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Forum

Delayering the global production network into congruent subnetworks

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ABSTRACT

The literature in operations management has not kept up with the growing complexity of and opportunities offered by global production networks. Managers need new tools to cope with this complexity. We propose one that is based on a model that delayers the global plant network into a set of subnetworks on the basis of complexity and proprietary information in the products they produce and production processes they use to produce them. This allows examining whether each subnetwork is *congruent*—i.e., has an appropriate manufacturing mission and the competencies that it would need to carry it out. We apply this tool to analyze the global production networks of five companies and illustrate its usefulness in performing periodic audit of the global production network and identifying potential strategic anomalies that deserve attention.

1. Introduction

The literature in operations management, on the whole, has not kept up with the increasing complexity of global production networks. After years of intense offshoring, outsourcing, global procurement, and expansion into new international markets, the global production network of a typical multinational manufacturing company today consists of plants dispersed around the globe, each under increasing pressure to coordinate its operations with each other and with the rest of its supply chain, which itself is becoming increasingly more global and fragmented. Meanwhile, the multitude of factors outside the control of the company or the plant, ranging from changes in foreign exchange rates and new trade agreements to emergence of new competitors and new technologies, continue to require adjusting the structure of these networks constantly. In addition, changes due to the firm's own decisions—such as introduction of new products, entry into new markets, mergers and acquisitions, or a shift in strategy—can rapidly turn a well-configured network into a poor one.

An important implication of this increasing complexity is the need for expanding the focus of research in this field from examining the role of individual plants in the network (Hayes and Schmenner, 1978; Collins et al., 1989; Ferdows, 1989, 1997a,b; Chew et al., 1990) to assessing missions and capabilities of *networks* of plants (Shi and Gregory, 1998; Jagdev and Browne, 1998; Karlsson and Skold, 2007; Ferdows, 2008; De Meyer and Vereecke, 2009; Friedli et al., 2014; Johansen et al., 2014). However, while many scholars have recognized the growing complexity and importance of these networks, the scholarly literature still does not offer many tools for how to manage them. Filling this gap deserves attention.

Among the most useful tools, we believe, are those that reduce the complexity of the network by delayering it into simpler and more manageable subnetworks. We see a parallel between the challenges that single plants were facing forty years ago and what global networks of plants face today. In his seminal article, "The Focused Factory", Skinner (1974) observed that many plants were trying to respond to too many manufacturing missions simultaneously, which made their design and management complicated and resulted in poor compromises in achieving most of their missions. Today many global production *networks* are in a similar situation. They must respond to a wide range of strategic mandates, which makes their design and management complicated, and this complexity is exacerbated by the fact that many external factors can impact their performance significantly or make them evolve in unintended directions.

Skinner suggested that the key to simplifying the design and

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management of a factory was to give it a limited and coherent manufacturing mission. Such a factory can become "focused"—i.e., it can align its structural elements (e.g., equipment, layout, capacity, and process technology) and infrastructural elements (e.g., production planning and control, quality management systems, inventories, job design, and key performance measures) to accomplish its mission effectively (Skinner, 1974). We propose the same approach can be used to simplify the complexity of a production network. In other words, the notion of focus, with a few modifications, can be applied also to a *group of factories* that work together to accomplish a manufacturing mission. If a complex production network is delayered into a set of such subnetworks, each with a coherent manufacturing mission, it will be possible to focus each subnetwork, hence simplify its design and management. Does the subnetwork, in fact, have an appropriate manufacturing mission and do the factories that comprise it have the requisite competencies to accomplish it? We use the term "congruent" to refer to a subnetwork that has both a coherent manufacturing mission and appropriate competencies to carry it out. We consciously did not use the term "focused" to reduce potential confusion.

Note that a congruent subnetwork can consist of many focused factories—i.e., one concept is not a substitute for the other. In fact, they complement each other: delayering the production network into a set of congruent subnetworks allows a higher level of analysis that helps determining the focus of the plants in each subnetwork.

In this paper we offer a model for delayering a production network into a set of subnetworks and assessing their congruency. To demonstrate its utility, we apply it to analyze production networks of five multinational manufacturing companies. We show that our model serves as a useful tool for answering broad strategic questions such as:

- Are there any anomalies in allocation of products to different subnetworks of plants?
- Do the subnetworks of plants (each producing a certain family of products) possess the appropriate level of resources and capabilities to carry out their strategic missions?
- Are the strategic missions of the different subnetworks sustainable?
- Are the plants in different subnetworks in right places?

