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Manufacturing Transformation toward Mass Customization and Personalization in the Traditional Food Industry

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Abstract

Digital transformation of the manufacturing process in high-tech has been underway for a long time. On the other hand, the transformation in low-tech and traditional industries progresses more slowly. Especially, the human factor is greater in the food manufacturing industry, which retains many more labor-intensive elements. This is because the development of foods was traditionally customized to the cultures of particular regions, so many foods were not suitable for mass production, which has led to the high level of personal skills. However, new trends have been shown recently in the sake manufacturing industry. Head craftsmen at a sake brewery, known as Toji, have managed the entirety of the manufacturing process and determined the length and timing of each process for hundreds of years. In these circumstances, some sake breweries have started to make sake in a new way that breaks with tradition. They implement smart manufacturing and customization to respond to diversified customer needs without altering the product price through the digitization of the manufacturing process and the formalization of personal skills. This chapter also discusses the prospects of this transition and considers its effects on the industry with theoretical framework and social background of manufacturing transformation.

Keywords: manufacturing paradigm, food industry, digital transformation, sake brewery, mass customization

1. Introduction

The digital transformation of the manufacturing process has been underway for a long time, as seen in innumerable examples [1–3]. In the high-tech sector—for example, in the electronics industry—digitization is rapidly progressing, as demonstrated by the advent of 3D printers [4, 5].

However, digital transformation in low-tech and traditional industries is progressing more slowly. The human factor is greater in the food manufacturing industry, which retains many more labor-intensive elements than other manufacturing industries [6]. This is because regionality is a major factor when differentiating foods from each other. Traditionally, the development of foods was customized to the climate and cultures of particular regions, so many foods were not suitable for mass production (except for certain kinds of foods that were consumed globally), which has led to the high level of personal skills in the food manufacturing industry.

The existing literature has noted that the food manufacturing industry is not deploying innovation activities as actively as other manufacturing industries [7–9]. Moreover, the industry's research and development intensity is also low [10–13]. In the traditional Japanese food manufacturing industries producing miso, soy sauce, tofu, sake, etc., quality control based on sensory-oriented skills continues to be performed by professional craftsmen. In some cases, the skills of these craftsmen, known as Takumi (“artisans”), have been handed down unchanged for hundreds of years.

In this chapter, we focus on new trends in the sake manufacturing industry. The head craftsman at a sake brewery, known as Toji, manages the entirety of the manufacturing process and determines the length and timing of each process, all of which greatly affect quality. Therefore, sake quality, including taste, scent, and texture is determined by the skills of the Toji.

However, in these circumstances, some sake breweries have started to make sake in a new way that breaks with tradition. This new approach represents a transformation from traditional production to mass customization and personalization. Some breweries are implementing smart manufacturing and customization to respond to diversified customer needs without altering the product price through the digitization of the manufacturing process, the formalization of personal skills, and the strengthening of the customer relationship.

After considering several advanced companies, we conducted a case study of the Sekiya Brewery Co., Ltd. (Sekiya), in the Aichi Prefecture of Japan. This pioneering company has developed a mechanized integrated system at the head factory and a custom-made sake-brewing system at its workshop. This company also switched from the external head Toji system to an internal Toji system. In the old Toji system, most Toji had a part-time contract. If the Toji changed, the taste of the sake might dramatically change. However, in the company's internal system, regular employees serve as Toji, thus enabling the long-term production of sake of a consistent quality.

This chapter makes two contributions to previous studies: one is for academic communication and the other is for the food industry. First, it shows and discusses the advanced customized manufacturing process. As mentioned below, the manufacturing paradigm has been shifting to mass customization; but the speed is different from industries. The most advancing industries for the paradigm shift are chemistry, automobile, and electronics, which have been driven by digitalization and remarkable innovations such as a 3D printer. And now, we can see that the traditional food industry also challenges the manufacturing paradigm shift, and they succeed.

Second, if the traditional food industry achieves the new manufacturing paradigm, it would be a great opportunity for SMEs in this industry because the case study this chapter will

discuss is the very medium-sized manufacturer. SMEs and even large companies could learn from the case about how the traditional manufacturer created a new manufacturing system and realized a new business model.

The structure of this chapter is as follows. In the next section, we summarize the theoretical background of process innovation, which has changed from mass production to mass customization, along with the transition of the traditional Japanese food industry. Next, we conduct a case study of sake breweries that have attempted to develop new manufacturing processes and provide added value. Finally, we discuss the prospects and problems of this transition and consider its effects on the industry.

