

Strategic positioning within the manufacturing supply chain: An investigation of decision making practices

Keywords: Manufacturing, supply chain, strategic positioning, decision process

Tim Baines¹, John Kay¹, and David Hamblin²

Cranfield University¹, University of Central Lancashire²,

Corresponding author

Professor Tim Baines,
Manufacturing Systems Centre,
Department of Manufacturing
School of Industrial and Manufacturing Science,
Cranfield University,
Cranfield,
BEDFORD,
MK43 0AL,
United Kingdom

Tel: 01234 750111 Ext 5484

Fax: 01234 752159

E-mail: t.s.baines@cranfield.ac.uk

Strategic positioning within the manufacturing supply chain: An investigation of decision making practices

Keywords: Manufacturing, supply chain, strategic positioning, decision process

ABSTRACT

Strategic positioning of a manufacturer concerns choosing those service, production and supply chain related activities that an organisation should carry out internally, and those that should be external and under the ownership and control of suppliers, partners and customers. This paper describes research that has investigated how manufacturers make this decision and what, if any, are the characteristics of a successful approach to forming such decisions. Six UK manufacturing companies have been studied in-depth and, in each case, the decision making processes that practitioners actually apply have been explored, recorded and analysed. This study has revealed distinctly different styles of thinking across these companies. Based on this insight the paper proposes three key principles that manufacturers should adopt when forming strategic positioning decisions.

INTRODUCTION

Strategic decisions have long-term implications and tend to be relatively irreversible. Within manufacturing industry, a key strategic decision concerns defining those operations (production, supply and service) that an organisation should carry out internally and those that should remain external. This is often referred to as the strategic positioning decision and concerns the degree and direction of vertical integration alternatives and links relationships with suppliers, distributors and customers (Hill, 1993). Such positioning is directly impacted by actions associated with outsourcing, offshoring, joint ventures, make versus buy, etc, and so should be a key consideration for many manufacturers. However, little appears to be known about how strategic positioning is successfully achieved in practice.

The research described in this paper has therefore set out to understand how senior management choose the strategic position of their manufacturing operations. The research method has been deductive in nature with initial hypotheses being formed from a review of manufacturing strategy and supply chain literature. Six case studies have then been carried out at manufacturers selected from a large database of 300 potential participants. Each case study has consisted of exploring in-depth how senior management have formulated recent decisions that can be associated, either explicitly or implicitly, with altering the strategic position of their company. Analysis of these cases revealed that, as described in the paper, more successful manufacturers seem to exhibit three distinctive characteristics in their approach to strategic positioning decisions. First, they tend to view their supply chain interactions collectively and holistically and, in doing so, appreciate how a change in one supply chain will impact on others. Second, they have a heightened awareness of organisational dynamics and appreciate that the strategic position of their organisation will need to change over time. Finally, they primarily evaluate any potential strategic positioning decision in terms of impact on competitive strategy. On the basis of these findings, this paper contributes to a better understanding of the strategic positioning decision and so lays the foundations for future work to develop improved decision support aids for practitioners.

The paper is structured to first describe the challenge faced by practitioners in more detail, along with previous research in this area. The research aim and methodology are then described, including the data

collection protocol, method of company selection and case study execution. Each of the six cases is then summarised, followed by the cross case analysis leading to the research findings. The final part of the paper summarises the key findings and proposes a direction for future research.

THE INDUSTRIAL CONTEXT AND PREVIOUS RESEARCH

A definition and illustration of strategic positioning

Traditionally, actions to improve the competitiveness of manufacturing operations have tended to focus on those production activities residing within the four walls of the factory. Manufacturing professionals have concerned themselves with such initiatives as technology investment, work-in-progress reduction, production scheduling techniques and component make/buy. Commonly these have been in response to pressures to reduce operating cost or improve delivery performance. Today however, there is a much greater awareness of the strategic potential of manufacturing operations and, as a consequence, concepts and methods employed in the development of manufacturing are changing. In particular there is a much greater pressure to view operations as a complete and integrated system within the wider supply chain network.

The concept of strategic positioning is one example of taking a more holistic view of manufacturing operations. In this context, strategic positioning refers to the decision process of choosing those production related activities that a manufacturer should carry out internally, and those that should be external and under the ownership and control of suppliers, partners, distributors and customers (Baines et al, 2005). The strategic position itself can be thought of as the foot-print or 'competitive space' that an organisation adopts within the network of supply chains that it operates. This is similar to the concept of process position put forward by Hill (1993) which he describes as the degree and direction of vertical integration and links with the supply chain. These linkages and interactions, between the host company and wider supply chain network, can be thought of as occurring at four principal interfaces as illustrated in figure 1. The practices at each interface (for example the extent of outsourcing) may well differ across product families produced and as a consequence the notion of strategic position is best thought about at the level of individual product families. For a single product family the four key interfaces are:

- **Production supply interface:** Here, supplies of in-bound materials, components and consumables are received and transferred into production. A notional boundary of a manufacturers strategic position occurs at the point where the responsibility for the conversion process changes from the supplier to the host.
- **Customers interface:** Here, products and services provided by the manufacturer are transferred to the customer. A notional boundary to strategic position again exists and, in this instance, it is at the point where the producer passes the products and services to the customer.
- **Infrastructure interface:** Here, equipment, machinery, technologies, services and facilities used in the manufacturing activity are sourced and transferred into the organisation from the wider supply base. Again, a notional boundary of strategic position exists at the point where responsibility is transferred from the supplier to the manufacturer.
- **Product range interface:** Here, the services, materials and components supporting the manufacture of one product range are shared with others within the same organisation. At the point where resources

are shared a boundary of strategic position again exists.

<Take in Figure 1>

The extent of integration at the interface with supplier, customers and other product families collectively defines the strategic position. This can be considered, either at the level of the product family or, as an aggregated view of the predominant practice across the range of products produced by an enterprise. This strategic position can be essential to competitiveness. Within the UK, a change of strategic position is a key element of the Government's strategy for manufacturers, when they state that: 'Our strategy is to help more manufacturers to move up the value chain and to reap the benefits of high-skilled, knowledge-intensive manufacturing operations' (DTI, 2002). Such prescriptions however need to be treated cautiously. Recently, JCB Excavators, the UK's leading privately owned manufacturing company, announced that it was commencing production of diesel engines. Similarly, a distinguishing characteristic of the highly successful home furnishing company IKEA, is that the customers themselves assemble much of the furniture they purchase. Neither of these examples necessarily fit the trajectory of strategic position advocated by the UK Government, but the success of each company suggests that their executives are making well informed decisions. Therefore, it would be helpful to better understand how such decisions are being formed. Such an insight would be widely beneficial to other manufacturers. Hence, the research question arises as to how successful manufacturers choose what activities should be internal and external, and so choose the strategic position of their organisation. This is the question that the research described in this paper has set out to address.

