

OUTSOURCING MANUFACTURING – AN ANALYSIS OF A LEARNING DILEMMA

by

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Abstract

This paper presents the results from a pilot study in which the consequences of outsourcing manufacturing on companies' competence and their ability to develop lasting competitiveness are discussed. Based on a literature study and five case studies the analysis shows that outsourcing of manufacturing engenders a dilemma for many engineering companies, regarding the balance between learning from others and learning that is based in integrated internal processes. Furthermore, the paper present some of the manufacturing competencies of value to exploration as well as exploitation and competitiveness. The paper concludes by formulating a challenge for future research in terms of models for analysing the correlation between long-term learning and outsourcing, and models to visualise and control the explorative capacity of manufacturing.

Introduction

There is a strong trend today among industrial companies to outsource manufacturing. Even if figures on the actual incidence in Sweden are lacking, it seems clear that outsourcing has progressively become an explicit strategy for larger companies to become more effective and competitive. One indicator is the decrease in the refinement rate within the Swedish engineering industry from 31 percent in 1990 down to 25 percent in 1998 (VI, 1999). Previously, outsourcing in industry mainly concerned clearly non-core activities, such as cleaning, building maintenance and restaurants. Today it is increasingly regular to outsource core activities, such as manufacturing and product development (Baden-Fuller et al., 2000; Arnold, 2000). The most common motives specified by managers are expectations of cost reduction, releasing resources, access to new competencies through alliances, and faster product development (The Outsourcing Institute, 2001). The effects of outsourcing are, however, not clear. Since most decisions on outsourcing are motivated by cost arguments, the effects on the company's competence and learning capacity are still mainly an open question. This is particularly valid for the outsourcing of manufacturing.

The question is also related to an emerging perspective on manufacturing in the networked economy. According to this perspective manufacturing is increasingly regarded as a commodity, which easily could be bought on the global market (Lundqvist, 2000; Castells, 1998). A typical statement could be read in the Harvard Business Review: "*Does Manufacturing Matter? The short answer is: not much. And that's a good thing*" (Ramaswamy & Rowthorn, 2000). Similarly Arnold (2000) claims that manufacturing is a non-differentiating activity that easily could be transferred and handled by other companies. The core competencies are product design, logistics and sourcing and marketing. Arnold describes four levels of outsourcing: traditional buying, modular sourcing, in-house plants and the "de-materialised" company. The desired level, according to Arnold, is the de-materialised company, which means that suppliers are responsible not only for different functions, but also the co-ordination between the suppliers. VW's truck plant in Brazil is put forward as a good example. In this case VW responsibility is restricted to quality assurance, marketing and sale. Correspondingly, a Swedish study on the role of IT in the future engineering industry promotes this kind of non-producing engineering company (Johannesson & Kempinsky, 2000).

This perspective is both controversial and problematic. The long-term consequences of outsourcing are not discussed in the literature. It is not least unclear where the limit of outsourcing production is, the limit that doesn't affect the future core competence of the organisation in a negative way. Furthermore, several researchers as well as industrial representatives claim that manufacturing incorporates a business strategic potential that often is disregarded, a potential which could be realised through conscious actions on development of production and production technology (Brown et al., 2000; Pfeffer & Sutton, 2000; Berggren & Bengtsson, 2000; DI, 2001). If this potential is not made explicit and visualised, there may be a risk that valuable competencies in production will be lost when outsourcing.

The purpose of this paper is to discuss the consequences of outsourcing manufacturing on companies' competence and their ability to develop and learn to obtain lasting competitiveness. The discussion is structured by two main research questions: (1) How does outsourcing affect the competence of the organisation? (2) Which are the strategic competencies in manufacturing? The paper is based on an explorative pilot study (Berggren & Bengtsson, 2000; Bengtsson &

outsourcing of manufacturing and the effects on learning capacity could be analysed. This model will be used in our further research.

Methodology

The research questions presented basically require longitudinal case studies as well as surveys. Such studies will be carried out during the coming three years. This pilot study was mainly explorative and inductive. The point of departure was the phenomenon of the outsourcing of manufacturing. The purpose was to elaborate the questions on the effects on competence and learning by analysing them both empirically and theoretically. The results presented here are based on three sources. First, we conducted a literature review of the previous research on outsourcing and its effects on competence and learning. Secondly, we carried out several mini case studies within the Swedish engineering industry in which we interviewed managers, mainly within production, during one day. Thirdly, the experiences and results from an ongoing project on management control in team-based and process-oriented organisations have been used (Bengtsson et al., 2000).

