"More instead of less" - Strategies for the use of logistics resources

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Abstract

This paper presents the theoretical background for a recently initiated research programme on the utilisation and development of logistics resources in supply and distribution networks. The paper opens with a discussion of previous approaches to logistics with a particular focus on whether and how resources have been dealt with. We conclude that attention has mainly been directed toward processes and activities, while resources have primarily been regarded as the means to an end. Further, we identify a need to focus on networks rather than supply chains since all companies belong to more than one chain. Accordingly, it is suggested that considering logistics networks in terms of inter-linked resources provides a fruitful complement to existing models. We continue by presenting some basic features of resources in general and by developing the foundations of the framework that is to be applied in the research programme. The basic building blocks are four types of resources that are crucial in logistics: facilities, products, business units and business relationships. Finally, three main research issues are derived from this framework.

Keywords: network, netlog, resource development, relationship, interface

1. Introduction

This paper presents the theoretical background for a recently initiated research programme on logistics networks at the Norwegian School of Management (BI). The five-year programme - NETLOG - began in 2001 and involves six full-time Ph.D. students in addition to senior researchers from two streams of research - logistics and industrial networks. The programme focuses on the utilisation and development of logistics resources within supply and distribution networks. The main objective of NETLOG is to analyse the interplay between the established physical structures for logistics operations and new opportunities provided through the development of information technology and transportation facilities. The outcome of this interplay is to a large extent contingent on the organisational arrangements adopted. Therefore, we will study the relationships and interdependencies among physical logistics structures, network organising and new technology. It is claimed, and many examples show, that one of the reasons for the rise and fall of 'the new economy' was the misfit between the opportunities provided through new technology and the existing logistics structures.

The paper presents the theoretical foundations of the research programme. The development of our theoretical framework takes its starting point in prior research. Accordingly, the paper begins by presenting and discussing previous approaches to logistics with a particular focus on whether and how utilisation and development of resources have been dealt with. We continue by discussing some features of resources in general, taking the theoretical starting point in Penrose (1959), followed by main conclusions from studies of industrial networks and technological development. The paper then presents the foundations for the framework that will be applied in the research programme, concluding with the main research issues.

2. Central issues in logistics

Logistics has usually been defined in terms such as 'the art of managing the flow of materials from source to user' (Magee et al. 1985). In this respect logistics operations have always been crucial to the efficiency of firms and industries. However, in long-term perspective, significant changes have occurred when it comes to perceptions of the most important issues in the art of managing the flow of materials. Furthermore, the view of the source and the user and the context around them has been modified considerably. A literature review makes it possible to identify at least three transformations during the last fifty years in the art of managing the flow of materials (for a historical overview see for example Kent and Flint 1997, Stock 1990, McGinnis et al 1994, Cooper et al 1997).

The logistics era prior to 1950 has been characterised as the 'dormant years' when logistics was not considered a strategic function (Ballou 1978). On the contrary, a common view

was that 'firms had to carry out logistics just to be in business' and 'all too often the activities were treated as cost *absorbing*' (Ballou 1992:10). Around 1950 changes occurred that could be classified as a first transformation. The significance of logistics increased considerably, when physical distribution management in manufacturing firms was recognised as a separate organisational function (Heskett et al. 1964). Early growth of the function occurred in manufacturing firms marketing a wide line of products through retail grocery outlets. Heskett et al. argue that the underlying reasons for the change stemmed from distributors of consumer convenience items who were eager to improve their profit performance. They did so by:

> ...reducing storage space, maintaining lower inventories and ordering replacement stocks more frequently in small quantities. This not only reduced sizes of shipments from processors and manufacturers, but also shifted some of the costs of warehousing and inventory maintenance to primary suppliers. (Ibid. p.39)

The main assignment for the physical distribution departments of manufacturing firms was thus to cut physical distribution costs, which were increasing due to the changing service demands from distributors. These efforts required firms to apply a 'total cost concept' approach, which became an important principle in the development of business logistics (Kent and Flint, 1997). The underlying conceptual framework was claimed to be the 'integrating and systems view', focusing on logistics as an entire system of activities working with and relying on one another (ibid.) The most significant characteristic of the total cost concept is that there is a trade-off between different types of costs in logistics - accepting costs in one part of the system can reduce costs in another part, thereby decreasing total costs (or the sum of costs considered). This trading of one type of cost for another was illustrated in a famous study of how airfreight might contribute to lower total costs. The conclusion of the study was that the high costs of air freight need not deter the use of the service, 'but that the key to its acceptance should be the total cost of air freight charges and the lower cost of reduced inventories that could be achieved through greater speed of airfreight movements' (Ballou 1978: 15). Thus, the first transformation of logistics development was focused on reduction of total costs in logistics.

