Factory Strategy: Research on the Role of Plants in Operations Management

Mitsuhiro FUKUZAWA

Abstract: Papers on operations management in major journals have studied (1) relationships between the level of alignment in business and manufacturing strategies, practice realization, and performance; (2) the role of plants in global production networks; and (3) the reconciling of business and manufacturing strategies by operational executives. However, while these studies have positioned the role of plants as a strategic weapon in firms, their perspective is that the role of plants is imparted by headquarters or business units. Actually, the phenomenon which Japanese domestic plants have continued to work on various issues in an advanced manner from a global view went beyond this scope. There is a need for exploratory research from the perspective of plants as to the relationship between the role of plants and the strategic behavior of factory managers in continuing to grow while trying to survive in challenging environments and organizational capabilities built in plants.

Keywords: manufacturing strategy, role of plant, behavior of factory manager, strategy of factory, lean management, Japanese factory
Skinner (1969) asserted that “manufacturing” strategically supports corporate competitiveness and is strategically important; thus, top management should make strategic decisions on their own without delegating them to plants. Since the 1980s, the operations management research has focused on the role of the production function (i.e., plants) on corporate competitiveness. In particular, a growing number of studies have made international comparisons of factors in high performance (QCDFs), and conceptualized lean production systems and operational practices with increasing global adoption (Holweg, 2007; Schroeder & Flynn, 2001; Shah & Ward, 2003, 2007; Womack, Jones, & Roos, 1990). These studies on lean management clarified what practices brought about “good flow of materials and information” in a series of activities, such as development, production, procurement, and sales and to what extent these practices are executed (Fukuzawa, 2019a).

In recent years, the reshoring of domestic plants and consolidation of domestic production facilities has progressed while developing the globalization of production activities (Ketokivi, Turkulainen, Seppala, Rouvinen, & Ali-Yrkko, 2017; Wada, 2018). The external environment of Japanese firms have also changed vastly, such as financial crises and currency fluctuations, fierce competition with firms in newly developing countries, rapidly growing complexity and digitalization of products; therefore, it is now an ongoing task to review and reorganize the global role of each business.

The typical role of plants is the “production activity” in the meaning of “the transfer of design information to media” (Fujimoto, 1999). Plants are also considered to be places where production technologies and procurement activities required to achieve their function take place efficiently and further have the role of creating employment in the surrounding area and contributing to tax
revenues for the local governments (Nakazawa, Fujimoto, & Shintaku, 2016).

This paper reviews how the role of plants has been understood and analyzed in papers published in major Western journals of operations management. Since the 1980s, theoretical and empirical studies on the content and the process of formulating manufacturing strategies as well as production activities (organizational activities and practices) in the role of plants have been advanced.

Manufacturing Strategy as the Core Topic in Operations Management Research

(1) Trends in the manufacturing strategy research

Pilkington and Meredith (2009) noted two main topics, manufacturing strategy and statistical analysis, in the field of operations management based on the analysis of citations and citation relationships in papers published in major journals from 1980 to 2006.

Having broadly reviewed literature related to manufacturing strategy in major journals, Chatha and Butt (2015) organized major themes in manufacturing strategy studies from the 1980s to the 2000s into eleven categories: manufacturing strategy components and paradigms; production capability; strategic choices; best practices; strategy processes; supply chain management; performance measurement; international comparisons; global production; environmental/green manufacturing; and literature reviews. However, the “role of plants,” in which manufacturing strategy should be conducted, and the “role of factory managers,” who manage the factories, were not included within those categories.
(2) Investigations of “good” alignment among business strategy, manufacturing strategy, and manufacturing practice

Following prioritization between QCDFs based on business strategy, Wheelwright (1984) and Hayes and Wheelwright (1984) note (1) capacity, sourcing and vertical integration, facilities, and information and process technology, related to structural aspects; and (2) resource allocation and capital budgeting systems, human resource system, work planning and control systems, quality system, measurement and reward systems, product and process development systems, and organizations related to infrastructural aspects as decision-making factors related to production activities. “Manufacturing strategy,” as a decision-making set of these factors, affects the building of capabilities for production activities and enables the realization of competitive advantage for which firms strive.