2. Theoretical framework and social background of manufacturing transformation and mass customization

The manufacturing paradigm has always experienced ongoing shifts. The first paradigm was that of the handcraft in which core processes were executed by highly skilled craftsman. When tools were required, the master of those tools generally possessed the needed skills. As wealth accumulated and market demand increased, the manufacturing paradigm changed to a wholesale handicraft manufacturing system. However, in the wholesale system, it was difficult to manage the equipment which was distributed to each manufacturer. Later, this system changed to employ hand-based factories that brought the equipment and the laborer together.

On the other hand, there are cases that have retained a household-based handcraft industry. Typical cases include traditional crafts industries across the country. The following three items are common aspects of such industries: (1) manufacturing regional products, (2) requiring skills that are difficult to mechanize, and (3) manufacturing products with a low price elasticity. Sake brewing, the main target of this chapter, is a traditional craft industry that features all three of these aspects.

Society then entered the Industrial Revolution. Important examples of this revolution include technical innovations in the process of cotton fabric, economic growth in the iron and steel industry, and reform for power source from the development of the steam engine. This revolution also established factory-based industry.

Both manufacturing and selling were limited to local geography during the age of handcraft manufacturing, as the steam engine had not yet been invented. Since it became possible to deliver products further, the industrialization process moved to mass production achieved through the rapid development of a production system. Factory-based industry realized mass production at a lower cost than before.

Nevertheless, the product types available were limited, and in the latter half of the 1980s, society had seen a change from an era in which many people wanted the same products to an era in which people expressed a diversity of interests; as a result, manufacturing industry competition evolved to provide high product variety, known as mass customization. Mass customization is a flexible manufacturing system that creates custom-made options. It is a system that combines the mass production process of low cost with flexible personalization.

The concept of mass customization first appeared in 1987 [14]. Tseng and Jiao [15] defined mass customization as the creation of products and services that meet customers' needs while maintaining productivity at a level close to that of mass production. There are already many examples of mass customization [16], including software based on product configurators that can both add to and change the function of a core product.

Mass customization is a stage of new business competition in the manufacturing and service industry. The service industry also enables various customizations without increasing cost. For example, a call center adopts agent-based voice technology to process customers' inquiries. The agent does not change everything every time, but he or she does change the response process depending on the customer's inquiries and needs.

Pine II [17] identifies four types of mass customization:

- Collaborative customization

Firms talk to individual customers to determine the precise product offering that best serves the customer's needs. This information is then used to specify and manufacture a product that suits that specific customer.

- Adaptive customization

Firms produce a standardized product, but this product is customizable in the hands of the end user.

- Transparent customization

Firms provide individual customers with unique products without explicitly telling them that the products are customized. In this case, there is a need to accurately assess customer needs.

- Cosmetic customization

Firms produce a standardized physical product but market it to different customers in unique ways.

Another production system, called a personalized system, reduces the distance between the customer and company and reflects a customer's idea. From a historical point of view, this method has existed since the time of the household-based handcraft industry. As a new approach in recent years, customers take part in the design stage [18]. Because customers have various needs, they actively join the design process, paying a price to affect the product's quality. Developing a ubiquitous network environment and a flexible process management method in manufacturing has made this possible.

Thus, to meet these customers' needs, manufacturers need to build new architecture with an open manufacturing platform [19]. In such an on-demand manufacturing system, product simulation, responsive, and cyber-physical systems have already been realized [20]. A more rapid assembly process might be necessary to respond to customers' requests. Hu [21] describes this paradigm as personalization and distinguishes it from both mass production and mass customization.

3. Japan's sake industry and market

Sake is defined by the Liquor Tax Act as an alcohol drink made from rice, water, and rice malt that is fermented and strained. Currently, it has two classifications: specific classes and other than specific classes. The specific classes are also divided into eight categories based on differences in ingredients and processes (**Table 1**). Generally, the specific classes are priced higher than the other classes.

Figure 1 shows the amount of sake production in Japan. Production peaked in 1975 and has gradually decreased. The share of sake in total alcohol drinks has also declined slowly, reaching 6% in recent years. This is because other alcohol drinks other than sake became popular. Beginning in the late 1970s, alcoholic drinks such as wine and whiskey were introduced to the market, and drinking places such as beer gardens and wine bars also became popular.

High-quality, high-priced sake in specific classes, for example, Junmai and Ginjo, thwarted this trend in the late 2000s (**Figure 2**). At the time, some consumers began to express interest in local small- and medium-sized sake breweries. These breweries produced unique and original sake in specific classes based on local materials and techniques. Consumers across the country enjoy those characteristics and diversities.