The main criterion for selection of case studies was that the company have substantial manufacturing and experiences with outsourcing. The companies comprise both product companies and subcontractors. In this paper, the managers viewpoints from five of the mini case studies are presented. The *tool company* has about 1700 employees. The workshop in our study produces standardised tool holders for metal cutting (turning, milling and drilling) in large volumes and employs about 300 manufacturing workers and 60 salaried personnel. The *telecommunications company* has about 1600 employees, of which 750 are blue-collar workers. The company is mainly a production unit, but also responsible for the design of test systems. Its main products are radio base stations. The manufacturing department, employing about 1000 people, is organised in product-oriented workshops, each one with complete resources for processing customer orders. The *telecommunications subcontractor* has about 700 employees, of which 550 are blue-collar workers. The company provides product companies within the telecommunications industry with production competence and –capacity. The *turbine company* has about 1500 employees, of which 400 are in the production department. The company develops and produces steam and gas turbines. The *component company* has about 3700 employees and develops, designs and produces various components for the motor vehicle industry.

There are a vast number of definitions on outsourcing (see e.g. Wasner, 1999). Some define outsourcing from a sourcing perspective, while others define outsourcing as the transfer process. In this paper we have chosen to define outsourcing as the process by which a function previously carried out within the company is bought from an external supplier. The idea behind using function instead of activity in the definitions is that outsourcing likely means that the supplier chooses to carry out the function in a different way.

The theoretical analysis is primarily based on theories concerning business competencies and learning. When discussing the first research question, our point of departure has been the theoretical discussion that has followed since Prahalad & Hamel, (1990) presented their conception of the core competence of a company. The second research question concerns the strategic competencies in manufacturing. One important point of reference is here the literature on production strategies (Brown, 1996; 2000). The question also relates to the classical distinction between exploration and exploitation made by March (1991), which is elaborated below. Due to the variety in literature the terms production and manufacturing are treated as synonyms in this paper.

Exploring the first question: Outsourcing and the effects on competence

Previous research on outsourcing (or insourcing) have been carried out from a number of different perspectives and theoretical frameworks, reaching from theories on transaction costs and production and factor costs to resource-based theories on companies core competencies (see overview by Axelsson, 1998). Numerous studies have the aim of building decision models clarifying what could be outsourced, but there are also some studies on productivity effects (see Wasner, 1999). Since one of the most frequent motives behind outsourcing of manufacturing is cost reduction, it is interesting to notice that the actual effects on efficiency and productivity seem difficult to evaluate and measure. There are studies reporting a positive correlation between increased outsourcing and productivity growth (e.g. Heshmati, 2000; Brandes et al., 1997). Nevertheless, this effect could not be verified in other studies (Gilley & Rasheed, 2000), nor in a large Swedish survey carried out by the Swedish Business Development Agency (Nutek, 2000). The problems with time lag and measuring when company structures change, are severe. Furthermore, several studies report that the difficulties occurring in the process following an outsourcing decision often are underestimated (Wasner, 1999), which can lead to unexpected transaction costs (Marx et al., 1997; Fredriksson, 2001). However, according to our objective we leave the cost-related literature aside and focus instead on the research related to learning and the manufacturing strategies.

A substantial part of the research on outsourcing and learning is based on an analysis of a company's core competence. According to Prahalad & Hamel (1990) core competencies are the fundamental strength of the company, which should be identified and cultivated in order to build new products and market opportunities. The core competencies are

core activities from non-core activities. The basic idea behind these model is that outsourcing facilitates a focus on the resources and activities that are regarded as core competencies and that the agenda of management could focus on strategic business areas.

