

# **Manufacturing capabilities: Mere drivers of operational performance or critical for customer-driven innovation?**

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## **Abstract**

It is becoming increasingly common that R&D and marketing is conducted internally and manufacturing performed by outsourcing partners, raising questions about the strategic role of internal manufacturing capabilities. This role can be evaluated by how they contribute to the focal firm's competitive priorities. Based on a survey of 267 Swedish manufacturing firms, the paper shows that when the competitive priority is innovation, the role of manufacturing capabilities is to facilitate more efficient product development in collaboration with customers. When operational efficiency is the dominant competitive priority, the role of manufacturing capabilities is naturally to provide high operational efficiency.

**Keywords:** Customer integration, Manufacturing, Survey

## **Introduction**

Many large companies have for a long time been very successful in their industries by combining leading edge R&D and marketing with strong internal manufacturing capabilities. For example, Nokia has even retained its manufacturing capabilities in high-cost countries, despite the fact that most of the growth in demand comes from countries where the cost of hiring workers is much lower. This traditional, horizontally integrated model is being challenged. Supported by the rise of low-cost production in countries such as China, an alternative model is getting increased attention, where R&D and marketing are conducted internally in the West and manufacturing performed by outsourcing partners in low-cost countries. Apple has achieved tremendous success by excelling in R&D and marketing while outsourcing all production to Foxconn in China. In Apple's view, manufacturing capabilities can be purchased from the best provider and have little impact on other functions.

The examples of Nokia versus Apple illustrate that companies can have widely different strategies due to divergent ways of assessing the strategic role of manufacturing capabilities. In the case of Apple, the contemporary role of a global production system is to produce, wherever it is cheapest, the products that marketing and product development come up with. In this view, manufacturing capabilities are expendable commodities and

outsourcing manufacturing is a sensible strategy, if overall costs can be reduced. This point of view has also gained recognition in the academic community by authors such as Arnold (2002) and McCarthy and Anagnostou (2004). In contrast, internal manufacturing capabilities are seen as essential for sustaining long-term competitive advantage by companies such as Nokia as well as by scholars within the manufacturing strategy field (e.g., Brown and Blackmon, 2005). Assessing the strategic role of manufacturing capabilities is thus both a timely topic and a topic that leading companies and scholars do not agree on.

Although assessments of the strategic value of manufacturing have been performed previously, recent industry trends such as the fragmentation of supply chains mean those assessments may no longer be relevant. Fragmentation means that an increasing share of manufacturing and product development is performed by entities not directly controlled by the focal firm. Manufacturing capabilities may still have a strategic role, but that role is no longer confined to the same boundaries as in the recent past.

A major theoretical contribution to our understanding of the role of manufacturing has been provided by the resource-based view, and in particular Barney (1991). He focused on the need to identify strategic resources, which are valuable, rare, imperfectly imitable, and it cannot be substituted. These resources are often used by multiple functions and successful companies leverage them in order to gain and sustain a competitive advantage. Strategy for the company is thus to develop, protect and exploit these strategic resources while non-strategic resources can potentially be divested. Many scholars have long held the view that manufacturing capabilities are indeed strategic resources, often pointing to the phenomenal success some, particularly Japanese, manufacturers have achieved through lean manufacturing (Womack and Jones, 1994; Liker, 2004). Others have highlighted that product development is dependent on input from the manufacturing department, (Clark and Fujimoto, 1991).

Few authors have, however, linked the strategic role of manufacturing capabilities to the role the capabilities can play in the wider supply chain. In this view the role of manufacturing capabilities is no longer confined to the direct contribution to overall company objectives. The focus is rather on the interaction with other entities and how manufacturing capabilities impact the efficiency of that interaction. The interaction may include both the daily operations of the supply chain as well as product development, which is increasingly becoming a supply chain issue (Lo and Power, 2010).

The ultimate goal of the supply chain is to deliver value to the customer, but companies have different ways of delivering value, which can be referred to as competitive priorities; e.g., innovation, rapid and secure delivery, or low cost. A strategy can be considered effective when it delivers efficiency in line with the prevailing competitive priorities. A more complete picture of the strategic value of manufacturing capabilities can emerge if their roles in fulfilling the company's competitive priorities are taken into account. The purpose of this paper is to assess the strategic role of manufacturing capabilities for a product-owning firm, by focusing on what impact its internal manufacturing capabilities have on the integration of customers.