Sake breweries are dispersed across Japan. Facilities producing less than 100 kl count for 60% of all sake breweries and those producing more than 300 kl are only 15% of the total. In terms of the market share, the top sake brewery, Hakutsuru, has almost 10% of the sake market, and the top five breweries have 37% of the market (**Figure 3**). Compared to the beer market, almost 99% of which is composed of the top four beer companies (**Figure 4**), we see how much the sake market is diversified and does not show oligopolization.

It seems that small- and medium-sized sake breweries have different market targets than large sake breweries, which continue to make their products at lower prices using mass production techniques. Although the amount of sake production has continued to decline for 40 years, high-value products made by small and medium breweries prevent the total market size from decreasing. These local breweries are also challenged to create new techniques and skills. In the next section, we study one typical brewery.

% of added alcohol	Rice-polishing ratio by weight			
	More than 70%	Less than 70%	Less than 60%	Less than 50%
0%	Sake other than specific classes	Junmai	Specific Junmai	Junmai-ginjo Junmai-dai-ginjo
Less than 10%	Sake other than specific classes	Hon-jozo	Specific hon-jozo	Ginjo Dai-ginjo
More than 10%	Sake other than specific classes			

Table 1. Classification of sake.

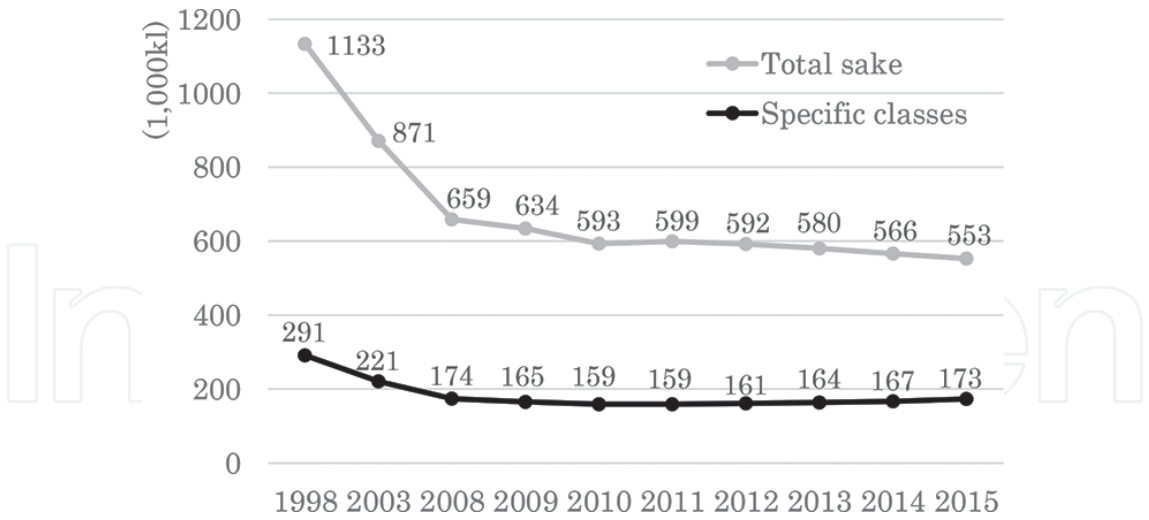


Figure 1. Amount of sake production in Japan.

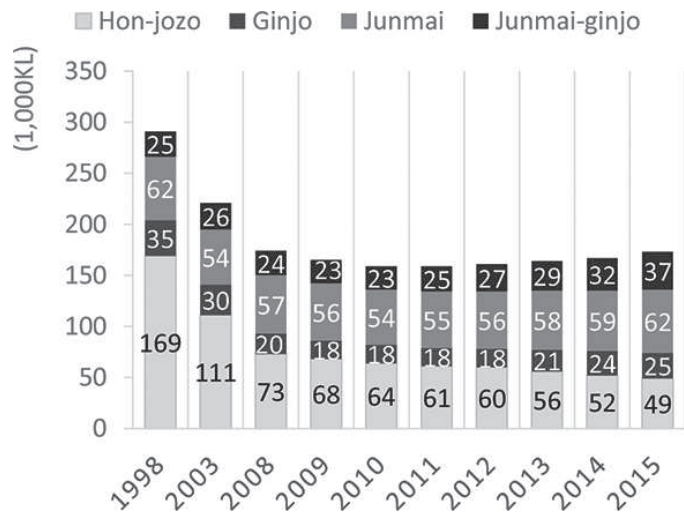


Figure 2. Amount of specific classes.