Overview of previous research associated with the strategic positioning of manufacturers

Strategic position as a concept for manufacturers, or strategic positioning as a process, is rarely addressed explicitly in the literature. There has however been considerable research that has focused in turn on each of the four interfaces mentioned earlier. For example, research on the in-bound material supply chain is addressed directly under the umbrella of make-versus-buy by authors such as Buchowicz (1991), partnerships and relationships by Lamming (1993) and Macbeth and Ferguson (1994), Quinn and Hilmer (1994), Bruck (1995), Probert (1996), Lonsdale and Cox (1998) and strategic sourcing and supplier selection by writers including Greaver (1999). Similarly, the out-bound customer interface is covered in marketing literature by such authors as Jones and Clark (1990), Christopher (1992) and (1998), and to an extent by authors concerned with the design of physical distribution management channels, for example Stevens (1990) and Ballou (1998). The infrastructure interface has been investigated by such researchers as Baines et al (1998) writing on technology sourcing, Henderson (1990) on facilities management and Frohlich (1998) on advanced manufacturing technology implementation. Other authors who have focused their attention at the management of the technology boundary include Swamidass (1987), Gerwin and Kolodny (1992), Goodman and Lawless (1994), Gregory et al (1996), Anderson et al (1997), Twiss and Goodridge (1989), Durrani et al (1999) and Farrukh et al (2000). Finally, the product range interface is addressed by authors covering a number of areas such as product development strategy and performance (Adler et al, 1996), competitor analysis (Brunt, 1999); quality function deployment (Hauser and Clausing, 1988) and costing issues such as direct product profitability (Aston, 1989).

Although there is a lack of work that has explicitly investigated strategic positioning an integrated view of supply chain decisions is provided to some extent by strategy-based research and work on core competences, for example Hayes and Wheelwright (1984), Prahalad and Hamel (1990) and Mills et al

(1996). Indeed, Abell (1980) defined industries in terms of a competitive space based around customers, technologies and products. A similar holistic view has been investigated by Fine and Whitney (1998, 1999), who cite cases where companies have treated their supply chain interfaces in isolation causing major problems to their overall organisation. Indeed, Fine and Whitney also represent the most recent descriptive studies of practice in this area. However, other than these there is a distinct lack of further theory building on this topic. Much of the existing work on the strategic positioning topic deals with interfaces (such as upstream or downstream) independently and, particularly within the manufacturing literature, is focused at the upstream tactical decision level. In contrast there is a lack of research that has explicitly addressed the strategic positioning topic. Therefore, the intention of this paper is to contribute to a better understanding of this concept.

RESEARCH AIM, SCOPE, OBJECTIVES AND PROGRAMME

Strategic positioning is an important decision for manufacturers. It deals with the identification of the production related activities a manufacturer should carry out themselves within the context of the wider supply chain network. Although a key decision, very little work has explored how successful supply chain positioning decisions are reached in practice. Therefore, the aim of the research described in this paper has been to improve the understanding of how practitioners, within successful manufacturing organisations, form the decisions that position the boundaries around their manufacturing operations and so choose the strategic position of their enterprise.

Prior to specifying the research objectives we considered a number of scoping issues. First, that within manufacturing management research, practice directly complements theory development and so we would need to work closely with practitioners to produce knowledge 'in the context of application' (Gibbons et al, 1994). Second, that decisions can be reached through complementary processes of judgement, bargaining and analysis (Mintzberg et al, 1976) and that there is a need to explore the extent to which each of these mechanisms are applied in practice. Finally, that the decision process, content and context (Whipp et al, 1991) needs to be carefully considered as the interplay between these can be key in appreciating how a decision was reached. With these considerations in mind the following objectives were formed.

Three objectives were defined and these naturally led to a four stage deductive research programme. The first objective was to use the existing knowledge base to identify the types of approaches that a practitioner may take to forming successful strategic position decisions. Hence the first stage of the research was to review the existing literature and from this deduce possible explanations as a series of principal hypotheses. Our second objective was then to design and execute a study of actual manufacturers to capture data and inform these hypotheses. Here, the considerations mentioned above led us to adopt a case study approach, and to stage 2 and 3 respectively of our research design. The final objective was to conduct analysis that would lead to identifying the principal characteristics of an approach that delivers successful strategic positioning decisions. This was the fourth stage of the research programme. The following sections of this paper now explain the execution of each stage of research and the subsequent findings from this work.

STAGE 1: FORMATION OF THE THEORETICAL FRAMEWORK

The intention of this research is to better understand how manufacturers choose the strategic position of their organisation. Although this is a novel research topic there is, as mentioned earlier, previous work that

has dealt with topics that are directly related to the strategic positioning decision. Such work may provide useful clues into the nature of the characteristics sought here. The challenge is then to decide on what basis to interpret these previous research contributions. It would be possible, for example, to identify the key decision factors put forward for the make-versus-buy decision and then test whether these remain valid for strategic positioning. Such analysis is however dependent on there existing sufficient descriptive research, for each of the four supply chain interfaces mentioned earlier, to give a reasonable guide as to the factors sought. Likewise, and more significantly, this path would lead more towards identifying specific relationships rather than the deeper understanding of practitioner behaviour that we seek.

As an alternative, the previous research in this area can be evaluated simply in terms of where it is focused. The interpretation being that the greater the number of studies on a topic, then the higher the potential value to competitiveness. This is undoubtedly a contentious proposition and, in being so, is actually well suited to forming a series of hypotheses that are open to debate. It is this debate, rather than the clinical testing of this hypothesis, that is likely to reveal the insights sought in this study. This approach can be rationalised further by considering the focus of previous studies in terms of the most closely associated supply chain interface. This provides a means to add precision when dealing with topics such as outsourcing where, for example, terminology is often used loosely.

On the basis of this approach to forming hypotheses, Table 1 has been constructed to provides a summary of previous work that can be associated with strategic positioning. Each supply chain interface can now be considered in turn. Hence, Table 1 illustrates that the production supply interface is well covered in the literature. As previously mentioned, key authors include Buchowicz (1991), Lamming (1993), Quinn and Hilmer (1994), Macbeth and Ferguson (1994), Bruck (1995), Probert (1996), Lonsdale and Cox (1998) and Greaver (1999). This range of contributions leads us to suppose that these upstream decisions are key to determining the strategic position of an organisation, and we have captured this significance in the following hypothesis:

H1: Production interface decisions are seen as most important to successful strategic supply chain positioning

Similarly, the downstream or out-bound customer interface is covered in marketing literature by such authors as Jones and Clark (1990), Christopher (1992) and (1998), and to an extent by authors concerned with the design of physical distribution management channels, for example Stevens (1990) and Ballou (1998). Hence, in contrast to above, the following hypothesis can be formed:

H2: Customer interface decisions are seen as most important to successful strategic supply chain positioning

Infrastructure interface decisions, such as those to outsource business activities could also explain supply chain positioning. This is reflected in the work of Henderson (1990), Baines et al (1998) and Chiesa and Manzini (1998). This leads to our third hypothesis as follows:

H3: Infrastructure interface decisions are seen as most important to successful strategic supply chain positioning

For completeness, it is reasonable to hypothesise that product range management may also explain performance. This leads to our fourth hypothesis as follows:

H4: Product range interface decisions are seen as most important to successful strategic supply chain positioning.