The second transformation had its roots in an enlarged perspective on logistics, which moved into being a management discipline in a much broader sense than it had been. In this period, thinking about logistics changed 'from a relatively compartmentalised orientation toward a relatively integrated one' (McGinnis et al.1994: 299). This, in turn, emphasised the interfaces with other disciplines and the need for 'linking them together' (Kent and Flint, 1997: 23). Ballou (1978) explores the inter-links between physical distribution on the one hand and marketing and production on the other. He argues that the three functions are strategically connected and that sales and production 'rightfully claim an interest in physical distribution' (ibid. p. 38). For example, logistics service dimensions like product availability, prompt delivery, and accurate order filling are important means of generating sales. Therefore, the analysis of the trade-off between different types of logistics activities must include the impact on customer service levels. The increasing significance of customer service is illustrated in two editions of the same book. Ballou (1978) identified three core activities in logistics: transportation, inventory maintenance and order processing (ibid. p. 9). These activities are included among four 'key' logistics operations in Ballou (1992). However, in this version the no. 1 activity is 'Customer service standards' - set in co-operation with marketing (ibid. p. 7). Logistics thus had become a more complex issue involving trade-offs between costs and services, co-ordination of logistics activities throughout the firm through computerised planning and control systems, as well as changing organisational mechanisms. In this phase, the main task was to find an appropriate balance between logistics services and costs, which put even more focus on the system perspective (Kent and Flint, 1997).

The third transformation, finally, moved logistics in the direction of serious process orientation. Logistics operations have been influenced by concepts including Time Based Management, Lean Production and Efficient Consumer Response. These approaches originate mainly from the Japanese car industry. Womack et al. (1990) reported the findings from a comparative study of car manufacturing in Japan and Western nations, and characterised the Japanese system in the following way:

> It uses less of everything compared with mass production - half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a product in half the time. Also it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever-growing variety of products. (Ibid. p. 13)

On the basis of these findings European and American car manufacturers started to restructure their logistics systems and were soon followed by firms in other industries. The most important implication of these findings was that the view of a trade-off between services and costs was challenged.

Empirically it was demonstrated that materials flows could be designed and operated in manners that were not only fast, but also reliable and cost efficient. Obtaining these effects required responsive logistics processes to secure product availability in other ways than through huge inventories. Accordingly, it was not only the costs of the activities being performed that were in focus, but also reduction of assets in terms of tied-up capital in inventories and other resources. It is interesting to observe that the changes and logistical adaptations that suppliers of automotive components and systems had to undertake were very similar to those of manufacturers of convenience goods described in the previous quote from Heskett et al. (1964). This transformation began as a defensive response to the need to become 'leaner'. However, the process capabilities gained through these efforts could also be used in more active ways. Kent and Flint (1997) argue that from then on logistics was considered 'a critical component in the strategy of the firm' and the problem in focus was how to link 'the whole supply chain and create value for the consumer and be competitive in world markets' (ibid. p. 25).

The supply chain concept was introduced in this third transformation, partly developing from Porter's value chain concept in the mid-eighties (Porter 1985). It was no longer enough to look upon the company as an autonomous entity, but rather as a chain of companies performing sequential and linked activities in order to fulfil the demands of the end-consumer. Accordingly, this transformation even changed the notion of 'the art of managing the flow of materials'. Christopher (1998) is of the opinion that supply chain management is an extension of logistics management, where logistics is primarily concerned with optimising the flows within one organisational system. Supply chain management builds on this framework and seeks to achieve 'linkage and co-ordination between processes of other entities in the pipe-line, i.e. suppliers and customers, and the organisation itself' (ibid. p. 17). Accordingly, 'real competition is not company against company but rather supply chain against supply chain' (Christopher 1992, p.14).