### **Manufacturing strategy and competitive priorities**

Whereas corporate strategy is concerned with broad issues like long-term investment decisions, the business unit strategy involves deciding which parameters are important to

attract customers (Brown, 1996), henceforth referred to as competitive priorities. First, a distinction can be made between order qualifiers and order winners (Hill, 2000). As the name describes, an order qualifier is the minimum requirement in a specific area. In this paper, competitive priorities refer to the order-winning criteria of the companies' most important customers and products.

Another model of competitive priorities is the sand cone model introduced by Ferdows and De Meyer (1990). The idea is that one must first fully conform to quality requirements before focusing on dependability, then speed and finally cost. It is thus a cumulative model, where the present competitive priority is dependent on what has been achieved previously. Christensen (1997) bases his conceptual framework on industry dynamics. Typically a new product competes over functionality, but when the functionality overshoots the requirements of most customers an opportunity opens for an alternative product with less functionality but superior reliability. It is thus a cumulative model, akin to the sand cone model of Ferdows and De Meyer (1990).

Competitive priorities are not primarily decided by manufacturing managers, and are therefore treated as external requirements that these managers must respond to. The role of manufacturing strategy is thus firstly to align decisions on developing and utilising capabilities in manufacturing and the supply chain with the competitive priorities (Hayes and Wheelwright, 1984; Colotla et al., 2003). In manufacturing strategy, the most cited competitive priorities are cost, quality, flexibility and delivery (Hayes and Wheelwright, 1984; Boyer, 1998). A successful strategy is when the actions taken correspond with the competitive priorities (ibid; Hayes and Wheelwright, 1979). Although this is widely accepted, there is surprisingly little empirical support (Boyer, 1998).

The classic view of manufacturing is an internal function that responds to either the overall business strategy or the characteristics of the products (e.g., Brown, 1996). By viewing manufacturing as a function, there is little sense in keeping it in house if there is an outsourcing partner that is better at improving performance in line with the competitive priorities. Rather surprisingly, Boyer (1998) finds that competitive priorities have little influence on actual implementation of manufacturing practises. This implies that implementing specific practises aims at improving general competitiveness, not improving a particular priority. However, Boyer's (1998) study only concerns how competitive priorities influence manufacturing, and not interaction with external entities. The trade-offs inherent in the strategic planning may be made at the supply chain level, and may not be visible on the manufacturing level, except as a general inclination to invest (or not) in a certain manufacturing unit. This implies that in order to study how competitive priorities and capabilities are aligned, the analysis must include at least parts of the supply chain. This also means that it may not be necessary to indentify clearly divergent manufacturing capabilities appropriate for the different competitive priorities. A key concern remains whether the manufacturing unit possesses adequate capabilities for interacting with other parts of the supply chain, no matter whether they are aimed at reducing costs or improving quality, delivery or flexibility.

### *Manufacturing capabilities*

This thesis will adopt the terminology of Ray and Ramakrishnan (2006), Day (1994), Grant (1991) and Narasimhan et al. (2001). In this view resources are tangible and intangible assets that firms utilise, and they can be external or internal (Ray and

Ramakrishnan, 2006). As this thesis focuses on manufacturing, all resources that are not directly related to manufacturing in the focal firm will be treated as external resources, including resources in other departments, such as product development. Capabilities are a combination of internal firm resources (Day, 1994; Grant, 1991), meaning they are particular types of bundled resources. Manufacturing capabilities are thus a combination of different manufacturing resources, both tangible and intangible. For example, manufacturing capabilities include the use of advanced machinery, where the resources needed for this capability are advanced machinery, personnel skilled at using them, and appropriate raw materials. The capabilities can be utilised both individually or in bundles. When the capabilities are utilised in an effective manner, the outcome is increased performance, such as in more efficient new product development (NPD) or increased productivity.

### **Customer integration**

The central premise of supply chain management is that it is increasingly supply chains that compete with each other, as opposed to individual firms (e.g., Christopher, 2005). Leading-edge companies have responded by allocating significant resources to utilising their supplier base more effectively as well as increasing their cooperation with their most important customers (ibid.). The most successful companies are usually those that have managed to integrate customers and suppliers with their internal processes (Frohlich and Westbrook, 2001). There is little consensus on the terminology of the supply chain management literature; what some refer to as involvement, cooperation, coordination, collaboration or partnering, others refer to as integration. In the remainder of the thesis the term *integration* will be used to describe the use of some of the key mechanisms involving customers. Customer integration is thus seen as bundle of mechanisms aimed at collaborative product as well as process development, and involve a company's most important customers.

