RESOURCE INTERDEPENDENCE IN SUPPLY CHAINS

Work in progress

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Background

Over the last two decades business researchers have paid considerable attention to the supply and demand chains of companies. Primarily, the research efforts have been focused on the processes and activities in the chains and the attempts of firms to make them more efficient. Examples of research areas and recent studies include:

• JIT (Just in time; e.g. White and Pearson 2001)

• EDI (Electronic data interchange; e.g. Bhatt 2001)

• ECR (Efficient consumer response; e.g. Kurnia and Johnston 2001)

• QR (Quick response, e.g. Perry and Sohal 2000)

These concepts and techniques seem to have their roots in the supply chains in the Japanese motor industry (see e.g. Womack et al. 1990). The efficiency and

effectiveness in these material flows inspired firms in other industries to develop similar systems. The main focus of these efforts was to reduce assets and tied-up capital in inventories and other resources, in turn requiring improvements of the processes in supply chains (Christopher 1998).

From this time (i.e. the beginning of the 1980s) the main strategic problem for firms became 'to link together the whole supply chain' (Kent and Flint 1997:25). At the same time the supply-chain-management approach (SCM) started to develop as a research framework. This 'school' has developed in close proximity with praxis, which means that research has been strongly orientated towards the processes and activities in the supply chains. The main attention has been devoted to the efficient undertaking of individual activities and the subsequent need for co-ordination among these. For example Christopher (1998) argues that SCM is primarily focused on the 'linkage and co-ordination between processes of other entities' (Christopher 1998:17).

Aim and scope of the paper

The strong focus on the activity dimension in supply chains has been questioned (Stock 1990, Gadde et al. 2002). Stock (1990) found it somewhat problematic that the discipline had retained its focus on activities and treated resources 'as a means to an end'. Stock suggested complementary approaches considering e.g. the resources in the supply chains. This paper is a modest attempt in that direction and deals with 'qualitative co-ordination' in supply chains. Most research within SCM is concerned with 'quantitative co-ordination'. This aspect of co-ordination is related to the matching of supply and demand and the co-ordination and scheduling of specific deliveries. The qualitative aspects of co-ordination, on the other hand, take the point of departure in the resource dimension of the network. In particular, qualitative co-

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ordination is concerned with how the resources in the supply chain are combined, recombined, and manifested in activities and products. It has been argued that changes in resource combinations are the main determinants of development and dynamics in general (Håkansson and Waluszewski 2002), as well as in logistics and supply chain management in particular (Gadde et al. 2002).

The aim of this paper is to analyse how the interplay among the different resource elements in a supply chain shapes the features of the end product of a specific chain. For this analysis we apply the framework developed in Håkansson and Waluszewski (2002) and Wedin (2001) where four main types of resources are identified:

• *Products*: the products, systems and services subject to business transactions

• *Facilities*: plants, equipment, etc. used for production and distribution of products

• *Business units*: firms, or parts of firms, involved in the business transactions

• *Business relationships*: the long-term relations that constitute crucial resources

The empirical context of our study is the supply chains and networks involved in shirt manufacturing. In this paper we describe and discuss the supply chain of a shirt with specific features and explore how these features are created through the interplay among the various resources involved. Owing to the space limitations of the paper the focus of the analysis is on the interaction between the product in its various intermediate forms and the facilities in the supply chain.

The supply chain of a shirt

The case presented in this paper illustrates a supply chain of a specific shirt. A shirt has certain features in terms of design, size, colour, pattern, quality, cuffs, buttons, chest pockets etc. These physical features are obtained through the activation of

specific resources. This case deals with the supply chain of a high quality, non-iron, patterned shirt (see figure 1).
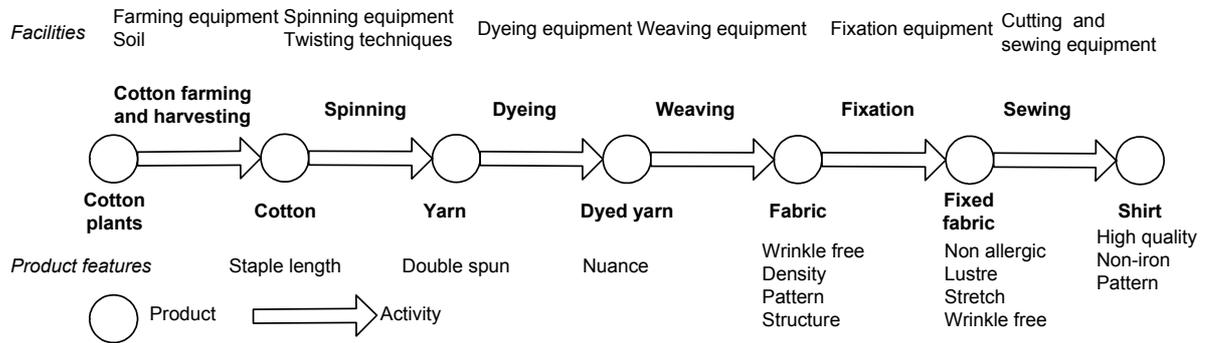

