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Evolution of Global Product Development Strategy
Daikin's Growth Trajectory

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Abstract

Promotion of global strategies is inevitable for Japanese multinational companies, but a fundamental challenge is resolution of the dilemma between global integration and local adaptation. This paper argues that a modular strategy can be effective in paving the way to solving this challenge. The paper introduces the process by which Daikin Industries, which is considered to be a remarkable success story of globalization, overcame the challenges it faced in the process of globalization and shifted from a conventional product development strategy to a modular strategy.

Key Words: Global Product Development, Dilemma of global integration and local adaptation, Design Rules, Architectures, Modularity

1 Introduction

In recent years, many of Japan's leading multinational organizations have been shifting their product development strategies. Traditionally, Japanese companies have excelled at developing finely-tuned products to meet the unique needs of disparate regions of the world. However, developing the number of product variations required to meet each and every diverse need of emerging markets is practically impossible to achieve. Ironically, the more aggressive their

globalization efforts, the more serious this problem becomes and the more it worries Japanese multinationals.

Even Toyota, one of Japan's leading automakers, shares this conundrum. To solve this problem, they have turned to a product development strategy they call TNGA (Toyota New Global Architecture). A Toyota engineer interviewed by the author explained the purpose of TNGA was to eliminate "unnecessary differentiation." It was a surprise to the author that Toyota engineers were aware that product variations intended to create value for customers did not lead to "valuable differentiation" for customers.

Daikin Industries, although in a different industry, faced the same problem and switched to a product development strategy generally called base model development. The actual name given to the new product development strategy differs from company to company, but the underlying principle remains the same, namely the principle of modularity.

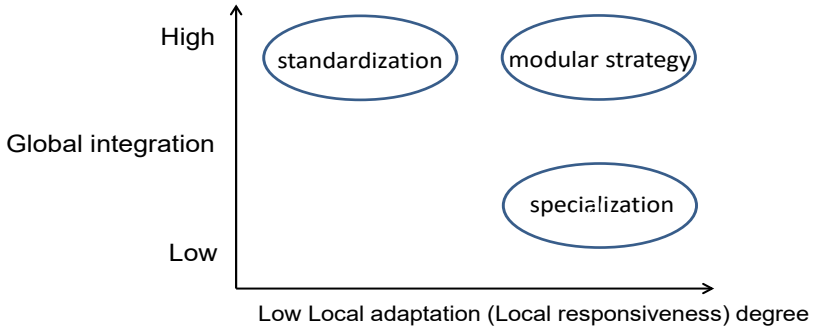
After describing the international management and modular strategy, this paper examines the case of Daikin Industries, which is highly regarded as a successful example of globalization, and discusses how the company evolved its product development strategy.

2 International management and modular strategy

The dilemma of global integration and local adaptation

A fundamental problem for multinational corporations operating in multiple markets across national borders is the dilemma between global integration and local responsiveness (Prahalad and Doz, 1987). This problem is conceptualized in the I-R framework shown in Figure 1, which plots the degree of global integration on the y-axis and the degree of local responsiveness on the x-axis, and maps a company's target position.

Figure1　I･R(Integration-responsiveness) framework



Utilising a modular strategy to achieve global integration and local adaptation

Source：Prahalad and Doz(1987) adapted

1

Global integration is a concept that aims to standardize products and services as much as possible and supply them worldwide, thereby allowing companies to reduce costs and improve efficiency. However, in reality, each market has its own unique needs, government regulations, customs, etc., and it is impossible to satisfy those unique needs with just one version of the product or service. In contrast, local adaptation focuses on responding to the unique needs of each region, which inevitably leads to more product variations through customization.

Multinational companies operating across national borders need to position their strategies somewhere between global integration and local adaptation, but the challenge is that the integration axis and the adaptation axis are on opposite vectors, making it difficult to achieve both. If integration activity is strengthened, local adaptation is weakened by standardization, yet if local adaptation is strengthened, the promotion of customization reduces cost competitiveness. In other words, companies must make a difficult decision on where to position themselves between integration and adaptation, which are theoretically two opposing forces. This is the management challenge known as the integration-adaptation dilemma. How can this dilemma be solved? This paper argues that modular strategies have some effectiveness toward solving this problem.

