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Abstract
The present study examines the triad coordination among R&D, production, and marketing activities when they are separated globally. We explore the global integration drivers to promote triad integration. Earlier research focused on supply chain integration (SCI) of directly linked activities, including R&D and production, production and marketing, and marketing and R&D, and attempted to solve their dyadic trade-offs. The present study focuses on triad integration among R&D, production, and marketing in supply chain research because the triad perspective can help understand the complex phenomenon of global SCI.

Keywords: Global supply chain management, supply chain integration, tacit knowledge, externalization, front loading

Introduction
Economic globalization has led to the proliferation of business activities to various countries, thus complicating supply chain integration (SCI). Parts and materials are often procured from several countries, products are assembled in low-income countries, and the final products are exported worldwide. Effective management and coordination of these global activities is challenging. Moreover, earlier studies on supply chain states found that coordination among different companies requires advanced management (Lee *et al.*, 2007; Sezen, 2008; Eltantawy *et al.*, 2009; Lo and Power, 2010). Global integration of the inter-enterprise supply chain is challenging.

In earlier studies, industry players considered the supply chain an essential feature that helped create high-value products and services for end consumers (Lee *et al.*, 2007; Sezen, 2008; Eltantawy *et al.*, 2009; Lo and Power, 2010). Manufacturing firms were often compelled to compete profitably without establishing interorganizational collaborative relationships or mutually beneficial partnerships with suppliers and distributors (Stock *et al.*, 2010). Similarly, intraorganizational (cross-functional) integration is imperative for competition (Turkulainen and Ketokivi, 2012). Therefore, from a supply chain management (SCM) viewpoint, there are inter- and intraorganizational integrations, which are the present study's focus.

Integrating all product-flow processes is essential for effective and efficient supply chain coordination. In the present-day global economy, each multinational company (MNC) competes successfully with help from cooperative partners worldwide (Gulati *et al.*, 2000). Thus, SCI remains a critical factor for global SCM.

Although the it is important to integrate all supply chain activities from upstream to downstream to realize high-performance outcomes, this integration is highly complicated because of the diverse actors (Bowersox *et al.*, 2000; Fawcett and Gregory, 2002; Nagashima, 2017). Too often, various departments and organizations work independently (Bowersox *et al.*, 2000).

The present study examines how to implement triad coordination among R&D, production, and marketing spread across countries and explores the key factors driving global integration to promote triad integration.

The study draws on a case study of a Japanese electronics manufacturing company, Company X. An overview of the literature on new product development for overseas local markets and global SCI is presented, followed by the case study. Finally, results, findings, and theoretical contributions are put forward.

Literature review

This study addresses two problem areas: new product development for overseas local markets and global SCI.

New product development for overseas local markets

Taskforce team for developing products

Since the 1990s, rapid economic globalization has raised the issue of how MNCs efficiently carry out R&D and produce and sell products to overseas markets (Bartlett and Ghoshal, 1989; Birkinshaw and Hood, 1998; Govindarajan and Trimble, 2012). International business globalization studies mainly focus on the trade-offs between the needs of global and local markets (Samiee and Roth, 1992; Cavusgil *et al.*, 1993). In particular, when the local market is a developing country, there are often large differences among the needs for global products. Thus, trade-off issues are likely to arise (London and Hart, 2004; von Zedtwitz *et al.*, 2015). Thus, it is difficult to adapt the technologies and knowledge developed in the home country to product strategies in the local markets (Govindarajan and Trimble, 2012).

To address this issue, Govindarajan and Trimble (2012) claimed that, to achieve product innovation for emerging countries, task force organizations, called local-growth teams (LGTs; e.g., venture companies) must be established in the local markets, independent from their home countries. The LGT is a cross-functional organization with various functions required for development. The present study examines how MNCs can effectively organize themselves to develop, produce, and market products in local markets.

Global SCI

Creating new products is a multidimensional effort involving various functional divisions, such as R&D, production, and marketing. Earlier studies have shown that the level of integration among these functions significantly impacts a firm's competitiveness index (Olson *et al.*, 2001; Brettel *et al.*, 2011; Turkulainen and Ketokivi, 2012; Turkulainen *et al.*, 2017). This issue leverages the same logic as the SCM discussion. Extant literature on SCM can be broadly divided into two types: those focusing on intra-company organizational collaboration and those on inter-company collaboration extending to consumers and suppliers (Flynn *et al.*, 2010). The present study focuses on internal SCM.

