Virtuality and Inter-organizational Co-operation in Logistics and Transport

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Abstract

The concept of virtual organization is a new form of inter-organizational co-operation. This paper applies the concept of virtual organizations to transport. Since there is considerable confusion with respect to the concept and there is a lack of empirical analysis, this paper examines three initiatives for inter-organizational co-operation in transport. To analyse these initiatives, a model of virtual organizations by Shao et al. (1998), focusing on strategic issues, and the concept of switching of Mowshowitz (1994), addressing inter-organizational co-operation at the operations management level, are applied. The paper identifies a number of organizational challenges that arise in the design or establishment of virtual organizations in transport.
1 Introduction

In today’s business environment, organizations face accelerating change resulting in increasing levels of uncertainty, instability, turbulence and insecurity. As a result of technological developments, changing customer demands and global competition, product life cycles are decreasing, product lines are proliferating and profit margins are decreasing. Therefore, many companies are investing in more flexible logistics systems and logistics processes. In addition, they have come to the conclusion that they have to co-operate with specialised third-parties more extensively in order to become a competitive and flexible organisation.

An emerging new concept in the area of inter-organizational co-operation is the concept of virtual organizations. Despite the proliferation of the concept, it is difficult to find a common definition of the virtual organization. It is, however, suggested that the concept has real value when addressing the subject of organizational development (Hale & Whitlam, 1999). Van Aken et al. (1998) have indicated that virtual organizations could be created to gain access to new markets, to defend existing positions, to use complementary technology to share risks or to attain economies of scale or scope.

As a major business, the transport sector also shows a rapidly changing environment. Supply chain competition have a significant impact on the transport sector demanding lower costs, higher frequencies and shorter transit times. Additionally, transport specific trends and developments like deregulation, congestion and environmental concern, increasing service levels, investments in Information Technology (IT), and global transport networks are driving transport companies towards reconsidering of their business and co-operation with others. An interesting question would be to what extent the concept of virtual organization is or could be applied to transport and what the main steps towards the design and realisation of a virtual organization in this sector are.

The objective of this paper is to explore the possibilities of application and the added value of virtual organizations in transport and to identify organizational issues that may emerge in the establishment of this type of inter-organizational co-operation. This exploration is centred round two examples of recent initiatives for co-operation in transport and a new strategic direction announced by a large firm in air transport. This paper is a first result of a recently started Joint Research Programme of TNO and TRAIL Research School.

The analysis in the paper contributes to the scarce empirical evidence of virtual organizations in business practice and in transport in particular. By analysing, the features of new initiatives of inter-organizational co-operation in practice, a better understanding of the characteristics of virtual organizations can be obtained and used to build a coherent theory on virtual organizations. To practitioners, the analysis provides insight in a number of problems or pitfalls that may be encountered in the
design or design process of a virtual organization and may provide guidance and support to this process.

The structure of the paper is as follows: First the concept of virtual organizations is introduced by discussing the recent literature. In section 3, the use of the term 'virtual' in the context of transport and logistics is discussed. Section 4 presents two models for virtual organizations that will be used for analysis. In section 5, some existing initiatives of inter-organizational co-operation are described and discussed by means of the models presented in section 4. In section 6, conclusions and topics for future research are presented.
2 The Concept of Virtual Organisations

As mentioned in the introduction, there is still considerable confusion in the literature with respect to the concept of virtual organizing or the virtual organization. The various interpretations start from the different meanings assigned to the term ‘virtual’. On the one hand, virtual is interpreted as ‘unreal, looking real’, i.e. a number of distinct functions or objects are perceived as a single integrated entity but in fact they are not. On the other hand, a function or object, that is usually performed through material resources, can be replaced by an equivalent one using immaterial resources (apart from a user interface) through heavy use of ICT and especially Internet. Rayport & Sviokla (1995) refer to this as ‘mirroring’. So the latter interpretation can be summarised as ‘immaterial, supported by ICT’ (van Aken et al., 1998).

Considering the concept of virtual organizations, the term virtual is applied to different aspects of inter-organizational co-operation or is defined from different disciplines. Main contributions are made by Davidow & Malone (1992), Byrne (1993), Mowshowitz (1994) and Venkatraman & Henderson (1998). These authors all describe an original vision or view on the concept of virtual organizations and its value to business practice.

