# INTERACTION INFRASTRUCTRE - A HOLISTIC APPROACH TO SUPPORT CO-MODALITY FOR FREIGHT

Inger Gustafsson, ig@bmt-ts.com

School of Technoculture, Humanities and Planning Division of Technoscience Studies

#### Introduction and acknowledgement

Efficient freight transport systems are cornerstones of our economy and a prerequisite for economic development but freight transport is also connected to a number of negative impacts. Not only the severe threat of global warming, but also issues like congestion, accessibility, safety and security have to be acknowledged and addressed. We are challenged to find solutions that respond to the demand for transports and at the same time allow a sustainable development. Co-modality, i.e. the efficient use of different modes in their own and in combination is suggested as a way forward by the European Commission.

This doctorial thesis is the result of research carried out in different settings. My entrance into the research area – Information and cooperation in Freight Transport Systems- was through participating in the INFOLOG project, a 4<sup>th</sup> Framework research programme of the European Commission that started in 1998.

Writing this thesis has included elements of reflection. Going back to the visions expressed in INFOLOG, I can see that the problem of sharing information within freight transport is still an issue. However, to my understanding major changes characterise the development the last decade. There are new possibilities for simplified communication through the emergence of the Internet and related communication platforms and there is also a matured understanding of the complexity of freight transport in general and co-modality in particular. This is manifested in a more open view on cooperation and information sharing among the players in freight transport.

It is my belief that we have a window of opportunity for creating more efficient and sustainable freight transport systems through improved interaction and information sharing. Such development will require freight transport to be given a higher priority on the policy agenda.

I hope that those involved in the practical work of building and managing complex freight transport systems will recognise their situation in my analysis of the state of the art and that my arguments for increased transparency and trust can be endorsed by commercial as well as public stakeholders. My contribution to a further development is to suggest that much could be achieved through the mutual recognition of the need for a formal structure facilitating the interaction between those involved in making transport more efficient and realising co-modality.

I would like to express my gratitude to my supervisors Professor Lena Trojer, Professor Peter Värbrand and Lars Källström. With their different backgrounds and competences our meetings have been very fruitful and their support has guided me through the writing process.

I am very grateful to the financing bodies that have supported my research in different formats including the Swedish Road Administration, the Swedish Rail Administration, the European Commission, BMT Group Ltd, Blekinge Institute of Technology and the Region of Blekinge.

I have been very lucky to work with competent and inspiring colleagues throughout the years and I am convinced that this is the single most important enabling factor for my research. In the process of finalising my work, I have received many valuable comments and I would like to thank you all for taking time to comment and to get familiar with the material. Special thanks to my colleague Detlev Fischer for his criticism and constructive comments.

Finally, I have experienced great support and interest in my writing from family and friends. I appreciate this very much, both the mental and practical support you have given.

Fagersanna, December 2007

Inger Gustafsson

#### To the reader

This doctoral thesis consists of seven parts; Part A through Part G, where Part G includes the articles of the thesis. During the writing, the thesis has developed into a hybrid between a monograph and a collection of articles. With more time given, I would have integrated the articles into the main text to turn the thesis into a monograph and achieved a more user-friendly text. Reading guidance and a description of the different parts and their chapters are given below.

Part A provides the theoretical background for the research. *For the reader who wants to get a quick overview* of the thesis I recommend reading Chapter 1 of Part A, which summarises the main contribution from my research. The reader who is interested in my *methodological approach* can read Chapter 2 (Part A) whereas the *policy oriented* reader might find chapter 5, (Part A) of interest.

Part B and Part C are the main contributions from my empirical material. Part B describes a number of projects that I have participated in. The findings from these projects form the understanding for my notion of transparency see Chapter 12, (Part B) for *definitions of transparency and interaction*. In Part C a number of initiatives are presented that have contributed to my research. Part B and Part C can be used as *a reference* on different aspects that might be of interest to a specific reader.

In Part D and Part E the findings presented in the earlier parts as well as in the articles are analysed and *conclusions* are drawn. In these parts my main contributions are described, in specific my request for increased interaction and my definition of *Interaction Infrastructure*.

Part F constitutes the list of references.

Finally, the three articles that I have included to the thesis can be found in Part G.

#### PART A - SETTING THE SCENE

The first chapter "Main Contributions" is a key chapter in which my notions are defined and my main findings are presented. This chapter serves as a summary of the main contributions.

The second chapter "Methodological Considerations" presents my methodological standing point and position in transdiciplinary practices. The chapter also includes an overview of methodological approaches in the research of logistic and Technoscience Studies as well as a description of the research methods I have applied.

The third chapter "Frame of Reference" provides an overview of ongoing research in fields connecting to my research and a comment on how these findings provide a fundament for my research.

In the chapter "Dare to Share", I highlight alternative views on sharing and producing information and use the theory of innovation to illustrate distributed cooperation between public and private partners.

Part A is finalised by the chapter "Snapshots from Policy Frameworks" where a short overview is provided on the European and US policy framework in regard of intermodal transports and information sharing.

#### PART B: TRANSPARENCY AND INTERACTION

In Part B, I am using my project experiences to illustrate and discuss the importance of information in transport chains. In total five projects are described. I also define the notions of transparency and interaction.

Chapter 6 "Information in transport chains and information models" provides a discussion on information in transport chains. I also present three models that I am using in my research to illustrate the tasks at stake.

Chapter 7 to chapter 11 present the findings from the projects INFOLOG, D2D, Baninfo, KombiTIF and PGCS. The chapters present the objective of the projects, an analysis and the main findings. A comparative analysis is carried out in the following chapter as well as in Part D and Part E. Please note that the projects Baninfo, KombiTIF and PGCS are also serving as empirical material for the papers in Part G.

In chapter 12 "Discussion on Transparency and Interaction" the findings from the projects are discussed and used to define the notions of transparency and interaction.

#### PART C: LEARNING FROM APPROACHES TO TURN TRANSPORT POLICY INTO ACTIONS

In Part C, I present a number of initiatives that all share the objective of turning transport policy into actions. Part C is mainly descriptive and includes no analysis. This is instead carried out in Part D and Part E.

Chapter 13 provides an introduction to Part C

Chapter 14 to chapter 17 describe the four initiatives:

- The EFM program initiative by the US Department for Transport to support the information exchange within the supply chain.
- RIS, an initiative by the European Commission for improving the information exchange for inland waterways.
- Freight Transport Telematics Architecture, a national system architecture commissioned by the Finnish Ministry of Transport
- FREIGHTWISE, a research project within the European Commission's 6<sup>th</sup> research framework program with the aim to facilitate communication in intermodal transport chains.

#### PART D: INTERACTION INFRASTRUCTURE

Part D is dedicated to the definition of Interaction Infrastructure and its content.

In chapter 18, "Discussing *Interaction Infrastructure*", I illustrate that the three domains I have defined are integrated parts of freight transport. I use findings from the projects and initiatives to provide examples of lack of trust between the domains.

I propose *Interaction Infrastructure* as a holistic approach which gradually translates the high level objectives of policy into business related, organisational and technical details. I analyse the findings from PGCS, KombiTIF, EFM and RIS to exemplify the notion of *Interaction Infrastructure* and point out that different segment for information sharing are addressed.

In Chapter 19, "Defining *Interaction Infrastructure*", I focus on making my definition of *Interaction Infrastructure* more tangible. I describe that *Interaction Infrastructure* can have different levels of detail depending on context and ambitions for interaction. I further suggest the content of an *Interaction Infrastructure* and map the content to the PGCS project.

#### PART E: A WINDOW OF OPPORTUNITY

If Part D focused on analysing and defining what Interaction Infrastructure is, Part E continues with arguments on why it is needed and the requirements for its realisation.

In chapter 20 a short introduction to Part E is provided.

In chapter 21 "A Call for Strong Leadership", I stress the need for strong leadership for promoting *Interaction Infrastructure* and provide a number of examples from my research. I conclude by defining three different approaches for promoting *Interaction Infrastructure*.

In chapter 22 "The Role of Policy", I argue that information issues need to get as high status in a policy as the issue of infrastructure in its classical meaning. I further discuss the importance of policy to support *Interaction Infrastructure*.

In chapter 23 "A Window of Opportunity" I summarise the findings from Part E and argue that a number of current driving forces open a window of opportunity towards increased interaction and information sharing.

#### PART F: REFERENCES

In part F the references from Part A to Part E are listed.