Another perspective that recently has become more prevalent in the literature is that outsourcing and the more intensive co-operation between companies that follows is a potential for learning. The co-operation is expected to expand the body of knowledge and stimulate innovations and renewal of products and processes (Quinn, 1999; Useem & Harder, 2000; SCB & Nutek, 2000). Outsourcing is here not only about instant cost reductions, but also to win competitive advantages and new intellectual capabilities by the formation of strategic alliances. This perspective is associated with the research and literature on innovation processes (e.g. Trott, 1998; Haragdon & Sutton, 2000), learning in networks (Håkansson & Snehota, 1995; Håkansson, Havila & Pedersen, 1999) and Supply Chain Management (Christopher, 1998) that emphasise strategic co-operation and the importance of combining different kinds of knowledge and competencies.

At the same time there are several critical viewpoints in the literature. According to Pfeffer & Sutton (2000), there are two main problems inherent in the outsourcing of production. First, the company loses an internal feed-back mechanism to evaluate construction in terms of manufacturability, quality, failure and costs. Secondly, the effect of outsourcing could be a signal to the organisation that short-term profit is more essential than developing the competence of the employees. Quinn & Hilmer (1994) have pointed out three kinds of risks: the loss of internal competence, a reduced ability to control and the loss of cross-functional competence networks. Bryce & Useem (1998) mention that the new supplier may transfer the company's knowledge to its competitors. Hendry (1995) argues that there are a number of hidden costs related to outsourcing. He means that outsourcing is mainly motivated by analysis of the formal side of the company, expressed in explicit value chains and business processes. The effects on infra-structure, values and informal co-operation, i.e. the informal side of the organisation, are seldom examined. Based on this notion, Hendry formulates several balance problems that need to be scrutinised when outsourcing. One is about the balance between short-term efficiency and long-term learning, which depend on the informal organisation. Another concerns the balance between focusing on core activities and paying attention to contextual changes, which relies on informal communication.

Case studies

The different perspectives on outsourcing are clearly illustrated by the case studies, even though the production managers due to their position mainly represent a critical viewpoint. The production manager of the tool company is very sceptical when it comes to outsourcing manufacturing activities. *"In our company manufacturing is a core competence. Outsourcing is mostly a matter of fashion. It may provide you short-term cost benefits, but it has a negative effect concerning flexibility, dependency on suppliers and product development. Outsourcing of key components will make you less flexible and vulnerable since suppliers that serve several customers are less willing to accept delays or to handle necessary volume variations. Outsourcing will also affect the intimate relationship between product development and manufacturing. In our business, the product designers need constant access to our workshop for prototype testing. Inversely, new functions in our machines are often a basis for product improvements."*

The telecommunications company has begun to outsource volume production to a great extent due to rapid product renewal and the access to efficient EMS companies (Electronics Manufacturing Services). Their new core competence is formulated as "adding manufacturability", i.e. being effective in the industrialisation of the products and transferring the optimised manufacturing concept to subcontractors. However, the company has some doubts about this massive outsourcing of large-scale volume production. The sourcing manager states that: *"today we know very well how to produce the products cost-effectively with good quality. But how will this affect our competence for industrialisation in the long run? And furthermore, how will we be able to judge and select among suppliers if we don't have this ability ourselves anymore?"* One idea for maintaining the knowledge about volume production is to keep manufacturing of a few selected products, but how this should be done and what it will cost is still an open question.

Their counterpart, the telecommunications subcontractor, has, not surprisingly, a more optimistic view. The plant manager said: *"Our core competence is to provide our customers with world-class manufacturing capabilities, reaching from pure manufacturing to the development of products and processes. We work in close co-operation with several customers. Production technology developed with one customer will thus directly or indirectly be of value for all customers"*.

The production manager at the turbine company reveals the contradictory views on production within the company. *"When I asked our CEO he immediately opined that production was of no strategic value. He meant that turbine orders are not won on advanced manufacturing capabilities. Strategically, the entire production could be outsourced. However, after discussing the process of product development more closely he reconsidered his standpoint."*

In the component company, production is strategic. The production strategy is to buy cheap components and focus on expensive and/or unique components. The target set up is to obtain world-class productivity by controlling the value chain. The manager expresses this in the following way: *"The crucial thing is to control the value chain. This is what discerns world-class companies from other ones. Toyota has no strategy called outsourcing"*. The technical manager means that this control could be realised by having both advanced production and product development within the company. The value added in production is also significant.

Outsourcing as a learning dilemma: In-house learning or learning in networks?

