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MANAGING INFORMATION FLOWS IN HORIZONTAL COLLABORATION FOR AN OPTIMISED AND MORE SUSTAINABLE SUPPLY CHAIN PERFORMANCE

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ABSTRACT

A logistics manager has to deal with different choices. Firstly, he needs to make a trade-off between efficiency (costs) and effectiveness (customer service) in his logistics related decisions. Currently however, a third dimension is becoming more and more important: sustainability. In order to improve substantially and simultaneously the three key dimensions one should collaborate to bundle freight flows.

Information transparency and visibility within and across supply chains are key issues which help improve supply chain performance, whilst nurturing collaboration across the supply chain in order to come more cost-efficient, more effective and more sustainable.
Studies of collaboration between supply chain actors illustrate that the sharing of information alone is not enough to ensure an improved, and thus more sustainable supply chain . Information sharing must be preceded by collaboration incentives and mutual trust.

The literature on collaboration focuses on the link of information sharing with strategic relationship building approaches and is not providing guidance regarding practical (technical) implementation to improve demand/supply synchronisation.

In this paper we want to explore the structure and processes involved in demand management and information flows within different supply chains, in order to establish the nature of information sharing practices. Furthermore we want to identify other factors that could play an important role in the improved management of information flows.

Keywords: sustainability, horizontal collaboration, Information and Communication Technology (ICT)

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1. INTRODUCTION

The globalization and evolution of information and communication technology (ICT) contribute to the increasing competition between various supply chain actors, including logistic service providers (LSP). Changed operating environments have encouraged the creation of partnerships between supply chain actors and other logistic service providers which aim to increase the competitiveness of the companies. In addition to the latter, collaboration can now be defined as an attempt to fully satisfy the concerns of the involved stakeholders, pursuing win-win solutions. And thus, setting their own different goals aside in order to obtain a mutual benefit.

Collaboration can be looked at in two dimensions; either vertically or horizontally. Barratt (2004) presented this concept in a simple, but very useful model in which he identified the four different potential relationship partners, suppliers and customers on the vertical axis and complementors or competitors on the horizontal plain.

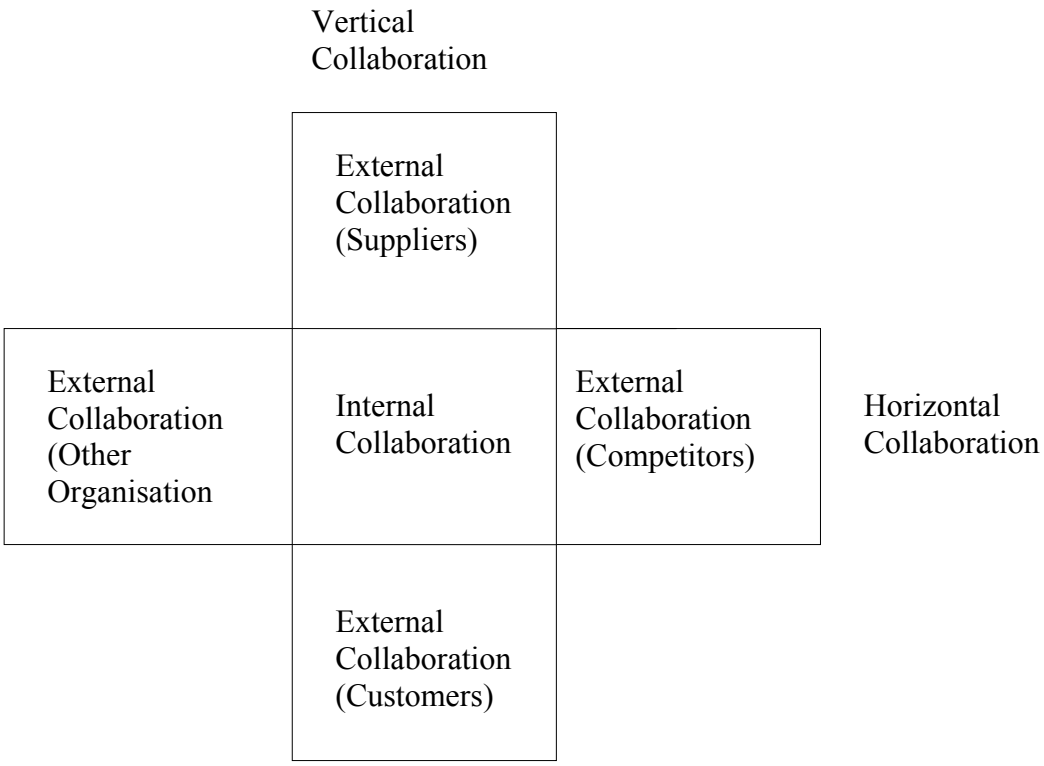

Figure 1: The scope of collaboration (Source: Barratt, 2004)

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In 2001, the European Union defined horizontal collaboration as follows; “the concerted practices between companies operating at the same level(s) in the market”.Various authors define this collaboration technique. Cruijssen et al in 2007 said that “The collaboration is based in the requirement of different enablers; whereas trust, commitment and information sharing are key elements in order to start a successful collaborative relationship which can make actors more competitive and can allow them to achieve better performance”.
Christopher already in 1996 spoke about “Collaboration between competitors can take place in a specific part of the supply chain; for example in the distribution phase. Thus, competition and collaboration will exist between the supply chains and not necessarily create an alliance between the companies”.