#### PART G: THE SCIENTIFIC PAPERS

Part G includes the following three scientific papers:

- Interaction between Transport, Infrastructure and Institutional Management, A Case Study on a Port Community System. Gustafsson I., (2007), Published in Transportation Research Record (2007), TRR 2033, pp. 14-20
- Interaction Infrastructure for Improved Information Experiences from an Initiative Carried out by the Swedish Traffic Administrations. Gustafsson I., (2006), Proceedings from TRA, Gothenburg June 2006

• Perceived benefits of improved information exchange – a case study on rail and multimodal transport. Törnquist J., and Gustafsson I., (2003), Published in Elseviers special edition (ed.) Bekaris, E., Where theory and practice meet: Innovations and case studies in assessing the economic impacts of ITS and telematics, in the book series Research in Transportation Economics

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### PART F: REFERENCES

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PART A: SETTING THE SCENE

# 1. Main Contributions

With my research I have illustrated that information is essential for the management of freight transport systems. The notion of transparency has been explored as well as its importance for transport chains. The conclusion drawn is that transparency does not mean that every player should have access to all information related to the freight transport system at all times. This is not possible from the point of view of competition neither needed from a point of view of quality and efficiency of the transport chains. Instead transparency should be viewed as accessibility of relevant knowledge to the players in the freight transport system based on a well defined sharing of selected information. Thereby enabling the controllability of the common task; the focusing of actions on a common goal; and the understanding of player's areas of responsibility. The production of this knowledge depends on all players being aware of and respecting their role.

The findings indicate that expertise in the freight transport system is distributed among its players, who possess situated knowledge and have their own internal agenda. Trust, mutual benefits, incorporation of situated knowledge and respect of all players' business contexts are key factors for achieving socially robust solutions for transparency.

There are indications of a change of mindset with regard to information exchange. It is being approached with less respect and with more pragmatism than before. The resource intensive implementation of  $EDIFACT^1$  is being increasingly replaced by the more accessible  $XML^2$  messages. Attitudes regarding the use of the Internet for information exchange have become more positive. In addition, in people's private life, the importance of the Internet has increased and users have started to participate and produce content<sup>3</sup>.

The results of my research point to obstacles on the way to more transparency. Some of the obstacles are of a technical nature and will disappear as the technological development continues and the available technology is accepted and implemented. Other obstacles, such as trust between the partners in the freight transport system and recognition of mutual benefits, must still be solved. Information has potentially a high commercial value for the players in a transport chain. Traditionally, transport service providers consider themselves exclusive owners of transport-related information and do not easily see the benefit of sharing information or cooperating with others to improve the quality of information. To some players the lack of information is even the business idea and the very basis of their existence.

Transparency is a prerequisite for security, i.e. information on the origin and the handling of the consignments is required for auditing. However, transparency accessed by someone not authorised can be dangerous. Obviously, there are complex relationships between transparency, security and competition which need to be acknowledged.

<sup>&</sup>lt;sup>1</sup> EDIFACT is an EDI standard. EDI stands for Electronic Data Interchange and is defined as "electronic transfer from computer to computer of commercial or administrative transactions using an agreed standard to structure the transaction or message data" (UN/EDIFACT, 1990). EDIFACT is complicated and although the messages are defined there is still much to agree upon. Jürgen Wehnert - one of the EDIFACT voodoo masters - explained the richness of the messages with the following example: imagine having a tool rich enough to order a nuclear plant and you want to use it to order 12 toothbrushes, it will require a high level of simplifications which you have to agree on with your business partners (Gustafsson 2004).

<sup>&</sup>lt;sup>2</sup> Extensible Markup Language

<sup>&</sup>lt;sup>3</sup> See Web 2.0

In an early stage of my research I was looking into the interaction between transport management and infrastructure management within the rail sector<sup>4</sup>. The understanding of the close interaction between both fields was a key finding that informed my further research. It illustrated how important information from the infrastructure operator is for the transport management, providing valuable information for planning, information on status and disturbances as well as contributing to the reduction of the consequences of disturbances.

Another project that has influenced the direction of my research is the project KombiTIF<sup>5</sup>. The project was initiated by the Swedish government and carried out by the traffic administrations for road, rail, maritime and air transport. The objective of the project was to support intermodal transport through electronic information from the administrations. By participating in KombiTIF I learned that issues related to cooperation both between the different traffic administrations and between the administrations and the transport market are by no means trivial. The role of the administrations as well as what to provide and the conditions for providing it were contentious issues, although there was a general opinion among the administrations that better information to their customers could be useful. The findings were important for my conclusion that *cooperation between public and private partners can bring value to the freight transport system*.

Based on the results regarding transparency and the importance of information in transport chains and inspired by the findings from KombiTIF I argue that it is not enough with cooperation between the traditional transport chain partners to reach transparency, instead *interaction* with a broader set of players is required. I have chosen to cluster the extended group of players into the following three domains, (see also Figure 1):

- Transport management (including the relevant commercial players in the transport chain). The transport management domain is commercial and characterised by business conditions where contracts are established between customer and service providers. One of the key players in the transport management domain is the transport chain manager, the entity with the overall control and responsibility of a transport chain.
- Infrastructure management (public and private traffic management networks and traffic information systems). The infrastructure management includes both public and private players. One core objective is to provide safe and efficient usage of the infrastructure. For the infrastructure run by public players, e.g. national administrations, safety and security are often paramount targets before commercial considerations.
- Institutional management (legislation to meet safety and security requirements, customs regulations, etc.). The institutional domain stands for administration and legislation and includes a variety of objectives, e.g. efficient, sustainable and safe transport systems. It defines the conditions governing transport and traffic and the use of the infrastructure. This domain consists of public bodies and processes where directives, regulations, policy documents and laws set the scene.

<sup>&</sup>lt;sup>4</sup> This was the BanInfo project described in Part B and in the paper "Perceived benefits of improved information exchange – a case study on rail and multimodal transport", in Part G:

<sup>&</sup>lt;sup>5</sup> KombiTIF is described in Part B and in the paper "Interaction Infrastructure for Improved Information -Experiences from an Initiative Carried out by the Swedish Traffic Administrations". The paper can be found in Part G



#### Figure 1: Interaction between transport-, infrastructure- and institutional management

I have illustrated that, mutual benefits including overall improved efficiency can be achieved through an increased interaction between the three domains, e.g.:

- Improved utilisation of production means and infrastructure
- More robust transport concepts
- Reduced transport time
- Improved safety
- Improved quality of logistic services through increased transparency
- Improved customer services and customer satisfaction

I have defined three main segments of information sharing between the domains that I address through my request for improved interaction. These are:

- Information exchange within the transport chain management (B2B, business to business).
- Harmonised routines (e.g. single window access) for fulfilling administrative requirements and improved cooperation between institutional domains (B2A, business to administration and A2A administration to administration).
- Improved access to information about infrastructure and traffic information and enabled common information structures between infrastructure domains (B2I, business to infrastructure and I2I, infrastructure to infrastructure).

The interaction between the domains needs to be facilitated, i.e. formalised and structured. For this I introduce the concept of *Interaction Infrastructure*, which indicates that interaction is not merely a question of being able to communicate from a technical point of view, but there is also a need for commonly agreed objectives (for the interaction), definitions, basic principles, rules for cooperation and communication.

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As one can see in Figure 1, I have placed the *Interaction Infrastructure* between the three domains. This central position reflects the basic definition of *Interaction Infrastructure*, being a support for making commitments and expressing willingness to share information. It thereby addresses one of my main arguments for an improved information sharing: that the players from the different domains need to meet to gain a better mutual understanding, to increase the shared pool of knowledge regarding information and transport chains, and by implication, appreciate the value of transparency.

My research indicates that there is a gap between the formulation of policy for information exchange and the technical aspects of realising this exchange, which I consider being a reason for the slow progress in realising transparency. *Interaction Infrastructure* aims at increasing the understanding of the complex interplay of the material and is proposed as a holistic approach which gradually translates the high level objectives of a policy into business related, organisational and technical details.

Without risking its flexibility to be applicable in different contexts the concept of *Interaction Infrastructure* may be captured in the following definition: *Interaction Infrastructure* is a conceptual framework that supports the definition of the appropriate processes needed for achieving interaction in a particular context.