Although intra-SCI becomes imperative as globalization progresses and functions are distributed worldwide, integration is highly complicated, given the diversity of actors along the supply chain (Bowersox *et al.*, 2000; Nagashima, 2017). The complexity is mainly a result of the common trade-off relationships among the objectives of functional organizations (Skinner, 1969; Silveira and Slack, 2001). The conflicting and dyadic relationships among each function of R&D, production, and marketing are described as follows.

Integration of R&D and production

Integrating R&D and production has been recognized because of increased production outsourcing in recent years (Kotabe, 1998; Kotabe and Murray, 2004). In particular, horizontal integration has worked well for digital consumer goods, and electronics production service has expanded (Sturgeon, 2003).

Under these conditions, there is homogeneous product performance between firms, and the focus of competition shifts from product differentiation to the speed of volume increase and expansion of the product line-up (Christensen, 2003). In parallel, the advantages of carrying out both R&D and production in the same company are commended. Although historically, United States firms have tended toward R&D innovation (Starr and Ullman, 1988), they have been able to maintain competitive advantages, even in commodity products, through production innovation (Wheelright and Clark, 1992). In addition, coordinating R&D and production is related to concurrent engineering issues, which is imperative to the competitiveness of Japanese manufacturing companies (Takeuchi and Nonaka, 1986; Clark and Fujimoto, 1991; Fine, 1998).

Integration of production and marketing

Studies on the conflict between production and marketing can be traced to Shapiro (1977). See Parente (1998) for a review. The production viewpoint stresses the need to manufacture standardized products in large volumes, whereas the marketing perspective underlines the need to provide the maximum range of products with short delivery lead times and flexible quantities. This conflict between production and marketing has been called the productivity dilemma (Abernathy, 1978). Literature on the concepts related to just-in-time production and lean production systems introduced by Japanese companies are included in this area (Schonberger, 1986; Womack *et al.*, 1990).

Integration of marketing and R&D

Most of the earlier studies on marketing and R&D interfaces have concentrated on the interactions of marketing and R&D in new product development (Maltz *et al.*, 2001). Studies were mainly from the viewpoint of conveying market information to the R&D division (Becker and Lillemark, 2006).

Although there are several conflicts between the functions of marketing and R&D, whether these functions should be integrated has been debated for a long time (Griffin and Hauser, 1996; Lau *et al.*, 2010). For example, marketing sections interact with customer needs, which are oriented toward short-term responses, whereas R&D sections tend to be oriented toward product innovation through medium- to long-term efforts. Studies have concentrated on the need for systems to adjust to such conflicts in a company (Lawrence and Lorsch, 1967).

Need for comprehensive and triad perspectives

Most of the studies have focused on the SCI of directly linked activities, such as R&D and production, production and marketing, and R&D and marketing. They explored

methods to solve dyadic trade-offs (Kahn, 1996; Silveira and Slack, 2001). However, these methods provide limited insight and fail to capture SCI comprehensively as a single-system firm-wide perspective (Hammer, 1990; Naylor *et al.*, 1999; Chen *et al.*, 2007; Brettel *et al.*, 2011).

Furthermore, although extant studies have shown that triad-functional collaboration and integration are particularly important when creating innovative products, its execution has not been elucidated. For example, Turkulainen *et al.* (2017) state that, to achieve functional integration, team structures (i.e., a group of individuals from different units working together and sharing collective responses for outcomes), integrator roles (i.e., a formal role serving as a contact between and within organizational units), and relationship building (i.e., informational communication across organizational units through various means) are key activities. However, Turkulainen *et al.* (2017) did not describe each activity's role in promoting functional integration in specific contexts, such as new product development.

Therefore, the present study elaborates the organizational mechanisms for realizing the internal SCI required in new product development, especially for developing innovative products (i.e., products for emerging local markets).

Research design

A multiple case study method is applied to describe a complex phenomenon and a context for the real-world supply chain. Yin (1994) identified that case studies are most appropriate for exploratory research.