Summarising the review of the perspectives on logistics, our first conclusion is that the art of managing the flow of materials has become increasingly important from a strategic point of view. The second conclusion is that the strategic orientation of logistics has changed. The first transformation made the logistics department important because it could contribute to decreasing total costs. The second transformation emphasised the issues related to the interfaces with other intra-organisational departments. In the third transformation, the supply chain management view has extended the strategic orientation in that the interfaces with other inter-organisational actors are emphasised. It is the chain of companies from raw material suppliers to end-consumers that is the object of main interest. For example, Christopher (1998) argues that the main focus in supply chain management should be 'to achieve a more profitable outcome for all parties in the chain' (ibid. p. 18). However, there are indications that the analysis needs to be taken one step further. The supply chain perspective contributes substantially to our understanding of efficient flows of materials but it fails to consider that relationships are not independent, but embedded. For example, Cooper at al (1997) argue that it 'would be rare for a firm to participate in only one supply chain' (p. 9). In the same vein, Christopher (1998) reports suggestions that supply chains could be viewed as networks, which is one important characteristic of our approach. Another key characteristic is a focus on resources: the issue we turn to in the next section.

3. Activities and resources in logistics

The above review shows that the literature in the field has increasingly applied a process-oriented perspective for analysis of logistics. Thus, it is primarily the activity dimension that has been emphasised, while our approach is to focus on the resource structure. In the logistics reality, activities and resources are completely intertwined, because resources are necessary for the undertaking of activities and have no value unless they are activated. However, depending on which perspective that is applied, different logistics issues, problems, and opportunities will be identified (Stock 1990). Therefore, a further exploration of this view of activities and resources is needed.

Heskett et al (1964) present their basic perspective of logistics in the following way:

> There are two basic elements in the logistics system of a business firm. The first of these is a set of fixed points, or facilities, which may vary in number from two to several thousand. These points are connected by the second element of a logistics system, a transportation network. (Ibid. p. 43)

According to this quote the main basis for logistics are the characteristics of the fixed facilities in terms of warehouses and the transportation network with its transport facilities and the opportunities and constraints they represent. The activities of the logistics system are derived from these resources and take the form of 'planning and operation of a logistics system' and 'organisation and management of

the logistics function'. Thus, from this perspective it is the logistics resources that are the foundations of the activities. The view applied mirrors the prevailing perception of logistics as a departmental affair mainly focusing on cost optimisation.

The perspective on logistics was modified when integration with other functions and other firms became a top priority. From then on, the focus was on the activities and how they can be conducted in the most efficient way. Ballou (1978) is a typical representative of the view that emerged:

> Business logistics deals with all move-store activities that facilitate product flow from the point of raw material acquisition to the point of final consumption as well as the information flows that set the product in motion for the purpose of providing adequate levels of customer service at reasonable cost. (Ibid. p. 9)

The main characteristics of the logistics systems are two kinds of activities: primary (transportation, inventory maintenance and order processing) and supporting (warehousing, materials handling, etc). The main issues in this perspective are the efficient undertaking of individual activities and the management of the 'logistics mix'. In these discussions the author brings up the resources and their utilisation, but only as a means of achieving efficient activities.

This new view represents a first shift towards increased attention to the activity dimension. From this point on, logistics resources were regarded more as 'facilitators of operations' than as 'facilities of value'. While Heskett et al (1964) identified two basic resource elements in logistics, for example, Coyle et al (1992) take 'two interrelated basic activities' as their starting point: movement and storage. In this case the activities required for movement and storage determine both the need for resources and their utilisation. The main issue for logisticians then is to decide on the optimal mix of customer service and logistics costs (Ballou 1992). A distinction is made between key activities and support activities and logistics efficiency is affected by changes in the combination of the two. Of course, the changes in the mix of activities impact on resource utilisation and the need for resource acquisition. However, the resource dimension is treated more indirectly than directly - the attention to resources is directed through the activities.

The increasing focus on the activity dimension in mainstream logistics literature has been questioned. Stock (1990) analysed the development of logistics thinking and found it somewhat problematic that the discipline had retained its focus 'on the logistics activity as a means to an end' (p.3). According to the author 'there is nothing wrong with this approach', but it tends to obscure other important aspects. Since the breakthrough of the process orientated view of logistics, the resource dimension seldom appears in definitions of logistics. One exception is Coyle et al (1992) where alternative interpretations of logistics are presented. One of them takes resources as the starting point and defines logistics as

> .... the area of support management used throughout the life of the product or system to efficiently utilise resources assuring the adequate consideration of logistics elements during all phases of the life cycle so that timely influence on the system assures an effective approach to resource expenditure (Ibid. p.8).

In this case the attention is on the long-term relationship between resources and the logistics system, but here, too, it is the predetermined utilisation of resources that forms the basis for the analysis. Resources are still regarded as a means to an end.