Davidow & Malone (1992) define a virtual organization as ‘a corporation geared to the production of virtual products. Virtual products are products that do not exist until a customer specifies them. A virtual corporation, based on mass-customisation through the heavy use of ICT and highly flexible processes and co-operation structures, is able to deliver the customized product at short notice. The virtual corporation will appear less a discrete enterprise and more an ever-varying cluster of common activities in the midst of a vast fabric of relationships. To the outside observer, it will appear almost edgeless, with permeable and continuously changing interfaces between company, supplier, and customers. From inside the firm it will be no less amorphous, constantly reforming according to need’. Although Davidow and Malone have defined the virtual organization as a new concept of organization that facilitates mass-customization. The concept is not restricted to the principle of mass-customization. The concept can also be applied to fulfill other business requirements that require flexibility and responsiveness, as mass-customization can also be achieved using other forms of organization.

Byrne (1993) defines a virtual organization as ‘a temporary network of independent companies – suppliers, customers, even erstwhile rivals - linked by information technology to share skills, costs and access to one-another’s markets. It will have neither central office nor organisational chart. It will have no hierarchy, no vertical integration’. Two aspects are highlighted by Byrne. First, companies come together when there is an opportunity in the market that requires a bundle of the core competencies of various firms. Second, in order to stay ahead in the market, each of the companies in the network has to focus increasingly on a small number of core-
competencies. Inter-organizational co-operation between the companies goes beyond outsourcing.

Mowshowitz (1994) defines the concept of switching as the principle underly ing the concept of virtual organization. ‘The virtual organization approach exploits the advantages of switching through a dynamic assignment procedure’. Virtual organizing is then defined as ‘an approach to management that explicitly recognizes abstract requirements and the means for their realisation (‘satisfiers’) in practice as well as providing a framework for taking into account dynamic changes in both requirements and available services. Promising greater flexibility and responsiveness, virtual organizations can be used to improve resource utilisation, achieve better quality products and services, strengthen managerial control and lower costs’. In terms of inter-organizational co-operation, the concept of switching can be explained as the flexibility to select business partners for each individual transaction.

Venkatraman & Henderson (1998) define virtual organizing as ‘a strategic approach that is singularly focused on creating, nurturing and deploying key intellectual and knowledge assets while sourcing tangible, physical assets in a complex network of relationships’. They reject the idea of a virtual organization as a distinct (organizational) structure (like functional, divisional or matrix) but treat virtualness as a strategic characteristic of an organization. In fact they give an elaboration of the concept of Byrne (1993) by specifying three vectors in which firms co-operate with others in the inter-organizational network: with customers by means of Internet based ‘customer communities’, with suppliers and competitors within ‘resource coalitions’ and with employees and outside business partners in terms of ‘professional community expertise’.

Considering the four definitions of virtual organizations it is clear that they all focus at means to increase flexibility in order to cope with the rapidly changing environment. Byrne and Venkatraman & Henderson present virtual organizations from a strategic management perspective. The essence of the virtual organization can be found in finding new opportunities and selecting appropriate business partners in the market. Davidow & Malone and Mowshowitz define virtual organizations at the operations management level. Both definitions emphasise the need for flexible operations within the network of organizations that comprise the virtual organization. Whereas Davidow and Malone are seeking to identify the main features, Mowshowitz attempts to capture the principles underlying the features of the virtual organization.

It must be noted that all definitions of the virtual organization mentioned above are of a conceptual nature. They describe the phenomenon or a vision of flexible inter-organizational relationships by emphasising the essence of virtual organizations, not its appearance or design. None of them describes the organizational structure or the nature of the inter-organizational relationships. This leaves quite some leeway in the operational and organizational design of virtual organizations in business practice.
3 Virtuality in transport and logistics

The term ‘virtuality’ has already been used in the area of transport and logistics. In logistics or supply chain management, the concept of virtual integration is mentioned by Michael Dell, founder of Dell Computers (Magretta, 1998). Dell Computers has based much of its rapid growth and profits on being almost non-existent in the physical retailing sphere (van Hoek, 1998). The company focuses on the individual customer and integrates the supply chain through linking up of the chain of information. Dell does not have stores or any other outlets. It does not make products and does not have inventories of finished goods. Instead, Dell sells directly to individual customers. It buys modules and only does the final assembly of products when actual customer orders have been received. Here, virtual is interpreted as ‘unreal, looking real’. The concept of virtual integration is derived from the definitions of Byrne and Venkatraman & Henderson.