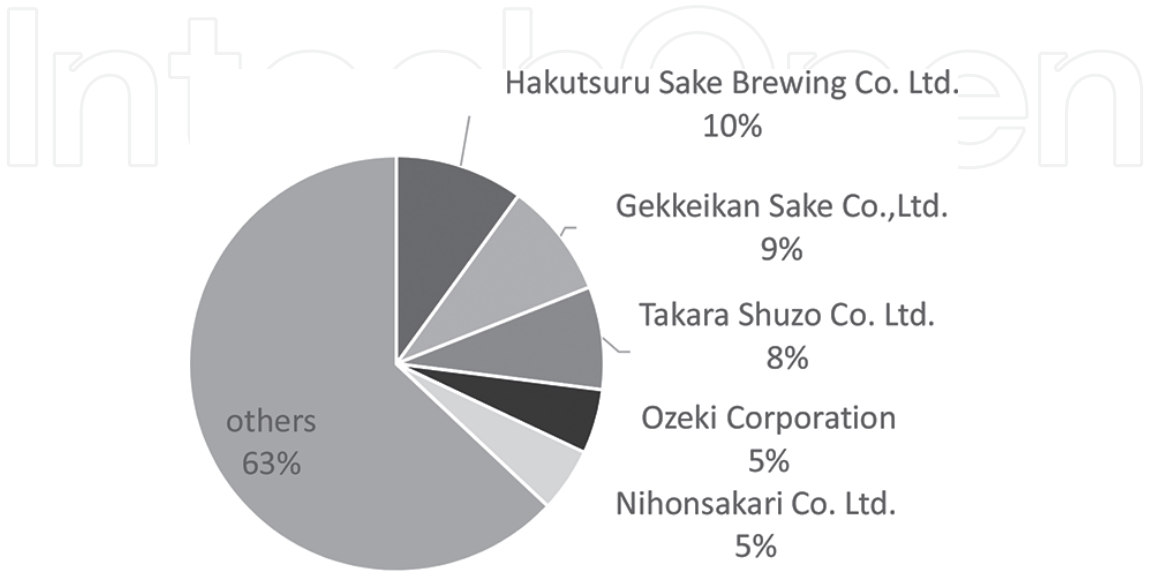


Figure 3. Market share of sake in Japan in 2016.

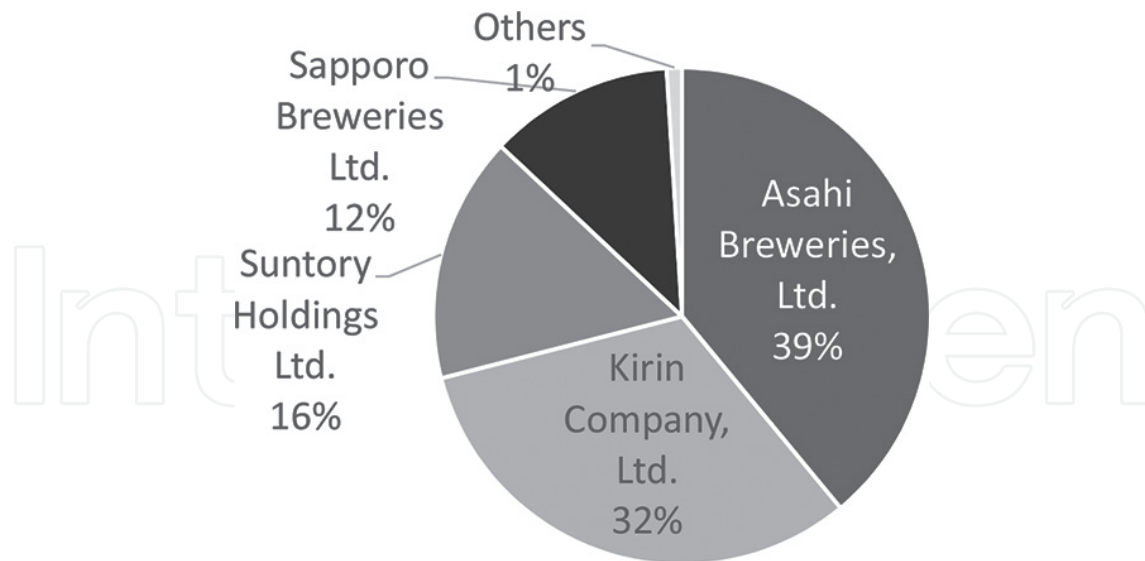


Figure 4. Market share of beer in Japan in 2016.

4. A case of new mass customization and personalization in the sake industry: Sekiya Brewery Co., Ltd.

4.1. Characteristics

Sekiya was founded in 1864 in the southeast prefecture of Aichi in Japan. Since then, Sekiya has been manufacturing high-quality sake using both traditional Japanese skills and advanced techniques. Sekiya has 53 employees and 1.7 billion yen of sales in 2016 (**Figure 5**); it is a middle-ranking company among Japan's sake breweries.