Figure 1. Activities and intermediate products in the shirt supply chain

The figure illustrates the activities in the shirt supply chain from cotton farming and harvesting to sewing. Each activity transforms the product from its origin as a cotton plant via intermediate shapes to its end-product form as a shirt. Furthermore, figure 1 shows important features of the various products (e.g. the staple length of cotton) and the facilities that are crucial for the undertaking of activities (such as the dyeing and weaving equipment).

The process starts at the cotton plantation with cotton farming and harvesting of cotton plants. Wrinkle free shirts require cotton with staple lengths of at least two centimetres. This kind of cotton only grows at certain plantations in specific geographical regions (e.g. in Peru). Long staple cotton also makes it possible to achieve a fabric of a very high quality, but is also more expensive.

The second activity is spinning, which takes place at a spinning-mill producing yarn. Spinning mills are commonly specialized on certain lengths of cotton staples and, for example, in Switzerland and Italy spinning mills are normally focused on long staple cotton. In order to make a non-iron fabric the cotton needs to be spun through a twisting technique resulting in double spun yarn. Different spinning mills are specialized in various kinds of twisting techniques and spinning equipment.

Since this case deals with a patterned shirt, the yarn is dyed before weaving. (For shirts of a single colour, weaving takes place before dyeing). The dyeing process is important, because the exact nuance of the fabric is a crucial feature of the shirt. The dyed cotton yarn is then used as input to the weaving process. The weaving mills use various qualities of spun yarn in order to create fabrics of different qualities. For example, in Switzerland, weaving mills normally use high quality yarn. Consequently, 'Swiss Cotton' has become a trademark of high quality fabric. Moreover, the creation of certain patterns, for example a specific striped pattern, requires particular skills. Furthermore, double spun yarn creates a very dense fabric, which makes the shirt quite warm. This, in turn, sets some constraints regarding to which geographical markets these shirts can be sold, as they are not comfortable to wear in very hot and humid climate.

The next step is the fixation process, which is crucial for the quality of the shirt. The outcome of the fixation process is a softer fabric with fixed staples, which is important in order to achieve high quality in terms of a fabric that maintains its shape over time. In order to reduce the chemical preparation and avoid potential allergic effects a particular fixation process is used. During the fixation process the fabric is stretched and this has to be done in a very precise manner to avoid an asymmetric fabric. If the fabric becomes asymmetric, problems occur when the various parts of the shirt are to be put together. The fixation process also increases the lustre of the fabric. In addition, in some cases it involves an additional dyeing of the fabric in order to emphasize certain patterns or colours. Furthermore, the last step of the fixation process is important to make a fully wrinkle free fabric.

The sewing process starts with the cutting of the fabric into parts. It is necessary to use as much of the fabric as possible in order to reduce waste. Therefore,

computer-based drawings are used when the parts of the fabric are to be cut out. In the sewing process various accessories such as thread and buttons are added. The threads and buttons need to be matched in colour with the fabric and its pattern. Moreover, different threads need to be used for different kinds of fabrics due to the fact that some threads might 'wrinkle' certain fabrics. It is also important that the thread and the fabric do not shrink to different degrees when washed.

Analysis

The shirt supply chain clearly illustrates the interdependence among various resource features forming the characteristics of the final product. Therefore, what we have identified as qualitative co-ordination in supply chains is an important issue in need of further exploration. In this paper the analysis of resource interdependence is focused on products and production facilities. The analysis of interaction among resources is divided into four parts:

• Resource interdependence in the supply chain of a specific shirt

• Resource interdependence in relation to other products sold by this shirt supplier

• Resource interdependence in relation to the products of other shirt suppliers

• Interaction among products, facilities, business units and business relationships