#### Interaction Infrastructure spans over three levels:

- <u>The contextual level</u> governs interaction between the domains and supports the understanding of the context and shared goals. An important element of the contextual level is visualising the context so that what is externalised becomes a shared object to be negotiated and improved in a consensual manner.
- <u>The protocol level</u>, where protocol should be understood as a mutually agreed way of running an activity. On the protocol level, *Interaction Infrastructure* can be viewed as a roadmap for improving information sharing in a specific case with the objective to simplify the information exchange regardless of the mode(s) involved. This can involve, for example, the agreement of a common view of the basic business processes, the definition of a suitable legal framework, or the definition of information elements and attributes under an appropriate syntax. The protocol level can include the definition of cases, situated conditions and appropriate responses.
- <u>The implementation level</u> guides the implementation of the agreed protocols, i.e. actions and communication is implemented using a choice of proper technologies. At this level, *Interaction Infrastructure* materialises, and requiring technical expertise and the translation of agreed concepts into a concrete system architecture. Importantly, it becomes tangible and testable and thereby subject to feedback and recursive improvements.

Figure 2, illustrates a set of agreements that I have defined as the main content of *Interaction Infrastructure*.



#### Figure 2: Suggested aspects of Interaction Infrastructure.

It is my ambition that the introduction to and definition of *Interaction Infrastructure* provides an outline on how the improvement of interaction can be approached and which issues to be addressed. I argue that *Interaction Infrastructure* can be viewed as an *agora* as defined by Nowotny et al (2003), characterised as "*the problem-generating and problem-solving environment in which the contextualisation of knowledge production takes place*" (*ibid, pp 192*) and thereby provide a platform for reaching a common level of knowledge and stability among and between the players and the domains.

My research shows that a number of issues are recurring in the discussions on achieving transparency. It is the connection to policy, sharing of information across the domain borders, a need for strong leadership, development in cooperation, thinking "outside the own box" in regard of information and in some cases cooperative planning.

Reaching transparency in the context that I describe will require trust. I argue that the relationship between trust and transparency is of an amalgam nature with trust being a prerequisite for transparency as well as transparency being a requirement for trust. Both trust and transparency, in the way that has been discussed in this work, build on a change of mindset with a new culture of information sharing including moving:

- From viewing information from a silo or vertical perspective to a horizontal perspective.
- From a "we and them view" to an "us view".
- From viewing the players as "providers or users" to "providers and users".

Changing mind sets is an extensive task but there are signs from other areas in this direction. Web 2.0, the open source movement and approaches towards open peer reviews provides examples of sharing information and participation when developing content.

Findings from both my empirical material and references stress the need for strong leadership and commitment over time and I argue that *Interaction Infrastructure* is an instrument to support the required processes. The findings have shown that different approaches are applied to support transparency initiatives:

• Legislation which is mainly applied when addressing public actors who follows political decisions and serves the public. This can be exemplified by the European Commission's

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initiative for a harmonised River Information System. The research project FREIGHTWISE indicates a possibility for using legislative measures to address also the private market on non commercial issues (in this case location codes).

- Establish (by investing money and commitment) a good example that provides the incentive to join. This is demonstrated by US DOTs EFM<sup>6</sup> initiative where the strategy of US DOT is to act as a facilitator for creating access and linkage to shipment information throughout the supply chain partners in real time. Through different demonstration and dissemination activities the market is encouraged to implement similar technologies for information exchange. Further US DOT will also provide implementation support. Another strong driver for increasing the attractiveness of EFM would be the functionality a single submission of data for regulatory requirements as demonstrated in PGCS<sup>7</sup>.
- Accreditation and trust building, as demonstrated by the Swedish customs with the Stairway programme<sup>8</sup> where trusted clients are given access to simplified routines.

A further – and urgent - argument for improved transparency and interaction is the overriding issue of global warming. It is not an option to ignore the overall demand for reducing CO2 emissions; hence a major responsibility is placed on freight transport systems due to their large and increasing share of the carbon emissions.

Increased efficiency of freight transport systems is also necessary to fight congestion on our infrastructure and to meet safety and security requirements. A policy should comprise responsibility for infrastructure in the conventional sense, but also include a responsibility for the processes performed on the infrastructure. Society must dare to extend its involvement by starting processes that will lead to a better interaction between the domains and in turn, a higher overall efficiency and a reduced environmental footprint of freight transport. The issue of transparency needs to be included into the policy agenda, both on a regional, national and international level because it is an objective which leads to improved transport efficiency.

I have compared policy approaches between Europe and the US and demonstrated similarities in policy but also different approaches towards solutions. I recommend sharing of experiences between the continents, and as recognised both in US and Europe, the freight industry is global and so should be the harmonised information.

I propose a closer interaction between the different domains, based on mutual respect and concern for the situation of the other players, combined with an understanding of the role the own organisation is performing in this context. This is challenging since it is mixing private and public players and issues. It is my belief that a number of driving forces open a window of opportunity towards improved information sharing. Firstly there is an increased awareness of the problems related to freight transports which will provide the policy maker with a stronger platform to act from and an increased acceptance from the transport industry towards stronger policy involvement. Secondly, through the ongoing development related to communication, technology is less of an obstacle. Thirdly, there is an ongoing change of mindset towards viewing information as something that is not primarily exclusive for one's own purpose but can be made available and benefit a wider group of players. Fourthly, there

<sup>&</sup>lt;sup>6</sup> EFM is described in chapter 5 and in chapter 14.

<sup>&</sup>lt;sup>7</sup> Port of Gothenburg Port Community System. PGCS is described in chapter 11 and in the article "Interaction between Transport, Infrastructure and Institutional Management, A case Study on a Port Community System" that can be found in Part G.

<sup>&</sup>lt;sup>8</sup> The Stairway programme is described in chapter 21

is a trend of an increasing blurring of the boundaries between public and private tasks, which is a material basis for increased interaction.

With my research I have contributed to:

- The development of a deeper understanding of the concept of transparency.
- The development of an understanding of what interaction is.
- A definition of the concept of *Interaction Infrastructure*.
- Examples on what an Interaction Infrastructure can consist of.

I have also contributed to the methodological development of transdisciplinary knowledge production. I have positioned myself and my research within a transdisciplinary practice. I have chosen to place logistic related issues in the academic field of Technoscience Studies at the Faculty of Technology. This approach included a risk of becoming a stranger in both academic fields. Instead it proved to provide me with an alternative opportunity for knowledge production. The awareness of situated and context sensitive knowledge as well as distributed knowledge production that are cornerstones in my epistemological platform within Technoscience Studies are good starting points for addressing logistic issues characterised by social and organisational complexity.

My activities are rooted in praxis through my background as consultant as well as in academia through my activities as a PhD student. I want to view the knowledge that I produce as robust in the sense of Nowotny et al (2001) and I have included the local knowledge of the different players in the domains when defining the concept interaction infrastructure.

A further aspect of transdiciplinarity is that the research focus is not within one of the defined domains of transport management, infrastructure management and institutional management but is situated in the borderland between them where my *Interaction Infrastructure* is positioned.

## 2. Methodological considerations

The findings and results presented in this thesis have been achieved through integrated research and consultancy activities<sup>9</sup> carried out between 1996 and 2007. The work has included areas such as the re-organisation of transport processes and the development of information and cooperation strategies but also the implementation of a road user charging system for heavy goods vehicles. The work has concentrated on freight transport, and the main focus throughout the different research and consultancy activities is *information in the freight transportation domain*.

The main objective of this chapter is to provide an overview on both the theoretical framework used in my analytical work as well as my use of empirical methods. I start the chapter with an overview of the research within the area of logistics where positivism is the dominant epistemological view. I also show that this view is challenged by a number of researchers. My epistemological platform is within technoscience studies and some of its fundamental assumptions is presented. A discussion follows on different view of the "reality" and the role of the researcher and research. The chapter also includes a discussion on my position in transdisiplinary practices as well as a presentation on the empirical methods that I have used throughout the research.

#### Research in the area of logistics

Much research has been undertaken in the area of supply chain management and logistics during the last several decades. According to Gubi et.al (2003) the research in logistics and Supply Chain Management in the Nordic countries experienced a significant boom during the 1990s. The authors identify 30 research environments and 75 theses published between 1990 and 2001.

Arlbjörn and Hallodson (2002) stress that researchers in logistics have different academic backgrounds such as business management, engineering, organisation and transport and therefore might look at logistics from different angles leading to different epistemological perceptions of the context and in turn, the research problem. They argue that the boundaries of the logistics discipline are hard to define and may actually be fragmented. They suggest that the content of logistics knowledge should be divided into a "hard core" which consists of a common study "of the object" and a "protection belt" that reflects the heterogeneity of concepts used to explain and understand the hard core. The unit of analysis regarding the hard core is essentially the flow (of material, information and services) whereas, for example modern information technology to solve logistics problems is a part of the protection belt.