The 'lean thinking' refocused the attention to resources. However, the common view stated in this literature is that the objectives are to 'lower the total amount of resources required to provide the necessary level of customer service to a specific segment' (Cooper et al 1997). The increasing interest in resources thus had a defensive orientation rather than being on the offensive when it came to the use of the resources.

Obviously the shift towards supply chain management is a change in the direction proposed by Stock (1990). According to this view, the logistics perspective is widened to include connections with other firms and their resources, but at the same time the focus on efficient business processes increased even more. For example, according to Alvorado and Kotzab (2001), SCM is defined as 'the integration of business processes among channel members with the goal of better performance for the entire channel system' (p. 184).

However, supply chain management need not necessarily be interpreted in terms of activity structures. For example, Christopher (1998) defines SCM as the management of upstream and downstream relationships, and also suggests its extended definition to be 'a network of connected and interdependent organisations mutually and co-operatively working together' (p. 17-18). Christopher's discussion thus implies that supply chains may be seen as connected actors as well. Harrison and van Hoek (2002) also suggest a

reorientation of the view of logistics. They argue that such a perspective could take its point of departure in 'the alignment of capabilities of supply chain partners'. Obviously it is possible to consider supply chains in terms of inter-linked resources, which is a key feature of the perspective applied in this paper.

4. Resources - some basic features

Above we presented some comments on how the logistics literature has focused its view with regard to activities and resources in supply chains and networks. Before we go into a more detailed discussion on how to perform analyses of resources in logistics networks, we describe and discuss some important general aspects of resource analysis.

Resource analysis can be conducted in two fundamentally different ways, depending on the assumptions regarding the function of resources from an economic point of view (Alchian and Demsetz 1972). First, in classic microeconomic analysis the basic assumption is that the value of a specific resource is a given - i.e. the value is independent of how this resource is combined with other resources. Resources are regarded as 'homogeneous', and the key issue is to allocate these given resources to given means (Pasinetti 1981). Resources are thus seen as more or less given conditions on which economic processes are built.

The main decision to be made in this type of resource analysis is the quantitative aspects of the resources, for example the production capacity of a machine, the size of a warehouse or the number of components to procure. Companies continuously strive to make better use of their resources in the applications in which they are used, for example by standardising products and the according activities, to be able to reap economies of scale. These efforts take the form of day-to-day rationalisations as well as investment projects that increase the capacity of resources. The basic assumption that resources are homogeneous thus provides opportunities to analyse the best use of individual resource elements for given applications. However, this assumption also restricts the analysis. When it comes to changes in the use of resources, the main emphasis is on rationalisation - i.e. decreasing the quantity of resources used. Models based on these assumptions cannot cover other changes. If the resources and their use are perceived as givens, development issues consequently have to be treated as exogenous in the economic analysis (Dosi et al 1988).

The opposite view is based on the assumption that resources are heterogeneous - i.e. the value of a resource can and will vary, depending on how it is used and particularly on the ways in which it is combined with other resource elements (Alchian and Demsetz 1972). This view is based on Penrose (1959), who argues that the value of a resource is determined by the services it can render:

> The services yielded by resources are a function of the way in which they are used - exactly the same resource when used for different purposes or in different ways and in combination with different types or amounts of other resources provides a different service or set of services. (Ibid. p.25)

According to this perspective, one and the same resource or resource element can be used in different ways. At a certain point in time it has a specific function - in this respect the resource might be perceived as a given. However, there are always alternative ways of using it. Every resource has multiple features. When the resource is used for a specific purpose some of these features are exploited, but others are hidden.

This means that resource development and innovation takes place not only through investments in new resources. On the contrary, to a large extent resource development is about using existing resources in novel ways, for example by exploiting unused features of the individual resource elements and/or combining the elements in new ways. In particular these effects tend to materialise when the resource elements of different firms are confronted. Therefore, business relationships promote innovation, as does the interaction of different types of resource elements (Gadde and Håkansson, 2001). Accordingly, resources can be regarded as results of economic processes and not just as conditions for them. This view is in contrast with classical microeconomic models in which resources are perceived as givens. In our view there is much to be gained from a perspective on logistics where it is considered that resources might be provided with new economic features. Thus, we have to start from the assumption that the economic processes in which they are involved affect resources.

Such a perspective has been applied in a number of studies of technological development, and has also appeared in both marketing and purchasing literature (Nelson and Winter 1982, Rosenberg 1994, von Hippel 1988, Ford and Saren 1996, Ford et al 1998, and Gadde and Håkansson 2001). Studies of technological development have identified one related dimension of interest to us. Technologies have obvious systemic features, which affect all resource elements involved (Hughes 1983, 1994). Consequently, resources can be more or less integrated; i.e. their features can be

related in a systemic way. One important effect of this integration is that technologies can gain momentum and become important development forces in themselves (Hughes 1994). In this view, resources have a more active role in the development, and this needs to be taken into account in the economic analysis.