Resource interdependence in the supply chain of a specific shirt

The case illustrates the interdependence among products and production facilities in relation to the specific shirt, some of which are mapped in figure 2.
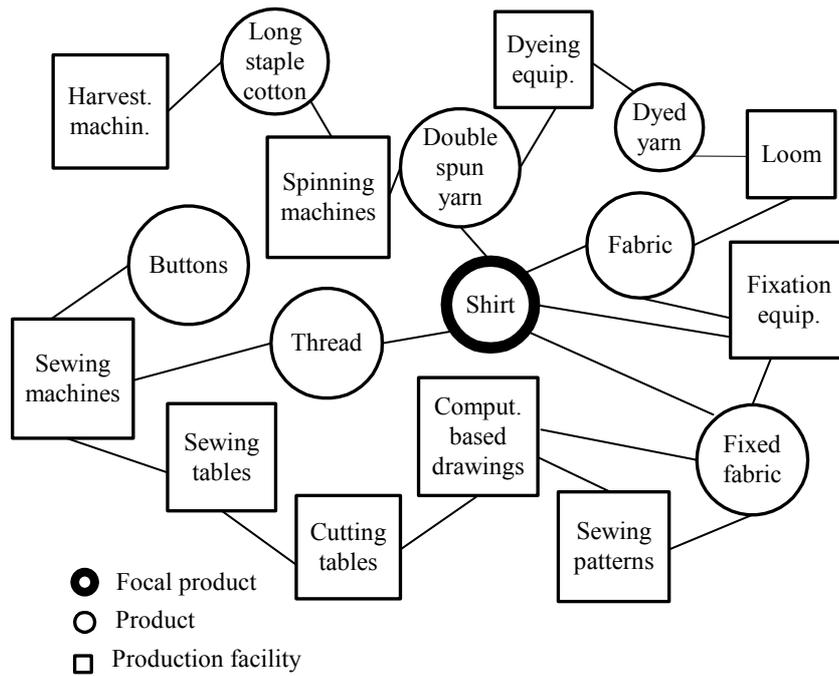
Figure 2. Resource interdependence identified in the production of a particular shirt.

The features of the specific shirt are formed by what we identified as 'qualitative co-ordination' in the beginning of the paper. There are two significant dimensions of qualitative co-ordination in the supply chain. The first deals with what resources to use. As shown in the case description some of the production facilities are specialised, while others are more general. Accordingly, the choice of, for example, a specific spinning mill to a large extent determines the features of the shirt. The second dimension of qualitative co-ordination is concerned with what features of a particular resource that are utilised. For example, the features of the specific shirt are completely dependent on which fibre length and fabric density that is used. Hence, the characteristics of the end product are developed through the actual combining of the various resources and the features of these resources that are utilised.

Resource interdependence in relation to other products sold by this shirt supplier

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The shirt supplier in our study sells a variety of shirts with different features. As argued above the particular features of these shirts are created through the activation of the various resources and their features.

The assortment offered by a specific supplier is determined through the matching of the desired shirt features with the features of the resources that are used. For some shirt features there may be similarities in terms of joint resource utilisation, thus enabling economies of scale. However, since it is crucial for the shirt supplier to create an assortment including various types of shirts, there is also a need to activate different resources and/or resource features. Consequently, for the supplier it is crucial to activate a mix of joint and specific resources and resource features in relation to the whole set of shirts provided. For example, several shirts may be activating the same sewing facility, while the fabric may be produced in different, specialised, weaving facilities. Qualitative co-ordination thus makes it possible for the focal firm to take advantage of economies of scale in the utilisation of some jointly activated facilities, while achieving variety in the assortment of shirts by activating different production facilities.

The second dimension of co-ordination of qualitative aspects is concerned with how the features of the particular resources are combined in relation to the different products sold by the company. By using, for example, different combinations of fibre length, density and twisting equipment, the desired end-product features are created, thus providing variety in the assortment.

Resource interdependence in relation to the products of other shirt suppliers
In most cases the end products of a company activate production facilities jointly with other firms' products. In these situations the qualitative co-ordination of one firm is

interdependent with the combining efforts undertaken by other firms. Therefore, for the shirt supplier, issues are raised concerning what other end products the own products are connected with in terms of joint resource use and how this affects the costs for producing the end product, as well as the features of it. Some of the different products may utilise the same features of a particular resource while other products may use other features of the same resource. This, in turn, impacts on the economies of scale of the operations and has profound consequences for the long-term development of the resources.

Interaction among products, facilities, business units and business relationships

In this paper we have been concerned mainly with issues related to how desired characteristics of end products activate various input products and production facilities. Furthermore it has been illustrated how the specific features of these products and facilities shape the features of the end product. We have not discussed how these resources relate to different firms (except for the shirt supplier) or the relationships among the firms involved. However, to understand how the features are developed we also need to include interaction among organising units. In a 'supply chain' as the one described in the case it is obvious that resource features are specifically related and combined into the end product's features. These aspects of relating and combining require interaction among the particular firms developing and using these products and facilities. The importance of this interaction, particularly for the exchange of information, is illustrated in a study of a clothing supply chain (Popp 2000). Similarly, the shirt supplier in our example is involved only in a minor part of the resource interaction necessary to bring about all the features of the end product.

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Therefore, an interesting issue for this study is to explore the roles of other business units and business relationships in the resource interplay through which the resource interdependencies and features are activated and developed.

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