Customer integration can mean different things to different people; the main distinction is found by defining who the customers are. The customers can be both internal, e.g., the next person on an assembly line, or external. The customer can also be either the next process or the end user. Traditionally, in the marketing literature (see Griffin and Hauser, 1996, for a review), the end users have been in focus and the need to integrate them in new product development has mainly been advocated as a means of assuring compliance with their needs. Authors like von Hippel (2005) have taken the argument one step further and describe how the lead user should be identified and integrated, since that customer possesses the knowledge to drive the innovative process forward and thereby assure the long-term survival of the company. Prahalad and Ramaswamy (2000) discuss the organisational challenges companies face when involving lead users in product development.

The focal firm's attractiveness in the eyes of their customers can be enhanced through developing innovation capabilities (Petroni and Panciroli, 2002). According to these authors, customers assign different roles to their suppliers depending on their innovation capabilities (see also Kamath and Liker, 1994. Campbell and Cooper (1999) are critical of the universal belief that it is always beneficial to be close to the customer, and reported that firms who involved customers in their product development project were no more successful than firms with in-house projects. They believe the main reason was an

asymmetric power structure, where the customer is usually larger and able to appropriate most of the value. Seungwha and Gyeong (2003) investigated benefits gained by the supplier in new product development partnerships and found that suppliers do benefit, but the results were mixed. Firms with extensive partnering with their customer were no better in innovation or quality, but had significantly better financial performance.

The success of customer integration in new product development can also depend on at what stage they are being involved, according to Gruner and Homburg (2000). Interestingly, they found that early involvement and late involvement increase the likelihood of success, whereas involvement at medium stages had no impact on product success. Stock and Tatikonda (2004) found that a high level of external integration is most effective when technological uncertainty is high.

In sum, the literature suggests that the desirability of customer integration is at best mixed. Some empirical evidence suggests that benefits will outweigh costs under certain conditions, whereas other studies see no evidence of success at all. The focus of this paper will not be on the end user but rather the customer firm in dyadic customer-supplier relationships. Customer integration in this respect is the mirror image of supplier integration, and typically firms that sell to other businesses are to some extent engaged in both. Thus, customer integration as described here can be seen as the same as supplier integration, just seen from the perspective of the supplier (see also Stjernström and Bengtsson, 2004).

### **Manufacturing-based absorptive capacity (ACAP)**

The impact of manufacturing capabilities on the effectiveness of customer integration can be studied using many different frameworks: in this paper the concept of absorptive capacity will be applied. Cohen and Levinthal (1990) introduced the concept of absorptive capacity in a widely cited article, where they showed that firms gain two benefits from investing in research and development. The first one is obviously technical knowledge, and the other is the ability to absorb knowledge from the external environment. The message in this article is fairly simple; the combined benefits should be taken into account when making investment decisions. In their paper a clear emphasis is put both on the ability to value and assimilate knowledge as well as on the ability to commercialise it. Cohen and Levinthal (1990) argue that the necessary absorptive capacity for product and process innovation is often firm-specific and difficult to acquire, and hence must be developed internally. Although Cohen and Levinthal (1990) tested the concept in an R&D setting, akin to most subsequent empirical studies, they pointed out that it is equally promising in a manufacturing setting.

Tu et al. (2006), von Haartman and Bengtsson (2009) and Mukherjee et al. (2000) provide rare empirical studies of ACAP in a manufacturing setting. Tu et al. (2006) test how ACAP, defined as related knowledge together with relevant communication mechanisms, impacts time-based manufacturing practices, and conclude that ACAP indeed has a positive effect on these practices. Von Haartman and Bengtsson (2009) consider the impact on ACAP of three types of manufacturing competence, and find that some manufacturing competencies contribute to ACAP. Mukherjee et al. (2000) conceptualise absorptive capacity as the manufacturing department's ability to adapt to new production requirements, and it is dependent on the available financial and intellectual resources. It can thus be expected that companies with high manufacturing

capabilities are more likely to benefit from customer integration than firms with lower manufacturing capabilities.