Our point of departure is that studies of logistics networks should take these characteristics of resources into consideration. In the following section we propose a framework for analysing the present use, as well as potentials for developing the use of resources in logistics networks.

5. Resources in logistics networks

A logistics network comprises numerous different resources. Above we argued that individual resource elements are always connected to other resource elements that have a substantial impact on both their value and their combined features. Efforts are constantly undertaken to relate resource elements to each other systematically. The most typical example is related to technology where technical and commercial elements are frequently combined (Rosenberg, 1994). In this way different resource elements are bundled together (Penrose 1959, Håkansson and Waluszewski 2002).

Another example is systematic combining in terms of supply chains. At a certain point in time various resource elements are combined in order to serve specific functions. Stock and Lambert (2001) discuss logistics in terms of an 'intangible asset supplying customers with products quickly and at low cost'. The combinations of resources change over time to fill the current functions in an appropriate way. However, these actual combinations tend to restrict the usage of the resource elements for other purposes. The specific adaptations make them less useful in other applications and functions. The prevailing bundling thus impacts on the resource utilisation and on short-term efficiency. Furthermore, it affects the opportunities for future development of individual resource elements and the ways in which they can be combined. In some situations the ties between the combined resource elements are very tight and therefore costly to change.

Changing resource combinations is one important determinant of economic efficiency and economic development. Piore (1992) argues that economic development is characterised by situations where 'technical change goes hand in hand with organisational change'. Therefore analysing the dynamics of resource combining requires a perspective that takes both technical and organisational factors as well as the interplay between them into consideration. To visualise the potential effects of active combining of logistics resources and particularly the interplay between the technical and organisational dimensions we present two mini-cases as examples.

Pooling for joint resource utilisation

The first case regards the organising of a supplier relationship through the establishment of a joint equipment pool. The initiating company is a large producer of petroleum products with six different production units in the same geographical region. The equipment is used by all the six processing units and is crucial from a production point of view. Furthermore, the equipment is quite expensive and the maintenance cost is substantial. As the production units are individual profit centres and the equipment is essential for the operations, all of the production units considered it important to handle and control both the procurement and the maintenance activities themselves. A decentralised approach was favoured because the production process is so dependent on the function of this piece of equipment. Therefore, the potential gains from centralisation were considered to be limited. However, at the same time each production unit was a small buyer and was not always viewed as an interesting customer by the few and highly international suppliers. Furthermore, the buying firm's decentralised approach was also costly from the suppliers' point of view because it required a differentiation in the handling of the product.

One of the managers of a production unit realised that this way of working was not efficient. It should be possible to handle procurement differently and in a more cost-efficient manner. However, as it was hard to mobilise internal support for an alternative approach he realised that there was a need for external pressure (or an opportunity) for a change to take place. In the same geographical region there is another producer of the same products that has more or less the same type of production units and utilises more or less the same type of equipment from the same suppliers. This latter company was at the time involved in a reorganisation of its procurement activities, which provided opportunities for joint action. During some initial meetings preliminary calculations and some estimates of present costs were made concerning the number and value of spare parts that both companies used. Based on these analyses the two companies decided to initiate a project in which they together developed an equipment pool. The main objective was to make the pool organisation responsible for maintaining and securing the function of the equipment for all the production units in the two companies.

Two years later all the production units had chosen to transfer the responsibility for the equipment to the pool. The individual production units are still the owners of the equipment but it is now allocated by the pool organisation - so it can be used by any of the production units. The establishment of the pool has decreased the number of breakdowns - because the pool can plan maintenance much better than the individual production units. The pool organisation also offers better conditions for testing the function of the equipment, which makes it easier to foresee problems in its functioning. Furthermore, it has been possible to reduce the total amount of spare parts and equipment.

The most important change is, however, in relation to the suppliers. The pool is now the second largest buyer in Europe of this equipment. Therefore it has managed to develop a close relationship with the largest producer in the world and is now one of this producer's key customers.