The application of information and communication technology in the logistics sector and its latest developments, have contributed to the improvement of vertical and horizontal relationships. Nowadays such collaborations can be distinguished within various fields such as forecasting, production, distribution and product development, providing more visibility to the different partners.
Where ICT allows and ensures the effectiveness of the shared information on one hand, a collaborating group shares the market information on the other hand

Throughout this paper we shall focus on the horizontal links of a homogeneous group of organisations in order to outline their mutual collaboration and benefit(s).

Trust and information sharing between stakeholders plays a vital role. The increase in shared information is directly associated with the intensity of trust. Partnerships are characterised by the time span, scope and objectives. After adding these features we can distinguish three types of collaboration (Vos et al. 2003):

- Operational collaboration: The organisations collaborate efficiently at an operational level. This collaboration is focused in very short term objectives and perspectives.
- Coordination collaboration: Close engagements between partners are combined with effectivecoordination, open sharing of information and joint planning. Their performance allows them to achieve savings and a certain level of integration. Such collaboration is committed to mid-term objectives.
- Network collaboration: Partners restructure and invest together in order to achieve structural savings. This results in a long term relationship.

The duration, strength and intensity also need to be considered within the different types of inter-organisational relationships and collaborative partnerships such as described by Lambert et al, 1996.

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Internet, e-business, digitization and mass customization have had a major effect on supply chains over the last two decades. The traditional competition of individual businesses has evolved into a global competition between entire supply chains, creating a new business concept; e-collaboration. In 2001, McDonnel described this concept as follows: “E-collaboration is a growing concept for which several definitions have been produced, for example: e-collaboration as internet-based collaboration which integrates people and processes providing better service and flexibility to supply chains whilst eliminating all unnecessary costs.”

This paper focuses on the added value of information and communication technology from a horizontal collaboration perspective, based on the review of literature and interviews with ICT service providers. Furthermore, it also includes a summary of best practices.

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2. HORIZONTAL COLLABORATION AND THE IMPACT OF ICT SYSTEMS

2.1 Applying ICT in the horizontal collaboration

In order to improve the efficiency and effectiveness of the communication within a logistics partnership or collaboration model, data sharing is essential. The data needs to be available throughout a functional system to different parties. Information systems are widely used to improve the management of mutual resources. For instance, Electronic Data Interchange (EDI) is being used to exchange information from one computer to another. EDI enables the company to exchange information more swiftly, reduces lead times and increases the frequency of deliveries which will also most likely influence the customers' stock levels.
Currently, many companies are updating their EDI applications, they are moving away from the traditional EDI translator to the EDI gateways which serve as a single management interface for the EDI system (Jonson 1998). And thanks to the global technological expansion and the Internet, these business methods are now also within the reach of small and medium sized companies.

When we look at the ICT needed to manage horizontal collaboration, Cruijssen et al. (2005) state that cooperation is greatly hampered by the required indispensable ICT-investments. Horizontal collaboration requires intensive data exchange between all parties. Especially for small and medium sized companies there is a high ICT-related barrier. Hoffman and Mehra (2000) discuss this problem and state that technology barriers still have to be tackled: "If there is one element that can cause the breakdown of any "best designed" supply channel, it is the technology factor. In this stage, a clear understanding of the technology needs of all partners must be assessed followed by information flow planning." (Hoffman and Mehra, 2000, p.372)

2.2 Effective horizontal collaboration

The first step towards a successful partnership is to define the various enablers. According to Mentzer et al, 2000 the main enablers werecommon interest and openness. Both parties are interested and motivated for the benefit of the collaboration and thus share information related to their practices and processes. Collaboration is characterised by sharing information, knowledge, risks and profit. Trust is a necessary condition for an effective collaboration. It should be present at every managerial and operational level.
It is about recognizing who and what is important: choosing supply chain activities that will deliver the greatest benefits and recognize them. Mutual help is needed when addressing problems or opportunities. Clear mutual expectations make that parties understand what is expected from them.

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Leadership commitment is necessary to ensure the harmony within the group whilst aiming for added value.
Within their collaborative spirit, the group may apply punitive actions which have a positive outcome. Clear agreements need to be made on how to allocate savings and gains within the group. The group should define as well their technological requirements in order to meet their objectives. Applying advanced technology is an essential enabler regarding the impact of the collaboration across the supply chain.