Crowley (1998) focuses on virtuality in transport using the interpretation of ‘immaterial, supported by ICT’ (Van Aken, 1998). Virtual or electronic mobility means that physical movement of goods or persons is substituted by electronic images or messages. This is possible for some forms of (human) interaction, e.g. conversations, meetings, and some activities of an administrative nature. For freight transport, the potential for substitution depends on the information content of the good, especially in the context of the trend towards the ‘de-materialisation’ of products and the ability of the material content and information content to travel separately, for instance books and music, and waybills and customs clearance in transport.

Clarke (1998) provides an introduction to virtual logistics and provides an overview of concepts. With virtual logistics, the physical and information aspects of logistics operations are treated independently of each other. In such operations, ownership and control of resources is effected through IT applications rather than direct physical control, and resources can, thereby, be owned and utilised remotely. Clarke applies the concept of virtuality to inventories, warehousing and transport. In transport, the concepts of virtual logistics services, virtual markets and virtual organizations all refer to the shared used of resources with an aim to increase utilisation, flexibility or to extent the range of services that a transport operator can offer to its clients. Neither the nature of inter-organizational co-operation nor its characteristics is discussed by Clarke.
4 Operational models of Virtual Organizations

In order to benefit from the concept of virtual organization and to apply the concept of virtual organizations in transport, there is need for a clearer description or definition of the characteristics of virtual organizations and how an organisation can become (part of) a virtual organization. The definitions in the literature on virtual organizations as well as in the literature on virtuality in logistics and transport use rather abstracts terminology and do not provide a consistent and concise description or model. In order to define its characteristics, the primary issue to deal with is how a virtual organization can be identified.

Various authors have made suggestions for the characteristics of virtual organizations. Van Aken et al. (1999) have suggested the absence of classical trinity (unity of ownership, power and loyalty) as a major characteristic. Jägers et al. (1998) suggest: boundary crossing, complementary core competencies/pooling of resources, geographical dispersion, changing participants, participant equality and electronic communication. The characteristics selected and the approaches chosen by various authors have not (yet) lead to an complete and consistent set of characteristics of virtual organizations. Analysis of these contributions shows that, although there is a union set of characteristics, this set is not exclusive to virtual organizations. The union set of characteristics does not account for the driving forces for the establishment and the essence and of virtual organizations compared to existing organizational forms. Therefore, in this paper we have selected two models addressing characteristics highlighting the essence and motivation for creating virtual organizations.

In this paper we use a model presented by Shao et al. (1998) and the approach of Mowshowitz (1994) to identify virtual organizations. Shao et al. (1998) have identified four major variables of virtual organizations: connectivity, purpose, technology and boundary (See Table 1). Shao et al. do not conclude that these are the only variables to describe and prescribe the virtual organisation, but they represent a key set of features of virtual organisations. Taken together, these four key characteristics give guidance for the assessment of virtual organisation’s stability and for the design of new virtual organisations.
Table 1: Variables of Virtual Organizations (Shao et al., 1998)

| Connectivity | The creation of unity or linkage through structural change, breaking of constraints of previously existing barriers. This usually means a structural change (breaking of constraints) in one of the following dimensions: space, time, asset use or legal status to achieve a new unity, e.g. distance barriers are broken through technologies that make distance irrelevant. |
| Purpose | The group or joint objective that provides the incentive for creating the new organisation and which serves as the cohesive force to hold the virtual organisation components together. The purpose defines the value of the virtual organization. |
| Technology | The enabling factor that allow the breakthrough and makes the virtual form possible |
| Boundary | The separation of those who are part of the virtual organisation and those who are not, in the absence of any clearly visible physical border lines. It defines who can share its activities and who receives benefits. |

According to Mowshowitz, the basic principle of the virtual organization is the concept of switching. The concept of switching makes explicit the need for a decision making approach that is open to all possible options, explicit about goals and selection criteria, objective in making choices and ever responding to changing conditions. Therefore, the virtual organisation can be characterised in terms of four basic management activities that depend on separating ‘abstract’ requirements from satisfiers.