Bontekoning et al (2004) review<sup>10</sup> research carried out within the field of *Intermodal freight transport*. They conclude that there is much isolated research and small research communities focusing on specific aspects of intermodal transport. They claim that today, no authoritative publications exist and that there is not even a commonly accepted definition of intermodal freight transport<sup>11</sup>. The authors distinguish eight research categories, one of which is: *multi-actor chain management and control*. For this area a number of questions are highlighted, including: Is the optimum of a transport chain also the optimum for the individual actors in the chain? How can cost and benefits of changes be redistributed when this does not take place automatically via market

<sup>&</sup>lt;sup>9</sup> At TFK Institute for Transport Research – a Swedish research institution owned by the Swedish transport industry, see <u>www.tfk.se</u> for a company description. In October 2002 the Hamburg division of TFK was sold to BMT British Maritime Technology, see <u>www.bmt-ts.com</u> for a company description. Since May 2003 I am additionally enrolled as a PhD student at the division of Technoscience Studies at Blekinge Institute of Technology, see <u>www.bht.se/tks/teknovet.nsf/</u> for an introduction to Technoscience studies.

<sup>&</sup>lt;sup>10</sup> They reviewed 92 publications (scientific journals, dissertations, books and proceedings)

<sup>&</sup>lt;sup>11</sup> 18 publications included a definition but only three used the definition by ECMT – the European Conference of Ministers of Transport: movement of goods in one and the same loading unit or vehicle that use successively several modes of transport without handling of the goods themselves in changing modes.

mechanisms? What are the consequences for individual organisations when they have to give up some autonomy for the sake of chain objectives?

Russel and Hoag (2003), argue that *social and organisational complexity* is an area of increasing importance in supply chain management, but one that, to date, has received minimal coverage in the top journals<sup>12</sup> (Russel and Hoag, 2003). They especially point out the low research attention logistics and supply chain scholars have for social aspects of IT implementations.

# Positivism, a dominating but criticised epistemological approach within logistic

After reviewing published research articles, Mentzer and Kahn (1995) conclude that the dominating epistemological approach within logistic is positivism. The authors define positivism as "*Positivism* has the goal to explain and predict reality, where reality is considered to be objective, tangible, and fragmentable. People are considered to be deterministic and reactive. Research findings in the positivist tradition are considered value-free, time-free, and context independent, with the general agreement that causal relationships can be discovered. Positivist researchers consider themselves separate from the research setting and at a privileged point of observation".

The dominant role of the positivistic approach and its use of mainly quantitative research methods have been challenged by a number of logistic researchers. Mangan et al (2004) point out that the discipline of logistics can be enriched by the application of more qualitative methodologies. The authors urge logistics researchers to think about the paradigm through which they view the world and to explore the use of alternative methodologies. They also discuss triangulation, i.e. using quantitative and qualitative methods, and claims that it increasingly provides multidimensional insights into many management research problems. Mangan et al cite Näslund (2001), who stresses that to develop and advance logistic research the use of both quantitative and qualitative methods, is required. Näslund argues that logistic problems often are ill-structured and need to be tackled in the absence of a firm definition of the problem. One of the qualitative methods he recommends is action research. According to Näslund, the core idea of action research is that the researcher does not remain an observer outside the subject of investigation but instead participates in the project and even in a change process.

In action research, involvement and improvements of the addressed problems are central elements (Robson 1993). Action research is also discussed by Gummesson (2005) who is active in the research area of marketing. He explains that an action researcher does scholarly research and is both an academic researcher and an external consultant with a twofold purpose: to contribute to science, and to help solve a practical problem. By being involved, the object of study creeps under the skin of the researcher in a way not possible in the study of documents or interviews.

Näslund (2001) further urges us to question the dominance of the positivistic approach and quantitative methods, primarily surveys. He even asks how useful such an approach is to advance an academic discipline when everyone conducts similar types of research, guided by leading academics choice of paradigm. He answers his question by saying that the discipline most likely will not evolve and the research may not be useful to the practitioner.

<sup>&</sup>lt;sup>12</sup> The following Journals were reviewed in a time period between 1997/98 to 2001: Journal of Business Logistics, Transportation Journal, International Journal of Physical Distribution & Logistics Management and International Journal of Logistics Management

Gammelgaard (2004) follows Näslunds question and her answer is that the research will be useful but not useful enough. In her article, Gammelgaard applies the methodological framework defined by Arbnor and Bjerke (1997), (Gammelgaard, 2004). She argues that their framework can be used to categorize former logistics research and to outline new approaches to future research. The framework includes the alternative approaches: analytical approach, systems approach and actors approach where both the analytical approach and the systems approach are in line with positivism. The actors approach on the other hand is more related to social science and seeks to show that terms such as supply chain management must be understood and implemented differently in different organisations according to their individual contexts. By analysing exemplary cases in logistics research Gammelgaard finds that the analytical approach and the systems approach are prevalent, suggesting that they form the two schools in logistics. She concludes that an understanding of logistics research must include also the actors school and that this approach would enable us to explore the human side of logistics strategies and implementations in a new and alternative way.

Mangan et al (2004) discuss a phenomenological paradigm as an antithesis to the positivist paradigm, in which the world is viewed as subjective and a social construct. Gummesson (2000) discusses the differences between a positivistic and a hermeneutic researcher. For researchers within the hermeneutic paradigm he makes the following statement: *pre-understanding that often cannot be articulated in words or is not entirely conscious – tacit knowledge – takes on an important role and researchers accept influence both from science and personal experience; they use their personality as an instrument.* 

#### Fundamental assumptions of technoscience and views of reality

Trojer (2006) argues that when we have acknowledged that we do research by drawing on a certain epistemological infrastructure, then it is high time to question this infrastructure whether is relevant and appropriate for our located needs. My epistemological platform is within Technoscience studies with points of departure including situated knowledge, distributed knowledge production and transdisciplinarity.

The notion of situated knowledge was introduced by Haraway (1988). According to Haraway, all knowledge is local and historically and culturally situated. Objectivity would require detachment but detachment is not possible. The researcher is always located somewhere and Haraway stresses that we are all caught up in a material-semiotic network. She further stresses that what we can contribute to the knowledge production can never be more than partial translations and that translations are always interpretative, critical and just partial (Haraway 1991). To not acknowledge this is to be irresponsible and to fall for the "god-trick", that is to see everything from nowhere. There is no objective observer and the researcher must acknowledge her or his involvement in the knowledge producing process (Haraway 1997). Or, as Barad (2003) states: "We are not outside observers of the world. Nor are we simply located at particular places in the world; rather, we are part of that nature in its ongoing intra-activity. This is a point Niels Bohr tried to get at in his insistence that our epistemology must take account of the fact that we are part of that nature that we seek to understand.....We are part of the world in its differential becoming" Barad (2003) pp. 828.

Latour discusses the difference between science and research: In the last century and a half, scientific development has been breathtaking, but the understanding of this progress has dramatically changed. It is characterized by the transition from the culture of "science" to the culture of "research." Science is certainty; research is uncertainty. Science is supposed to be cold, straight, and detached; research is warm, involving, and risky. Science puts an end to the vagaries of human disputes; research creates controversies. Science produces objectivity by escaping as much as possible from the

shackles of ideology, passions, and emotions; research feeds on all of those to render objects of inquiry familiar. (Latour, 1998, pp. 208-210)

Law (2004) discusses the view of singularity (the existence of one reality out-there) and pluralism in regard of the view on reality and show that both views have weaknesses. He introduces the concept of multiplicity/fractionality as a third way between singularity and pluralism, and claims that we do not have to make a choice between singularity and pluralism. Law is critical about the production of singularity since in his opinion, it hides the practice that enacts<sup>13</sup> it and conceals the possibility of enacting realities in different ways. He further explains that not accepting singularity do not lead us to a word full of pluralism, and he states: *For the absence of singularity does not imply that we live in a world composed of an indefinite number of different and disconnected bodies (...). It does not imply that reality is fragmented. Instead it implies something much more complex. It implies that the different realities overlap and interface with one another. Their relations, partially coordinated, are complex and messy, pp.61. In Table 1, an overview of Laws description of the different views can be found.* 

Singularity	Multiplicity/fractionality	Pluralism
Re-enact Euro-American	More than one and less than	The horror of relativism,
singularity	many	epistemological, ethical and
		political
We see the true world – the	Our hinterlands partially	Fragmented realities, a world
others` perspectives are flawed.	intersect with one another in	composed of an indefinite
	complex way	number of different and
		disconnected objects, hinterland
		not connected
One truth	Varieties of truth. Our	No global truths
	arguments work – but only	
	partially	

Table 1: An overview of Laws description of singularity, pluralism and multiplicity

Haraway (1991) gives a prompt answer to the fear of relativism by stating that "*Relativism is the* perfect mirror twin of totalisation (singularity, author's remark) in the ideologies of objectivity; both deny the stakes in location, embodiment and partial perspective; both make it impossible to see well. The alternative to relativism is partial, locatable, critical knowledges sustaining the possibility of webs of connections called solidarity in politics and shared conversations in epistemology."