One also needs to take into account collaboration pitfalls such as (Mentzer et al, 2000) resistance to adopt changes, conventional accounting practices instead of measuring the cross- company value. Negotiation is a time and energy consuming process.
Inadequate and inconsistent communication or even betrayal can make that misunderstandings lead to discontinuation of the partnership.
Partner selection is a complex and time consuming aspect which needs to be based on extensive research in order to ensure whether a potential candidate has the strategic and organisational abilities and resources in order to contribute value to the partnership.
Last but not least information and communication technology investment need to be taken into account because it facilitates the flow of information between companies and it contributes to a better screening of the business environment and assists companies to seize new market opportunities.

2.3 Collaborative culture and Other Strategic elements for a sustainable Partnership

Different organizational levels are involved before joining a partnership; therefore it implies a move to a collaborative culture which can be attained by taking into account the following elements which have been described by the following authors:

- Managing change: (Ireland and Bruce, 2000, Barratt and Green, 2001); “Embarking in a collaborative initiative requires a thorough preparation for internal and external changes. An internal and holistic approach should be taken into consideration in the introduction of the “new” culture in order to ensure that information about the collaboration process is shared between the employees, customers and suppliers. The participation of employees in the joint decision for the development of the collaboration can have a significant positive influence on potential success. The employees should be aware of the new culture implying the importance of information exchange at different levels within the partnership.”
- Cross functional activities: (Forrester and Drexler, 1999; Lee and Whang, 2000; Ellinger, 2001) “The management of the boundaries between partners is necessary in order to secure the flow of information and the confidence in the partnership. The gaps in sharing of information can have influence on the level of trust between collaborators.”

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- Process alignment and intra-organizational support: senior management needs to coordinate the focus of the process, commit resources and monitor the internal harmony of the different functions as well as assure the external relations in a cross functional manner.
- Joint decision making and corporate focus: (Lambert and Pohlen, 2001) “Decisions need to be based on mutual interests, e.g. forecasting and metrics. The group should define the work frame in the execution of the proposed activity and report the results within the group.”

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3. IMPACT OF ICT SYSTEMS

3.1 ICT application in collaborative initiatives

ICT cooperation between organisations can bring benefits by assuring more effective communication and increasing the level of trust and transparency.
The investment in ICT technology in relation to horizontal collaboration should be in accordance with the level of requirements regarding availability of information and reflect its visibility throughout the supply chain. This will increase the flexibility and create a competitive advantage for the involved organisations.

Full transparency of the community information while safeguarding confidentiality of company-specific information. No information about costs, volumes, customers should be directly shared between competitors-shippers, due to anti-trust. A trustee can act as "firewall".

3.2 The added value of ICT in horizontal collaboration

Currently, business information between small and medium-size companies is more and more being transferred over the Internet. The ease of use, accessibility and swiftness (higher flow of data) is obvious compared to old systems such as telephones and fax communication.
ICT investments assist the Logistics Service Provider in creating value adding partnerships at all organizational levels in order to help secure market share.
In general, the implementation of ICT systems in small and medium logistics companies tended to be slow (Gunasekaran and Ngai, 2004). However, with the development of the Internet and new electronic business concepts, these implementations become a lot less time consuming.
In relation to horizontal collaboration between small organisations (low intensive initiatives) one does not necessarily require a specific investment in ICT, contradictory to medium size companies whose processes require an intensive exchange of data and thus have a higher ICT investment cost.
The application of ICT in a collaborative relation contributes to the creation of a long term partnership which will result in cost reduction, better efficiency and improved service and product quality. E.g. radio frequency identification (RFID) could have a major impact throughout the supply chain. Not only logistics, but also retailers, manufacturing etc. can benefit from the use of this technology.

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Visibility in the supply chain becomes a major topic. Even large logistics service providers have only a limited view on transport flows and can thus not completely add the value that they could bring.
A clear need is thus defined for an independant party that receives all transport flows, tries to find matches and brings parties together who by collaborating can reduce their costs, improve their service levels and reduce their carbon foorprint.

In this context one would need a tool such as the Cross Supply Chain Cockpit™ of TRI-VIZOR which has started as a simple collaborative cross company business intelligence and communications tool and is gradually evolving towards an orchestration tool with a broad variety of cross supply chain services. Optimization of transports could then be endeavoured in collaboration with transport providers.