In addition to these hypotheses, it is also important to consider inter-dependencies. When considering Table 1, it emerges that the formation of manufacturing and supply chain strategies should consider issues across the supply chains described above. It must reflect the inter-relationships of existing activities and resources as well as the inter-dependencies of decisions made. For example, a choice to increase product range should mean that the organisation has to consider vertical integration (span of process) for new product families, and similarly, to choose the level of integration with suppliers of the required production activities. Alternatively, an organisation may choose to integrate into the infrastructural supply chain of a manufacturing technology to develop a unique competence. This led to our fifth hypothesis:

H5: Coordination of all four interface decisions is seen as most important to successful strategic positioning.

With these five hypotheses established it was possible to proceed with the case study research to establish which best explained the practices of successful managers.

STAGE 2: CASE STUDY DESIGN

A case-study based research methodology was chosen so that an in-depth understanding of the practice could be gained. This was based on Yin (1994) and replicates that described in Baines et al (1998).

Selection of cases

Fundamental to this research is the belief that the success of manufacturers will be positively reflected in the processes they use to formulate their strategic decisions. Therefore, to gain an insight into the differing approaches used to form strategic positioning decisions, a selection of companies were sought which demonstrated a variety of competitive performances. A suitable source of possible companies to study came in the form of respondents to a survey carried out on 'Sourcing for Competitive Manufacture' (Baines and Kay, 2002). In this survey, 96 companies indicated that they would be willing to discuss being involved in a subsequent study of supply chain practices. This survey had included an assessment of the level of success each company attained in managing and exploiting their manufacturing supply chain practices. This was based on a form of practitioner self-assessment of practice and is described in greater detail in Baines and Kay (2002). Two sets of companies could therefore be chosen for the study, the first where supply chain management was regarded by the managers as particularly effective, and a second where this was not currently the case.

Selection of the cases then proceeded by first ranking the survey in terms of success. These companies were then categorised in terms of size, location, and ownership, and were then approached to seek participation in the case study research. Six companies were selected that met all criteria and were willing to participate in the study. Table 2 presents an overview of the background of each of the six companies. Each of the companies are leading players in their own product marketplace. The identity of the companies is not essential to the interpretation of the results and so to enable sensitive issues to be discussed we have used surrogate names that loosely reflect their core business. These names are shown against each company on table 2. Belt-co and Paint-co recognised that there was significant opportunity for improvement in managing their supply chain activity, whilst Print-co, Floor-co, Weigh-co and Inspect-co considered themselves quite successful. The sample covers a range of products, geographical location and company

ownership. With the exception of Belt-co, the UK part of a large European-owned multinational, they are all comparable in size.

<take in Table 2>

Design of the data collection protocol

For each company, and with our hypotheses in mind, we set out to ask how the strategic position decision was made. To achieve this, we chose to initially focus our discussions on an actual decision recently made at each company and from this explore the general approach adopted. Our focus was on activities the company currently carried out internally, those that were external, and recent changes to this state and any associated motives or circumstances. Questions were also asked about the perceived success of the approach to forming decisions. This was most difficult to assess. The business success of each company was noted, but acknowledged as a fragile indication of the impact of any specific supply chain decision. Therefore, the researchers relied in the main on practitioner self assessment but set out to confirm this from a number of perspectives within each organisation.

Execution of the case studies

The data collection protocol was applied at each of the six companies. In each case the company was contacted by the research team, a project brief was despatched, and a telephone discussion held confirming the purpose, scope, and participation sought. Then, each company was visited and a selection of senior managers were interviewed. The actual number varied across the sample (typically 3-4 people) and in each case was felt sufficient to gain an objective indication of process and impact. A typical interviewee would be a manufacturing, production or supply chain executive. Taken collectively, the interviewees would be well informed and knowledgeable about the company practices relating to each hypotheses. Each company visit lasted one to two days, and the same two members of the research team visited each company to ensure validity and comparability of the case findings. On completion of each visit a case report was compiled and despatched to the company. A follow-up telephone discussion was then held, and in two cases a short visit made back to the company to check and confirm that the report was accurate. Subsequently, these reports formed the basis for the cross-case analysis.

STAGE 3: CASE STUDY RESULTS

This section presents a summary of each of the six case studies. Each summary describes the company, supply chain practices, and how decisions are formed.

Belt-co has been part of a large multinational since the mid 1990s. The company is a leading manufacturer in the global market for power transmission belts. The product range is large, with many variations of specification, length and width. In terms of upstream integration, once a product specification is fixed it tends to tie Belt-co down to staying with the original supplier of raw materials requirements for rubber compounds. Downstream, Belt-co has a long established relationship with automotive OEMs, belts are collected daily, and there is minimal stock holding. Nevertheless, there is some long-term potential for Belt-co to develop an aftermarket distributor capability. Finally, infrastructure integration development has focussed on both stepped and incremental process improvements rather than on radical technology change. There is a major ongoing investment programme in tooling and material handling within the process, partly in order to remain cost effective for high volume products.

The parent company in Germany makes many of the strategic decisions centrally and so Belt-co has limited autonomy. Probably as a consequence of this, personnel within the company feel that the upstream and downstream boundaries are in practice fixed. For example, they feel unable to migrate their operations downstream to capitalise on after-market sales opportunities. The infrastructure boundary is a little more flexible, with the company developing considerable involvement with suppliers to improve tooling. Likewise, some support facilities such as the workers canteen have been outsourced. Decisions do not follow a prescribed process rather they are based principally on the cost of providing the internal versus external facility.

Paint-co is proud of its reputation as a leading manufacturer of high quality artists' materials, UK sales are approximately £20 million/year, and it is privately owned. Its core competences are considered to be maintenance and development of colour recipes, sales and distribution, but not necessarily manufacturing. Manufacturing of colours is fairly labour-intensive and involves low-tech processes such as grinding, mixing, filling, labelling and packing.

Upstream, the main bought-in materials for the colour products are sourced from around 160 suppliers, mainly in the UK. In many cases, Paint-co is an insignificant customer, as the materials are more often supplied for quite different applications. Downstream, together with the large customer base of established High Street retailers of artists' supplies, Paint-co now has some large accounts with non-traditional outlets such as Office World in the UK and Wal-Mart in the US. The two customer sectors have different needs. The traditional High Street art shops often rely on sales representatives to check on their stock, advise on shortages, and in effect work out their order for them. The big customers are much more professional with sophisticated purchasing systems, and expect a better margin, rigid delivery requirements, and point of sale support such as display units. These customers buy a narrower range of products, and delivery is made in one hit into their own distribution centre.

Major decisions are made at regular board meetings, and there are clear pressures for the company to adjust the position of all boundaries. First there is a product range dilemma; whether to maintain a diverse range to meet the requirements of specialist customers, or to focus on high variety and low volume to complement the demands of retail outlets. Upstream there is pressure to relinquish manufacturing, whilst downstream there is pressure to develop stock-holding and distribution capabilities. Some investment in infrastructure is currently underway, for example, some machines are nearing the end of their life, and a major capital expenditure programme is now in place. Each of these boundary decisions are being addressed independently, and the decisions are largely posited on information provided by the cost accounting system at the company. As a consequence, the decisions don't appear to be congruent, and even some conflict exists. Managers are conscious of, and even a little frustrated by, some of these issues.