Through the absence of a singularity, or the absence of one reality out-there, method becomes a tricky issue. Law argues that method is not a set of procedures to report on a given reality. Instead, method is performative and helps produce realities. Therefore method can never be innocent. A core issue is how we chose to set the borders between presence, manifest absent and Otherness since these boundaries will influence our results. Presence, Law explains as what is in-here, made presence and it depends both on manifest absent and otherness. Manifest absent is what is described as not being present and not taken into account but it's recognised that it is excluded. Otherness on the other hand is simply excluded. Law argues that there is no problem as such with Otherness, boundaries are necessary and there will always be Othering. The problem is when we deny that things are being excluded. Law provides a number of reasons for Othering, e.g. things can be obvious or uninteresting.

<sup>&</sup>lt;sup>13</sup> The notion of enactment is central to Law and he explains it as: the claim that relations, and so realities and representations of realities are being endlessly or chronically brought into being in a continuing process of production and reproduction, and have no status, standing or reality outside those processes.

However they can also be repressed for one reason or another. Therefore we need to attend to the way in which method enacts divisions between manifest absent and Otherness.

Depending on which methodological school one chooses to lean on, the role of the "reality" or the "out-thereness" varies as well as the understanding of the role of the researcher. In the traditional positivistic approach the researcher is an observer who by different means try to produce value free knowledge about an "objective" reality. In other, non-positivistic approaches, the reality is a construct and the researcher is both a viewer and influencer. Law even argues that researcher produces realities<sup>14</sup>. Barad (1998), stresses our responsibilities "*We are responsible for the world in which we live not because it is an arbitrary construction of our choosing, but because it is sedimented out of particular practices that we have a role in shaping*".

#### Implications on my research

The dominant positivistic approach in logistic research is quite a distance apart from the epistemological point of departure in technoscience, but the methods of actor school, action research and the phenomenological paradigm bridge the gap to some extent. Having worked within the area of transportation, logistics and intelligent transport systems I have learnt that this field of study is messy, complex and characterised by a broad mixture of players with different driving forces. When I experience the "reality" I see that it is full of contradictions. Selecting a research question already introduces a choice that foregrounds some aspects and pushes back others, creating commitments that will invariably skew the field of research itself. This means that any choice of topic and method can never be innocent and neither am I as a researcher.

I welcome the alternative knowledge views of knowledge production departing from the positivistic approach, and I see it as a challenge to study how the system's tissue is made up of "sticky" economic, technical, political, organic and historical threads. I subscribe to Latour's description of research as warm, involving and risky as well as Haraways ideas of situated knowledge. I also acknowledge Laws description of multiplicity and fractionality with hinterlands overlapping each other, where it is possible to detect resonance patterns. Regarding my notions of transparency and interaction, I believe that there are minimum levels of needs that correspond across sites, that there is a "least common multiple". However, today the needs are being differently expressed through the usage of "local languages".

It is my belief that to find an acceptable solution for transparency and interaction much more is required than to find a technical solution. If my research was to follow the positivistic logistic research tradition the goal would be to generalise and find a generic model for transparency and interaction. I do not believe that such an approach is fruitful. Instead my aim is to use a set of cases which I can analyse to arrive at commonalities which I can lift to a more theoretical level. These theoretical constructs may then reveal certain characteristics, patterns or 'behaviours' in my field of study and offer new explanations that a positivistic approach would simply be unable to provide. I base these assertions on the following arguments:

- Technical solutions alone fail to solve the problem.
- Transparency and interaction depend on human relationships trust, expectations, risks etc, all of which have a real impact on performance in operating chains across many actors.

<sup>&</sup>lt;sup>14</sup> Reality producing aspects in research are in the core of technoscience that is inspired by Donna Haraway, see www. bth.se/tks/teknovet.nsf.

- A broader set of methods may provide an opportunity to understand the social and psychological dynamics that impact on performance because these dynamics play a vital role in instantiating the processes that the positivist researcher simply treats on an abstract functional and causal level.
- Researching interactions between behaviour and the economic and material context of logistic processes can produce insights useful both for managing agents and the organisational context of processes (e.g. setting responsibilities introducing better ways of monitoring, reporting, or learning) as well as provide a better understanding of the operational context of systems and technologies, leading to more useable and fault-tolerant systems."

With my research, I address Gammelgaard's (2003) claim that research potential can be released by adopting approaches alternative to positivistic ones. Through my choice of methods I am responding to Mangan's (2004) point that the discipline of logistics can be enriched by applying qualitative methods and my choice of topics addresses aspects of identified research needs:

- The lack of research on organisational complexity in supply chain management as identified by Russel and Hoeg (2003).
- The issues related to the field of Multi-actor chain management that needs to be further investigated as pointed out by Bontekoning et al (2004).
- The issue of relationships in supply chain management that is defined as important for further research by Power (2005).

# My position in transdisciplinary practices

Researchers at Technoscience studies acknowledge that the production of knowledge is taking place in distributed systems, i.e. knowledge is produced in the borderland between universities, companies and other regional, national and international actors (Trojer, 2006). What we face are processes of non-linear character far removed from our traditional perceptions of sequential processes in knowledge making in basic research followed by applied research or dissemination to exploitation of knowledge in products (Gulbrandsen et. al., 2007).

Transdisciplinarity is discussed by Bruun et al. (2005) in their study on interdisciplinary research in Finland. Transdisciplinarity is a term defined by Gibbons et al. (1994) that follows on the transgression of society and science. Gibbons et al (ibid) define transdisciplinarity as a cognitive and epistemological framework that is "generated and sustained in the context of applications and not developed first and then applied to that context later by a different group of practitioners". Bruun et al (2005) cite Schulz and Marks (2001) and states that transdisciplinarity has become a label for collaborative research and problem solving that cross both disciplinary boundaries and sectors of society, engaging a shift form science on/about society towards science for/with society.

Creation of knowledge in the interaction between society and science is the core topic for Nowotny et. al. (2001), who stress that "socially robust" knowledge only can be produced in a mixed environment and that it is the product of intensive interaction between results and their interpretation, people and environments, applications and implications. Socially robust knowledge is further described by Nowotny et al (2003) "*reliable knowledge, the traditional goal of scientific inquiry, is no longer* (*self?*) *sufficient in the more open knowledge environments that are emerging; knowledge also needs*  to be "socially robust", because its validity is no longer determined solely, or predominantly, by narrowly circumscribed scientific communities, but much wider communities of engagement comprising knowledge producers, disseminators, traders and users"

The mixture of research and consultancy enables a combination between the worlds of academia and practice. Brulin et.al. (2003), states that knowledge in the emerging knowledge society is increasingly created in interaction between researchers and practitioners which implies a different form of knowledge formation. They name this different formation "interactive knowledge formation" and explain it as knowledge formation in direct contact with practitioners in the development processes, both technical and social. It is further explained that not just empirical results amendable to codification has to be brought into the knowledge formation process, but also tacit and practical knowledge.

In the research projects, I as a researcher filled a central role as: assistant project manager responsible for the evaluation (Infolog), responsible for user requirements (D2D) and project manager (Baninfo). In the consultancy projects I was responsible for the freight issues (KombiTIF) and project management for the consultancy part of the project (PGCS). The research project as well as the consultancy projects included tasks such as defining visions and missions, set up and carry out interviews, organise workshops, collect user requirements, analyse results and develop solutions. The projects have in common that they stretched out over a long period of time: Infolog 24 months, Baninfo 12 months and D2D 36 months, KombiTIF 9 months and PGCS close to a year, all enabling longitudinal studies.

This close involvement in the projects is to my understanding in line with the approach of action research and the mixed environments correspond to the production of socially robust knowledge as described by Nowotny et al and the "interactive knowledge formation" of Brulin et al. I view my involvement in the projects as me having an insider perspective in contrast to the outsider perspective that I had in other parts of the research, e.g. when comparing different policy initiatives. Table 2 provides an overview of the different characteristics between the perspectives that I experienced.