2. Literature review

Several overlapping streams of research provide the context for studying global production networks. The first stream is the rich literature on multinational companies. In the last three decades, research on the structure and organization of multinationals has shifted from a focus on a hierarchical view of relationships between the company's headquarters and its subsidiaries towards a perspective of a web of diverse inter- and intra-firm relationships. Theories that have been used to examine these relationships include network theory (Ghoshal and Bartlett, 1990; Gulati et al., 2000; Vereecke et al., 2006), evolutionary theory (Kogut and Zander, 1993), learning organization (Nonaka and Takeuchi, 1995; Grant, 2010) and knowledge transfer (Grant, 1996; Szulanski, 1996). A common theme among these theories is that multinational organizations can benefit greatly from transferring resources and competencies developed in different locations within their company.

The second stream of research, with a slightly different perspective, is the literature on industrial networks. The focus here is on the external, mostly vertical, networks in which the firms – especially original equipment manufacturers (OEMs) – operate. Relationships with suppliers (Dyer and Nobeoka, 2000), subcontractors, and contract manufacturers (Plambeck and Taylor, 2005) have received considerable attention in recent years. At a more conceptual level, Håkansson (1990) views the industrial networks as interplay between actors, resources, and activities that reside in different firms that comprise the network (where actors have knowledge of activities and control resources, and activities change or exchange the resources). A key implication of this perspective, as Dekkers and Van Luttervelt (2007), Karlsson (2003), and Karlsson and Sköld (2007) also observe, is that manufacturing strategy is best defined in the context (i.e., industrial network) in which the firm operates. In other words, the role of plants in the firm's global production network extends beyond the firm's boundaries to its level of dependence on long-term suppliers, alliance partners, contractors, design labs, distributors, arms-length suppliers, and other key actors in their relevant industrial networks. This is what Pisano and Shih (2009) mean by "industrial commons," and how their presence or absence can completely alter the options for locating global production sites.

Since industrial networks in rich countries have historically been more advanced, this stream of research suggests that plants in these usually high-cost environments can benefit from their proximity to advanced industrial networks. The consensus among these scholars is that firms should exploit the full benefits of this proximity and be very careful when considering moving such plants offshore to low-cost environments or outsource what they produce (Arrunada and Vázquez, 2006; Pisano and Shih, 2009; Zirpoli and Becker, 2011). Although most of these scholars have focused on industrial networks in the US, Europe, and Japan, their conclusions can be applied to any industrial network, including the more recent ones in other regions of the world, like Singapore, Taiwan, South Korea and China.

The third stream of research, complementing the first two, has focused directly on the intra-firm production networks. The central question here is how each plant can support the firm's strategy both individually and as a part of the network. Skinner (1974), as mentioned earlier, suggests that a coherent manufacturing mission would allow a plant to align its structural elements and infrastructural elements to achieve this mission effectively. Such a plant would be focused. While there may be situations where a plant may choose, or need, not be focused (Boyer et al., 1996; Vokurka and Davis, 2000; Ketokivi and Schroeder, 2004; Ketokivi and Jokinen, 2006), theoretical and empirical investigations suggest that if a plant can become focused, it would improve its performance (Hayes and Wheelwright, 1979; New and Szwejczewski, 1995; Brush and Karnani, 1996; Pesch and Schroeder, 1996; Bozarth and Edwards, 1997).

Hayes and Schmenner (1978) suggest that plants in the firm's production network can be organized along products, processes, or a combination of the two, and discuss under what conditions a product-oriented versus a process-oriented network would be more effective. Ferdows (1989, 1997b) and Vereecke et al. (2006), among others, suggest that plants in a network have different strategic roles which define their relationships to headquarters and to each other, as well as to other functions in the firm (especially research and development, procurement, and distribution) and to other entities outside the firm.

A subgroup of this stream of research uses the network—as opposed to plants within the network—as the unit of analysis (Shi and Gregory, 1998; Colotla et al., 2003; Vereecke et al., 2006; Ferdows, 2008; De Meyer and Vereecke, 2009). An important premise here is that intra-firm manufacturing networks can develop capabilities that go beyond the sum of plant-level capabilities. On the other hand, Lampel and Giachetti (2013) suggest that there is an inverted U-shaped relationship between the firm's