Print-co is one of the world's leading suppliers of specialised industrial equipment, with a strong presence in the food and drink manufacturing industry. It is a successful company, with gross margin approaching 50%, and an annual R&D spend of around 6% of turnover. Continuing success in the market is based on technical competence, patented features and worldwide support competence.

Development of product families is ongoing, and the company is actively developing its next generation of products, based on laser technology. Upstream, manufacturing of some key systems is retained in-house. Downstream, the company seeks to provide the customer with a turn-key facility. Infrastructure integration is

variable across the organisation. Print-co has quite recently established its own laser design and production facility, and it is learning how to use and exploit this capability for the next generation of products.

Print-co takes a holistic management approach to supply chain operations. For example, manufacturing is retained where there is concern about loss of control which could impact on customer service. Integration into infrastructure is seen as key in developing and retaining the IPR of the laser manufacturing process and application, and hence helping to ensure product differentiation. Some analytical tools are used by senior managers, including technology road mapping. However, Print-co's managers have not been able to identify a useful support tool that tackles all the critical supply chain management issues holistically.

Floor-co Two entrepreneurs who identified a new marketing opportunity for flooring accessories established Floor-co over 36 years ago, and it became a public company in 1994. Floor-co has long been established as the UK's leading supplier of contract flooring accessories, such as stair edgings, PVC covings and carpet trims, entrance matting, wall protection, step and aisle safety lighting.

The company actively manages the product range, and accessories are now complemented by contract carpets and fabrics. A very wide range of coordinated products are available to match individual customers' requirements for materials, colours and designs that meet both their performance specifications and their aesthetic wishes. Upstream, Floor-co aims for open relationships with its suppliers, stopping short of "open book" arrangements. PVC extrusion is retained in-house, in order to maintain flexibility and fast turn around times whilst holding minimal stocks. Downstream, accessories are sold through around 70 distributors. In terms of infrastructure, Floor-co has carried out extensive improvements to its PVC extrusion manufacturing methods in order to guarantee 24-hour deliveries from its large product range at the same time as controlling costs. It also now makes its own tooling as it was unable to get the desired quality and delivery speed externally.

Floor-co consciously manages the company's boundaries of responsibility (upstream, downstream, horizontal and technology) with an holistic approach. It has emerged from within through the original entrepreneurial management style. Totally reliable delivery and quality performance are required and total supply chain performance is seen as being far more important than simple material cost. The management team works together and makes decisions largely using "logic and experience", but backed up with analysis and use of a range of tools and techniques such as Ishikawa cause and effect diagrams, Pareto analysis, process mapping and SMED. Multi-disciplined teams are set up for major change projects, and every division has improvement teams.

Weigh-co is a market leader in automated weighing and packing equipment, primarily for the food industry. Weigh-co sees itself as a "solution provider" of turn-key projects rather than simply an equipment provider.

The two main products are multihead weighers and checkweighers. Customer specifications vary widely, depending on the characteristics of the product being weighed and packed, the product mix, operating environment and so on. Hence the operation is largely based on build to order. Upstream, in-house manufacturing know-how is limited. Suppliers are invited to tender to supply product families, and may suggest worthwhile changes. Downstream, the company is market led, and has a high profile presence in the industry. In their drive to be a solution provider, Weigh-co offers its customers a wide range of support for its products. These include installation, commissioning, maintenance, efficiency engineering, service

contracts and repair services. In terms of infrastructure, Weigh-co sees the development of skills needed to provide complete integrated lines as the key to future success.

In general, the horizontal and downstream integration boundaries tend to be managed by marketing, and the upstream boundary by manufacturing. The business is small enough for effective informal contact, but routine ways of sharing information are being developed. Decision-making tends to be informal, yet the managers feel that, on the whole, this is a good working arrangement.

Inspect-co, founded over 30 years ago, is a leading manufacturer of food inspection systems, with installations in many of the world's largest food companies. Since 1998, Inspect-co's new management team have transformed the company and have brought about a manufacturing "culture change".

The company seeks to provide complete systems which include transport conveyors, reject facilities, alarms and data management software. Upstream, the company now has a supplier development function rather than a purchasing department, and runs a suppliers' club for aligning 1st and 2nd tier suppliers with its needs. However, to improve control over the delivery performance for key components, the company has moved to increase vertical integration, and invested in machine tools for the production of stainless steel components. Downstream, the main customers see themselves as "buying service rather than machines". Infrastructurally, new product development is a crucial component of Inspect-co's business strategy. The most important part of these products is the software, which Inspect-co has developed in conjunction with the supplier of the external technology. There are 4 main suppliers of these systems, and Inspect-co is one of the leaders, having developed wide application knowledge.

Strategy is developed and managed by the board of 4 directors who report to the holding company. The board describes itself as having a "joined-up" approach to sales and marketing, manufacturing and R&D/product development issues. The directors work together to develop the strategy and to define the "boundary of responsibilities" for the company. They are conscious of the need to manage the range of products on offer, the level of integration with both suppliers and customers, and their own manufacturing processes and technology. They also recognise the value of managing these holistically, rather than in isolation. This approach cascades through the organisation. Inspect-co's directors do not use specific tools, techniques or frameworks for this, other than those in everyday use. They rely more on their own business experience and know-how, and close working relationships.

STAGE 4: ANALYSIS AND DISCUSSION OF RESULTS

The approach taken to analysis has been to first consider the validity of our hypotheses and then to draw upon these, and other observations made through this study, to generate the key findings from this research.

Cross case analysis

In setting up the initial hypotheses we were guided by the extent of previous work that has targeted each of the four supply chain interfaces. Thus the first four hypotheses posit that the positioning decision can be successfully treated in this manner and thus the principal issue is to identify which decision area is most influential (eg: upstream, downstream, etc.). Evidence to refute each of these hypotheses is necessary if the fifth holistic hypothesis is to be supported. By way of contrast, the fifth hypothesis posits that the key issue is one of coordinating across these decision areas. Again we explore whether evidence to refute this

hypothesis exists in these cases, or whether this hypothesis could be advanced for more wide scale scrutiny. On this basis we have first considered our initial hypotheses independently.

H1: Production interface decisions are seen as most important to successful strategic supply chain positioning

Belt-co and Paint-co (both followers) exhibited this approach to decide which activities to carry out internally compared to external. For example, Paint-co are heavily engaged in outsourcing the production of a sizeable product range to China. This decision is based solely on production cost. During conversation the issue of core competency was raised and how this might be affected by this decision. However, the Senior Managers interpreted this concept in various ways and did not share an opinion about the impact of this off-shoring activity. In contrast, Print-co, Floor-co, Weigh-co and Inspect-co (all leaders) did not exhibit such characteristics. Instead, as discussed later they were more mindful of the implications of sourcing practices on the whole business. For example, Inspect-co had recently chosen to purchase equipment, and train personnel, that would enable them to undertake pressed steel fabrication. This activity had previously been carried out by external suppliers. This vertical integration had taken place because it improved their ability to improve delivery performance even though costs increased marginally. Here, although the practice had occurred at the production – supplier interface, this was not a localised decision. The marked difference in practice between companies indicate that hypothesis 1 does not adequately explain formation of successful strategic positioning decisions.