The previous section reveals a dilemma or balance problem between companies' own competencies and their network capabilities. The potential of networking needs to be elaborated in our further research. Nevertheless, it is not possible to fully evaluate this potential without a closer analysis of how outsourcing affects the company's competence. The case studies as well as the critical literature on outsourcing indicate that an analysis of core competence should include an analysis of the dependency between different kinds of functions and competencies.

This reveals a problem when using core competence as a basis for outsourcing. Prahalad & Hamel's (1990) conception has often been interpreted as the question is about nurturing the core competencies and liquidating the non-core competencies. However, Prahalad & Hamel assert "*core competencies are the collective learning in the organisation, especially how to co-ordinate diverse production skills and integrate multiple streams of technologies*". They have a system view when describing core competencies as cross-functional and embedded skills that could not easily be outsourced by cost reasons if not recognised properly. The non-core competencies are thus not disposable per se, but should be evaluated according to their contribution to the core competence. Axelsson (1998) and Hendry also emphasise that it is difficult to decide what is core and what is non-core since the company is an organised technical and social system. Due to the systemic character of company competence, a disposal of non-core competencies could thus easily affect what is regarded as core competence. In line with this systemic perspective, Long & Vicker-Koch (1992) separate five different kinds of activities which recognise the system character of organisational competencies: cutting-edge activities (future core competence), the present core activities, support activities necessary for the core activities, disposable activities and peripheral activities. Another important distinction when discussing outsourcing manufacturing is proposed by Fine & Whitney (1996), who distinguish between integral and decomposable subsystems. Their main idea is that a decomposable subsystem, which is independent of other subsystems when it comes to both requirements and performance, is the system that could be considered for outsourcing.

Another problem is that analysis of core competence often is rather static (Wasner, 1999). The industrial dynamic, however, makes it difficult to evaluate what will be core and non-core in the future. Furthermore, in line with the views expressed in our case studies, Wasner points out that there are few studies on the question of the outsourcing process and how this partly irreversible process affects the competence base within the organisation. This lack of analysis is particularly true for the effects on production competence. A related problem is also described by Niss (2000). Based on Nonaka & Takeuchi's (1995) work on knowledge creation processes, Niss has shown that outsourcing is not only a transfer of knowledge but also a more complex transformation of knowledge.

Conclusively, both the case studies and the literature indicate that outsourcing incorporates several difficult balance problems. These concern the dependency between learning and the formal and informal aspects of the organisation; the significance of having feed-back mechanisms between market, development and production, which could vanish unless specific actions are taken; the dilemma of systemic company competence; and the difficulty of discerning core and non-core competencies in a dynamic context. The question is also whether manufacturing is a core activity or competence in engineering companies and whether manufacturing is a disposable subsystem or not. One basic balance problem seems to be that outsourcing may provide a company with the potential for knowledge creation by combination, a potential that, however, has to be evaluated with respect to the risk of irreversibly undermining their own base of knowledge. What seems to be lacking in the research is what this balance looks like in manufacturing and what the possible decisions are. An interesting research question is thus to decide the limits of outsourcing manufacturing that don't undermine the company's long-term capacity for development and renewal. A possible point of departure for this analysis is to analyse the explorative competencies of manufacturing and their role for the company's strategic development of knowledge.

Exploring the second question: Strategic competencies in production

The question of the strategic role of production is rather invisible in the market-oriented literature on business strategies (Brown et al. 2000). Production competence is mainly regarded as a purely operative ability to manufacture products effectively and rationally subordinated to the market strategy. The term production development is often limited to the development of new production technologies to enhance productivity. Another perspective is prevalent in the research and literature on production strategies or operations management, in which, not least, the importance of production for product development is analysed (e.g. Hill, 1993; Lindberg, 1993; Olhager, 2000). Steve Brown has for instance shown (Brown, 1996; 1998; Brown et al., 2000) that companies who have formulated an explicit and offensive production strategy, in parallel and not subordinated to a market strategy, are more competitive than other companies. This indicates that a closer analysis and visualisation of the strategic competencies within production is a research task crucial for the companies' renewal and competitiveness.