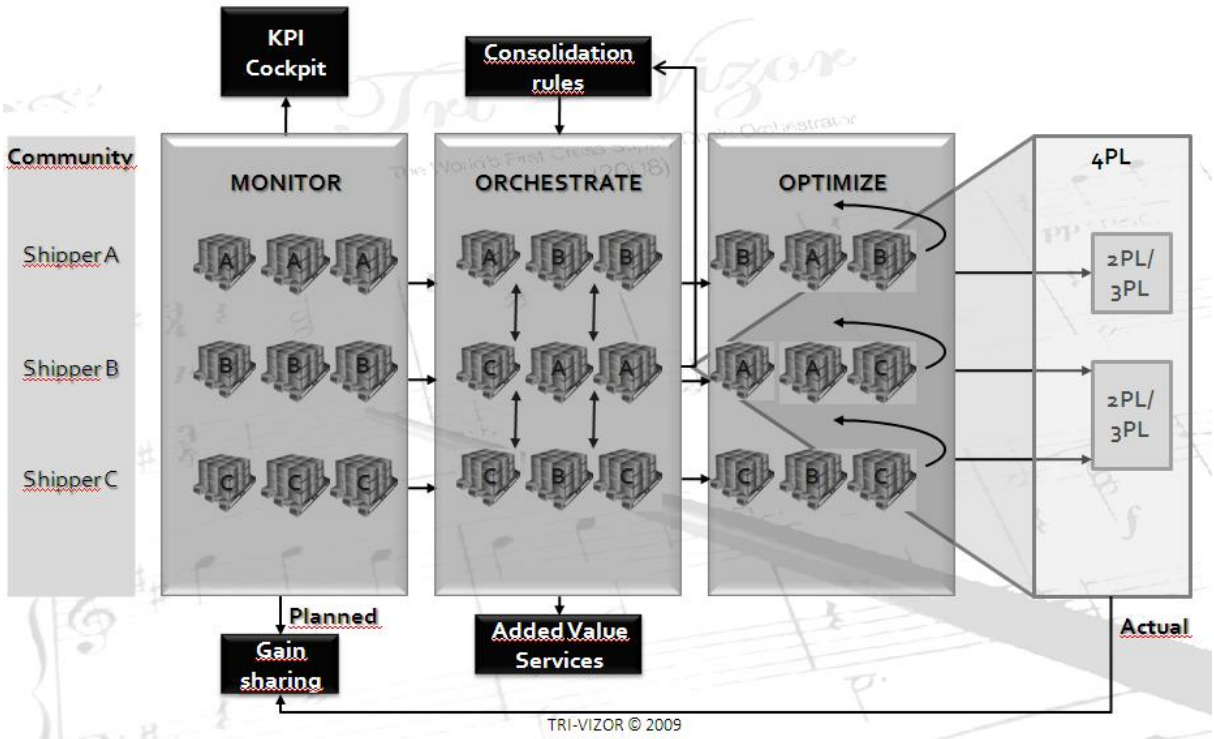

Figure 2: TRI-VIZOR Cross Supply Chain Cockpit™ (Source: TRI-VIZOR, 2010)

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3.3 KPI's in horizontal collaboration:

With the use of ICT, KPI measurements can be stored, analysed and shared between parties in a partnership, which will bring more mutual benefit to the parties.
Some freight transport management KPI's in horizontal collaboration are for example:

- Vehicle utilization: This can be measured by two key indicators: Vehicle Fill (% of available capacity actually used – in weight and volume terms) and Vehicle-km Run Empty. They translate tonne-km movements into vehicle-km.
- Fuel efficiency: This can be measured by the distance that vehicles travel: km per litre of fuel.
- Gain sharing based on mutual agreements. This can be measured by either the Shapley value or the Equal Profit Method (EPM).

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4. BENEFITS AND CHALLENGES OF HORIZONTAL COLLABORATION

4.1 Main Benefits

It is rather difficult to evaluate every benefit obtained by horizontal collaboration, as there are various aspects, linked to the processes which are not always easy to measure. However from a financial perspective, the benefits can be described as follows:

- Cost reduction and higher productivity by Increasing the company's productivity for core activities, e.g. decrease in empty hauling, more efficient use of storage facilities; cost reduction for non-core activities, e.g. safety trainings; reduction of purchasing costs, e.g. vehicles, on-board computers, fuel. (Cruijssen et al., 2005)
- Better service delivery: partnerships enable companies to learn from each others' skills and capabilities (Hamel, 1991; Kogut, 1988; Westney, 1988). By doing so, the logistics service providers can benefit from Specialization whilst broadening their services at the same time. LSPs can offer better quality of service at lower costs, e.g. in terms of speed, frequency of deliveries, geographical coverage, reliability of delivery times, etc.
- Expanded market place: partnerships are a useful tool to expand a company's fleet, service range and geographic coverage, and, as a result, to increase their customer's network (Bleeke and Ernst, 1995). A collaborative initiative enables individual LSP's to tender with large shippers on larger contracts. This consolidation will reinforce their position in future negotiations. The collaboration helps LSP's to protect the company's market share. Through collaboration, companies obtain a better position in order to secure their market shares and to boost their competitive position (Kogut, 1988).

4.2 Challenges of horizontal collaboration

Horizontal collaboration creates pooled interdependence (Lazzarini et al., 2001). The unit uses common resources but stays independent. Such practices are regularly organized in the public sector. E.g.: one group of buyers forms a pool to consolidate their demands.
Such a structure poses fewer problems as long as the negotiation power of the network is not affected by the withdrawal of one member. Ideally, standard procedures are being used, which are highly structured, but overall communication and coordination are kept to a minimum at the same time. In order to avoid problems, resources and procedures need to be clearly identified, defined and standardized. (Nollet and Beaulieu, 2005; Dyer and Nobeaka, 2000).