Table 2: Four functions of the concept of switching (Mowshowitz, 1994)

| Requirements | Formulation of abstract needs that have to be satisfied? |
| Satisfiers | Tracking and analysis of concrete options to satisfy the need? |
| Dynamic assignment | Assignment of concrete satisfiers to abstract requirements on the basis of explicit criteria |
| Exploration of assignment criteria | The determination of the assignment criteria for the dynamic assignment. |

The combination of the two models can be helpful to identify virtual organizations since the models are complementary in the sense that they focus on different elements of the virtual organization. Shao et al. provide a model covering characteristics at the strategic level, focusing on the establishment and composition of the inter-organizational co-operation. Mowshowitz deals with operational characteristics of the virtual organization in describing the functions that have to be performed.
5 Examples of new concepts in organizational networks in transport

In this section, three new initiatives in the transport sector are analysed using the models of Shao et al. and Mowshowitz. All three initiatives involve change in inter-organizational relationships. Information technology plays a central role in each of the initiatives.

5.1 Planning And Routing Intermodal System (Paris) – Intermodal Transport

Paris (Planning And Routing Intermodal System) is an information system that plans the hinterland transport of containers to and from ports (van Klink et al., 1997). The main characteristic of the Paris system is that it attempts to identify opportunities for increasing transport efficiency since it plans simultaneously for several shippers and several transport companies, i.e. it is a multi-actor planning system. Shippers send their transport orders to the Paris system, while transport companies provide information on the availability of their capacity and resources. The increase in scale allows the system to generate more efficient trips and to combine flow to and from the port. The optimisation of the transport planning is dynamic, which means the planning can be adjusted until the moment the transport order is sent to a driver or transport operator.

The Paris system is developed and operated by Cairo Systems, which is an IT-service provider and is used by several shippers and deep sea container carriers, like SeaLand that uses the system in the Port or Rotterdam and in Felixstowe. The main objective of the system is to minimise empty mileage and to reduce transport costs within the rules and preferences indicated by the various shippers. The cooperation that is established between the shippers and deep-sea carriers leads to an increase in efficiency that is not achieved by individual logistics service providers. Furthermore, it creates flexibility since shippers can use a larger scope of transport operators and each transport operator is free to determine what capacity he puts in and what orders he accepts.

The network of companies related to Paris (shippers, transport companies and Cairo) can be considered a virtual organization. In terms of the model of Shao et al. (see Table 3), the joint planning of operations supported by the Paris system creates connectivity. The main constraints to overcome in the realisation of the connectivity are organizational boundaries, because shippers have access to the transport capacity of other transport companies. Time constraints are broken because the PARIS-system dynamically optimizes and allocates transport capacity. Furthermore, transport orders are communicated directly to drivers by means of
mobile data communication. Monitoring of operations by means of tracking and tracing services is not available. The boundaries of the initiative are defined by the contracts between Paris and the various shippers. These contracts clarify the guaranteed service levels and responsibilities, etc.

Table 3: Paris - the four variables of virtual organization

| Connectivity | Creation of a network of companies that integrate their transport planning and operations. The constraint of asset use is broken because shippers have access to the transport capacity of transport companies with whom they have no direct relationship. Time constraints are broken because the PARIS-system dynamically optimizes and allocates transport capacity. |
| Purpose | Reduction of empty mileage and reduction of transport costs by exploiting economies of scale in transport planning. |
| Technology | Algorithms for dynamic optimisation, EDI communication with shippers and transport companies and mobile data communication with drivers. |
| Boundary | Boundaries are defined by an agreement between the companies participating in the shared planning system and the IT service provider and furthermore by the preferences and criteria for allocation of shipments defined by each of the shippers. |

The four variables of the approach of Mowshowitz can also be easily identified (see Table 4). The ‘abstract’ requirements are the transport orders, time constraints and the preferences and rules defined by of the various shippers. These rules and preferences may concern a specific mode, a specific transport company or the range of transport tariffs. The ‘concrete’ satisfiers are the available resources of the rail, inland shipping and truck operators. The criteria for allocations of the requirements to the satisfiers are transport costs. This criterion is set by the algorithm of Paris, all other criteria, like the preferences of shippers are considered as requirements.