Characteristics outsider perspective	Characteristics insider perspective
Knowledge gained through literature and	Knowledge produced in a mixed environment,
interviews. The studied object is independent of	researcher actively involved in the process
the researcher.	
Difficult to catch the whole picture	Possible to gain tacit knowledge and to
	understand personal relations and hidden causes
Easy to keep a distance	Influenced by the situation, difficult to keep
	distance and to point out negative issues when
	involved with the people and organisations
Qualitative limited material	Quantitative limited material

#### Table 2: an overview of insider/outsider perspective

At the time I was employed at TFK, it was a research institute with a focus on different areas of transport, e.g., intermodal transports and Intelligent Transport Systems. The nature of research carried out at TFK was characterised by its close connection to the transport industry who also were members of the institute. A number of committees consisting of members, chaired by a member and with a researcher as secretary, both exchanged experiences and identified problems of relevance that was further developed into research projects. The research projects were often partly founded by different

national programs for transport research and to some extent also by the research programmes run by the European Commission. Normally the members who had been involved in the identification of the problems also participated in the projects. This setup enabled a meeting between society and science and contextualisation as described by Nowotny et al (2001) occurred. This was my first research environment in which my understanding of knowledge production was embodied. In my understanding, it was a mixed and open environment that allowed for collaborative problem identification, projects in mixed environments and constant re-negotiations as a basis - if not a prerequisite - for producing relevant as well as robust knowledge.

#### **Empirical methods**

The empirical material for the first part of the research with focus on transparency was gained from the research projects Infolog, D2D and Baninfo. Baninfo was a national Swedish research project, and Infolog and D2D were part of the 4th and 5th Framework research programmes of the European Commission. The research policy of the Commission has a strong focus on bringing together user and user needs with a diverse group of problem solvers and it is explicitly problem driven. In the case of Infolog and D2D, the top level objective set by the Commission was to promote intermodal transports. The consortiums around Infolog and D2D were made up by a mixture of industrial partners as well as researchers from different institutes and universities. The partners of the consortiums came from different parts of Europe, had different styles of working and internal agendas and all were working part time in the projects. The management of such projects is challenging, however, both Infolog and D2D provided a heterogeneous environment allowing close interactions between researcher and industrial partners. The industry partners not only brought problems to be solved but also provided deep knowledge on the business environment in which the research was applied.

The second part of the research which focuses on interaction is mainly using empirical material from the projects KombiTIF and PGCS – an analysis for a port community system for the Port of Gothenburg. After discussions with the commissioner of the projects, I have been allowed to use material from the projects in my research and have been able to analyse them and apply them on my ideas regarding interaction. An additional element to the research on interaction is the comparative study between an initiative led by the European Commission on River Information Systems and an initiative from the US Department for Transport on improved information exchange within supply chains.

Through my profession I have participated in a number of different projects and gained experiences that are not explicitly used in my research. However, if accepting Gummesson (2000) ideas about preunderstanding and the researcher accepting influence also from personal experiences, these experiences have supported an improved understanding of the research area and are integrated in an implicit way in the thesis as well as acknowledging my epistemological bas in technoscience studies.

The empirical material used in the research is described in the papers attached. I see a need to stress that the results from the projects are context dependent and shaped by specific local conditions. Each paper also includes a description of the methods used in the specific projects, interviews, workshops, referral processes etc, Table 3 provides an overview of the methods applied. Please refer to the papers for more detailed descriptions.

Method	Comments
Interviews	Mainly semi-structured face to face interviews. Baninfo 11
	interviews, PGCS 18+36 interviews.
Work flow analysis	Mapping of processes in a transport chain. Processes are
	identified and broken down into sub-processes, activities,
	information exchanges and use of IT systems is mapped into
	diagrams. Enables analysis for process improvements.
	Methodology applied and improved in D2D. Applied also in
	Baninfo and KombiTIF.
Discussion groups	Discussion groups have been used in most projects to gain insight
	into the problems but also for quality assurance, e.g. discussing
	the results from different analyses. One specific example is the
	reference group consisting of 39 participants that followed the
	KombiTIF project.
Literature and content analysis	Used throughout the research

Table 3: overview of used methods for collecting empirical material

# 3. Frame of reference

The following chapter aims to provide an overview of research carried out in fields of Supply Chain Management (SCM), Sharing of information, Intelligent Transport Systems (ITS), Information and Communication Technologies (ICT) in transportation and System architecture. Some of the findings provide a fundament for my research:

- Supply Chain Management research illustrates an increased level of cooperation, closer relationships and partnerships between the players with information sharing as an important element.
- Research in the field of sharing information points out benefits for both public and private partners from improved information sharing between traffic and transport management but also that lack of integration between transport modes causes negative impact on the users.
- Information and Communication technologies are stressed to be important for achieving efficient SCM and transportation. The market penetration is highly heterogeneous due to problems for small and medium sized companies to get access to ICT solutions.
- System architecture is viewed as important for interoperability between different systems. Efforts have been put on architecture for individual transport modes but there is an increasing focus in system architecture for intermodal transport.

# **Supply Chain Management and Transport Chain Management**

Globalisation, lead-time reduction, customer orientation and outsourcing are examples of changes in business that influence the management of logistics. Supply chain management, supply chain integration and collaboration are topics that have been much discussed during the last several years as ways to gain competitive advantages. The competition between and among supply chains has superseded competition among firms (Angels, 2003). Skjott-Larsen et al, discuss the changing character of supply chain relations characterised by "partnerships" or "strategic alliances" as opposed to the traditional "arm's length" type of relations. The authors conclude that the new relations share the following characteristics: (1) increased quality emphasis, (2) cooperation on cost reduction programs and continuous improvements, (3) exchange of information and open communication, and (4) a long term approach including sharing risks and rewards, (Skjott-Larsen et al, 2003).

Supply chain management refers to the management of different processes, such as customer relationship management, customer service, demand management, order management, production and material flows and purchasing (Lambert et al., 1998). Transport chain management on the other hand can be viewed as a sub-process of supply chain management as it organises the movement and handling of goods between two specific points through the deployment of a possibly intermodal transport chain involving added-value services. *A strategic partnership between two companies, whether it is a buyer-supplier or a third-party logistics arrangement, can be considered as a segment of an extended supply chain. (Skjott-Larsen et al, 2003).* The supply chain normally contains intermodal elements and research on Supply Chain Management can provide good insight in the problems of intermodal transport chains.

In a literature review on supply chain management integration, Power provides examples of the significance of inter-company relationships. It is emphasized that technology and physical transfer elements are understood, but that the issue of relationships is more difficult and less well understood and therefore more fundamentally important as a topic for further research. He also discusses the challenging situation when benefits land with some members at the cost of others (Power, 2005).

Humphries et al provide a review of literature with focus on the importance of relationships within Supply Chain Management and show that research results stress that successful Supply Chain Management depends on co-operative relationships throughout the supply chain in order to achieve benefits for all participants. This involves closer relationships between members including trust, commitment and collaboration. Although suppliers recognise the need to integrate with their customers, it is apparent that full Supply Chain Management implementation is not being achieved for a number of reasons. The importance of long-term partnering relationships are acknowledged, but the need to base these arrangements on openness, shared risks and rewards that leverage the skills of each partner to achieve competitive performance not achieved by the individual, is a step that firms find difficult to take. The review is concluded with the following statement: *"the importance of improving relationships to achieve successful Supply Chain Management implementations appears to be well known to academia and businesses alike and, after more than a decade, it is still actively pursued as a strategy by the private and public sectors." (Humphries et al, 2004)* 

The importance of collaboration is further pointed out by Sanders et al, who states that the philosophy of Supply Chain Management is founded on collaboration between the supply chain partners and that the collaboration includes exchange of large amounts of information. They refer to information as the "glue" that holds the business structures together, (Sanders et al, 2002). The key point of logistic information integration is the real-time acquisition and recognition of distribution information (Hou and Huang, 2006).

#### **Sharing information**

To identify the perspective of global shippers on the ongoing challenges in the shipping operations, in-depth interviews of top logistics and supply chain managers in 52 major intercontinental companies were carried out, (Shawdon, 2006). The study included the view of the shippers on information about shipments. The shippers chose estimated time of arrival as the real-time information that is of most valuable to them. That information received a 4.6 on a five-point scale (where 5 points was the highest score). The estimated time of arrival information is closely connected to information on deviations and the shippers expressed a preference for reporting only when a shipment is not moving according to plan. The interviews also provide results on how information is electronic data interchange (EDI) which was mentioned by 51 percent of the shippers. Others wanted information to be provided via a central Internet-based portal (26 percent), e-mail (21 percent), or telephone (2 percent). Shawdon (ibid) further states that there's a general acceptance that the industry will have to learn to live with more bureaucracy, compliance, and paperwork due to the regulatory and security environment.