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5. EXAMPLES OF BEST PRACTICES

5.1 Description of a Swedish case

In “FuelOpt – A decision support system for forest fuel logistics” Frisk et al. describe the case of the Forestry Research Institute of Sweden that has developed a DSS for the forest supply chain of roundwood for both tactical and strategic transportation and harvesting planning, called FlowOpt, Forsberg et al. (2005). This is a DSS for strategic and tactical management of round wood procurement. The main questions to be answered in FlowOpt concern allocation of timber, back hauling possibilities, location of train terminals and cooperation between companies. FlowOpt uses different transport modes in the optimization such as truck, train and boat. The system is based on a GIS interface which is connected to a road database.

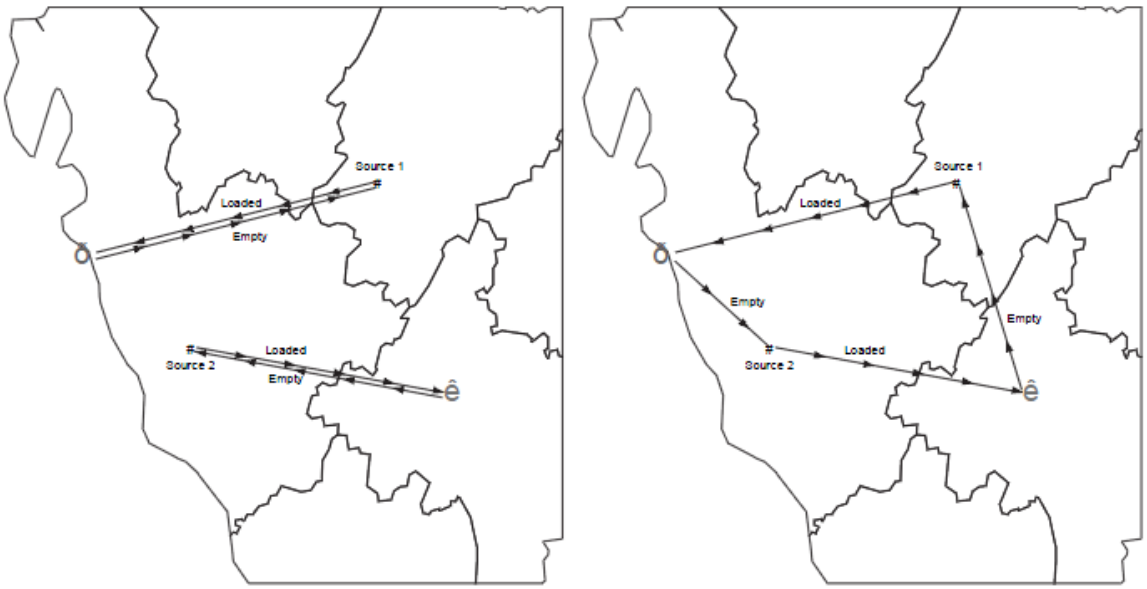

Figure 3: Example of two direct flows and a backhauling tour (Source: Carlgren, 2006)

The objective is to either minimize the costs for a given demand or to maximize the profit with a minimum demand level but with the possibility to have additional supply. The profit is calculated as revenue minus costs. The optimization model is a Linear Programming (LP) problem.

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There are several systems available to collect and perform the forwarding and chipping operation. Many different options are available for the transportation. If the chipping is performed in the forest, we may use larger chip trucks, which are loaded directly during the chipping operation, to transport directly to heating plants (or terminals).
It is also a possibility to use a container system where one container is filled up while the truck is taking another to the customer. If the chipping is done at terminals or at customers, we can use logging trucks for slash bundles or special forest residues trucks to take the assortments to terminals (or heating plants). There is also a possibility to combine any of the mentioned systems with train systems for longer transports. Some trucks combine chipping and transportation, where the vehicle has a mounted chipper and loads itself.

There is an interesting trade-off with the chipping location and transportation due to the transportation capacity. In Sweden, the weight limit of a truck (including the truck
itself) is 60 tons and the length limit of the truck (including trailers) is 24 meters. It is important to balance the chipping and transportation decisions in order to get the best cost efficiency. The chipping decisions involve location selection (forest, terminal or heating plant) and chipping system selection. The transportation decisions involve selection of transport system.