## Methodology

The paper is based on a large-scale survey that was mailed out to the plant managers of a representative sample of the Swedish manufacturing industry. All plants in the sample had more than 50 and less than 6500 employees and operated in the following sectors: metal goods, machinery, office equipment and computers, other electronics, telecommunications, instrumentation, and automotive (ISIC codes 28-35). This constitutes a diverse cross-section of both the Swedish and the European manufacturing sectors. Because many of these firms compete successfully in the global marketplace, the results are of interest for manufacturing firms competing world-wide. A representative sample was desired, as the aim was to investigate the validity of the previously mentioned conceptual framework for general manufacturing environments. The sample was limited to firms with at least 50 employees, since smaller firms have limited resources for developing elaborate manufacturing and supply chain practices and programmes. Tables 1 show the constructs and how they have been operationalised.

Table 1: Constructs and survey questions

<b>Customer Integration</b> ( $\alpha = .86$ )	<b>Manufacturing capabilities</b> ( $\alpha = .70$ )
- Early customer involvement in NPD	- The use of advanced machinery and technical equipment <sup>1</sup>
- Customer collaboration in cost reduction	- Utilisation rate of machinery <sup>1</sup>
- Customer access to production planning & systems	- Flow-orientation in production <sup>1</sup>
- "Customer contributes significantly to product improvements"	- Particular efforts to increase flexibility <sup>1</sup>
<b>Competitive priorities (3 factors)</b> <sup>2</sup>	- Systematic efforts aimed at increasing competence of personnel <sup>1</sup>
1. Innovation ( $\alpha = .53$ )	- Proportion of independent teams with responsibility for planning and performing <sup>1</sup>
- Product quality	<b>Operational performance</b> ( $\alpha = .87$ ) <sup>3</sup>
- Product functionality	- Productivity
- After sales, service	- Product Quality
2. Customer focus ( $\alpha = .51$ )	- Production cost
- Brand, reputation	- Delivery lead time
- Customisation of products	- Production lead time
- Product variety	- Delivery dependability
3. Operational efficiency ( $\alpha = .71$ )	- Product mix flexibility
- Price of product	- Volume flexibility
- Order-delivery lead time	<b>NPD efficiency</b> ( $\alpha = .69$ )
- On-time delivery	- Time-to-market
- Time-to-market	- New prod. development cost
- Volume flexibility	

<sup>1</sup> How has your mfg operation changed over the last 3 years, <sup>2</sup> Why do your customers choose you, rate the importance of the following factors from 1-5, <sup>3</sup> How has the performance improved over the last three years? (9-point scale),  $\alpha =$  Cronbach alpha

## Results

Table 2 displays the results of the hierarchical regression analysis. Not at all surprising, manufacturing capabilities are strongly associated with operational performance, and the association is the strongest for firms whose main competitive priority is operational performance. Manufacturing capability has no direct impact on new product development (NPD) efficiency in any of the models. Likewise, customer integration has no significant impact on operational performance or NPD efficiency in any of the 6 models. Customer integration, in combination with manufacturing capabilities, is strongly associated with NPD efficiency for companies focusing on innovation (and to a lesser extent for customer focused firms). Including the interaction effect improves the NPD efficiency models significantly for innovation and customer focused firms.

Table 2 – Hierarchical regression models with interaction effects

Competitive priority ►	Innovation n=98 Standardised beta (t-value)		Customer focus n=71 Standardised beta (t-value)		Operational efficiency n=70 Standardised beta (t-value)	
	NPD efficiency	Operational efficiency	NPD efficiency	Operational efficiency	NPD efficiency	Operational efficiency
<b>Dependents ►</b>						
<b>Independents</b>						
Mfg capability	-0.41	.443**	.192	.547**	.089	.672**
CI	-.459	.160	-.249	.049	-.124	-.254
CI x mfg capability	.670**	-.236	.459*	-0.32	.338	.154
<b>Model summary</b>						
R-square	.102	.202	0.089	.315	.092	.459
R-square change <sup>1</sup>	.080	.010	0.082	.000	.027	.000
Adj. R-square	.068	.172	0.043	.281	.049	.432
F-value	3.052*	6.833**	1.929	9.073**	2.105	17.512**
F-value change <sup>1</sup>	7.170**	1.000	5.310*	.035	1.830	.024

\*significant at .05, \*\* significant at .01, <sup>1</sup> Change in relation to model without interaction effects, CI = customer integration, NPD=new product development

## Discussion and conclusions

The purpose of the paper is to assess the strategic role of manufacturing capabilities, by focusing on what impact internal manufacturing capabilities have on the integration of customers. The paper has argued, and shown, that in order to evaluate the strategic role of manufacturing capabilities, it is important to look beyond manufacturing capabilities' direct contribution to performance, and to look at how they can assist customer integration in improving performance in line with competitive priorities.

