: R&D outsourcing to create core competence. Kenkyu Kaihatsu Manejimento **8**(6), 4–13 (1998)
10. Spencer, L.M., Spencer, S.M.: Competence at Work. Wiley, Hoboken (1993). Trans: Umedu, Y., Narita, O., Yokoyama, T.: Seisansei Shuppan, Tokyo (2011)
11. Weick, K.E.: Sensemaking in Organizations. Sage Publications, Thousand Oaks (1995). Trans: Enta, Y., Nishimoto, N.: Bunshindo, Tokyo (2001)
12. Maitlis, S., Christianson, M.: Sensemaking in organizations: taking stock and moving forward. Acad. Manag. Ann. **8**(1), 57–125 (2014)

13. Matsumura, K., Sugimoto, K., Hara, Y.: Gap model between expectation and perception in health-conscious nonessential grocery foods: practical application to the renewal of carbohydrate-free sake, In: 7th Annual Conference on Serviceology, pp. 447–450. Society for serviceology, Tokyo (2019)
14. Sarasvathy, S.D.: Effectuation: Elements of Entrepreneurial Expertise. Edward Elgar Pub, Cheltenham (2009)
15. Engeström, Y.: Learning by expanding: an activity-theoretical approach to developmental research. Cambridge University Press, Cambridge (1987). Trans: Yamazumi, K., et al.: Shinyosha, Tokyo (1999)