H2: Customer interface decisions are seen as most important to successful strategic supply chain positioning

As mentioned above, the decision by Inspect-co (leader) to in-source the pressed steel fabrication process was driven by a need to improve performance to customers. However, this is not consistent with this hypothesis, which suggests both the priority drivers, and the actions themselves, are taken at the customer interface. Of the cases, only Paint-co (follower) again exhibited this approach. A particular example was given concerning warehousing and transportation of finished goods. Decisions had been made to outsource some logistics to a third party provider. This was a localised decision based predominately on cost, but most significantly, had taken preference within the organisation over decisions to outsource production to China (as mentioned earlier). Paint-co, however, accepts that its supply chain practices lag the competition and so this hypothesis is refuted.

H3: Infrastructure interface decisions are seen as most important to successful strategic supply chain positioning

These decisions were considered to be very influential by all companies except Paint-co (follower) and Floor-co (leader). Belt-co (follower) worked closely with suppliers to develop new press-tooling. The parent organisation did not, however, recognise the importance that was justified on the basis of production efficiency improvement. Print-co and Inspect-co (both leaders), being smaller and not constrained by a larger corporation, exploited this interface to develop new production capabilities and hence new business opportunities. One example was the development of laser capabilities to form a core for new business development. In this they were distinctly different to Belt-co as they were able to justify this investment in terms of new business potential. However, in this way they also demonstrated that their decision making was based on a variety of factors and that hypothesis 3 did not explain these.

H4: Product range interface decisions are seen as most important to successful strategic supply chain positioning.

Product range issues were prevalent at Belt-co (follower) in particular, but these were being considered alongside infrastructure interface decisions. Belt-co makes considerable investment in tooling. Such tooling is acquired to complement expansion or contraction of product range. Hence, these product range decisions were not made in isolation, and so hypothesis 4 is refuted.

H5: Coordination of all four interface decisions is seen as most important to successful strategic positioning.

This hypothesis most closely reflected the actions of the most successful companies, and at the same time, was absent in the other cases. For example, when acquiring fabrication equipment and vertically integrating, Inspect-co (leader) described their actions as “joined up thinking”. Similarly, Print-co (leader) described how they were holding steady the supply chain practices for one product family associated with ink-jet printing so that they could concentrate management resources into developing a new product family based around laser printing. In contrast, Belt-co and Paint-co (both followers) demonstrated that their supply chain initiatives were dealt with locally.

Development of key findings

The exploration of the hypotheses against the six cases, along with more general observations made during the execution of these studies, leads to the formulation of three key findings from this work.

First, two decision processes appear to exist amongst the six cases. The first is characterised by treating supply chain interactions independently while the second is a coordinated approach. In none of our cases did the two decision processes co-exist; the thoughts and actions of the senior practitioners pertained to one approach or another. This situation is represented by our fifth hypothesis (H5) and leads us to the finding that:

Finding 1: More successful actions are taken by manufacturers who consider the implications to their organisation across supply chain interfaces holistically.

The origin of this decision process is not clear. The personnel in all the companies considered their approaches to be the way that the company always did things. Print-co, Floor-co, Weigh-co and Inspect-co exhibited this approach. As mentioned above, Print-co chose to divest in the upstream integration of a mature product family as this would release resources to develop the infrastructure for an emerging product. In this way they adopted a systems style of thinking. Indeed, Inspect-co used the term ‘joined-up thinking’ to describe their approach in this situation. The origin of this integrated approach is not clear. One explanation is that it is an emergent practice originating from a stage when a company was created. Evidence for this appears with Floor-co, when the management team trace their approach back to an earlier stage in the company’s life cycle. In Inspect-co, this thinking was considered to be so important, that decisions about upstream and downstream boundaries have remained the responsibility of one person as the company has grown.

In contrast the tendency to view supply chain interfaces independently may be influenced by corporate structuring. For example, Belt-co required endorsement of decisions from head-office in Germany both at the level of the SBU and also with some direct function to function responsibilities. This may have

encouraged personnel to develop specialisms and expertise in one aspect of the business. Infrastructure appeared as the only supply chain decision area not fitting this structure, and coincidentally, was the area where some flexibility was demonstrated. Unfortunately, this explanation does not fit the case with Paint-co which had much greater autonomy. A second explanation is the nature of the competitive environment within which each company operated. Belt-co was a leading manufacturer of power transmission belts. Changes to the product were relatively small and incremental, such as the introduction of a new size of belt or material specification. Similarly, Paint-co had produced traditional materials and products for artists over many decades and sold these through small and often privately owned high street shops. Recently however, the company has started selling some products through Wal-Mart, and this has introduced the company to a new customer base with very different requirements to their traditional market. Without doubt, the company is facing a new and very different competitive environment. This change seems to have influenced the way with which senior managers view their supply chain decisions. In the case of Paint-co, they demonstrated some emerging awareness of coordinated thinking about supply chain opportunities and some frustration with the traditional independent approaches.

A second key finding was generated through the debates that occurred when testing the hypotheses. During discussions with the leading manufacturers it appeared that each understood that the strategic position of their organisation is dynamic in nature and that opportunities and threats may appear in any aspect of their supply chains over time. For example, personnel at Print-co quite freely discussed how previously in-house assembly of a now mature product had been the right strategy, but that now this was no longer the case. Similarly, they thought that a new and revolutionary laser technology that they were now developing would probably follow a similar cycle. This awareness of organisational dynamics was very strong, being mentioned repeatedly, in each of the four leading companies but quite absent in Paint-co and Belt-co. In the latter cases they demonstrated in their discussion a belief that the decisions they had made were now fixed whereas in the other cases there is a willingness to potentially adopt a wide range of practices 'when the time is right'. This leads to our second key finding that:

Finding 2: More successful actions are taken by manufacturers who recognise that organisations are dynamic and any decision is temporary.

The third key finding also occurred through discussion around the hypotheses and concerns the over-riding factors considered when forming a decision. This emerged during the debate around hypothesis H2. Although this hypothesis as written was not valid, there was a consistent tendency for the leading manufacturers to justify their actions in terms of improved competitiveness. These actions may have occurred at any one of the four supply chain interfaces. Inspect-co (leader) provided a good example of this thinking. As mentioned above, Inspect-co decided to in-source pressed steel fabrication processes so as to improve performance to customers. In contrast, both Belt-co and Paint-co sought to justify their actions solely in terms of cost reduction and, when explored further, a substantive reason for this focus was lacking amongst the associated practitioners. Thus, the third key finding from this study is as follows:

Finding 3: More successful actions are taken by Manufacturers who link their decisions to the competitive priorities of their organisation.

CONCLUSION

This research has contributed to a better understanding of the strategic positioning decision process. It has revealed that more successful manufacturers seem to exhibit three distinctive characteristics in their approach to strategic positioning decisions. First, they tend to view their supply chain interactions collectively and holistically and, in doing so, appreciate how a change in one supply chain will impact on others. Second, they have a heightened awareness of organisational dynamics and appreciate that the strategic position of their organisation will need to change over time. Finally, they primarily evaluate any potential strategic positioning decision in terms of impact on competitive strategy. As a result of these findings, this work provides a basis for future work to develop improved decision support aids for practitioners. Furthermore, not only does this knowledge impact the strategic positioning decision, but provides a foundation for improving decisions associated with, for example, make-versus-buy, outsourcing and offshoring.