Qualitative data on the microwave oven business at Japanese Company X were derived from 17 in-depth interviews between 2005 and 2019. Company X is one of the world's largest electronics manufacturing MNCs. In particular, four managers from Company X Appliances in China, seven managers from Home Appliances Company in Japan, and six from Home Appliances Company's China factory were interviewed. These managers are responsible for R&D, production, and marketing activities.

In this empirical study, we provide a framework from a triad perspective on the methods to implement effective global integration of interrelated activities among R&D, production, and marketing (Figure 1). This approach could help in exploring significant findings that have been overlooked from the dyad perspective, but are necessary for obtaining high-performance outcomes.

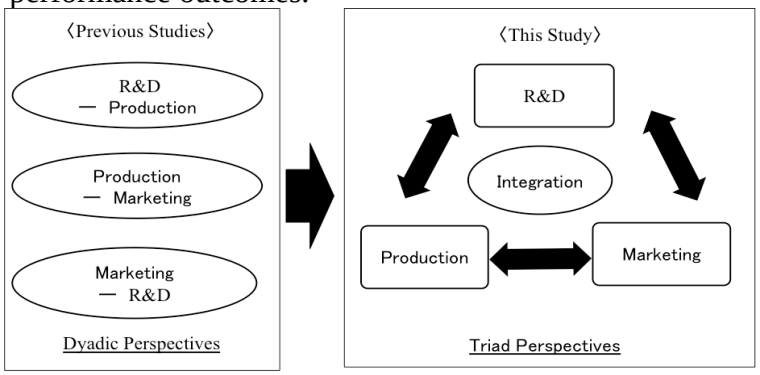

Figure 1. Framework for Global Supply Chain Integration

Case of Company X microwave oven business unit in China

Company X is Japan's leading electronics company, with consolidated sales of 8 trillion yen and 280,000 employees as of April 2019. Its business areas include B-to-C activities, such as home appliances, beauty products, and health care products, as well as B-to-B activities, such as cooling and heating appliances for commercial use, automotive parts,

and industrial components. Company X was organized around considerably independent business units (BUs) segmented by product categories, such as microwave ovens, washing machines, air conditioners, and television sets.

Established in 1969, the various departments of the microwave oven BU of Company X constantly engage with the markets through software, such as soft R&D, through recipes and soft promotion department in sales and marketing that demonstrated using a microwave oven to customers and also allowed food sampling, because a microwave oven creates value only when the hardware (function) and the software (cooking) are integrated for a customer. In this case, the value implies that the customer could enjoy eating delicious foods easily by using a microwave oven. Therefore, the R&D department should understand the market needs, as well as the sales and marketing departments. This idea of the importance of having interfaces with the market through such software is Company X microwave oven BU's core value since it was established.

The microwave oven BU entered China through a joint venture in 1994 in Shanghai. At that time, the microwave oven BU had six production companies in countries including the United States, the United Kingdom, Brazil, Taiwan, China, and Japan, consistent with their strategy of having a production base near the emerging market. The Shanghai factory has suffered low profitability since its establishment because of stiff competition. Its local capabilities in China were developed gradually over multiple phases by addressed deeper localization, enabled by a more extensive cross-border integration of its home-grown resources and capabilities.

Furthermore, Company X's organizational structure combines manufacturing (R&D, production, and marketing) in Japanese BUs of the home country and sales overseas of the host country. This organization was established to balance both manufacturing and sales. However, having all manufacturing functions and skills built in BU organization makes it complex for a sales organization because of the differences in values, processes, and methodologies.

First Stage: Initial adaptation to local market (1994–1998)

The Company X microwave oven BU entered China and established a production subsidiary in 1994. The operations were significantly motivated by labour arbitrage. A considerable portion of their output was for the emerging Chinese market. Opening a production subsidiary implied creating local competition in terms of production facilities operating under the local conditions and constraints as well as local human resource development. In particular, key people, such as those in charge of production lines, were trained extensively at the BU in Japan. Thus, in the initial phase, the competitive value, mainly in the production arena, relevant to China's local conditions and constraints was created accordingly.