A modular strategy with two aims

Many previous studies on modular strategies (Baldwin and Clark, 1997; Baldwin and Clark,2000; 1992; Robertson and Ulrich, 1998; Ulrich ,1995; Sanchez and Mahoney,1996; Shibata, Yano and Kodama, 2005; Shibata, 2009) have reported that modular strategies theoretically bring strategic flexibility and advantages such as cost competitiveness and speed of product development.

To summarize, modular strategy is a design concept that divides a product as a system into a group of highly independent modules, establishes rules for the interfaces that connect the modules, and tries to meet customer needs through flexible combinations of each module. The process of deciding how many and what kind of modules to include and what kind of interface specifications to use to connect these modules is called design rule formulation. The ability to formulate good design rules is the key to modular strategy. The extent to which the theoretical benefits of modular strategy can be realized in practice depends on the quality of the design rules. For example, the degree to which cost reduction effects can be realized depends largely on how well the design rules are implemented.

Using this modular strategy, we can see a way to solve the dilemma of integration and adaptation to a certain extent, which can be outlined as follows. Products can be roughly divided into two groups: common basic components that can be used in any market, and variable components that need to be adapted to each market. In any given market, there are certain functions and performances that are required, and these are grouped together as common basic components. The idea is that the creation of a common basic components that can be used in all markets will have the effect of increasing the degree of global integration, while variable component groups will take care of local adaptations that cannot be handled by the common basic components alone.

However, it is not obvious how much of the common basic components should be grouped together and how much should be variable. If the scope of common base is taken too broadly, the diversity of variations will be lost, and it will not be possible to respond to the unique needs of each region. In other words, the axis of local adaptation will become too weak. In contrast, if the scope of commonality is too narrow, economy of scale cannot be optimised, resulting in inferior efficiency and cost competitiveness. This in turn weakens the axis of global integration. In other words, to achieve both local adaptation and global integration, it is necessary to solve the difficult problem of design rules that determine the extent to which common basic components should be used.

However, as an industry gradually matures as the product life cycle progresses, knowledge of the technology system becomes more sophisticated and predictable, and it becomes easier to find good design rules for modularizing a product (Baldwin and Clark, 2000; Shibata, (Baldwin and Clark, 2000; Shibata, Yano and Kodama, 2005). With good design rules in place, a modular strategy can provide valuable differentiation for customers. On the other hand, if a company does not adopt a modular strategy even though it is in the mature stage, it tends to have too many product variations resulting in unnecessary differentiation, as Toyota engineers pointed out. In short, as an industry gradually matures, it becomes easier to implement a modular strategy, and the

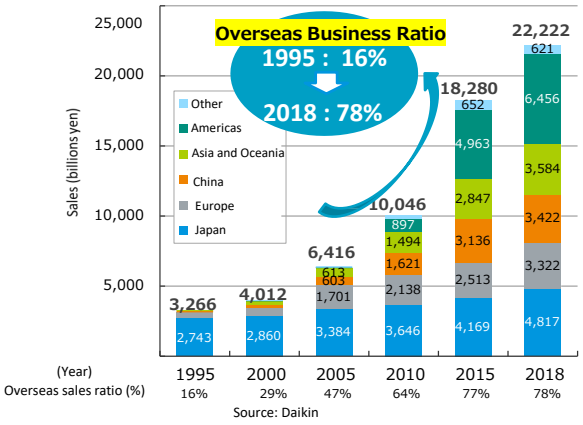
benefits become greater than the costs of implementation. The series of new product development strategy adopted by Toyota and Daikin can be understood in this context.

3 Case study: Daikin's growth trajectory

Daikin Industries, Ltd. (hereafter referred to as Daikin), headquartered in Osaka, Japan, is the world's largest air-conditioning company in terms of sales, and had consolidated sales of 24.811 billion yen, consolidated ordinary income of 277.1 billion yen, and a consolidated workforce of 76,484 people in fiscal 2018. Daikin's business domain consists of three segments: air conditioning and refrigeration equipment; chemicals including fluoropolymers and oil and water repellents; and others including hydraulic equipment, specialized machinery, and electronics systems. Since about 90% of its sales come from the air conditioning and refrigeration equipment business, although it is a large company with sales reaching 2.5 trillion yen, Daikin is considered to be a specialized manufacturer of air conditioning equipment.