The literature mainly lacks a systematic analysis of what kind of business strategic competencies, i.e. unique and explorative capabilities, are embedded in or could be developed in advanced production units. This is also our second research question. Based on the mini case studies and the literature, we could in the pilot study (Berggren & Renatsson 2000; Renatsson & Berggren 2001) discern five different areas describing potential strategic competencies

in production: quality, productivity and flexibility; procurement, product development, industrialisation and environmental management.

1. Quality, productivity and flexibility.

As a typical example the manager in the component company stresses that *“the increased productivity and lower costs as a result of constant rationalisations in production provide significant competitive advantage”*. The manager in the turbine company believes that *“the ability to simultaneously manage on-time-delivery and volume variations is a competence of central importance that often is taken for granted. Such a flexibility is hard to maintain if you have to rely solely on external vendors”*. The ability to provide high product flexibility, i.e. to manage rapid resetting of production facilities when introducing new products or phasing out old products, is also emphasised by the managers in the case studies. The interesting thing is that these abilities seem to be valid also for companies regarded as innovative. A large survey of innovative companies in Sweden shows that the key factors for competitiveness in innovative companies are more or less directly related to production capabilities, namely attractive price, high product quality, high flexibility in production and on-time delivery (SCB & Nutek, 2000). These factors were ranked far more important than factors such as products embodying a high level of knowledge, logo, unique products and novelty. Brown et al. (2000) present a similar list of strategic competencies in production.

To obtain the right quality, delivery on-time and increasing productivity are likely linked to the production ability of continuous rationalisation by implementing new technology. On a strategic level this concerns the ability to identify and implement new kinds of manufacturing methods. One could claim that this innovative process should be detached from the existing solutions and conditions. On the other hand, it seems valuable that new methods need to be related to experiences (March, 1991). It is not enough to design a new technical solution, it must also work in practice in order to be evaluated towards solutions used under realistic conditions.

2. Procurement

All the managers interviewed stress that production competence is a crucial basis for the procurement and sourcing process. This competence is not least about judging a potential supplier in terms of their ability to deliver components of the right quality on time, as well as whether the proposed prices are reasonable. This also concerns the transfer of production knowledge to suppliers or vice versa to pick ideas and learn from them.

3. Product development.

All interviewed production managers emphasize the intimate, mutual and productive co-operation between design, product development and production. The manager in the tool company states: *“In our business the product designers need constant access to our work-shop for prototype testing. Inversely, new functions in our machines are often a basis for product improvements.”* The manager in the turbine company explains that: *“80% of the costs for producing a turbine are decided in product design. Close co-operation between production and design also optimises product function in relation to production costs. It is also easier to customise the production of specific components in order to reduce lead times”*. Within the telecommunications company the conception is *“Our core competence of ‘adding manufacturability’ is crucial within the telecom sector due to the rapid product renewal and non-mature products”*. These attitudes are verified by several studies. Swink (1999) concludes that production is essential for the ability to design new products and to obtain sufficient manufacturability in the solutions. Based on an analysis of 91 product development projects, he shows that outsourcing of product development often ends up with products that become less suitable for manufacturing. Furthermore, to explicitly involve production personnel in product development has positive effects on the adjustments to manufacturing. The study also shows the significance of engaging production personnel when implementing new technology. However, Swink asks for more close analysis on what kind of production competencies are most decisive. Accordingly, Brown et al. (2000) have shown in a survey study that the development of new products is faster and more successful if production is involved. Susman & Dean (1992) suggest that production may have three roles related to product development: Inform designers about the capabilities and capacities of production, suggest product revisions that increase manufacturability and develop production processes parallel to the development of products, a kind of concurrent engineering. The importance of the latter is underlined by McDermot & Handfield (2000). They claim that by parallel processes the development departments will learn more about the capacities of production and at the same time production will learn more about customer requirements. Furthermore, the technical capabilities in production could increase the potential for building new functionality into the products. The parallel processes will also facilitate faster development and introduction of new products.