Table 4: Paris: four management functions of virtual organizations

| Requirements | The requirements are the transport order of shippers and the preferences and rules defined by the shippers in terms of tariffs and carrier selection. |
| Satisfiers | The satisfiers are the transport resources made available to the system by the various transport operators in rail, road and inland shipping. |
| Dynamic assignment | The Paris system allocates assigns the transport orders of shippers to vehicles and equipment of operators by means of a dynamic algorithm that focuses on finding quickly a satisfactory or acceptable planning. The algorithm does not strive for a mathematical optimal solution, but is designed for calculation speed. |
| Exploration of assignment criteria | The criteria for assignment of transport orders to the transport capacity is based on transport costs, which is programmed into the algorithm of the system |
The establishment and operation of the Paris system leads to a number of organizational issues. Main issue of the Paris system is that it is not or may not be in favour of transport companies. In the case of complete flexibility of allocation, i.e. for a transport order of a shipper any transport company may be used, the increase in efficiency leads to a reduction in required capacity and probably to further erosion of transport prices (in case of excess capacity). The latter will happen because transport companies compete on the basis of prices in the system and the system increases the transparency of the transport market to shippers. Furthermore, contractual arrangements have to be adjusted since shippers will not have contracts, liability agreements and negotiated tariffs with the various transport companies. These issues suggest another way of organizing in which transport companies have a contract with Cairo Systems, which will have contracts with the shippers. In this case transport companies loose their contacts with shippers and are degraded to capacity providers.

5.2 Barge Control Centre – Inland Shipping

The concept of the Barge Control Centre (BCC) enables the operational co-ordination of round trips for collection and delivery of containers by inland shipping in the Ports of Antwerp, Rotterdam and Amsterdam (Verduijn & ter Brugge, 1997). The planning and co-ordination of these round trips is complex because it involves the planning of various barges simultaneously calling at the port and the planning and availability of quays, cranes and crews on the side of the various terminal operators. Currently, each barge operator generates a round trip planning by contacting the planners at the terminals that have to be visited and negotiating the time slot for the call. Unfortunately, there are again and again disturbances and delays. These delays spread quickly throughout the port and create a situation of confusions since there is little information on the actual situation in the port.

The concept Barge Control Centre is an initiative of the Netherlands Rhine and Inland Shipowners Association and four large container barge operators on the river Rhine, and is still in development. The main objective of the BCC is to improve the competitive position of inland waterway transport. Although the volume of container transport by inland waterways is rapidly growing, higher service levels in terms of high frequencies and reduced costs may contribute to an even better competitive position of transport by inland waterway. Since barges spend approximately 16 to 24 hours in the Port of Rotterdam itself, the initiative focuses on port operations first. The BCC will co-ordinate the calls of the various vessels and has contact with all container terminals. In case of disturbances and delays, it will have a complete overview of the actual situation and can co-ordinate the re-allocation of the available slots. The ultimate levels of co-operation envisaged by the
BCC are central disposition and grey fleets. In the former, a central office allocates containers to any of the ships of the participating barge operators, which determine the sailing schedules of their barges. In the latter the commercial aspects, i.e. generation of transport orders, are totally independent of the operations.

Reflecting on the operational models presented in section 4, the concept of the BCC can be considered a virtual organisation. In terms of the model of Shao et al. (see Table 5) connectivity is created by the establishment of the joint planning or co-ordination unit called the Barge Control Centre. By breaking organizational boundaries, the scale of the operations can be extended and operations can be integrated. In the ultimate situation, the resources, although owned by the various operators are shared and costs are divided among the participants. Real time and on-line information systems gather the data of the actual situation in the port and at the various vessels in order to optimise the entire operation. For the moment, the boundaries of the BCC are clear since it has four founding members. However, because the purpose of the BCC is to improve the competitive position of inland shipping in the hinterland transport other barge operators are allowed to enter.