Access to infrastructure and traffic information is vital for the transport management for planning and production of transport chains. Research carried out in Michigan, US (Seongmoon, 2005) indicated that integration of real time road traffic congestion information with vehicle routing leads to 7% cost savings and 11% decrease in usage time for the trucking industry when used in a congested traffic environment.

Törnquist et al, discusses interaction between transport management and traffic and infrastructure management within the rail sector. Traffic and infrastructure management play an important role in the transport chain, responsible for providing information for planning, information on status and disturbances as well as contributing to the reduction of the consequences of disturbances (Törnquist et al, 2004).

Seitz stresses that to make intermodal transport as attractive as truck transport, integration between traffic and transport management is necessary. He calls out for the possibility to use real time traffic information for logistics planning and monitoring (Seitz, 2006).

The thematic network THEMIS funded by the European Commission, examined the status of the interaction between traffic management systems and freight transportation management systems and concluded that at this moment, the integration of traffic information with the freight transportation management tasks is still in its infancy. However, awareness is growing, but real applications and service providers are still in the first stage of development, (Giannopolous, 2002). The question is how joint solutions and cooperation should be supported when the responsibilities and benefits are blurred and who or what should take on the role of a facilitator?

O`Sullivan et al, show that the lack of integration within transport modes as well as across transport modes generates externalities that is, additional costs to the users of the system. They argue that it is the task of the authorities to promote efficient integrated transport network offering the customers optimal level of interconnections and inter-ticketing and suggests a supranational Strategic Authority or Regulator in close connection to the European Commission could be a solution (O`Sullivan et al, 2004).

There is an increasing awareness that freight information would be useful for transportation planners in public service (Lawson, 2004). Lawson argues that decision makers in the area of transportation planning need to better understand the freight movements and suggest a framework for freight data collection. She calls for a strong leadership from the authorities to enable the access of information and identifies the following set of data: origin and destination, commodity characteristics, weight and value, modes of shipment, routing and time of day and vehicle type and configuration.

One example of cooperation between public and private partners for sharing information can be found in the US initiative of developing a freight data framework, (Committee on Freight Transportation Data, 2003). The lack of harmonisation among different databases is viewed as a major problem and it is recommended to move as rapidly as possible toward a more integrated approach that eliminates unlinked data "silos". The use of compatible data elements, standard survey methodologies, and other techniques for facilitating data fusion will be essential to the successful implementation of the national freight data framework. It is concluded that the framework initiative will require *strong leadership to coordinate the data collection activities of diverse entities within the context of an overall strategy and no single organization by itself has the resources and expertise necessary to develop and implement a national freight data framework. Following this analysis it recommended that the USDOT<sup>15</sup> should assume a leadership role in developing and implementing a national freight data framework. It is further stated that the interest and cooperation of a range of public- and private-sector organisations will be essential to the overall success.* 

<sup>&</sup>lt;sup>15</sup> US Department of Transport

# Intelligent Transport Systems and Information and Communication Technologies in transportation

Information and Communication Technologies (ICT) have been used in the field of transport since the mid-80s (Giannopoulos 2004).

One of the major obstacles for implementing ICT solutions within transport chain management is the heterogeneity of the players involved ranging from big companies with internal IT departments to one person companies equipped with a mobile phone. The European Commission recognises the problem for small and medium sized companies to have access to ICT solutions due to start up costs for technology (European Commission 2006).

Davies et al, carried out a case study of the UK road freight transport industry to identify the extent to which Internet freight exchanges and the use of ICT are affecting general haulage. 46 haulage companies of different size were surveyed and 85% agreed that ICT was important for their business. 15 of the companies used vehicle tracking and tracing but only 6 vehicle telematics<sup>16</sup>. The results showed that while many of the smaller haulage operators remain dependent upon traditional communication and process systems, the larger logistics companies, who control the majority of vehicles and freight movements, are progressively developing new ways of working supported by ICT adoption. (Davies et al, 2007)

There is extensive literature available on IT and Supply Chain Management. Gunasekaran et al, carried out a review of 113 articles from different journals with the aim to develop a framework on the application of IT for achieving effective SCM. One of the results from the review is that IT has a major influence on achieving effective SCM. One of the SCM areas investigated was E-commerce with logistics as a sub-area. For logistics it is stated that IT is an indispensable tool for logistic operations. It is also stressed that the concept of e-logistics has been gaining ground after companies selected to go for third party logistics, (Gunasekaran et al, 2004).

Intelligent Transport Systems (ITS) utilises information and communication technologies to support transportation. Traditionally the notion of ITS have been used in relation to private cars, traffic flow and road infrastructure. However there is a growing interest of including also other modes of transport, freight and intermodality to the ITS notion. The US department for Transport includes both commercial vehicle operations, e.g. fleet management and intermodal freight to the main ITS applications. Another indicator for the broader interest can be found when viewing the focus of the annual world congresses on ITS. It is increasingly including other modes of transports and freight issues and moves more towards a focus on systems instead of technology components.

The connection between ITS and ICT is illustrated by e.g. the ITS working group within the ICT Standards Board (ICTSB)<sup>17</sup> or by the ARKTRANS<sup>18</sup> project, which states that Intelligent Transport Systems, are ICT (information and communication technology) systems for the transport domain.

ERTICO, the ITS organisation for Europe provides a short outlook on ITS, a world in which people and goods are connected by the necessary information<sup>19</sup>. Sussman describes ITS as: ITS apply well-established technologies of communications, control, electronics and computer hardware and software

<sup>&</sup>lt;sup>16</sup> Telematics in this context refers to systems that integrate telecommunication and ICT and is used by road vehicles

<sup>&</sup>lt;sup>17</sup> See www.ictsb.org

<sup>&</sup>lt;sup>18</sup> ARKREANS is a Norwegian research project and system architecture. It is presented in Part C.

<sup>&</sup>lt;sup>19</sup> See www.ertico.com/en/what\_is\_its/its\_basics/

to the surface transportation system. He also describes ITS as an enabling technology for: The transportation /information infrastructure, an extended definition of infrastructure, and integration of IT, communications, sensors (Sussman 2005).

Giannopoulos points out technology as an "agent" of the change in the field of transport and describes it as: "*Technology that is impendent everywhere, user-friendly and above all more and more available in every aspect of everyday life*". He further points out the problem of systems having a unimodal focus and not an intermodal approach which would enable better and more efficient planning and operation. He argues that there is a strong commercial need for systems to address the whole information chain in an open horisontal framework to ensure commercial viability. He further concludes that an effective inter-modal information chain capable of serving the needs of both transport users and other participants has yet to be delivered, (Giannopoulos 2004).

Already in the mid-90s, McQueen et al, stressed the need to involve a wider community and provide ITS which have a more holistic nature integrating air, land and sea transportation modes for both passengers and freight, (McQueen et. al., 1994). The authors further stress the following arguments for the success of ITS – arguments that are valid also today:

- Most problems are institutional and organisational not technological.
- 'Technology push' must give way to 'end user pull'.
- Identification of public/private interfaces and development of appropriate cooperation mechanisms are essential to successful wide scale deployment.
- Standardisation is a prerequisite to the exploitation of global market opportunities.

On the European policy level, ongoing efforts aim at advancing the usage of ITS and an "ITS road map" is planned for 2008 (European Commission 2006 b).

# Standardisation and System architecture

Open connections, standard data sets, harmonised databases and data framework etcetera are returning notions when discussing how to improve information exchange. Standardisation and system architecture are two approaches that are claimed to be a way forward.

A known shortcoming in managing freight information is the incompatible data standards as well as retyping data from one electronic system to another. Handfield et al, addresses the problem of data representing different things at different times to different people. To illustrate this the authors cite an example from a data visibility provider<sup>20</sup> that shows that "arrive" have nine different meanings within the same company, e.g. arrive into inventory, arrive load port, arrive final destination, etc.. The authors also stress that such a problem can be solved through fact-to-face meetings where common data definitions are agreed upon for all data to be exchanged. Once the agreements are settled a data definition guideline and data dictionary should be published, (Handfield et al, 2004).

System architecture is important when different organisations are to cooperate around different information services and when different systems are to work together, i.e. to be interoperable. The system architecture can illustrate how the different systems are connected. Natvig et al, point out the there are several system framework architectures for the transport domain. However, up till now most of the work has been related to road transport (Natvig et al, 2003).