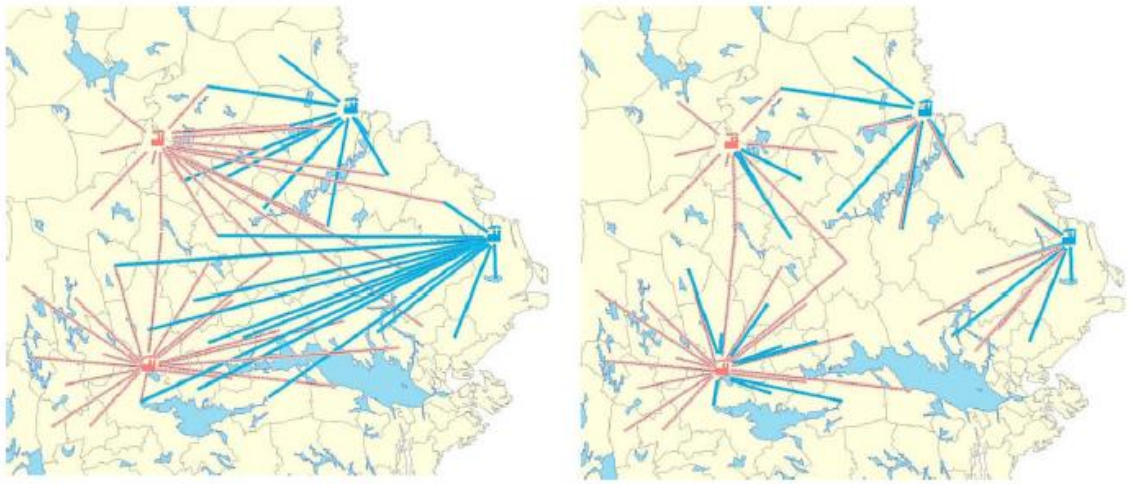

Figure 4: Illustration of wood bartering. In the left part each company operates by itself and in the right part both companies use all supply points as a common resource. (Source: Frisk, 2010)

Potential savings of collaborative planning are important, often in the range of 5–15%.

In order to support these optimizations, a decision support system has been developed with two major purposes. First, in order to get acceptance from future users the models and methods have to be visualized in an easy way.

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Second, when analyzing large and difficult forest fuel logistic problems with many scenarios there must be a system for effective data preparation and for interpretation of results. Many scenarios have to be analyzed in short time. The system is built as a client-server solution which makes it possible to have all data processing done on a high performance server. The user will only need a thin client for viewing and editing data. The client-server solution also makes it possible for
different users to use the same functionality without installing heavy applications on their own computers. The optimization is also done on the server. This is very suitable since most of the cases are very large and demand hardware with high performance. The solution also permits different applications to use the same platform, for example optimizing other transportation problems. This is possible since a lot of functionality, for example distance calculation and visualization in maps, is the same for different problems. The system uses two open source applications and consists of three major parts: a user interface
or client (left) includes a map, a checklist and window for verifying and editing data. Data is stored in adatabase which delivers data to the optimization module.

5.2 Example of an horizontal collaborative initiative in Flanders

Through an interview carried out at TRI-VIZOR in Belgium (Flanders), we learned about a potential case in the consumer goods sector. Companies A and B showed the following pattern and geographical overlap (see figures below):

	AS IS A	AS IS B
Costs (Euro)	188685	446078
Distance (Km)	110154	244918
Working time (Hours)	4134	9948
Orders	1610	6086
Pallets	20670	26174
Clients	55	696
Vehicles	497	1168
Trips	742	1374
Total CO2-emission (kg)	77561	175576

Figure 5: TRI-VIZOR case data (Source: TRI-VIZOR, 2010)

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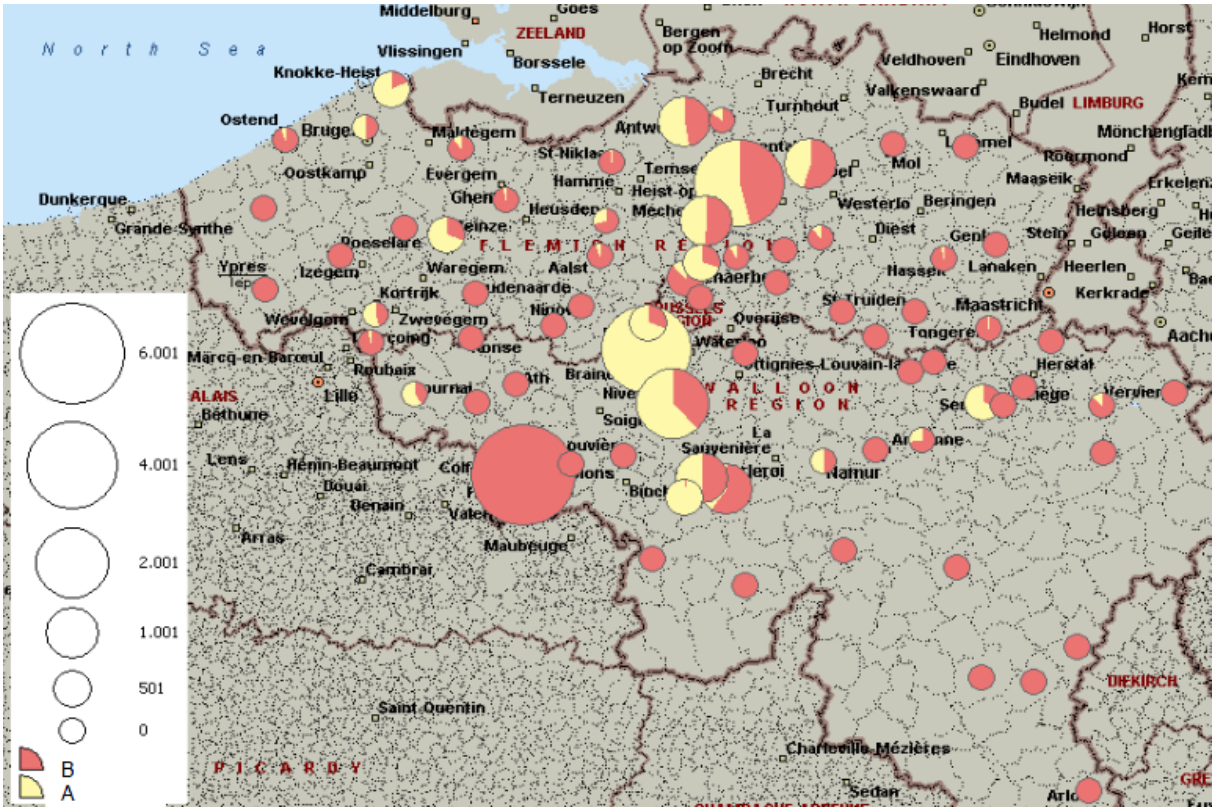