A perceived weakness of this study is that we have avoided relation between the success of each decision process and the competitiveness of the case organisation. Such knowledge is often interpreted in terms of the practices a manufacturer should adopt to become more profitable. However, as highlighted in the earlier section on the case study design, each of the companies studied were themselves successful businesses. Neither is the frequency of occurrence of a decision process in the six case studies in any way a reliable measure of success given such a small sample. Such success is undoubtedly due to a wide variety of issues, and it could be very misleading to attempt to isolate the impact of specific supply chain strategies. At best, we can only point to clearly inappropriate actions in some of the cases, for example, both Belt-co and Paint-co had recently experienced actions in one decision area that had impacted negatively on another. In this work we have however, drawn some relationships between the perceived importance of manufacturing to the host, and the approach taken by people to form decisions. Hence, if manufacturing is, or is becoming important to the competitiveness of a company, the coordinated decision process appears more appropriate. A new challenge then appears in the form of how to operationalise such thinking in a manufacturing company.

ACKNOWLEDGMENTS

We wish to acknowledge the support of Instem Technologies, and The Engineering and Physical Sciences Research Council, GE Amersham and LCP Consulting. Also, thanks to Gwyn Kay, Martin Higson, Sola Adesola, Howard Lightfoot and Derek Thomason for their help throughout this research.

REFERENCES

- Abell, D.F., 1980, "Defining the Business: The Starting Point of Strategic Planning". Prentice Hall.
- Adler, P.S., Mandelbaum, A., Nguyen, V. and Schwerer, E., 1996, "Getting the most out of your product development process". *Harvard Business Review*, March-April, pp. 134-152.
- Anderson, J., Fears, R., & Taylor, B. (eds.) (1997). *Managing technology for competitive advantage*. Cartermill International / Financial Times Healthcare, London.
- Arnold, H. U. (1999), "New Dimensions of Outsourcing: A combination of Transaction Cost Economics and the Core Competencies Concept, *8th International Annual IPSERA Conference*, Belfast and Dublin. University of Ulster.
- Aston, M., 1989, "Method Trade-offs and DPP". *Focus*, Institute of Logistics and Distribution Management, vol. 8, no.8.
- Baines, T.S., Whitney D.E. and Fine C.H. (1998), "Manufacturing technology sourcing practices in the USA", *International Journal of Production Research*, Vol 37 No 4, pp. 939-956
- Baines, T.S., Whitney, D.E., & Fine, C. (1999). 'Manufacturing technology sourcing practices in the USA'. *International Journal of Production Research*, Vol. 37, Issue 4, 939-956.
- Baines, T.S and Kay, G. (2002), "UK sourcing practices and relationships", *Manufacturing Engineer*, Vol 81 No 3, pp. 137-142.
- Baines T.S., Kay G. Adesola S. and Higson M. (2005), 'Strategic positioning - An integrated decision process for manufacturers', *International Journal of Operations and Production Management*. vol 25, no 2, 180 – 201.
- Ballou, R.H. (1998), *Business Logistics Management*, 4th Ed., Prentice Hall.
- Bessant, J. (1997), "Developing technological capability through manufacturing strategy." *International Journal Technology Management* 14(2/3/4): 177-195.
- Bhattacharya, A.K. and Coleman, J.L. (1995), "Re-positioning the supplier: an SME perspective." *Production Planning and Control* 6(3): 218-226.
- Brandenburger, A.M. and Harbourne, W.S. (1996), "Value-bases business Strategy." *Journal of Economics and Management Strategy* 5(1): 5-24.
- Bruck, F. (1995), "Make versus buy: The wrong decision costs", *McKinsey Quarterly*, 1, pp. 28-47
- Brunt, D. (1999), *Value Stream Mapping Tools: Application and Results*. *Logistics Focus*. 7: 24-31.
- Buchowicz, B.S. (1991), "A process model of make-vs-buy decision-making; the case of manufacturing software", *IEEE Transactions on Engineering Management*, Vol 38 No1, Feb. pp. 24-32
- Burstein, M.C. and Pearson, G. (1990), *Markets, Manufacturing Strategy, and Technology Acquisition: An Integrative Development Approach. Manufacturing Strategy; The research Agenda for the Next Decade*, Ann Arbor, Michigan, Kluwer Academic Publishers.
- Butler, R. and Carney, M.G. (1983), "Managing Markets: Implications for the Make-Buy Decision." *Journal of Management Studies* 20(2).

- Chiesa, V. & Manzini, R. (1998). 'Towards a framework for dynamic technology strategy', *Technology Analysis and Strategic Management*, 10 (1), 111-129.
- Christopher, M. (1992), *The Customer Service Planner*, Butterworth Heinemann.
- Christopher, M. (1998), *Logistics and Supply Chain Management*, Financial Times Pitman Publishing.
- Cox, A. and Lonsdale, C. (1999), Beyond the Core Competence perspective: A Contingency model for Effective Outsourcing in The Public and Private Sectors. *8th International Annual IPSERA Conference*, Belfast and Dublin, University of Ulster.
- DTI Competitive Manufacturing (1987), *A Practical Approach to the Development of a Manufacturing Strategy*, IFS Publications.
- Department of Trade and Industry, (2002), *The Government's manufacturing strategy*.
- Durrani, T.S., Forbes, S.M., Broadfoot, C. & Carrie, A.S. (1998). 'Managing the technology acquisition process', *Technovation*, Vol. 18, Nos. 8/9, 523-528.
- Ettlie, J. and Ward, P. (1998), *US Manufacturing in the 1990s: The Chase and the Challenge. International manufacturing Strategies: Context, Content and Change*. P. Lindberg, C. A. Voss and K. Blackmon. Boston, Kluwer Academic Publishers: 401-416.
- Ettlie, J.E. and Penner-Hahn, J.D. (1990), *Focus, Modernisation, and Manufacturing Technology Policy. Manufacturing Strategy : The research Agenda for the next decade*, Ann Arbor, Michigan, Kluwer Academic Press.
- Farrukh, C.J.P., Phaal, R. & Probert, D.R. (2000). *Technology management assessment procedure – a guide for supporting technology management in business*, IEE, Stevenage.
- Frohlich, M. (1998). 'How do you successfully adopt an advanced manufacturing technology?' *European Management Journal*, 16 (2), 151-159.
- Fine, C. and Whitney, D.E. (1996), *Is the Make-Buy Decision Process a Core Competence? uncaptured*, MIT Center for Technology, Policy, and Industrial Development. 2001.
- Fine, C.H. (1999), *Clockspeed*. London, Little Brown and Company.
- Fine, C.H. & Whitney, D.E. (1996) 'Is the make-buy decision process a core competence?'. Working paper, Sloan School of Management, MIT.
- Fine, C.H. and Whitney, D.E., 1999, "Is the make-buy decision process a core competence?". Proceedings of the International Symposium in Logistics, Florence, Italy, pp. 31-63.
- Fisher, M.L. (1997), "What is the right supply chain for your product?" *Harvard Business Review* 75(2): 105-116.
- Gerwin, D. & Kolodny, H.F. (1992). *Management of advanced manufacturing technology: strategy, organisation, and innovation*. Wiley, New York.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1994), in. *"The New Production of Knowledge: the Dynamics of Science and Research in Contemporary Societies*, London, Sage