There have been subsequent studies based on the above framework regarding manufacturing strategy and organizational outcomes (Alves, Filho, Nogueira, & Bento, 2015; Boyer & Lewis, 2002; da Silveira & Sousa, 2010; Frohlich & Dixon, 2001; Gonzalez-Benito & Lannelogue, 2014; Joshi, Kathuria, & Porth, 2003; Peng, Schroeder, & Shah, 2011; Rosenzweig & Easton, 2010; Schroeder, Bates, & Junnila, 2002; Ward, Bickford, & Leong, 1996; Ward & Duray, 2000; Ward, Leong, & Boyer, 1994; Ward, McCreery, & Anand, 2007; Ward, McCreery, Ritzman, & Sharma, 1998). These studies focused on (1) the relationship between priorities among QCDFs related to competitiveness and organizational outcomes; (2) the relationship between organizational outcomes and the unity of the priorities between headquarter/business unit and plant; and (3) the relationship between operational practices (lean practices) and performance.

In addition, there have also been studies not just on the content of
manufacturing strategies but on the process of formulating strategies (Barnes, 2002; Brown, Squire, & Blackmon, 2007; Brown, Squire, & Lewis, 2010; Kim & Arnold, 1996; Kim, Sting, & Loch, 2014; Kiridena, Hasan, & Kerr, 2009; Maruchec, Pannesi, & Anderson, 1990; Menda & Dilts, 1997; Platts, Mills, Bourne, Neely, Richards, & Gregory, 1998; Platts, Mills, Neely, Gregory, & Richards, 1996; Swamidass, Darlow, & Baines, 2001).

Among these studies, Barnes (2002) stated that decision-making processes move from business strategy to manufacturing strategy in a top-down fashion, and when that happens, organizational culture, political factors inside the company, or personality factors (manager’s personality, knowledge, and experience, etc.) impact manufacturing strategy. However, that study did not clarify the relationship between manufacturing strategy and performance.

Kiridena et al. (2009) understood the process of forming manufacturing strategies in four phases, such as initiation, consolidation, commitment, and realization, asserting that priorities in business strategy impact the process of strategy formation, and focusing on organization type, size, and maturity, as organizational contexts. As three patterns for strategy formation, the study noted top-led (those done in top-down fashion for urgent issues), senior-led (emergent), and bottom-led (small-scale kaizen, etc.), though it ignored the relationship between performance and differences in strategy formation patterns.

Kim et al. (2014) noted that manufacturing strategy formation processes in plants could be both top-down and bottom-up. What is called manufacturing strategies in this paper are action plans, an example of a top-down action plan being increasing product variation for overseas markets in new businesses such as those for lithium-ion batteries. Examples of a bottom-up action plan include improving production process flexibility and reducing energy costs in specific processes. An organizational factor that impacts the frequency of
top-down and bottom-up action plan occurrences is an organizational structure (centralized or decentralized). Competitiveness priorities seen in QCDFs do not impact differences in top-down or bottom-up frequency and, similarly, neither does the number of employees.

To summarize the aforementioned studies on manufacturing strategy, increasing the performance of a firm or plant, a firm should (1) have alignment between business strategy and manufacturing strategy (QCDF priorities, and structural and infrastructural production-related decision-making) achieved; (2) have a high level of lean practice execution; and (3) have alignment between business strategy, manufacturing strategy, and practices achieved. In other words, studies on manufacturing strategy have validated an “alignment hypothesis” using various variables and data. Certainly, they have made important academic contributions by empirically showing the relationship between the level of alignment and level of performance. However, there have not been sufficient studies on the role of plants as nodes in the ideal achievement of alignment between business strategy, manufacturing strategy, and practices.

The “Role of the Plant”

Thus, the “role of the plant” is not a major theme in manufacturing strategy research, but how is it dealt with in operations management research? Hayes and Wheelwright (1984) stated that manufacturing is a strategically important function, and the role of manufacturing escalates in four stages.

Stage 1: Plants (production divisions) passively and blindly follow the demands of other divisions.
Stage 2: Plants make efforts to get rid of production weaknesses as they compete squarely with other rival companies.
Stage 3: Plants become important contributors in support of the business strategy, but their contribution is in achieving the defined business strategy.

Stage 4: Plants contribute to the competitive advantage of the firm by leveraging new operational practices and new technologies in the production division, with a business strategy based on partnerships and collaboration between the production division and other divisions.