Inventories as assets

The second case concerns a large distributor of electronics components. This particular company has a goal that at first glance seems amazing for anyone interested in logistics and supply chain management. The goal is to have an inventory turnover of *maximum* three times per year. Furthermore, the people responsible for the inventory are called asset managers. The company has an ambition to utilise the stocks as an asset in relation both to customers and producers. The logic is based on customers who want to minimise their own stocks and are prepared to give the distributor the role of stock keeper. For such customers and for products for which there are at least five customers world-wide the distributor guarantees that it will keep a stock representing one third of the yearly demand of the customer. In this way the distributor is able to create a very stable and safe flow of products for the customer, which is important in this industry where the availability of (standard) components can vary significantly.

The inventory is also used in relation to the producers. These producers are very capital-intensive companies that prefer customers with stable demand. The distributor will consequently be an ideal customer to them. The arrangement provides benefits for the distributor as well. One example is that the distributor is informed about all plans for new products, which is very valuable in relation to the customers. Another characteristic of this market is that it is very sensitive to even small changes in demand, which sometimes lead to substantial fluctuations in price. The distributor makes use of two different pricing strategies in relation to its customers. The close customers are guaranteed a fixed price for the contract period, while all other customers are priced according to the existing world market price. Thus, by using the stock to level out fluctuations in demand, the distributor represents both an interesting customer for the producers, and an interesting supplier to the end-product producers. In other words, by creating stability in some materials flows the distributor can be of value both to customers and suppliers.

As can be noted in these two cases, the way in which physical resources are combined determines their use and therefore also the value of the resources. The actual combining of the physical resources is strongly affected by the organisational arrangements such as business relationships and joint ventures. However, the way resources are combined also has an impact on which organisational arrangements are appropriate. Thus, physical resource elements and organisational resource elements, as well as the interplay between them, have to be considered in the study of logistics resources.

6. The research framework

The model used in this research programme is based on four main types of resources. 'Facilities' and 'products' represent the technical/physical dimension, whereas 'business units' and 'business relationships' cover the organisational aspects. The characteristics of the four types of resources are discussed below.

Facilities

The physical infrastructure for transportation and communication represents significant logistics resources. The elements of this infrastructure that provide time, place and form utility (Alderson 1954) are identified as 'facilities'. As mentioned above, Heskett et al (1964) made a distinction between fixed facilities (such as warehouses and carrier terminals) and transportation facilities, which connect the fixed facilities. Bowersox and Closs (1996) identify facilities in the form of buildings, vehicles, equipment and machines. They extend the view of logistics resources by including buildings and machines for production in the logistics system as well as packaging (ibid. p. 435). Other important facilities discussed are the basic infrastructure in terms of roads, railways and shipping lines, as well as software resources such as systems for planning and information exchange.

Shapiro (2001) argues that 'changeability' is an important dimension of a resource element. Following his discussion

we can conclude that some facilities are easier to change than others. For example, light vehicles and materials handling equipment can normally be replaced and adapted without major problems. On the other hand, facilities constituting the physical infrastructure (railways, ports, airports etc.) are more or less unchanged over a long period of time and have to be regarded as fixed nodes. The same is true for some of the facilities of companies. For example, according to Heskett et al (1964) 'the fact remains that the relocation or installation of fixed facilities, especially plants, is an expensive proposition' (p. 101). Therefore, the optimal plant and warehouse location has never (and will never be) found. The reason is that the conditions on which such a plan is based will have changed before the plan is fully implemented. The typical approach to these issues is of a piecemeal nature: 'A warehouse is opened here; two are closed there. A plant is opened at another place' (ibid. p. 101). The main issue then is to make the best use of existing facilities.

Products

Logistic facilities are used as means for creating time, place and form utility by directing the flow of goods, services and information. The second variable related to the technical dimension deals with the physical aspects of this flow - the products that are exchanged between customer and supplier. The nature of these products is an important determinant of logistics networks and it has even been claimed that 'all logistical management revolves around the product' (Ballou 1978: 85). Further, it is argued that the product's characteristics 'shape the strategy to be used in making it available to customers'. The product represents a challenge in logistics because 'the logistician has only partial control over this element' (Ibid. p. 85).

The most important characteristics of the product that influence logistics strategy are the attributes of the product itself such as weight, volume, perishability, flammability and substitutability (Ballou 1978:91). Other dimensions discussed are, for example, the lifecycle of the product and whether it is intended for consumer markets or business markets. In many cases these products are strongly adapted to the existing facilities, which might cause problems in making use of other facility resources. This means that the development of new products needs to take the physical infrastructure into consideration.

At first glance the attributes of a product might seem to represent fairly objective dimensions. However, closer examination reveals a more complex pattern, as expressed by Ballou (1973).