- Goodman, R.A. & Lawless, M.W. (1994). *Technology and strategy: conceptual models and diagnostics*. Oxford University Press, New York.
- Gregory, M.J., Probert, D.R. & Cowell, D.R. (1996). 'Auditing technology management processes', *International Journal of Technology Management*, 12 (3), 306-319.
- Ghemawat, P. and Collis, D.J. (1999), *Strategy and the Business Landscape: Text and Cases*. Reading - New York - Sydney, Addison Wesley Longman, Inc.
- Goldberg, B. and Sifonas, J.G. (1994), *Dynamic Planning: The Art of Managing Beyond Tomorrow*. New York, Oxford University Press.
- Greaver, M.F., 1999, "Strategic outsourcing". American Management Association International, New York.
- Hartmann, M. (1999), "Theory and practice of technological corporate assessment." *International Journal of Technology Management* 17(4): 504-521.
- Hauser, J.R. and Clausing, D., 1988, "The House of Quality". *Harvard Business Review*, May-June, pp. 62-73.
- Hax, A.C. and Majluf, N.S. (1983), "The Use of the Attractiveness-Business Strength Matrix in Strategic Planning." *Interfaces* 13(2): 54-71.
- Hax, A.C. and Majluf, N.S. (1992), *Competitive Cost Dynamics: The Experience Curve. Strategic Planning: Models and Analytical techniques*. Chichester, Wiley.
- Hayes, R.H. and Wheelwright, S.C. (1984), *Restoring Our Competitive Edge: Competing Through Manufacturing*, John Wiley & Sons, New York
- Hayes, R. and Wheelwright, S.C. (1988), *Dynamic Manufacturing: creating the learning organisation*. New York, Simon and Schuster.
- Hedley, B. (1990), *A Fundamental Approach to Strategy Development. Developing Strategies for Competitive Advantage*. P. McNamee. Oxford, England, Pergamon Press.
- Henderson, J. C. (1990), "Plugging into Strategic Partnerships: The Critical IS Connection", *Sloan Management Review*, Spring, pp. 7- 18.
- Hill, T. (1993), *Manufacturing Strategy*, McGraw-Hill.
- Jauch, L.R. and Wilson, H.K. (1979), "A Strategic Perspective for Make or Buy Decisions." *Long Range Planning* 12: 56-61.
- Jensen, E.K. and Heinzl, L (2000), "Stimulating Manufacturing Excellence through Outsourcing - Networks of Interdependent specialised production units",. *SMESME International Conference*.
- Jones, C. and Clark, J. (1990), "Effectiveness framework for supply chain management." *Computer-Integrated Manufacturing Systems* 3(4): 196-206.
- Kee, R. (1998), "Integrating ABC and the theory of constraints to evaluate outsourcing decisions." *Journal of Cost Accounting* (January/February).
- Lamming, R. (1993), *Beyond Partnership: Strategies for Innovation and Lean Supply*, Prentice Hall.

- Lamming, R.C. (1996), "Beyond Vendor Assessment - RAP." *European Journal of Purchasing and Supply Management* 2(4): 173-181.
- Li, H. and Williams, T.J. (2000), "The interconnected chain of enterprises as presented by the Purdue Enterprise Reference Architecture." *Computers in Industry* 42: 265-274.
- Lamming, R.C. (1993), *Beyond Partnership: Strategies for innovation and lean supply*, Prentice Hall.
- Lonsdale, C. and Cox, A. (1998), *Outsourcing*, Earlsgate Press.
- Lonsdale, C. (1999), "Effectively managing vertical supply relationships: a risk management model for outsourcing" *Supply Chain Management* 4(4): 176-183.
- Macbeth, D.K. and Ferguson, N. (1994), *Partnership Sourcing*, Pitman Publishing.
- McDermott, C. and Handfield, R. (2000), "Concurrent Development and Strategic Outsourcing: Do the Rules Change in Breakthrough Innovation?," *Journal of High Technology Research* 11(1): 35-55.
- Mclvor, R. (2000), "A Practical framework for understanding the outsourcing process." *Supply Chain Management: An International Journal* 5(1): 22-36.
- McKay, A. and de Pennington, A. (2001), "Towards an Integrated Description of Product, Process and Supply Chain." *International Journal of Technology Management* 21(3/4): 203-220.
- McNamee, P. (1990), *Developing Strategies for Competitive Advantage. Developing Strategies for Competitive Advantage*. P. McNamee. Oxford, England, Pergamon Press.
- Mills, J., Platts, K., Neely, A., Richards, H., Gregory, M., and Bourne, M. (1996), "Creating a winning business formula", *University of Cambridge*, Manufacturing Engineering Group, England
- Minshall, T.H.W. and Garnsey, E.W. (1999), "Building production competence and enhancing organisational capabilities through acquisition; the case of Mitsubishi Electric." *International Journal of Technology Management*, 17(3): 312-333.
- Mintzberg, H. and Quinn, J.B. (1995), *The Strategy Process: European Edition*. Hemel Hempstead, England, Prentice Hall International.
- Mintzberg, H., Raisinghani, D., & Theoret, A. (1976). 'The structure of unstructured decision processes'. *Administrative Science Quarterly*, 21 (June), 246-275.
- Park, D. and Krishnan, H. (2001), "Supplier selection practices among small firms in the United States: testing three models", *Journal of small business management* 39(3): 259-271.
- Porter, M.E. (1980), *Competitive Strategy: Techniques for Analysing Industries and Competitors*. New York, The Free Press.
- Porter, M.E. (1998), *Competitive Advantage: Creating and Sustaining Superior Performance*. New York, The Free Press.
- Probert, D.R. (1996), "Developing a make or buy strategy for manufacturing business", *Institution of Electrical Engineers*
- Probert, D.C. and Farruckh, C. (1999), "Linking technology to business planning: theory and practice." *International Journal of Technology Management* 18(1/2).