4. Industrialisation

The capabilities to ensure fast industrialisation and production ramp-up, i.e. to develop, in a very short time, appropriate processes in pilot production and then to optimise these processes for high-volume production and distribution, becomes more and more critical for companies operating on dynamic markets for volume production. A few month´ delay jeopardises the market share and potential profit. Industrialisation capability is a combination of competencies, inherited in production planning, development of manufacturing technology and tests and procurement and logistics, that are needed to realise effective prototype and pilot production. The sourcing manager in the telecommunications company states: *“Manufacturing competence as a basis for efficient industrialisation of new products. Industrialisation requires intimate co-operation between design and production, both when it comes to production of prototypes and pilot products and rapid ramp-up to volume production. The flexibility in manufacturing*

capacity for flexibility, furthermore, require competence on material supply which is based on knowledge both of buying and logistics. The interviewed managers declare that this industrialisation capability requires cross-functional and process-oriented co-operation between various units and functions. To obtain an effective co-operation takes time, and it facilitated by having in-house production.

5. Environmental management

Another kind of competence, emphasised in two of the case studies, concern environmental management and certification. The experiences in production of such methodological work and measurement systems may be of value for improving the entire company's environmental work as well as to contribute to the corresponding work by the suppliers. These competencies, furthermore, include knowledge of continual process development and process optimisation in order to maximise quality and the use of material and at the same time to minimise the use of energy and discharge.

Production competence as a basis for exploitation or exploration?

Even if these competencies not are identical and do not appear in all kinds of production, the preliminary analysis indicates a need to further analyse and visualise the strategic competencies in production. Theoretically, this relates to March's (1991) classical distinction between exploitation and exploration. According to March exploitation means to exploit existing knowledge and skills in order to successively improve efficiency and reliability. Exploration, on the other hand, focus innovations through experimentation and trying new combinations, which also contains a risk of failures. There is an intimate relationship and dependency between these two. Exploitation is based on the collected experiences that form a basis for exploration when combined in new ways. A focus on exploration on the other hand creates new experiences that can be exploited. The research on organisational learning stress the need of balancing these two approaches (Brown & Eisenhardt, 1998; Holmqvist, 2000).

The production competencies presented above indicates that production seems to contain capabilities that are not only valuable to exploitation but also to exploration. If the companies regard manufacturing as an non-strategic commodity there is a risk of losing the ability for both effective product development, industrialisation and procurement. One main problem, however, seems to be that as long as the potential and the real competencies in production are made explicit and visualised it is difficult to evaluate how production may contribute to exploitation and exploration, and to make any decisions on the desired balance between these two approaches. Furthermore, it is difficult to evaluate what kind of competencies could be won or lost when outsourcing manufacturing.

Conclusions and implications for further research

The analysis in this paper focused on two main questions. The analysis of how outsourcing manufacturing affects the company's competence indicates that outsourcing embodies a learning dilemma for many engineering companies. On the one hand, in line with research on innovation processes and industrial networks, outsourcing may lead to extended co-operation and a broader competence base, which cultivates learning and the creation of innovative products and processes. On the other hand, outsourcing manufacturing may negatively affect productive co-operation between manufacturing, design and marketing. Another problem is the difficulty of making a dynamic distinction between core and peripheral competencies. The second question concerned the strategic competencies in manufacturing. The analysis shows that the discussion and literature on outsourcing mostly lack an explicit analysis of the explorative competencies of manufacturing. This may result in limited learning, which affects both the working situation within manufacturing and the capacity of the entire company. In the paper we presented five areas of manufacturing competencies that could be of value to both exploitation and exploration.

The analysis can be summarised in a model visualised in Figure 1. The model distinguishes four different dimensions. The first dimension, describes the company competencies, classified in three different levels. The second dimension concerns the differences between competencies connected to integral and decomposable activities, respectively. The third dimension clarifies the balance between exploitation and exploration, when competence is regarded as a basis. The fourth dimension (not visualised) represents a dynamic perspective, e.g. the necessity of distinguishing present and future competencies. In the model is also marked the balance between outsourcing and external collaboration that concerns the interplay between internally and externally based learning. The idea is that the competencies of a specific function or activity, such as manufacturing, could be plotted into the model and thus specify the character of this function within the three dimensions. The analysis model thus provides a framework for both analysing manufacturing competence and to discuss the effects on organisational competencies when outsourcing manufacturing. Our analysis indicates that manufacturing competence, at least in some engineering companies, appears in all three circles describing the core competence. There are, furthermore, indications that manufacturing and product industrialisation is an integral activity, i.e. that the competence of volume production is closely linked to the industrialisation process. Finally, the five manufacturing competencies which we discerned concern both exploration (e.g. product development and industrialisation) and exploitation (e.g. quality, productivity and flexibility).