Although the potential role of manufacturing capabilities is dependent on the firms' competitive priorities, just possessing manufacturing capabilities will not automatically translate into high performance. Instead, the performance outcome is dependent on both the level of manufacturing capabilities, but also on how they are leveraged through customer integration. The results show that a high capability in manufacturing makes customer integration more efficient and results is faster and more cost-efficient NPD. Previous studies have shown that the integration of customers (Gruner and Homburg,

2000) are beneficial when developing new products. This paper has shown that high capabilities in manufacturing can make customer integration more efficient and thus reduce the cost of NPD and reduce the time to market.

The findings of the paper imply that manufacturing capabilities may well seem expendable, but only if they are assessed in isolation and when evaluating them by their direct contribution to firm performance. Although manufacturing capabilities is strongly associated with operational performance, if suppliers were to offer even better operational performance, the best choice may well appear to be to outsource manufacturing. Arnold (2000) suggested that complete outsourcing of manufacturing is optimal; no competitive advantage can be gained from possessing manufacturing capabilities. In his view the firm's main role is to integrate a number of external partners. Similarly, McCarthy and Agnastosou (2004) argued that the relative decline of manufacturing is not a cause for concern since it is compensated for by the increased importance of purchasing brought about by outsourcing. The findings of this paper suggest that the arguments of Arnold (2000) as well as McCarthy and Agnastosou (2004) are fallacious; the advantages these authors attribute to the efficient utilisation of external sources cannot be realised without possessing adequate internal manufacturing capabilities. This becomes evident when looking at how manufacturing capabilities influence the efficiency of integration. When looking at manufacturing through an "ACAP lens", manufacturing capabilities are almost inevitably seen as indispensable. This is true because the ACAP it provides helps firms integrate external sources more efficiently and thereby achieve performance improvement both in terms of operational efficiency and in terms of efficient product development. Manufacturing capabilities improve operational performance directly, and NPD efficiency through an interaction with customers. When the performance improvement corresponds with the prevailing competitive priority, the strategy can be said to be effective. Manufacturing capabilities are thus not mere drivers of operational performance, but also critical for customer-driven innovation.

The paper contributes to the discourse on the role of manufacturing capabilities by focusing on their impact on the effectiveness of customer integration. One of the main parts of optimising the supply chain is to ensure that customers are integrated in an efficient manner, and this paper showed that manufacturing capabilities play an important role in this process. Operational efficiency is more important for firms focusing on cutting costs, whereas NPD efficiency is of prime interest for innovation-focused firms. Competitive priorities have not previously been linked to the role of manufacturing capabilities in the supply chain. Previous studies have instead focused on whether manufacturing is a strategic function or whether, and how, manufacturing capabilities can directly contribute to performance.

The findings of this paper have implications for managers contemplating whether to outsource manufacturing due to a perceived high cost/benefit ratio of such a decision. The paper argues that an assessment of the strategic role of current manufacturing capabilities must be based on the current and future competitive priorities. If a firm's main competitive priority is, or will be, high-level innovation, the contribution of manufacturing capabilities to NPD efficiency needs to be assessed. This paper has shown that manufacturing capabilities, in combination with customer integration, can make NPD more efficient. If the firm's main competitive priority is low cost, the contribution of manufacturing capabilities towards meeting cost reduction targets needs to be assessed.



The main concepts of this paper were manufacturing capabilities, customer integration, competitive priorities and ACAP, where the last one in particular is in need of more research. Multiple case studies, or perhaps ethnographies, would provide a deeper understanding of what actually constitutes absorptive capacity and how it causes the observed effects. The findings of the paper suggest that ACAP should be taken into account when making investment decisions, but the relation between ACAP and other economic parameters has not been explored. Future research could focus on measuring how the economic impact of ACAP relates to the other factors that investment decisions need to take into account.

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