The goal of the company is to brew high-quality sake that explores the possibility of sake flexibly. Their brewery is actively implementing new technology and does not have the atmosphere

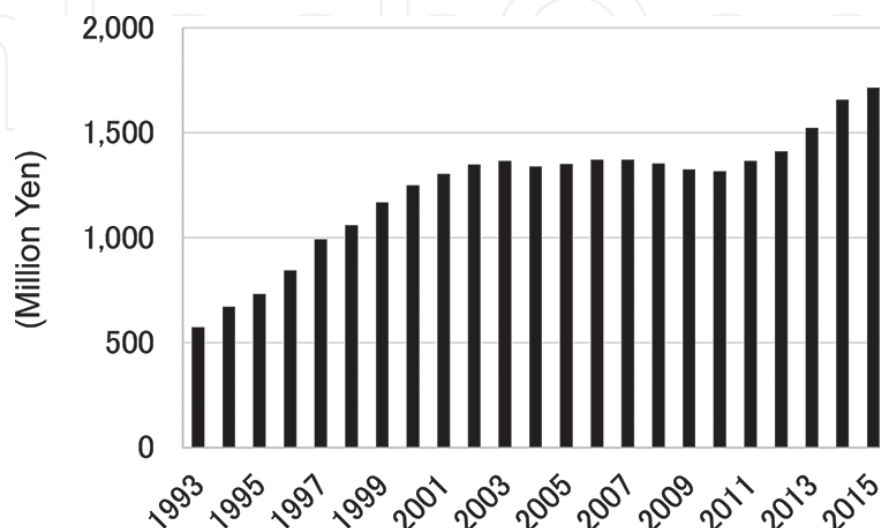


Figure 5. Sales of Sekiya.

of a traditional brewery. They decided to mechanize both so they could proactively rationalize the process that requires high labor costs and so they could closely monitor the details that need a great deal of work to pass down traditional sake-brewing skills to future generations. They devoted continuous efforts to controlling the machines as tools for the brewers and collecting elaborate amounts of data to utilize in future brewing (Figures 6 and 7).

4.2. The process of manufacturing sake

Table 2 shows Sekiya’s process of manufacturing sake. Sekiya thinks that one of the most important steps in sake brewing is “grand design.” This concept does not refer to the usual designs of manufacturing products, but instead to designing all the components that are required to explain the product’s concept and ideal taste to customers. Sekiya assumes a scene in which customers consume its products and decides what kind of rice to use, how much to shave the outside of the rice, what kind of yeast and koji to choose, and how to ferment. These processes are included in the concept of “grand design.”

4.3. Digital transformation and mechanization in the sake-brewing process

Sekiya divides its brewing processes into two types. One is the process that should be carried out by employees, and the other is the process that utilizes mechanization for higher quality. For example, Sekiya mechanized the transportation process to reduce heavy labor and make it easy for women and the elderly to work.

By digitizing and automatizing procedures such as temperature control, it became possible to manufacture products without requiring employees to work all night. As described in the next section, this technological improvement has had a substantial impact on the company.

By mixing handwork and digitalization, Sekiya created a sake-brewing process that is not affected by external conditions such as temperature and humidity. The company also learned to control the quality of its products with diversified raw material rice. Moreover, various data related to each process accumulate through mechanization, leading to the standard products being of stable quality.



Figure 6. Sekiya Brewery Co., Ltd.



Figure 7. Various Sekiya products.