Figure 2 : Sales of air conditioning systems by region

■ **The coloured bands show sales grew at a similar rate in all five global regions. This was achieved through measures such as moving production sites closer to markets, creating localized products, and developing in-company sales outlets while utilizing M&As.**



Source: Daikin

In the latter half of the 1990s, Daikin utilized M&As in the air conditioning industry focusing on global expansion. It acquired sales agencies in Germany, Spain, Italy, and other parts of Europe and made them subsidiaries. In 2007, it acquired OYL Industries, a major air-conditioning company in Malaysia, and in 2013, it acquired Goodman, a similar company in the United States. While it is usual for consolidated sales to increase at the time of acquisition, what is unusual is that Daikin's sales continued to increase afterwards. In fact, their sales grew from 531.9 billion yen in 2000 to about four-fold that in 2018. The reason for this rapid growth was Daikin's success in globalization.

In the air conditioner business, Daikin's ratio of overseas sales to total sales was 16% in 1995 reaching 78% in 2018, when about 80% of its air conditioner earnings were from overseas markets. Daikin's global product development strategy ensured it was not dependent on any particular region.

Rather than focus on any one region, it formed a well-balanced regional structure with sales of about 300 billion in each of five regions: Japan, Europe, China, Asia/Oceania, and the Americas. The company has so far expanded into most markets except Africa. It can be said that Daikin has developed a system wherein markets in some regions compensate for downturns of markets in others.

Until the early 1990s, however, Daikin had relied heavily on the Japanese domestic market and had not explored overseas markets. In addition, Daikin was a company with a low market share in Japan. This turnaround begs the question-how did Daikin achieve such remarkable results in its global strategy? To answer this question, this paper describes the global product development strategy that enabled Daikin to evolve so successfully, and the circumstances that led to it.

A sense of stagnation brought about by the initial success of global expansion

The person that brought about the success of Daikin, Noriyuki Inoue (hereinafter referred to as Inoue), was appointed president in 1994 as the company posted a loss in ordinary income for the first time in 17 years. Immediately after taking office, Inoue announced a policy of withdrawing from unprofitable businesses and returning to the core business of air conditioning, concentrating management resources there and steering the company toward aggressive global expansion. Daikin had been diversifying its business ventures because the air conditioning business was unstable and easily affected by weather, and because the domestic air conditioning market had already matured.

However, this had been a parachute type diversification strategy that was not expecting synergy with the air conditioning business. For example, Daikin diversified into robotics, electronics, medical equipment, and other businesses that were neither technologically, nor market related to its core air conditioning business. There was no certainty that these businesses would contribute to profits going forward. Therefore, in 1995, immediately after Inoue took office, he withdrew from the robotics business which Daikin had entered in 1982 and had been its largest loss-making business. This was followed by successive withdrawals from floor heating, electronics, and medical equipment. When asked the question-why had Daikin's diversification not been successful?

Inoue said, "I realized that having excellent engineers and profitability did not necessarily go hand in hand" ("Believe in the Power of People and Go to the World," by Noriyuki Inoue). In short, Inoue recognized that the root cause of Daikin's unsuccessful diversification was a problem of management, not technology. There are many challenges to management, but the first and foremost challenge is deciding which businesses to enter. Consequently, Inoue changed the company diversification strategy from parachute type, which it had pursued until the bubble period, to concentric by focusing on technologies surrounding its core business. He steered the company using a diversification strategy allowing it to take advantage of the strengths and advantages of its refrigeration equipment and chemical business. At the same time, Daikin concentrated its resources on its core air conditioner

business and aggressively pursued global expansion. Daikin's rapid growth in recent years was due to a return to its core business and its global strategy.