Ferdows (1997) referenced findings regarding management of overseas subsidiaries in international management theory, and positioned plants within a global production network. In particular, the strategic role of plants (overseas plants) was categorized into six categories for the role of plants/factories including outpost, offshore, server, source, contributor, and lead based on the factors of site competence and strategic reason for the location of overseas plants. Empirical studies subsequently examined the role of plants within global production networks based on this model (Blomqvist & Turkulainen, 2019; Cheng & Farooq, 2018; Feldmann & Olhager, 2013, 2019; Demeter, Szasz, & Boer, 2017; Granlund, Rosio, Bruch, & Johansson, 2019; Maritan, Brush, & Karnani, 2004; Vereecke & Dierdonck, 2002).

Of these studies, Vereecke and Van Dierdonck (2002) conducted a questionnaire survey to validate the Ferdows model, creating a nine-point scale for the strategic role given by headquarters to plants,

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1 Ferdows (1997) posited up to nine steps in the development of site competence, from the first being responsibility for production, and the ninth being responsibility as global hubs of product and process knowledge. In addition, the study set three factors as strategic reasons for location: access to low-cost production (locations with cheap labor and material costs), market access, and access to skills and knowledge.

2 There have been many studies on the role of mother plants with discussions on global plant networks in international management theory, and even studies of Japanese firms (Amano, 2005; Hamamatsu, 2017; Oki, 2012, 2014, 2015, 2016; Suh, 2016, 2017a, 2017b).
and a measurement scale for choosing the top three “reasons for locating and using a plant” from among supplier proximity, labor availability, usability of skills and know-how, market proximity, sociopolitical reasons, competition, energy, and other factors. One discovery of interest was the differences in recognition between headquarters and plants as to the strategic role of plants. In particular, within a plant that hits higher than average cost and quality targets, the plant’s understanding of its role is lower than the headquarters assessment of the plant.

In a questionnaire survey of 103 plants of Swedish firms, Feldmann and Olhager (2013) measured eight types of performance (subjective assessments of comparisons with rivals on a 7-point scale) with QCDFs and the role of plants (subjective assessments of the level of authority given to plants in regard to production activities, supply chain activities, development activities, on a 7-point scale). Three clusters were found in a cluster analysis, with differences in roles given to (A) manufacturing, (B) manufacturing and supply chain, and (C) manufacturing, supply, and development. There was a tendency in these clusters toward high performance in (C) plants, with significant differences in cost efficiency, quality, and new product development. In other words, this suggests that the performance in plant costs, quality, and new product introduction increases by giving plants roles in production, supply chain, and development.3

Demeter et al. (2017) analyzed the role of plants as moderators in the relationship between best practice implementation in each plant and operational performance (QCDFs). The best practices here denote activities including new production technologies, quality

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3 The phenomenon that concentrating the multiple functions of plants increases performance has also been shown in Japanese plants (Fukuzawa, 2015b; Fukuzawa & Inamizu, 2017; Inamizu, 2015; Inamizu & Fukuzawa, 2017; Shintaku, Inamizu, Fukuzawa, Suzuki, & Yokozawa, 2014).
improvement, lean production, human resource development, supplier relationships, and customer relationships. The study measured their level of implementation on a 5-point scale. The analysis showed that, when the roles of plants differ, best practices affecting performance differ. In leading plants, in particular, many of the best practices affected performance.

In addition, Maritan et al. (2004) and Cheng and Farooq (2018) conducted a questionnaire survey of the level of delegation of decision-making authority related to the role of plants and production activities. The results showed that this level differs by the role of the plant. Olhager and Feldmann (2018) investigated to what extent decision-making for production activities in one’s plant could be made autonomous when there is a network of multiple plants in the same company. Result of cluster analysis showed that there are three types of delegation levels in decision-making (centralized, integrated, and decentralized), and there are the same patterns of authority delegation levels in all decision-making types. Moreover, though there is no difference in performance (QCDF) among the three types, types of effective decision-making authority were significantly different when production quantities and process types differed.