1. Milling	The brown exterior of rice is polished to make it white rice. Rice is one of the most important factors in determining the quality of sake; Sekiya polishes its own rice on site.
2. Washing / Soaking	Polished rice is washed and soaked at the same time in an amount of water consistent with the desired purposes. Since highly polished rice absorbs water quickly, the soaking time must be controlled.
3. Rice Steaming	In general, there are 2 types of sake brewing, one with cooked rice and the other with steamed, although the water content is approximately the same whether it is steamed or cooked. When the rice is cooked, it has the advantages of not being sticky on the surface, so it is easy to handle. Because it will not stick on the tools and hands, it is easier for koji mold to grow on it. Sekiya uses Koshiki, which has the same mechanism as a steamer.
4. Kojimai	Kojimai is made by planting Koji bacteria on the steamed rice. The bacteria are then cultivated for approximately 50 hours in a special temperature- and moisture-controlled room called the Koji room. Koji changes the starch contained in rice to glucose (sugar).
5. Shubo	In sake brewing, it is necessary to have Koji, which converts starch into glucose, and yeast, which converts glucose into alcohol. The process for cultivating the high grade yeast is called Shubo making.
6. Moromi	Shubo is then transferred into the tank and water, Kojimai, and steamed rice are added three times to the preparation. The preparation involves three steps. In Moromi, the saccharification of starch by Koji and glucose fermentation to alcohol by Shubo occur simultaneously. In general, Toji perform a delicate task from the top of the tank on TV. Moromi creates various Tura (meaning “face” or the surface, such as bubbles), so it is a critical job of Toji to determine temperature control while considering the appearance, taste, and results of composition analysis.
7. Joso / Sake less	Moromi is finished in 25 to 40 days. Next, it is separated into sake and sake less by Joso (pressing). Although this percentage depends on the type of sake, 10% to 20% typically becomes sake less. Sekiya’s Daiginjo class leaves about half of the rice that was used for brewing as sake less.
8. Pure sake / Heating	Pressed sake is filtered pure sake. All fresh sake is pure sake. Pure sake is still fermenting in very small amounts, so it is heated to stop the fermentation if necessary. Heating is also effective in killing bacteria that can cause spoilage during storage.
9. Storing / Maturing	Sake is stored in storage tanks. The storage period is from six months to 3 years, and low-temperature maturation eliminates hardness and roughness and makes the sake deep and mild in flavor.
10. Bottling / Delivering	Sekiya uses a cold-storage warehouse from bottling to shipping. Sekiya thinks that it is important to control the temperature, even while the bottled sake is delivered to the liquor store.

Table 2. Manufacturing process of sake in Sekiya.

Sekiya used to brew sake that relied on an external Toji like any other sake brewery. Most Toji were so-called migrant laborers. They made rice in the summer and worked at sake breweries in the winter. Considering the period necessary for making rice, external Toji could stay at a sake brewery from December to March. Sekiya hired Toji from Niigata, a site of mass rice production. However, Sekiya faced a difficult situation, in that migrant Toji from Niigata markedly decreased after 1993 because of aging. Inevitably, Sekiya switched to brewing sake by employees, and Sekiya was the first company to make sake without external Toji in the Aichi prefecture.

When introducing the brewing system by employees without external Toji, the problem of techniques and skill transfer of high-skilled professionals is often raised. Sekiya was no exception to this problem and had modified this system for three generations. Advancing digitalization attracts a strong impression that machines substitute for the work that laborers do by hand, but what really matters is something else. Laborers, particularly experienced craftsmen, have sharpened senses. It is necessary to install sensitive information into the machine to optimize the next process. This is why computerization of sake brewing through mechanization was a difficult challenge. However, Sekiya has tried for years and achieved the ability to make sake of high and more stable quality.

Furthermore, the great advantage of digitalization and mechanization was a new brewing system for making sake three times a year. As mentioned above, the usual brewing period allows sake to be made only once a year, from December to March. Sekiya does three rounds of sake brewing within 10 months, except in July and August, when it performs maintenance on its machines.

Another achievement that should be noticed with the introduction of digitization is improvement of the labor environment. Sekiya employees go to work at 8 AM and leave before 6 PM. Therefore, unlike in ordinary sake brewing (especially among Toji), there are essentially no night shifts.

4.4. Introduction of custom-made system

Sekiya started an original sake brewery with a custom-made system. Very few sake breweries have a custom-made system. Sekiya's second factory, Ginjo factory, was built for the system in 2004. The Ginjo factory's capacity is only one-tenth that of the main factory. In the main factory, 12,000 l of sake are made in one lot. The Ginjo factory originally aimed at making small quantities of many varieties. A small tank serving as a single unit uses 60 kg of rice and produces approximately 100 l of sake. Sekiya receives a wide range of orders from individual consumers, companies, organizations, and restaurants in units of 720 ml \times 100 bottles.

At the beginning of this project, there were very few orders. However, the custom-made system has gradually expanded into the market, and the current number of orders is approximately 220–230 tanks annually. Major customers are brides and grooms and their families, companies, and individual groups who want to celebrate their memorial anniversaries. These customers can send their original sake to someone as an expression of gratefulness and celebration. Customers can select a favorite container, label, and box.

5. Discussion

5.1. The impact of mass customization on sake breweries

According to the case study of Sekiya, the key factor in the success of the custom-made system over those of other sake manufacturing companies is the continuous challenge of digitalizing and transferring professional techniques and skills. Recently, many other sake breweries have attempted to transfer their techniques and skills from Toji to employees and failed because they focused on transferring implicit knowledge and techniques without digitalizing and improving the manual tasks. In contrast, digitalization alone is not enough to create a major impact on their business because companies have to understand what kind of data is important for high-quality and stable production from experienced professionals.