Starting in 1996, Daikin formulated a five-year strategic management plan called Fusion 21 (1996~2000). After Fusion 21, Daikin continued its strategic management plan with Fusion 05 (2000~2005), Fusion 10 (2006~2010), Fusion 15 (2010~2015), and Fusion 20 (2015~2020). One of the main pillars of these plans was the global expansion of its air conditioning business. As a result, the overseas sales ratio of air conditioners, which was only 16% in 1995, reached 64% in 2010. In the process, the company pursued a production strategy of locating its manufacturing bases closer to its customers on the principle of local production and local sales, rather than in Japan and exporting. In other words, what is sold in Southeast Asia is made in Southeast Asia, and what is sold in Europe is made in Europe.

Close-to-market production can reduce the risk of exchange rate fluctuations and risks associated with change in demand, and also transportation problems such as when freight trucks were stuck in days-long gridlocks after some countries closed their borders to the UK when COVID19 appeared. Furthermore, close-to-market production shortens the lead time from production to sales. Daikin started close-to-market production of medium and large size air conditioning systems in 2004. To ensure a stable supply of compressors to Europe, it started production in the Czech Republic in 2004. As of 2007, the company had established overseas production bases at over 85 locations in 28 countries worldwide. Although Daikin had been working on localization of overseas production bases from an early stage, product development was in principle concentrated in Japan. However, demand for air conditioners differs by region due to factors such as climate, voltage availability, and design preference. For example, in India air conditioners must operate under high outdoor temperatures that may reach as high as 49 °C; and due to air pollution in China, demand for air quality is high to deal with atmospheric aerosol particles, in particular, particulate matter with a diameter of 2.5 μm (PM 2.5); whereas in Europe, air conditioners with stylish designs are favored.

Figure 3 Images of air conditioners

Room air conditioners for China. Red, the color favored by Chinese, was used for indoor units.

Room air conditioners for Europe. Stylish models favored by design-conscious Europeans.

Source: Daikin

3

To meet such different needs, the amount of development work in Japan, where responsibility for all development remained, increased enormously. The ability to handle this swiftly was contingent on development resources, yet the more successful globalization became, the more development requests arose, and the more exhausted the engineers became in responding to them. Thus, by the time globalization accelerated at around the year 2000, a sense of stagnation and fatigue began to appear within the company. Development requests kept streaming in one after the other and the company became unable to respond to the waves of such requests coming in from around the world. Although the company had achieved an increase in both sales and profits, the employees began to feel frustrated by the incessant load from development tasks that kept arising with no end in sight.

Looking back on those days, Inoue said, "We were so busy with our daily work that we were unable to discern our future direction. We had grown so fast, but I couldn't help but feel that we were hitting some kind of wall before we could take the next step. ("Believe in the Power of People and Go to the World," by Noriyuki Inoue).

Therefore, in 2002, the company issued the "Daikin Declaration of Technology" and the air conditioning development team was divided into project teams to create as flat an organizational structure as possible. The development system was changed so that project and group leaders were directly connected to the director in charge and were themselves responsible for setting and attaining their own goals. In short, Inoue tried to boost the morale of the engineers and revitalize the engineering department. However, despite their best efforts, and although the engineering department was temporarily revitalized, they could not cope with the rapid pace of globalization and the sense of stagnation began to reappear.

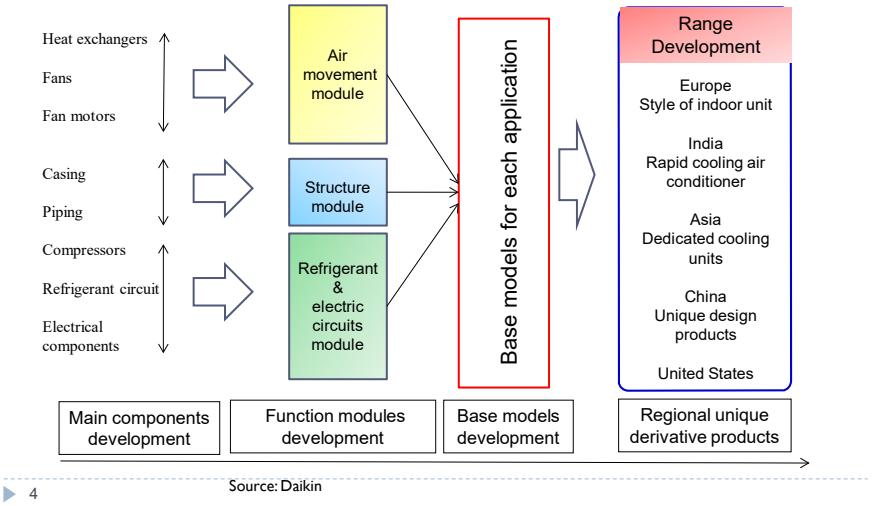
Let me borrow Inoue's words again. “As global expansion accelerated further, the technology development department was flooded with various requests. Around 2004-5, we were in a situation where we couldn't run out of work, and the feeling of blockage began again." ("Believe in the Power of People and Go to the World," by Noriyuki Inoue). There was no end to the amount of work that could be done, and a sense of stagnation began to set in again.