Figure 6: TRI-VIZOR case map (Source: TRI-VIZOR, 2010)

The average delivery cost per pallet was 9 euro for A and 17 euro for B.
Two simulations were done, one with groupage and a second with collaboration.
An incremental drop in kilometres, vehicles and trips was the result of reactive order consolidation by date (=groupage) for both shippers (see figure below). In this scenario, the cost per pallet changed to 13 Euro per pallet for both shippers. There was no incentive for Shipper A to collaborate. The picture below shows the effect of groupage for companies A and B. Only a saving of 3.5% was realized in the amount of kilometers.

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	AS IS (Sum)	TO BE 1	Result
Costs (Euro)	634763	612841	-3,58%
Distance (Km)	355072	326352	-8,80%
Working time (Hours)	14082	13785	-2,15%
Orders	7696	7696	0%
Pallets	46844	46844	0%
Clients	751	751	0%
Vehicles	1665	1544	-7,84%
Trips	2116	1931	-9,58%
Total CO2-emission (kg)	253137	239555	-6%

Figure 7: TRI-VIZOR case groupage savings (Source: TRI-VIZOR, 2010)

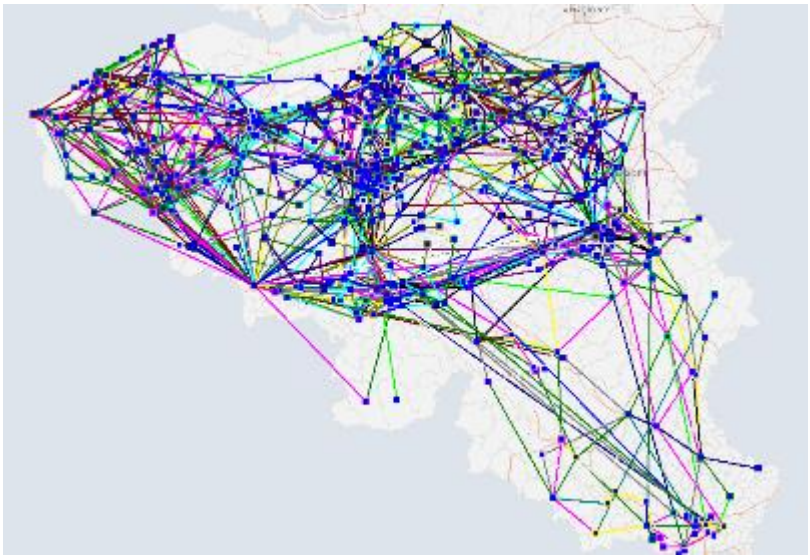

Figure 8: TRI-VIZOR case groupage map (Source: TRI-VIZOR, 2010)

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In the collaboration scenario, orders were then orchestrated to maximize vehicle loads and to synchronize delivery dates (with same or higher service level). The distance was reduced with 45% (see picture below).