- Probert, D. and Shehabuddeen, N. (1999), "Technology road mapping: the issues of managing technology change." *Int. J. Technology Management* 17(6): 646-661.
- Quinn, J.B. & Hilmer F.G. (1994). 'Strategic Outsourcing'. *Sloan Management Review*, Summer, 43-55.
- Quinn, J.B. and Hilmer, F.G. (1995), "Strategic outsourcing." *McKinsey Quarterly* (1): 50 -.
- Stewart, G. (1997), "Supply-chain operations reference model (SCOR): the first cross-industry framework for integrated supply-chain management." *Logistics Information Management* 10(2): 62-67.
- Stevens, G.C. (1990), "Successful Supply-Chain Management", *Management Decision*, Vol. 28, No. 8, pp. 25-30.
- Swamidass, P.M. (1987). 'Planning for manufacturing technology'. *Long Range Planning*, Vol. 20 (5).
- Towill, D.R. (2000), "A Route Map for substantially improving supply chain dynamics." *Int. Journal Manufacturing Technology and Manufacturing* 1(1): 94-112.
- Trienekens, J.H. and Hvolby, H.H. (2001), "Models for supply chain reengineering." *Production Planning and Control* 12 (3): 254-264.
- Tschirky, H. and J. P. Escher, J.P. (2000), "Technology marketing: a new core competence of technology-intensive enterprises." *International Journal Technology Management* 20(3/4): 459-474.
- Tschirky, H. and Lichtenthaler, E. (2000), "Integrated framework for a holistic approach to technology management." *International Journal Technology Management* 19(3/4/5): 357-367.
- Twiss, B. & Goodridge, M. (1989). *Managing technology for competitive advantage*. Pitman, London.
- Venkatesan, R. (1992), "Sourcing: to make or not to make." *Harvard Business Review* Nov: 98-.
- Vernet, M. and Arasti, M.R. (1999), "Linking business strategy to technology strategies: a prerequisite to the R&D priorities determination." *International Journal Technology Management* 18(3/4): 293-307.
- Wehrich, H. (1992), *The TOWS Matrix: A Tool for Situational Analysis. Strategic Planning: Models and Analytical Techniques*. Chichester, New York, Brisbane, Toronto, Singapore, Wiley.
- Welch, J.A. and Nayak, P.R. (1992), "Strategic Sourcing: A Progressive Approach to the Make or Buy Decision." *The Academy of Management Executive* 6(1): 23- 31.
- Wernerfelt, B. (1984), "A Resource-based View of the Firm." *Strategic Management Journal* 5: 171-180.
- Whipp, R., Rosenfield, P. & Pettigrew, A.M., (1991). 'Managing the twin processes of competition and change'. In 'Implementing strategic process, change, learning and co-operation' Lorange P., et al (eds), Blackwell Business.
- Yin, R.K., 1994, *Case Study Research: design and methods*. (Sage Publications).

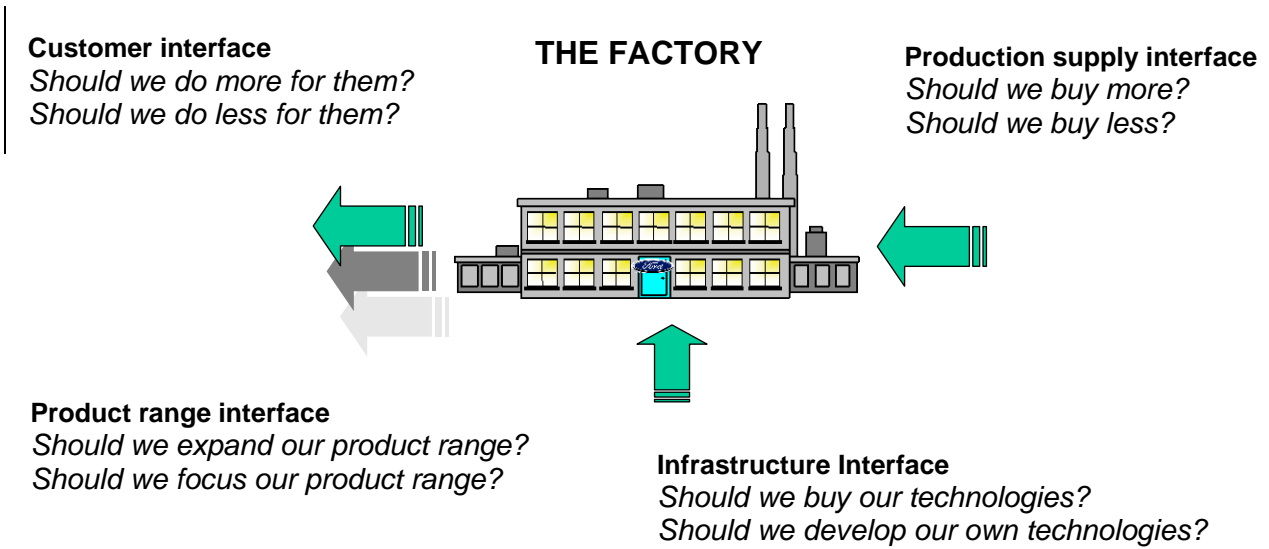


Figure 1: Illustrating the principal supply chain interfaces and integration options

Table 1: Summary of the focus of literature associated with manufacturing supply chain strategy

Author	Impacts product range interface	Impacts production supply interface	Impacts customer interface	Impacts infrastructure interface
(Arnold 1999)				
(Baines, et al. 1999)				
(Bessant 1997)				
(Bhattacharya and Coleman 1995)				
(Brandenburger and Harbourne 1996)				
(Brunt 1999)				
(Burstein and Pearson 1990)				
(Butler and Carney 1983)				
(Cox and Lonsdale 1999)				
(DTI 1987)				
(Ettlie and Penner-Hahn 1990); (Ettlie and Ward 1998)				
(Fine and Whitney 1996); (Fine 1999)				
(Fisher 1997)				
(Ghemawat and Collis 1999)				
(Goldberg and Sifonas 1994)				
(Hartmann 1999)				
(Hayes and Wheelwright 1984); (Hayes and Wheelwright 1988)				
(Hax and Majluf 1992); (Hax and Majluf 1983)				
(Hedley 1990)				
(Jauch and Wilson 1979)				
(Jensen and Heinzl 2000)				
(Jones and Clark 1990)				
(Kee 1998)				
(Lamming 1993); (Lamming 1996)				
(Li and Williams 2000)				
(Lonsdale 1999)				
(McDermott and Handfield 2000)				
(McIvor 2000)				
(McKay and de Pennington 2001)				
(McNamee 1990)				
(Mills, et al. 1996)				
(Minshall and Garnsey 1999)				
(Mintzberg and Quinn 1995)				
(Park and Krishnan 2001)				
(Porter 1980); (Porter 1998)				
(Probert 1996); (Probert, Farruckh et al. 1999)				
(Probert and Shehabuddeen 1999)				
(Quinn and Hilmer 1995)				
(Stewart 1997)				
(Towill 2000)				
(Trienekens and Hvolby 2001)				
(Tschirky and Escher 2000) (Tschirky and Lichtenthaler 2000)				
(Venkatesan 1992)				
(Vernet and Arasti 1999)				
(Wehrich 1992)				
(Welch and Nayak 1992)				
(Wernerfelt 1984)				

Table 2: Overview of the six case study companies

	Products	Size of business unit		UK location	Ownership
		Annual sales £ (millions)	Employees		
Belt-Co	Rubber-based components for mainly automotive OE and aftermarket customers	50 – 99.9	over 500	North West	European
Paint Co	Artists' materials	10 – 19.9*	100 – 199	South	UK
Print Co	Specialised industrial equipment, mainly for food and drink sector	over 100	over 500	East	UK
Floor Co	Contract flooring accessories, carpet, fabrics	20 – 49.9	200 – 499	North West	UK
Weigh Co	Automated weighing and packing equipment	20 - 49.9	100 – 199	Midlands	Japanese
Inspect Co	Food inspection systems	20 – 49.9	100 - 199	South	UK

*this figure is for UK sales only