The situation where there seemed no end to the work probably refers to one where they were busy with immediate tasks without time to consider any future outlook. This was an issue caused by the success of their global strategy. Reviewing the organizational structure alone was not a fundamental solution. What Daikin did was to incorporate the modular concept into air conditioner design and shift to a bird's eye view and systematic development strategy.

Making design concept modular - Toward Base Model Development

Daikin's modular concept of air conditioners refers to the following product development strategy: For air conditioners to be sold globally, Daikin must first determine the needs of the world markets as much as possible, then formulate and develop a base model in Japan with common functions and performance as a standard to which extensions and tweaks may be made to suit unique needs overseas. To meet customers’ needs that are not included in the base model, overseas sites can add functions to the base model. This kind of development is called range development. Range development could be defined as developing a range of different applications and components among which items may be selected to construct a model suitable for local needs. Thus, a base model is set as the global standard from which derived products can be developed quickly at local sites.

Figure 4: Development of base models air conditioner (2010~)



Source: Daikin

The main components of an air conditioning system include, heat exchangers, fans, fan motors, compressors, and refrigerant circuits, etc. These can be classified into function modules by grouping

components which have close interdependencies. The example of function modules are air movement module, structure module, and refrigerant module as described in Figure 4. Within the refrigerant module, changes to the compressor directly affect the refrigerant circuit. Similarly, there is interdependence among components within the air movement module, i.e., the heat exchanger, the fan, and the fan motor. Therefore, if a change is made to the heat exchanger, the fan and fan motor will be affected and must be altered accordingly. Close interdependence among these components requires that they be effectively managed allowing multiple variations of function modules with different performance and function to suit different needs. For example, the air movement module is able to achieve multiple performance variation, depending upon the pattern of interdependence between three components, that is, the heat exchanger, the fan, and the fan motor.

Accordingly, the base model should be made up of multiple variations of function modules, which can be flexibly combined to realize a product that meets a particular market's needs. To achieve this, the interfaces between these functional modules must be specified. From 2010 onward, Daikin began to study this kind of product strategy with standardization at its core.

The most difficult part of developing a base model is to determine which functions and performance are optimal, that is, drawing task boundary between base model development and range development.

Since it is impossible to incorporate every requirement from around the world, it was necessary to determine the optimum number of variations of function modules to be included in base models. Daikin realized that if they narrowed down the number of variations of each function module too much, there would be too much room for range development, and the significance of creating a base model would be diminished. In contrast, if the range were too small or narrow, the base model would not be sufficiently versatile.

It was difficult to determine how far to go with the base model and how far to go with range development to achieve overall optimization. In addition, the number of base models to be developed needed to be carefully considered. If the number of base models were kept at a minimum, economies of scale would be realized improving cost efficiency. However, the fewer the number of base models, the higher the number of variations of function modules to be included in each. The development of a base model involves such trade-offs, and even in this situation, the organization must make decisions. What kind of system did Daikin use to make such difficult decisions?

First of all, Daikin product development headquarters team based in Japan was responsible for collecting customer needs worldwide. The team was divided into two main groups: Product Development, and Component Technology Development. The former was responsible for the product concept, performance, and function of air conditioners, and was familiar with the needs and

specifications of air conditioners at each overseas market. The latter was responsible for the development of core technologies for air conditioners such as inverters, heat pumps, and refrigerant control. Both of these groups participated in developing the concepts and specifications of base models, which were then proposed to overseas development offices. Each overseas development office evaluated the base model proposal and examined whether it met their needs and functions for range development at their end and feedback their results to Japan.