Table 5: Barge Control Centre - the four variables of virtual organization

| Connectivity | Creation of a network of companies that integrate their round trip planning and operations, and share their capacities; establishment of a co-ordination centre; breaking of organizational boundaries allowing access to capacity of other operators and access to information on the planning of terminals and other barge operators. |
| Purpose       | Improvement competitive position of inland shipping sector; reduction of round trip times in various ports; increase service levels and reduction of operational costs. |
| Technology    | Algorithms for dynamic optimisation; EDI and on-line communication with shippers and transport companies and mobile data communication with barge operators, tracking and tracing equipment to gather data on the actual situation of vessels and at terminals. |
| Boundary      | Boundaries are defined by an agreement between the four companies participating in the shared planning system. |

Table 6 indicates how the four management functions of Mowshowitz are applied. Dependent on the scope of co-operation the ‘abstract’ requirements and ‘concrete’ satisfiers refer to the round trip planning at the various ports or the optimisation of the entire inland shipping operation of the participating barge operators.

Table 6: Barge Control Centre: four management functions of virtual organizations

1 The name ‘grey fleet’ originates from the fact, that the vessels are no longer affiliated to any of the operators bringing in cargo, but are chartered by the BCC on behalf of all participating operators.
**Requirements**  
The requirements are the time slots for loading and discharge at the various container terminals or slot capacity at barge for transport orders that have received by the various barge operators.

**Satisfiers**  
The satisfiers are terminal capacity at the various terminals or the vessels in the sailing schedule of the various barge operators.

**Dynamic assignment**  
The BCC allocates the slots to the barges that have to load or unload to the slots of container terminals in the various ports minimising the delays of the vessels or allocates the containers to the various vessels using the time-constraints of the container and the preferences of the barge operators.

**Exploration of assignment criteria**  
The criteria for assignment of containers to the vessels are performed using pre-defined criteria. These criteria are re-evaluated on a regular basis by the participating barge operators.

So far, the BCC has not been established yet. There are two main problems. The first problem is lack of trust. Barge and terminal operators are reluctant to share information, to give up part of their autonomy and to become more dependent on others. The delays have caused much confusion and annoyance that has evolved in a situation of blaming and accusing. Therefore, the co-operation has to be developed step by step to allow trust to be (re-established). Earlier attempts for the development of joint information systems have not been successful. The second problem is the capital needed to start the initiative. Furthermore, the co-operation leads to a number of other issues that have to be resolved: liability and competition. For instance, who can be responsible if a vessels and its containers are delayed as a result of an allocation of the BCC, is it the operator or the BCC. The co-operation in terms of grey fleets and central disposition will shift the competition between the various operators towards the markets for intermodal container transport and to the time-charter market for container vessels. There may be limits to the market share of the BCC. If many operators join the BCC a monopoly situation will arise that may not be accepted by anti-trust authorities on a national and EU-level.

### 5.3 KLM Cargo Air Logistics – Air Transport

KLM Cargo Air Logistics is a new business unit of KLM Cargo\(^2\). KLM Cargo Air Logistics services include door-to-door services, warehousing, and inventory control. It is a logistics service provider to large shippers and has direct contact with the customers of KLM Cargo’s air operations. The competitive advantage of KLM Cargo Air Logistics is based on an information system that can offer complete insight in the schedules, capacity and progress of KLM Cargo operations: a service that forwarders do not have. Air forwarders that traditionally offered cargo to the KLM will remain responsible for the document and physical handling of the shipments.

The main reason for KLM Cargo to establish its business unit Air Logistics to increase efficiency. Although KLM Cargo is relatively flexible in the size of its capacity since a large part of its capacity is provided by combi-aircraft, an operational objective is to fill the available capacity in the network. A problem is that KLM Cargo has little grip or visibility on the supply of air cargo. Air cargo is provided by air forwarders, which may offer the cargo at any time and in many cases also very late. For planning purposes, it is in the interest of KLM Cargo to have information on demand as early as possible.