This preliminary model can be used as a framework for further analysis on the research questions concerning the relationship between long-term learning and outsourcing, and furthermore to visualise and control the explorative capacity of manufacturing. The model also clarifies some of the remaining questions and tasks for our further research.

One remaining and crucial question is how to clarify the position and the content of manufacturing competence, marked by a shadowed area in Figure 1, and furthermore to relate this to various production situations, e.g. the complexity of products and processes. This requires more thorough investigations and analysis based on longitudinal case studies. This analysis will also include an operationalisation of the different dimensions in the model. Another challenge is to develop management control methods that visualises manufacturing competencies and capabilities. A starting point here could be to use the concept of Balanced Scorecard (Kaplan & Norton, 1996) as a tool for recognising and controlling the intellectual capital (Edvinsson & Malone, 1997). If applied in another way, the intellectual capital of manufacturing could be visualised and its contribution to the entire company evaluated. Measurements that capture such things as industrialisation competence, manufacturability, etc. would possibly be relevant.

A second task is to further evaluate the effects of outsourcing manufacturing. This includes an analysis of the potential of strategies for internal production development weighted against outsourcing and the greater access to network capabilities. If the real competencies of manufacturing are not recognised and visualised the result may be a productivity gap, e.g. a difference between the productivity obtained in a shrinking internal manufacturing compared to the potential of increasing productivity that conscious actions on production development may have. It is not least this potential that has to be compared to the potential of mutual learning that may occur between the company and its new suppliers.

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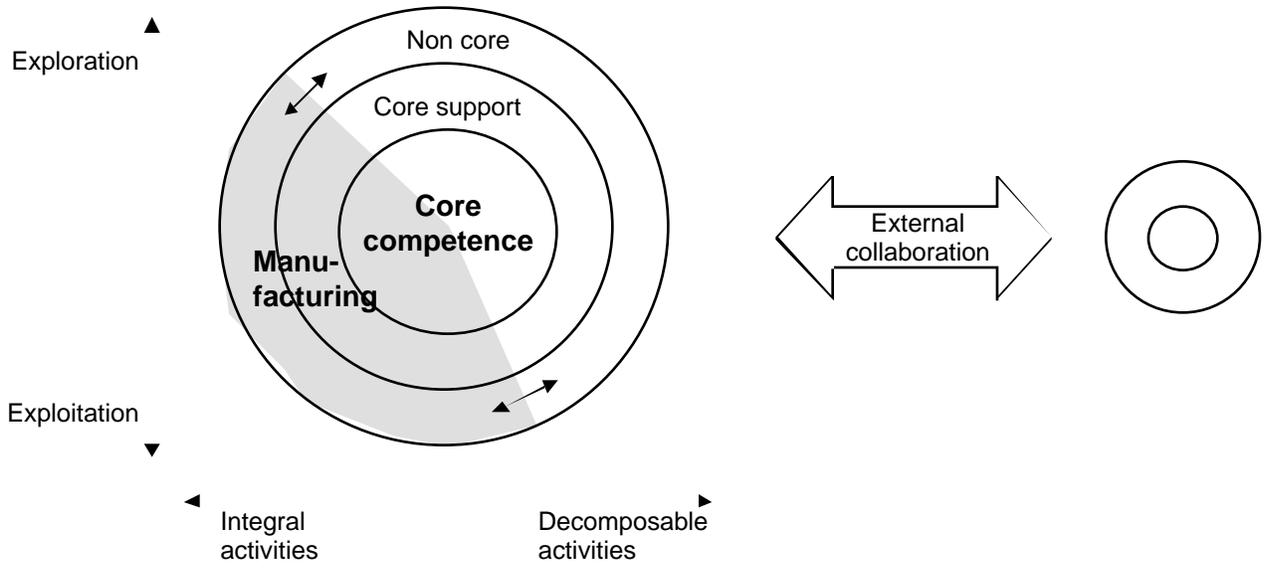


Figure 1. Model for analysing outsourcing of manufacturing and its effects on competence