Japan re-examined the base model given the feedback and proposed an updated base model, and this cycle was repeated. It was not always possible to incorporate every need of each overseas market, so there were often heated discussions between Japan and overseas sites. While repeating such discussions, Daikin proceeded to formulate the base model which was eventually completed by around 2015. However, once a base model is created, it is not fixed forever. When there is a need for a major addition of functions or performance that cannot be handled by range development, the number of base models may be increased.

In addition, there are cases where overseas development offices take the lead in changing the base model. An example of this is the development of a base model dedicated to air-conditioning by a group in Thailand. For Southeast Asia, where heating is unnecessary, a base model with a heating function would be an over-specification. In addition, the price would be unnecessarily high. Therefore, the development group in Thailand, with cooperation of the development headquarters in Japan, developed a base model in 2015 that was designed for cooling by eliminating the heating function thereby reducing the cost by 20% aiming for higher sales volumes in the Southeast Asia market. This is an example of how Thailand has developed a specific base model.

Transformation of the development system - from the headquarters in Japan to an autonomous decentralized system

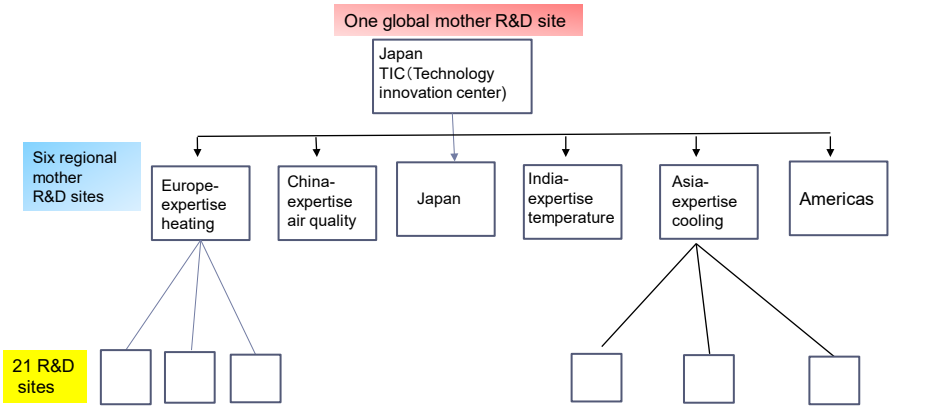
Around 2015, when standardization of the air conditioner design concepts was almost complete, Daikin began to review its global development system. First, in November 2015, they established a Technology Innovation Center (TIC) in Osaka Prefecture to serve as their global development headquarters. Until then, development for local needs had been performed at different centers around the world, resulting in duplication of development work. To prevent such duplication, TIC became the control tower and changed the system to steer the promotion of technology integration and industry-academia collaboration, based on a bird's eye view of global technology and product development trends. In July 2017, Daikin began to incorporate a mother concept for R&D aiming to optimize global development by dividing development bases around the world into a three-tiered division of labor according to organizational capacity and function.

At the top of the global development system Japan's TIC, positioned as the "global mother," was responsible for the development of base models as well as core technologies for air conditioners, keeping an eye on global technology and demand trends, and serving as the control tower for global development.

Daikin's three core technologies includes inverters, heat pumps, and refrigerant control. The inverter is a technology that finely controls the motor speed of the compressor, the heart of the air conditioner, and dramatically improves energy efficiency. Compared to systems without inverters, energy efficiency is increased by about 30%. A heat pump is a technology that cools or warms air in a room by extracting heat from air outside the room.

The TIC was responsible for the development of these core technologies, and below the TIC , there were six "regional mother R&D" centers; Europe, China, Japan(TIC), India, Asia, and America. In addition to developing specific base models, regional mothers specialized in functions limited to specific products. For example, Belgium, which was the Europe regional mother, specialized in the heating function where it had a track record of development, having developed a heat pump system in 2006. Similarly, China specialized in indoor air quality because of its unique know-how and technologies related to air quality, such as PM2.5 compliance. Twenty-one general R&D centers positioned below the regional mothers performed local development with support of their regional mother. As shown in Fig. 4, the development system comprised three levels: the TIC as a global mother site with a bird's eye view of the entire world driving overall design optimization; the six regional mother R&D centers with limited mother functions; and 21 general R&D sites around the world. Thus, Daikin tried optimisation for global product development through division of labor among three kinds of R&D sites with different roles and capacity.