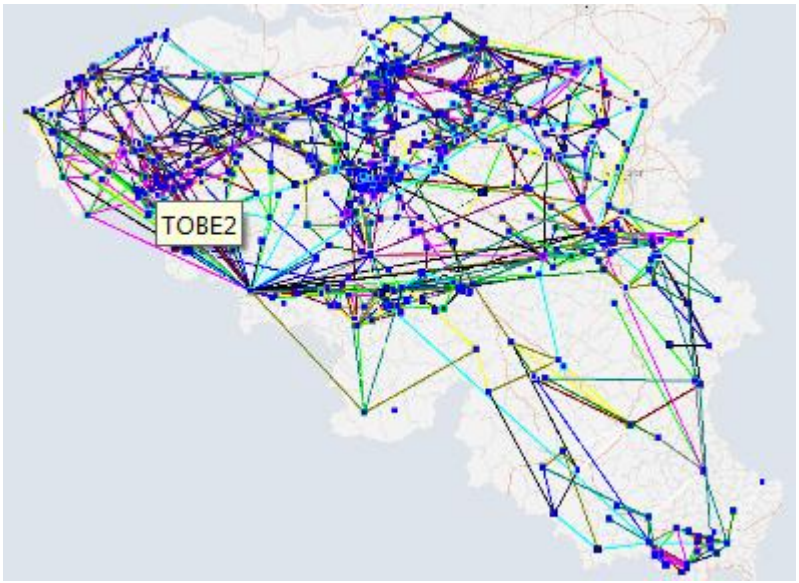

Figure 9: TRI-VIZOR case collaboration map (Source: TRI-VIZOR, 2010)

The cost to serve decreases to 10 Euro per pallet in the horizontal collaboration scenario. At first sight there is still no incentive for A to collaborate. However through a fair gain sharing the initial cost for A can be decreased resulting in a gain for B which is a bit less. So collaboration and gain sharing between A & B becomes possible.

	AS IS (Sum)	TO BE 2	Result
Costs (Euro)	634763	456545	-39,04%
Distance (Km)	355072	243814	-45,63%
Working time (Hours)	14082	10262	-37,22%
Orders	7696	7696	0%
Pallets	46844	46844	0%
Clients	751	751	0%
Vehicles	1665	1187	-40,27%
Trips	2116	1647	-28,48%
Total CO2-emission (kg)	253137	183172	-38%

Figure 10: TRI-VIZOR case collaboration savings (Source: TRI-VIZOR, 2010)

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Where today the flow matching and gain sharing calculations are still mainly done using spreadsheets, in the near future a solution such as the Cross Supply Chain Cockpit™will allow independent players such as TRI-VIZOR to play an even more important role, starting from dynamic data instead of static data.

It should be the aim to come to one system, managing all of the information flows. However, today, one still needs at least three different tools. One for analysis purposes, one for visualisataion of the flows and a third one for the optimisation of the flows.

5.3 Challenges and constraints of these initiatives

Building trust and sharing information still pose challenges to the participants in the collaboration. In order to come to the full potential of collaboration, one will need specific expertise and methodologies. Critical mass will have to be gathered and partner alignment will have to be assured.

A legal framework is still under construction. Some say collaboration is possible as long as the price mechanism is not impacted, others are still afraid of the non-collusion policy in the EU. Distinction should be made between horizontal collaboration among direct competitors and among other sector players. It is clear that one will also need impartial moderation, certainly where the gain sharing is concerned.

ICT integration of the different transport flow data will play a major role, not only to identify opportunities, but also to monitor the functioning and eventually the gain share.
Active involvement of a 3PL/4PL (collaboration and orchestration are not the same as adding up purchasing power between shippers to squeeze LSP's) will have to be considered.

Despite the dependability on the human factor, the partnership will provide a lower cost alternative in order to meet stake-holders' requirements on cost efficiency, effectiveness or sustainability and will eventually provide insights to explore further improvement possibilities.

The new function of orchestrating will create trusted referees of logistics partnerships, playing a neutral gain sharing role. Governments and infrastructure operators will finally have to set the right conditions and stimulate (multimodal) collaboration.

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6. SUMMARY & CONCLUSIONS

Horizontal collaboration is a recent development in logistics and supply chain management. The success of the inter-organisational collaboration is based on trust, information sharing and commitment.

The strategies and ICT investment plans need to be aligned between the partners as early as possible and need to be maintained throughout the entire life cycle of the partnership.

Whilst multi nationals can invest enormous amounts on ICT, medium and small companies are still very cautious.

Through the discussed business cases, we have experienced how the coordination of information flows can be managed by a single player. This resulted in cargo consolidation and improved back haulage, meaning lower costs and less carbon footprint.

However, it is still difficult to evaluate all of the potential profits that can be obtained through the establishment of a horizontal collaboration.

A proper alignment at strategic and cultural levels between the companies plays a crucial role in the definition of the type of ICT investment which needs to be done.

Thus, we can conclude that ICT has an added value in the optimal utilization of resources in the logistic sector and that it acts as a reliable point of communication and visibility of the supply chain. Beside ICT, an orchestrating independent actor is still needed in order to manage, to monitor, to balance and to expand the partnership. This will encourage more initiatives, boost the moral and reduce impediments and other pitfalls.

Further research should be executed in order to define appropriate, suitable and simple ways to perform the fair allocation of gains which are linked to the horizontal collaboration initiative.

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