Initially, the factory in China was only in charge of production, while the BU in Japan was in charge of R&D and marketing.

Second Stage: Manufacturing-centric for the global market (1999–2012)

The Company X microwave oven BU positioned China as its global production base and transferred resources, in various forms, to its subsidiary in China, such as production process know-how, quality management techniques, product design, and SCM. Through arbitrage and resource transfer, the Company X microwave oven BU has integrated its operations in China into its global production network. In the early 2000s, over 50% of global production came from China. However, they were concerned about competing with Korean and Chinese manufacturers, who were strengthened by cheap, "made in

China" products in the global market. Therefore, the BU focused on developing the global leader model for mass production.

The factory in China is engaged in mass production of microwave ovens that produced a maximum of 4 million for export, mainly to the U.S. market. However, profitability has fallen over the years due to rising labour and material costs that could not accommodate the severe pricing from market. This unstable business structure that depends on the export at severe pricing was further exacerbated by the deteriorating exchange rate. Therefore, it was necessary to change this business structure significantly.

At this phase, the factory in China was in charge of production as well as product design of R&D, while the BU in Japan was in charge of product planning of R&D and marketing.

Third Stage: Development of Local Product Planning Capabilities (2013–2019)

To address the issue of establishing a stable business structure, the factory in China decided to discontinue supplying the U.S. market for mass sales and promote the growing Chinese market without currency risk. In particular, the factory in China aimed to develop different high-value products with enhanced cooking performance and adapted to the emerging Chinese market. By developing local product planning capabilities, in 2013, a new, high-value product category of steamer for the Chinese markets was launched. This appliance specialized in steaming, baking, and frying without a microwave oven function to prepare delicious Chinese foods. The next section presents a detailed case on how to develop, manufacture, and market this steamer oven by coordination for trade-off problems among R&D, production, and marketing is described.

At this phase, the factory in China was in charge of R&D, production, and marketing for Chinese market, while the BU in Japan was in charge of R&D and marketing for the global market, except Chinese.

Case: Steam oven

The planning department at the factory in China played an important role in interfacing with the market through the software of cooking food in a microwave oven, which is the core value of the Company X microwave oven BU's business operation. The role of planning was to understand the market needs for R&D and to promote product value for sales and marketing. In 2013, Mrs. Z., who was responsible for planning, collaborated with R&D, production, and marketing.

Planning proved to be the mainstay in China for deeper localization, as the company gathered critical knowledge and insights on local lifestyles related to the use of home appliances. They found that Chinese people eat steamed dishes on a daily basis; thus, there is extremely high demand for steaming dishes. However, there were few steam ovens for home use in the Chinese market, while professional steam ovens were used frequently used in restaurants. To meet this demand, the planning made several surveys as follows.

They found that there is limited kitchen space for installing yet another small cooking appliance. In an average Chinese household, the kitchen is very small, and single-function microwave ovens were already installed in most homes. Therefore, compactness was a mandatory condition for developing the new steamer. Through these surveys, the planning department found that the oven capacity had to hold the height of a baby bottle and enough width to steam fish. The outer dimensions were determined as width 35 cm × height 35 cm × depth 40 cm, with the internal dimensions of width 28 cm × height 28 cm × depth 18 cm. It was slightly larger than a rice cooker. The challenging part was to fit all the functions of steam, convection, and ventilation within the limited size to cook

foods. Moreover, there was no industry standard for steam ovens for home use because there were few steam ovens in the Chinese market at that time. Initially, the factory in China designed the steamer based on the microwave standard with which they had been working. However, given that Chinese steamed dishes require a very large amount of steam, the microwave standard did not work.

After repeated coordination and trial designs among R&D, production, and planning, they succeeded in developing a heater structure that generates steam in a form that is different from the conventional microwave ovens and with limited space. Moreover, a new standard for Chinese steamed dishes that require a very large amount of steam was created. It was designed based on the numbers of tests to check how to release the steam from the product and how to control the inside pressure due to the steam.

Although the initial survey of this steamer concept was evaluated carefully, it was difficult to predict the market demand size since no examples existed to evaluate the demand volume of steam ovens for home use in the Chinese market at that time. Furthermore, considering that Company X had a low market share since the Chinese microwave oven market was very weak at that time (2%–3%), there were no sales channels willing to take up the challenge of selling this new appliance. Most channels were apprehensive because of the risk; just catering to the current microwave oven market demand.