Sekiya has faced the two challenges for a long time and succeeded. In this traditional and extremely old industry, it is incredible to receive more than 230 orders per year from original sake-brewing groups. Therefore, although other sake breweries have mimicked Sekiya's history, they have not been readily able to catch up.

In addition, Sekiya has tried to strengthen the relations with consumers to achieve the smart manufacturing and customization. In 2013, they opened up a directly managed restaurant, "Sake Bar Marutani," in the center of Nagoya which is the third largest economy in Japan. Marutani is the oldest business name of Sekiya, and they used 150-year-old storehouse as the restaurant. This restaurant has four important managerial factors: (1) introducing how to drink traditional sakes and enjoy differences such as glasses and seasons, (2) promoting communications between employees (technicians) in the factories and consumers, (3) conducting test marketing for new products and new lineups, and (4) investigating the trend of foods and tastes.

These factors are all aimed to intensify the connection with end users. By obtaining the feedbacks from end users for years, Sekiya has built a capability to determine which information is important (and which is *NOT* important) for the development of smart manufacturing and customization. Avoiding unnecessary information is also important as much as to acquire valid information for the smart system.

5.2. Theoretical review on the transition of manufacturing processes

Hu [21] illustrated the evolution of the manufacturing paradigms in **Figure 8** using a volume-variety relationship. As noted in Section 2, the first paradigm in manufacturing is described as craft production. These manufacturing processes were driven by professionals with highly skilled handcrafts.

Mass production began in Michigan with the introduction of the Henry Ford moving assembly line, which was built in 1913 and reached its peak after the end of the World War II, when demands for products became very high [21]. Next, Toyota invented a new manufacturing

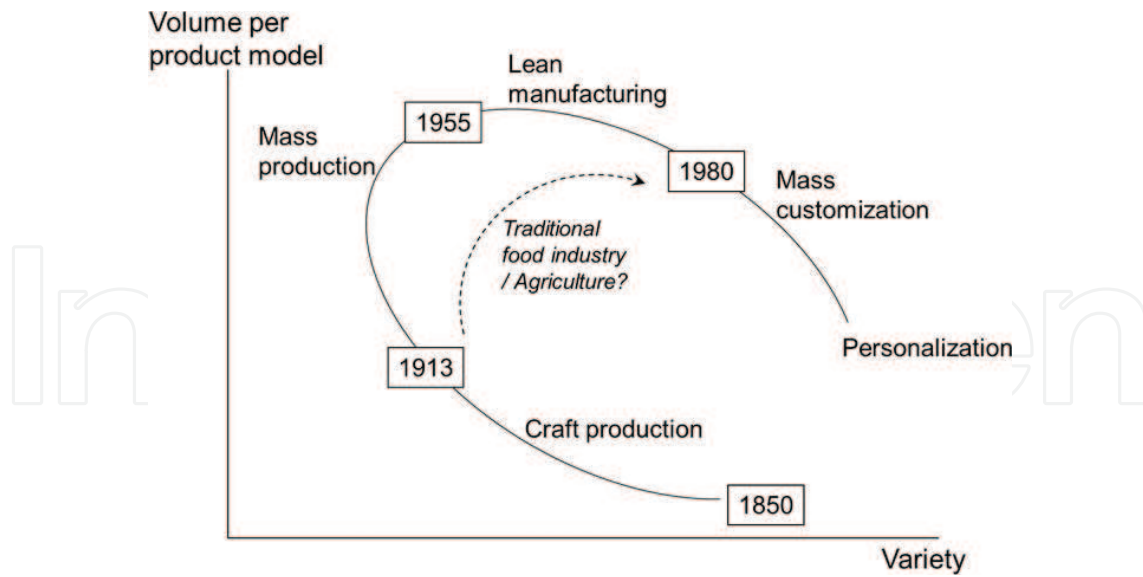


Figure 8. Evolution of manufacturing paradigms [21].

management philosophy called lean manufacturing. The goal of the management system was to minimize waste from the manufacturing process and maximize value of their customers simultaneously [22].

As mentioned above, Pine II [17] described the mass customization emerging in the 1980s as a new frontier in business competition. The main field of global competition evolved from high productivity with low costs to high customization, because the needs of consumers in advanced countries had been almost fulfilled with high-tech products. Those needs then changed from volume to quality and from singularity to diversity. Therefore, the number of varieties offered by consumer product manufacturers increased significantly. The manufacturers prepared various models of their products with combinations of each assembly line so that consumers could select among various options and enjoy original products.