> The product is a collection of perceptions by the logistician, by sales people, and by the customer regarding the characteristics of the product, the customer service associated with the product, the product price and the package. (Ibid. p.90)

This view is in accordance with our emphasis above on the fact that resources are not givens. Depending on how they are interpreted they can take various shapes, thus representing different values.

Business units

The organisational dimension of the framework has to consider economic and human factors. Some resource elements are controlled by the society as a whole and, in this respect, have the nature of free utilities. However, most resource elements reside within the ownership boundary of single firms and this affects resource combining and bundling substantially. The resource elements of a firm are built together to serve its objectives in an appropriate way. Some resources are physical, like facilities and products, while others are human and social. Stock and Lambert (2001) argue that the main issue in logistics is the combining of human and financial resources and technology, because these different resource elements complement one another. Human resources are used to design and control the physical ones. Using the physical resources requires specific capabilities, which are located in the firm. Together these resources - their use and development - form the basis of something that constitutes a resource in itself. For example, Bowersox and Closs (1996) define 'logistical competency' as 'a relative assessment of a firm's capability to provide competitively superior customer service at the lowest possible total cost' (p. 8). In the same vein, Stock and Lambert (2001) discuss this capability 'as an intangible asset' for supplying customers with products quickly and at low cost (p.11).

It is the actual bundling of resource elements that directs - and is directed by - the development of logistics capabilities. This process shapes a problem-solving actor, which in turn is a resource that can be used by others. We refer to this resource as a business unit, which can be a firm or part of a firm. The business unit is important not only as a reservoir of logistic capabilities. It is also most relevant from an economic point of view because it is the basis for the settlement of economic deals, balance sheets, and profit and loss accounts.

Business relationships

The resource elements within a business unit are connected to resource elements in other business units. Every business unit is part of a larger collective entity involving relationships to more or less close counterparts (Håkansson and Snehota 1995, Ford et al 1998). In the interaction between two business partners the resource elements of the two units are affected - both in terms of how they are used and how they are developed. Again both the technical and the organisational/economic dimensions are important. Technical adaptations have to be made to enable different technologies to function across boundaries of firms. Organisational solutions of various types may encourage - or impede - these efforts. In this way business units are connected through relationships that couple them together through actor bonds, activity links and resource ties (Håkansson and Snehota, 1995). Actor bonds connect actors and influence how actors perceive each other and form their identities in relation to each other. Activity links regard technical, administrative, commercial and other activities of a company that are connected in different ways to those of another company as a relationship develops. Resource ties connect various resource elements of companies and result from how the relationship has developed (ibid.). A significant part of a company's total resource base is thus located beyond the ownership boundaries. For some firms the resources made available by customers and suppliers may be more important than the internal resources.

This view of resources is not new to logistics. For example, Heskett et al (1964:49) discuss the issue in the following way:

> Properly speaking, the logistics system of a business firm includes not only its own facilities and the transportation network, which connects them, but also the facilities of the company's suppliers and the company's customers and the transportation network which connects each of these to the company's facilities.

Therefore it is argued that the effective planning and operation of a firm's logistics system depends in part on the knowledge and understanding of the characteristics of the fixed facilities of customers and suppliers. This means that many facilities are considered to be within the purview of more than one firm. It is claimed that these conditions require close co-operation and co-ordination between logistics management and the logistics function in firms doing business with each other. Such efforts are required because - in the general scheme of business logistics - 'no firm can be an island unto itself' (ibid. p. 49).

The existence of relationships also affects the content and function of the resources described above. Through the existence of relationships they become embedded into each other. The function of products, facilities and business units become systematically interrelated. Through the business relationships, the combining of resources will take place across firm boundaries. Furthermore, the relationships can also be systematically combined, which results in further effects.

Business relationships are thus important resources in themselves. They may account for substantial economic impact in terms of sales and procurement, but they are even more important as potential resource reservoirs. Furthermore, they connect the business units in a specific dyad to other business units in the surrounding network.

7. Conclusions and research issues

As stated in the introduction, the aim of this paper is to present a frame of reference for analysing logistics from a resource perspective. The literature review revealed that mainstream literature in logistics has considered resources as the means for the efficient undertaking of logistics activities. This approach emphasises some dimensions of resource utilisation and resource development, while others are more or less neglected. The review illustrated that recent attention to lean operations has emphasised the reduction of the assets of companies, which impacts in turn the view of logistics resources and the value they are perceived to provide. Therefore, an approach viewing logistics resources in a more extensive way could be a useful complement due to the fact that other dimensions of the resources will be focused on. Particularly, we are interested in exploring those hidden and unexploited value dimensions of logistics resources that spring from systematic combining in business relationships as illustrated in the two cases.