The April 2019 edition of *Production Planning & Control*, Vol. 30, Issue 2-3, was a special issue entitled, “The management of international manufacturing networks: A missing link towards total management of global networks.” It had the following three papers that focused on the role of plants in Northern European (Sweden or Finland) firms. Granlund et al. (2019) made a comparative case analysis of eight plants belonging to Swedish firms and showed that the roles expected in lead plants and priorities of plants, along with initiatives they need to work on, differed by the plant. Blomqvist and Turkulainen (2019) portrayed the international production networks of five companies, further development of the Ferdows model done through the comparison of differences. Feldmann and Olhager (2019)
Fukuzawa
drew a global network of parts and finished goods spread among overseas plants of five companies (three headquartered in Europe, one in Asia, and one in North America), organized them into four types of networks, and showed that their characteristics varied by horizontal coordination (between production, purchasing, R&D, and product and process development), vertical coordination (characteristics of make/buy decisions and supplier location), market types, process types, and major management issues.

The aforementioned studies have advanced empirical research regarding the roles played by plants in international networks of plants, the delegation of authority, and implementation of practices. Each of them understands site competence by the “level of responsibility” in plants in regard to production activities and supply chain-related activities, development activities, and knowledge and technology. Each argues from the perspective of headquarters and business units as to what roles should be given to plants.

The “Role of Operational Executives”

Next, let us review studies related to the managers of plants and production activities. In recent years, in particular, studies on the role of operational executives started to be published, but they are still limited (Brown, Squire, & Blackmon, 2007; Demeester, De Meyer, & Grahovac, 2014; Papke-Shields & Malhotra, 2001; Phadnis, Sheffi, Caplice, & Singh, 2017).

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4 In discussing manufacturing proactiveness by Ward, Leong, and Boyer (1994) and Gonzalez-Benito (2005) investigated (1) the level that production executives participate in decision-making for business strategy; (2) the level of structural and infrastructural investment decision-making in plants; and (3) the relationship between these things and performance. Phadnis et al. (2017) focused on strategic cognition of operations executives in regard to the future supply chain strategy of the company as an assumption in decision-making for manufacturing strategy.
Papke-Shields and Malhotra (2001) investigated and clarified the relationship between “involving (participation)” and “exercise of influence” by operational executives and “alignment between business and manufacturing strategies” in the strategy formulating activities by the top. Moreover, the study also investigated the impact of alignment between business and manufacturing strategies on business growth (sales, profits, changes in market share, and ROI). There was no significant direct effect from involvement on business performance or the exercise of influence on business performance, although there was a significant positive indirect effect mediated by “alignment between business and manufacturing strategies.”

Brown et al. (2007) empirically demonstrated three relationships: (1) the level of participation by factory managers in strategic planning activities at the business unit level is higher in world-class (i.e., high performance) plants than in other plants; (2) high-performance plants have clearer plant-level strategies; (3) the level of incorporation of circumstances regarding plant-level operations (supply chain, process technologies, production capabilities, product mix, equipment, new product development) in strategic planning at the business unit level is higher in high-performance plants.

Demeester et al. (2014) investigated the ratio of time spent by operation executives in coordinating with top management or other functional managers regarding top-level strategic decision-making (i.e., top-level communication) and in coordinating with one’s subordinates and suppliers. The performance became higher as the time spent by operational executives for top-level communication when confronted with complex or difficult environments with low production strengths.

However, the prior research regarding the role of these operational executives does not completely clarify the relationship integrally between strategic behavior of site (plant) managers, organizational
capabilities of the production field, and organizational outcomes. In addition, in an analysis of the relationship between performance and achievement levels of “alignment of business and manufacturing strategies” through the participation of operational executives in the business strategy formation process, focus was placed on realizing a state of alignment, with no examination of the potential and “strategic significance of not having alignment.”

Discussion and Conclusion

Prior research reviewed in this paper regarding manufacturing strategy and the role of plants empirically analyzed production activities and the role of plants as strategic weapons. However, the focus of these studies was on manufacturing strategy portrayed by top management or a business unit, and not on “plant strategy.” “Plant management” means “operations management,” and by increasing performance through lean operations and continuous improvement, plants and factory managers are seen as fulfilling their roles as strategic weapons.