To solve the problem of predicting the market demand and absence of sales channels, the planning department decided to expand the target segment from young mothers to those who like to cook at home, specializing in the channel of internet sales. In particular, (1) advertising on online cooking programs and broadcasting it on video panels in taxis, (2) advance product release notice with recruitment of trial users, (3) advertising on blogs of cooking experts, and (4) monitoring reports on cooking performance by third-party organizations. Consequently, internet sales targeting those who like to cook at home led to word-of-mouth communication and rapid growth in demand in a short time. This help in predicting market demand.

Therefore, the planning department created a new steamer category for the Chinese appliance industry, even though it was priced at 1,699 RMB, almost three times higher than the average microwave oven in the market, which helped improve the performance outcomes of the factory in China.

However, this approach created new trade-offs between the global coherence of basic design elements, such as global chassis and local adaptation to the market needs. Thus, the deeper triadic integration among R&D, production, and marketing in China led to new trade-offs between Japan and China.

Results

In this case study, the planning in charge of soft promotion was the key driver of global integration among R&D, production, and marketing. Thus, why would such an organization connect R&D, production, and marketing in this case? This question is explored from the perspectives of triad integration and leadership as follows.

Triad integration at an early stage: front loading

SCI has been considered relay integration in the form of R&D and production, and production and marketing, as product development progresses (Krishnan *et al.*, 1997; Krishnan and Ulrich, 2001). However, it is necessary to consider integrating these three functions in a triad. If the problems occurring during mass production are not solved at the product development stage, it will be costly and time consuming to push the problems

back to the R&D section. In addition, it would be too late to recognize that it is a product marketing cannot sell once the relay of production marketing arises. Consequently, it would be better to solve the problem related to these three functions as early as possible.

The planning in charge of soft was positioned as top entity in new product development through advanced product planning actvities. In the early stages, the front loading of problems can be done through proper communication with R&D, production, and marketing.

Leadership of planning: Mrs. Z

Most of the models manufactured at the factory in China are exported with bad profitability; however, there was a strong desire to change the business structure and sell more of the products made in their own factory. Mrs. Z., in planning, played important roles in managing, guiding, and motivating diverse team members toward these common goals and objectives of the project. By elaborating and continuously communicating the project mission like, "It was our first chance to develop, manufacture and market our made in China product to Chinese market and we have to absolutely answer customer needs and make this introduction successful," she motivated the cross-functional team from the early stages of the project. She focused on designing processes to create powerful product concepts, and ensuring that the concepts were translated into design and manufacturing process details.

The planning department, headed by Mrs Z, in the factory in China interfaced with the market through software, thus facilitating effective global integration among R&D, production, and marketing activities as a driver.

Mrs Z. had broad experience as a product designer as well as in marketing in the factory in China and had worked closely with the sales company as well. The planning team in the China factory began to be integrated into the manufacturing and sales network in China.

Findings

Two important findings emerged from the present study. First, the global SCI could be implemented effectively if the triad perspective is considered for organizational capability of co-evolution of global integration and local adaptation, which have been overlooked from the dyad perspective in order to achieve high-performance outcomes.

Second, it was possible to build such a global SCI because the local capability of planning section in charge of soft to propose a market-led product concept, cultivated by its deeper data interpretation. This local capability made implementing global SCI effective, thus convincing the parent BU in charge of global production in Japan and their production subsidiaries in China as well as the Chinese marketing section.

Theoretical contribution

These findings have some important theoretical contributions. First, it is meaningful to find out the strategy and process of global SCI among R&D, production, and marketing activities for Japanese MNCs who could not achieve high-performance outcomes.

Second, it is necessary for the MNCs' head offices to make the effective decisions of supply chain design on how to support in order to promote triadic regional integration.

This study uniquely contributes to studies on the strategy and process of global SCI based on the triad perspective. We do hope that researchers, as well as MNC managers, can benefit from this research to implement global SCI among R&D, production, and marketing activities successfully, and that could lead to high-performance outcome.

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