Sekiya is one of emerging sake breweries creating a new and original mass customization manufacturing system. In a shrinking market, this brewery has developed a substantial business in Japan. Takeshi Sekiya, the CEO of Sekiya and its seventh-generation heir, notes that the brewery does not want to expand rapidly. Instead, it continues to develop productivity in its services.

Eventually, the manufacturing paradigm will enter the personalization phase in which consumers' roles include not only choosing and buying, as in mass customization, but also designing products by themselves with manufacturers (Table 3). At that point, the design process will involve either value creation or what consumers are willing to pay.

5.3. Design of open platform and future perspectives for food industry

The drivers of manufacturing processes have further evolved from manufacturers to customers driven by the huge power of digitalization and smart manufacturing. In this chapter, we see a small sign of the new paradigm, personalization, emerging in the traditional food industry. However, there are a few substantial barriers in the way of the growth of this new paradigm.

	Craft production	Mass production	Mass customization	Personalization
Price	High	Low	Middle	Middle
Main player (firm size)	Small	Large	Large and Medium	Large and Medium
Product value	Functionality	Functionality Brand	Functionality Variety Story	Functionality Variety Story Originality
Customer role	Buy Possess	Buy Consume	Buy Choose Combine	Buy Design Experience
Key manufacturing system	Handcraft Professional skill	Efficiency Low cost	Interactivity Reconfigurability	Open platform Flexibility

Table 3. Key differences between manufacturing paradigms.

First, although the volume per product model is insignificant compared to mass production, a certain level of volume must be produced to satisfy mass demand. A medium production volume is also needed to keep manufacturers active and strong. A small amount of production for a high price should be easier and can be realized by anyone. The production of a certain volume for a relatively low price will be the challenge. For this reason, the next two barriers are discussed.

Second, to realize mass customization and personalization, an open platform for communication and a sophisticated module design for manufacturing must be constructed [23, 24]. Not all processes and modules can be personalized at a low cost. Therefore, usually at least three kinds of modules are required: (1) a module similar to mass production; (2) a module that customers select, mix, and match; and (3) a module that customers design from the beginning with engineers and designers. The difficulty of realization increases from (1) to (3). Of equal importance is the meta-design, which is required to adopt a higher perspective through which to create these three modules in the end products. Since the most attractive point of personalization production is extreme differentiation, the combination of the three modules becomes even more important for product competitiveness and superiority.

Third, manufacturing companies must pay careful attention to the fact that customers need different levels of participation in the codesigning process, meaning that some customers may request deep participation with designers and others may not. Therefore, it is also very important for manufacturers to build a system to realize customer requests. Sophisticated visualization and prototype creation are good examples because they enhance the customer's imagination and clarify the customer's deeper needs. By doing so, customers have an experience that cannot be obtained with other manufacturers, thus increasing the degree of satisfaction. These manufacturers could also employ even more useful and competitive open platforms to communicate with their customers [25, 26].

The final barrier especially relates to the food industry and agribusiness. Mass customization and the rise of personalization have been realized in industries such as automobile manufacturing,

chemical industry, electronics industry, and other high-tech industry. And the food industry and agriculture will be following. Food is based on organics that can be eaten, which means that manufacturers must see many limitations for its components and ingredients. This is one reason that 3D printers cannot make foods in bulk. Manufacturing also cannot overcome agriculture. Most of our foods are grown from the land, including grains, vegetables, feed for livestock, and even water. Although we have recently seen successful plant factories, most of which have focused on specific vegetables and do not produce in high volume. We must wait for ICTs to undergo further advancements and integration with biotechnology, botany, and environmentology.

6. Conclusion

Management in the shrinking traditional industry becomes harder and harder. It requires significant investment to upgrade “hardware systems” such as manufacturing equipment and capacity. It costs considerable risks to the manufacture as well. It also requires even more significant efforts to reform “software systems” such as distribution channels and employees’ mindsets. In such circumstances, leaders have to make a decision to survive in the shrinking economy. Smart manufacturing and mass customization could give them a great opportunity to make a major progress.

Sekiya challenged these missions as a traditional sake manufacturer. They introduced digital transformation and mechanization in the sake-brewing process, which enabled Sekiya to expand the product lineups and distribution channels. The brewer also started an original sake brewery with a custom-made system. This challenge created a huge amount of fans who buy the high-quality products regularly. These fans also have been discovered through the direct channel to consumers with a restaurant in Nagoya. The restaurant has contributed to strengthen the connection with end markets. The feedbacks from end users have made Sekiya to build a capability to develop the smart manufacturing system and customization.

As you can imagine, these challenges should be related to each other deeply. In fact, we can find out from the case study that the smart manufacturing and digitalization have a big potential to generate a synergy effect for the manufacturers in the traditional food industry.

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