Figure 5: Three-tiered global development system（2017~)



A global development system comprising three levels to decentralize global development, which had been concentrated in a single location, and create a system to mutually share know-how and technology accumulated at each site throughout the world.

Source: Daikin

Inoue describes the role of the TIC as follows: "It is important for the TIC to act as a control tower, to grasp the human resources in each region, absorb their technologies and opinions, and strategically consider how and where to manage them after consulting with the top of each regional R&D mother center. This is the root of Daikin's technological development capabilities. (Noriyuki Inoue, Nikkei Business, Jan. 21, 2019).

For example, how are the needs of countries around the world, which do not have development bases, handled? TIC knows what kind of engineers and what kind of technologies are accumulated in the development sites around the world and allocates development work to regional mother R&D sites as needed. They in turn formulate development plans and budgets and propose them to the TIC, which makes the final decision on development from the perspective of total optimization. In this way, total optimization is achieved through information sharing and communication between TIC, as the global mother, and regional mother R&D sites. To facilitate this, there is a semi-annual meeting of the heads of regional mother R&D sites along with the TIC to communicate and share information with each other.

The concept "mother" is usually applied to the function of production, with roles akin to that of a natural mother, namely supporting and nurturing. The term "mother factory" in Japan describes an exemplary factory with the role of supporting and nurturing new factories to be built overseas. Daikin applied this concept not only to production but research and development functions. One factor that facilitated application of the mother system to the development function was the fact that a certain degree of standardization of design had already been promoted, in particular, the shift to standardization of the air conditioner design concept from around 2010, which realized base model development.

By standardizing base model development as much as possible and allowing it to be done with various combinations of functional modules, it was possible to reduce the complexity of the development process. Accordingly, a certain level of development can now be done by regional mother R&D sites overseas. Even so, a certain level of organizational and technical capability is required by regional mother R&D sites. In the days when the concept of base model development had not been introduced, all development activities were concentrated in Japan in order to guarantee the function and quality of air conditioners. This is why the sense of stagnation and fatigue at that time came about. However, since Daikin established a global autonomous decentralized development system, they have been able to effectively utilize the technologies and human resources accumulated at development sites around the world and greatly improve development efficiency. In this way, a way emerged to fundamentally overcome the sense of stagnation and fatigue that once manifested itself due to the initial success of globalization in the early 2000s.

4 Conclusion

In this paper, we have shown that with the traditional way of product development that Japanese companies have excelled at, the more successful they are in globalization, the more product variations there are, and the more serious the problem of integration and adaptation dilemma becomes. This paper argued that the fundamental solution to this problem is to change the product design approach to a modular strategy. In fact, if we look back at the growth process of Daikin Industries toward globalization, we can see that it followed such a trajectory. The same situation applies not only to Daikin but to the automobile industry. As can be seen from Nissan's introduction of CMF (Common Module Family) (Shibata, 2014) and Toyota's introduction of TNGA, automakers have also turned to modular strategies.

Finally, if we look back again at Daikin's global growth trajectory, we can see that another strategy that has played an important role is openness. Since there is a close relationship between modular and open strategies, I would like to briefly introduce Daikin's open strategy.

Japanese companies have traditionally been said to hold the principle of doing everything within the organization. This means the Japanese management stance is to seek to develop and produce something as much as possible on their own without cooperation from outside. However, Inoue says that it is important to abandon the principle of doing everything in-house because a wave of creative destruction continues at an accelerating pace in the modern era, also known as the fourth industrial revolution.