Table 7: KLM Cargo Logistics- the four variables of virtual organization

<table>
<thead>
<tr>
<th>Connectivity</th>
<th>KLM Cargo has not created any new unity with other actors. Instead they have taken over specific tasks of the air forwarder.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>To get more grip on the demand for air transport in order to be more flexible in the allocation of shipments and to achieve a higher utilisation of KLM Cargo resources.</td>
</tr>
<tr>
<td>Technology</td>
<td>Information technology is used to obtain insight in the actual availability of air capacity and for tracking and tracing of shipments in the KLM pipeline.</td>
</tr>
<tr>
<td>Boundary</td>
<td>Boundaries are clearly defined: the system consists only of KLM Cargo.</td>
</tr>
</tbody>
</table>

Table 8: KLM Cargo Logistics: four management functions of virtual organizations

<table>
<thead>
<tr>
<th>Requirements</th>
<th>The requirements are the logistics or air transport needs of large shippers. KLM Cargo extents its exploration of requirements by approaching shippers directly instead of their air forwarders.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfiers</td>
<td>The satisfiers are primarily the air transport services of KLM Cargo, its partners (like NorthWest and Alitalia), and its competitors. The process of identifying satisfiers is also extended since KLM and its partners do not offer services on all possible destinations.</td>
</tr>
<tr>
<td>Dynamic assignment</td>
<td>KLM Cargo Logistics assigns the shipments to its own services/aeroplanes or to that of partners or competitors. The assignment process is based on the criteria of availability of a service or capacity.</td>
</tr>
<tr>
<td>Exploration of assignment criteria</td>
<td>The criteria for assignment of shipments are determined by KLM Cargo itself, but not explicitly formulated.</td>
</tr>
</tbody>
</table>

Contrary to the other initiatives discussed, KLM Cargo Logistics is not a virtual organization. The primary reason is that KLM Cargo does not establish an inter-organizational co-operation (Table 7). It takes over the role of the air forwarder in order to optimise its own operations. Technology is, however, a major element in the creation of its competitive advantage, since KLM Cargo has extended its information system to other parts of the chain. In terms of the four functions of management (Table 8), the exploration of requirements and satisfiers are certainly extended. The exploration of the criteria for allocation of cargo to its own services (including its
partners) or the services of competitors and the assignement procedure itself are performed by KLM Cargo, but are still topics for further research.

In order to increase efficiency, KLM Cargo is taking over tasks of other actors in the chain by establishing its business unit Air Logistics. This will create a competitive advantage compared to traditional forwarders because KLM Cargo can provide more information on its air transport services and progress to shippers than air forwarders can. On the other hand, KLM Cargo will stay dependent on these forwarders. Forwarders remain providing cargo to KLM because KLM Cargo Air Logistics will not be capable to deal with all KLM Cargo’s customers. The main question is how a new balance will be established. Therefore, closer co-operation might be required. The disadvantage is that other airlines and forwarders may copy these arrangements very quickly.
6 Conclusions

In this paper we have applied two models of virtual organizations to three initiatives for inter-organizational co-operation in the transport sector in order to identify virtual organizations in transport. Paris and the Barge Control Centre are examples of virtual organizations in which horizontal co-operation is established. In both cases, benefits can not be realised by each of the actors themselves. KLM Cargo has opted for vertical integration since it is likely that establishing a virtual organization does not lead to a sustainable competitive advantage. The latter example shows that inter-organizational co-operation is not always considered to be an appropriate of feasible option.

To identify virtual organizations in transport, the models of Shao et al. and Mowshowitz were selected. Although these models are useful in providing insight into the appearances of virtual organizations in practice, there is no guarantee that these models provide a complete coverage of the characteristics of virtual organizations. Additional empirical research further specifying the characteristics of virtual organizations remains necessary. However, the two models have been helpful in the analysis to identify organizational challenges.

The establishment of virtual organizations gives rise to a number of organisational challenges: establishment of new relations with other actors, co-operation with competitors, new types of operational co-ordination of operations, issues of re-distribution of costs and benefits, and the introduction of new information systems and data-sharing concepts. At this moment it is not yet clear what issues are specific for the transport sector or for the types of co-operation covered in this paper.

In this paper, the concept of virtuality or virtual organizations has been applied to the transport sector. However, the role of transport organizations within supply chains is changing. The concept of virtual organizations can also be applied to supply chains, as was shown by the Dell example discussed in Section 3. The main challenge is to determine what changes in the supply chain structures will occur when companies target virtual organizations and what the consequences of virtual integration are for logistics and transport operations and organizations. Further research is planned to explore these changes.
References