Our empirical starting point is an individual resource element - a product, a facility, a business unit or a business relationship. This resource element may be used in a multitude of ways, but in reality only a few of them are taken into consideration. There are always opportunities to enhance the usage of resources. Some alternative options directly compete with prevailing use, while others might not interfere at all with the ways the resource is used at the moment. At a certain point in time, various resource elements are combined in specific ways - they are the results of previous interactions in which they have been more or less systematically interrelated. They form resource constellations where each resource has a specific function (Håkansson and Waluszewski 2002). The features of the

single resource are determined by its interfaces with other resources, as is its value. These resource constellations have three key characteristics. The first is that individual resource elements can be integrated into several constellations of different types, such as supply chains, distribution systems, regional networks and technological systems, which impose both opportunities and restrictions. Second, the efficient utilisation of a resource is founded in economies of scale. However, 'scale' is a multidimensional phenomenon because an individual resource element is integrated in different functions and constellations. Third, resource constellations are dynamic - implying that resource combinations have to be changed over time. There is a continuous need to form new resource constellations. These new forms include recombining resources in existing constellations as well as establishing novel constellations. The outcome of these changes affects the value created by the logistics resources. The traditional focus on logistics activities has put very little emphasis on resource combining issues. Therefore, the knowledge of the impact of different forms of resource combining is limited, as are the consequences of changes of these combinations.

Our research programme is focused on three main research issues:

- The individual resource element in its context
- The combining of different resource elements
- The role of business relationships in resource combining.

The first research issue is to explore how an individual resource element is embedded in its context of other resources. This analysis is made with an individual resource element in focus. The focal resource (for example a facility) is analysed in terms of its interfaces with other resource elements of the same type (other facilities) and with other types of resources (products, business units and business relationship). The analysis is conducted in similar ways when the focal resource is of one of the other three categories. The basic hypothesis related to the first research issue is that there is a small set of other resources that are of crucial importance for the individual resource element. Although the focal element is embedded in a large resource constellation it is its interfacing with a limited number of resources that really give rise to impact.

The second research issue deals with the principles applied in resource combining. The actual combination of resources as discussed in relation to the first research issue is partly an effect of attempts to combine resources in certain ways and partly an outcome of unplanned and unanticipated effects. What needs to be determined is the basis on which the resource combining rests - i.e. understanding the actor's underlying intentions. One viable option is that the main consideration for the actor is to find an appropriate combination of two resource elements, i.e. emphasising the directly related effects of a single combination. An alternative is to try to capture the more complex pattern of indirect effects inherent in the interaction among various resource elements. The basic hypothesis is that a combination of the two approaches is most useful. This means that a focus on direct combining of two resource elements can create a closeness that is favourable, while at the same time the inherent complexity of indirect combining adds an ingredient of complexity and thus uniqueness, which can also be beneficial.

The third issue is to analyse the role of business relationships in resource combining. Business relationships are identified as one of the central types of resources in relation to the first research issue. A particular business relationship is an important resource element in itself, but it is also important in that it relates other resources to each other, for example through connecting a focal facility with other facilities and with various products in a highly systematic way. Business relationships are also crucial in relation to the second research issue. Numerous studies have shown that they are an important means in the active combining of resources. The basic hypothesis related to this research issue is that the nature of business relationships determines the opportunities for resource combining. The actual content in terms of activity links, resource ties and actor bonds impacts on the potential role a relationship can play in this respect.

These are the most central issues to explore in the analysis of resources in logistics networks. The basic assumption is that researching these issues will enhance the understanding of both the determinants of the utility of logistics resources and the opportunities for increasing the value created from these resources. It is hypothesised that such effects arise from changes in the existing combinations of resources. Even more significant dynamic effects can be expected from novel combinations, in which new resource interfaces are developed. So far, these are only speculations. Developing a framework for understanding logistics resources in a network context must be rooted in empirical findings about logistics practice. The empirical settings for the studies in the research programme mentioned in the introduction to this paper cover various facilities, products, business units, and business relationships. The setting includes the fruit and vegetable industry, the chemicals industry, the milk and dairy industry, the paper industry, logistics services, ship supplies, plastic materials and recycling equipment. Both the theoretical framework and its managerial consequences

will be further developed on the basis of the findings from extensive case studies in these areas.

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