Certainly, steadily fulfilling the role expected by headquarters or business units is essential for plants. However, the phrase “strategic role of manufacturing” used in prior research shows the stance of researchers in thinking of this role from the perspective of headquarters, business units, or other functions, and it is not to analyze or theorize from the perspective of plants. Arguments over the level of delegation to plants and the level of implementation of lean practices in plants are all from the side of headquarters or business units. One reason for this is that prior studies do not view plants as agents in a search for survival and growth under external and internal selection pressures, and do not have the
“genba-perspective” of exploring how capabilities are built.\(^5\) Because of this, little analysis has been done on the intentions and strategic behaviors of “factory managers” that manage skills, organizational capabilities, technologies accumulated in plants, as well as people working there, and the impact of these things on production field capabilities. Further, a study on the management behavior of highly reputed factory managers (Smith, Plowman, Duchon, & Quinn, 2009) focused on three factors of factory manager personality, methods of interaction, and methods of overseeing subordinates as means of exercising influence on subordinates. The study suggests that these factors have a positive psychological influence on subordinates, and increases the performance of plants since subordinates are thereby enabled to do good work. As such, we can see the beginnings of empirical analyses of the behavior of factory managers toward subordinates, though there are few citations\(^6\) of Smith et al. (2009) in major papers on operations management. This also suggests that there has not been enough research on the behavior of factory managers.

In addition to manufacturing strategy and the role of plants given by headquarters and top management, the “strategies of factories/plants,” and organizational formation by factory managers in

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5 As an exception, there have been some empirical studies on the evolutionary process of organizational capabilities development regarding production systems (Fujimoto, 1999) and the impact of internal resource allocations on strategy formation and organizational capabilities (Burgelman, 2002). Fujimoto (1999) focused on the shop floor, and the relationship between headquarters and other functions, with an understanding of the evolutionary process of production systems. Burgelman (2002) focused on the process of strategy formulating forming from the relationships between top, middle, and lower strategic behaviors.

6 A query of Web of Science on July 23, 2019 for citations of this study resulted in 33 hits. Of those, two papers were published in the *Journal of Operations Management*, and one in the *International Journal of Operations & Productions Management*, both major journals in operations management research.
conceptualizing and executing those strategies also require analysis. In other words, there is a need to empirically identify (1) how factory managers draw a picture of how they want the plant to be and how they find their role; (2) the acquisition of necessary resources and authority from headquarters and business units and their allocation within the factory; and (3) what capabilities plant managers intend to build and how well those are realized.

The effectiveness of strategic behaviors of plants for creating work and building businesses is suggested in recent studies of Japanese sites (plants). Shintaku et al. (2014) and Nakazawa et al. (2016), both examples of diversification at the business site level leveraging production field resources and capabilities of production field, demonstrate that, even without products to make, companies survive by factory managers finding new business and capturing it from other companies. In addition, Tsuchiya (2018) presents the case of Fuji Xerox, which grew and succeeded through proactive strategic behavior in its “Japan office,” ostensibly a subsidiary of Xerox. These cases suggest that plants are not only places for implementing lean practices or the strategic weapons of headquarters but are also agents that grow and survive on their own.

From the 1980s through the 1990s, Japanese firms were the source of lean production methods promulgated in many studies; however, relatively few studies on Japanese firms are available as this review showed. Many manufacturing sites have continued to survive and grow in Japan, despite facing a severe business environment starting in the 1990s. There is a need for an exploratory study of Japanese domestic plants that have made globally pioneering efforts on various issues such as decreases in the overall population and in youth, succession of skills, and the use of ICT and IoT on the field, as to the relationship between the role of plants and the strategic behavior of factory managers, and organizational capabilities built in plants. Such a study should not examine the
relationship between performance and alignment between business, manufacturing strategies, and practice, but rather on the strategic behavior,\(^7\) and its antecedents, of factory managers as middle management caught between headquarters/business units and the production field, in order to achieve this kind of alignment. Moreover, by understanding misalignment and identifying why alignment is not achieved, and the impact of misalignment on a genba capability and corporate growth, and the ability to adapt\(^8\) to environmental changes, it will be possible to better understand effective roles and behaviors for headquarters and business units in cultivating and leveraging manufacturing field capabilities, and to further advance the development of theory in this area.

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\(^7\) Smith et al. (2009) identified important findings on the exercise of an influence of factory managers on subordinates. There is a need for further research into the influence of factory managers’ behavior on other departments (marketing, R&D, etc.), headquarters, or business units as to behavior. Through such research, the strategic behavior of factory managers can be clarified, both vertically and horizontally, and the capabilities built as a result of that behavior as well as the process of building those capabilities can be explained.

\(^8\) It is also hoped that this will lead to the clarification of dynamic capabilities, from shop floor to an overall company (Fujimoto, 1999, 2012; Fukuzawa, 2015a; Sato, 2017).
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