“The fourth industrial revolution, as it has been called, is a wave of creative destruction that will continue at an accelerated pace. We must develop our technologies that differentiate us from other companies and work together with our partners to create other areas. On top of that, it's essential to move at a fast pace to produce results." (Yomiuri Shimbun, March 17, 2020, Leaders Interview with Management)

A key notion that symbolizes the collaborative approach is the concept of openness. However, there are two types of openness with different purposes, namely openness to expand the overall market by making friends, and openness to promote innovation. The act of opening up itself is the same, but the purpose of these two types of opening is not the same. Daikin has implemented both types of openness with different objectives. A typical example of opening up to expand the market by making friends is Daikin's 2008 business alliance with Gree Electric Appliances Inc. of Zhuhai, China's largest manufacturer of home air conditioners and a rival, to which Daikin disclosed some of its inverter technology. Since inverters are one of Daikin's core technologies that it has cultivated over the years, it should be unlikely for Daikin to disclose such information to a rival. In fact, there was great opposition from Daikin technical team at the time. In spite of this, Inoue as CEO steered the

company toward an open strategy. What was Daikin's goal? By disclosing some of its inverter technology to Gree, Daikin hoped to get the Chinese market to adopt inverter technology as soon as possible. In addition, they thought that if they could make the Chinese standard, it would be a shortcut to a global standard. For this reason, Daikin abandoned their closed, self-imposed policy and promptly chose to collaborate with their rivals.

At the time of the business alliance in 2008, the Chinese air conditioner market was overwhelmingly a non-inverter market, centered on inexpensive products, and the market for inverter-equipped units, which was Daikin's forte, was very small. At that time, the Chinese market was entering an era in which energy conservation was required, and Chinese air conditioner manufacturers were faced with the choice of accelerating energy conservation development with non-inverters or working on new inverter technology. As mentioned previously, an inverter is a system of voltage, current, and frequency technology that continuously controls the heating and cooling operations by controlling the air temperature, which improves the energy-saving efficiency by about 30% over air conditioner systems that do not include inverters.

As a result of Daikin's open strategy, the entire Chinese market moved to inverters when Gree chose to use them. In fact, the percentage of air conditioners that used inverters in the Chinese market rose from 7% in 2008 to 56% in 2015. In other words, the nature of the Chinese air conditioner market changed dramatically from non-inverter to inverter equipped systems. It can be said that this is a successful example of open strategy aimed at expanding the market by making friends. However, not all of the inverter technology was disclosed. The inverter software used to optimally control the compressor motor was supplied to Gree in black box form to prevent it from being deciphered. Other basic technologies such as temperature control technology and air flow control technology were kept open.

To reconfirm, the meaning of openness here is the act of disclosing core technologies to rival companies, rather than keeping them closed within the company. The purpose of this is to grow the market. In fact, both Daikin and Gree grew with each other, and the inverter market grew significantly.

Another type of openness is open strategy to promote innovation, which is often referred to as open innovation these days. It is an openness for new technological innovation and value creation. For example, in the case of Daikin, centered on the TIC, the company is actively promoting co-creation to create new value and technological innovation through collaboration between industry, government, and academia, leveraging each other's strengths and complementing each other's weaknesses. For example, TIC signed a co-creation agreement with the University of Tokyo in December 2018 and is actively working on the development of new technologies. Ten billion yen in funding will be provided to the University of Tokyo by Daikin over 10 years. The company is also building relationships with

370 venture companies related to the University of Tokyo and is aiming to exchange human resources through the "cross appointment" system. The meaning of openness here is the act of creating value by linking the advanced technologies and human resources of the University of Tokyo, which exist outside of Daikin, with Daikin's core technologies and human resources.

These two types of open strategy are often both discussed in the context of importance of collaboration. However, their objectives differ, the substance of what is open is different, and the specific mechanisms for doing so are also different. Daikin is actively engaged in both open strategies in order to achieve further growth.

Note:

The case of Daikin was prepared based on interviews with Daikin Industries (November 8, 2019 and January 29, 2020) and published materials including books, magazines, and newspapers.

November 8, 2019 Interview (Honorifics omitted)

Yuji Yoneda (Executive Officer, Air Conditioning Product Development)

Isao Hasegawa (Executive Officer, Deputy General Manager, Air Conditioning Production Headquarters)

Yuichi Kita (General Manager, Technology Innovation Strategy Office, Technology Innovation Center)

January 29, 2020 Interview (Titles omitted)

Yuichi Kita (General Manager, Technology Innovation Strategy Office, Technology Innovation Center)

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