<sup>&</sup>lt;sup>20</sup> Stephanie Miles at Bridgepoint

Giannopoulos stresses that a common freight transport systems architecture is required to overcome the problems of lacking interoperability and compatibility of systems. Widely adapted freight transport systems architecture would allow a common approach to developing new systems and applications for freight transport and the following advantages could be reached, (Giannopoulos, 2004):

- interoperability of equipment with different infrastructures;
- compatibility and consistency of information delivered to end users through different media;
- better integration and co-ordination of services;
- solutions that meet the wider needs of the community;
- greater choice for users;
- multiple use of data and infrastructure;
- reduced risks for industry by developing products against national and international standards
- a wider (world) market offering economies of scale in production

# 4. Dare to share

This chapter includes short introductions of the distributed knowledge production and the concept of Web 2.0. This is to provide an alternative view on producing and sharing knowledge and information and also to exemplify existing services based on radical trust. The short overview of innovation systems is added for illustrating distributed cooperation.

# **Distributed knowledge production**

Knowledge and its mode of production and dissemination are the core topics for Gibbons et al, in The New Production of Knowledge, (1994). The message of the authors is that the production of knowledge and the processes are transformed. The authors define traditional knowledge generated in a strict disciplinary context as Mode 1 knowledge. The notion of Mode 2 knowledge is introduced and defined as knowledge created in a broader and transdisciplinary social and economic context and implies a larger number of participants in the research.

In Re-thinking Science, Nowotny et al (2001) further develops the ideas from The New Production of Knowledge and conclude that the closer interaction of science and society signals the emergence of a new kind of science: contextualized or context-sensitive science. The framework of Re-thinking science is set by four main processes:

- Co-evaluation of science and society towards mode 2, e.g. the nature of the Mode 2 society. Both science and society are subject to the same driving forces: generation of uncertainties, pervasiveness of a new economic rationality, transformation of time and space and a self-organising capacity. Science and society have become transgressive, and society can talk back to science.
- Contextualisation of knowledge– society speaks back and meetings take place in the agora. The contextualisation is divided into weak and strong contextualisation. In weak contextualisation, the message from context to science is very general and there is a limited dialogue between users and producers and it is characterised by bureaucratic procedures. In strong contextualisation the researchers both can and want to respond to society.
- Social robust knowledge. Socially robust knowledge can only be produced in a mixed environment and will be superior to purely academic knowledge produced in a mode 1 environment due to more intensive testing in more contexts. The site of problem formulation moves into the agora (science meets society, contextualisation occur). Socially robust knowledge is defined as the product of intensive interaction between results and their interpretation, people and environments, applications and implications.
- Narratives of the experts, e.g. emergence of socially distributed expertise. The authority of expertise rests on its ability to handle many heterogeneous and context-specific knowledge dimensions involved. Narratives become one of the central ways in which the voices of experts are orchestrated to help produce more wide-ranging epistemic, social, political or legal authority, which then is re-introduced to and fed back into the specific context in which expertise is required.

My understanding of knowledge has matured through the idea of knowledge production taking place within the context of applications. I argue that one of the main problems for different solutions for information exchange, reporting or information sharing, is that solutions have been developed in

isolated environments and thereafter transferred to the users. This has lead to solutions that have not fully reflected the heterogenic and complex environment characterising the freight transport market. It is my belief that if the development would take place in the context of applications, much more robust solutions would be produced. The context of application is described by Nowotny et al (2003) pp. 186 as: *"The context of applications describes the total environment in which scientific problems arise, methodologies are developed, outcomes are disseminated, and uses are defined"*.

#### Web 2.0

My definition of *Interaction Infrastructure* in the chapter "Purpose of the research" is based on the idea of interaction between the different domains and includes sharing of information as well as players involved being both producers and consumers of the information. The development and ideas connected to the notion of Web 2.0 includes similar approaches and will be discussed briefly below.

Web 2.0 is a development of the usage of internet towards participation and engagement where people cooperate on creating content. Tim O'Reilly was one of the persons coming up with the notion of Web 2.0. In 2005 he wrote an article with the goal to clarify what Web 2.0 is (O'Reilly 2005). He explains that Web 2.0 does not have a hard boundary but presents a number of ideas that are connected to the core of Web 2.0, e.g.: the users are viewed as contributors, it is about participating, not publishing, and there is a move from "all rights reserved" to "some rights reserved". It includes radical decentralisation as well as radical trust and the services get better the more people are using it. It also includes getting control of the "collective intelligence", i.e. using the users' information. O'Reilly uses Chris Andersons notion of The Long Tail<sup>21</sup> to describe how Web 2.0 tries to reach out to the entire web and not only to the popular centre.

A number of companies are used to illustrate different aspects of Web 2.0. Amazon, the online bookstore, is used to illustrate user engagement; users are invited to participate, e.g. by writing their own reviews. eBay, the auction site, illustrates how a product is built up by the activities of its users and how it grows in attractiveness by the number of users. It is also a good example on how both small and very specific transactions are supported – again The Long Tail. Wikipedia, the online encyclopaedia, where every entry can be edited by any user, is an example of radical trust. It achieves its stability through an extensive set of principles worked out in the wikipedia community such as "articles should be written neutral point of view" and their application to the underlying wikimedia software, (Kapor 2004).

O'Reilly calls the network impact from user contributions, the key to market dominance and explains that the services have built in mechanisms that enable the inclusion of the users' contribution, i.e. these technologies demonstrate network effects, simply through the way that they have been designed.

Critics towards Web 2.0, e.g. Carr (2005), claims that there is a unalloyed praise of Wikipedia. In his opinion, it is at a factual level unreliable and the writing is often appalling. He also asks when the intelligence in "collective intelligence" will begin to manifest itself.

The idea of Web 2.0 is central to the research of Giger (2006) who has coined the concept: "participation literacy" and defines it as "learning to share and participate in a Native Web<sup>22</sup> world

<sup>&</sup>lt;sup>21</sup> The Long Tail, described in Chris Anderson book: The Long Tail: Why the Future of Business is Selling Less of More (2006). It basically describes the phenomenon that niche products can make up a significant share of total sales.

<sup>&</sup>lt;sup>22</sup> Giger defines Native Web as: a concept to denote software, services and activities born on the web and living all their lives on the web.

where participation and sharing is going to be an important feature in our lives". He further states "to be participation literate you have to be equally skilled at sharing your knowledge and letting others share their knowledge with you, but it also includes knowledge of when it is safe to share and when it is not".

#### Innovation

The ideas on interaction infrastructure and cooperation between the privat and public domains are supported by the theoretical framework connected to innovation systems.

The concept 'Innovation system' was one of the first put forward as an interactive alternative to the linear model. The term is in widespread use in the Nordic countries. Finland is usually held up as the paradigmatic case because of its use of the term 'national innovation system' (NIS). The analysis of Miettinen (2002) of how the NIS has developed in Finland can also be called paradigmatic because of his focus on the role of the NIS as a mobilising metaphor.

Supporters of innovation systems acknowledge innovation as an interactive process between universities, public authorities and the business community, i.e. the idea of triple helix. Uhlin and Johansen (2001) describes the triple helix as "three institutional spheres (university, industry and government) formerly operated at arms' length now are increasingly working together, with a spiral pattern of linkages emerging at various stages of the innovation process, to form a 'triple helix' ".

As is discussed in Guldbrandsen et. al. (2007) tripple-helix practices are characterized by coevolutionary processes built on relevance and situated knowledge, which are cornerstone concepts in feminist technoscience studies (Haraway 1988, 1997). The significance of the local, the situated, is expressed by Reijo Miettinen (2002) in the following: "... innovation is about adapting to changing circumstances and making new things in new ways. New ways to do things always emerge locally".

Brulin et.al. (2003), stresses that it is an empirical fact that innovative development of products always contains a great deal of networking and experimentation under rather chaotic circumstances. The authors also provide an overview of new perception of innovation processes and knowledge formation in the era of globalization. "An alternative model of successful innovation processes that focuses on relationship-building and networking is described. The guiding metaphor is the economy as relations, the economic process as conversations and co-ordination, and the subject of the process is not objective factors but reflexive human beings, both individuals and collectives. In this perspective the nature of economic accumulation is not based on material assets but on relations. New products and business ideas are seen as the result of many complicated patterns of cooperation and interaction with external actors, sub-contractors, customers, researchers etc. Successful innovation processes are due to how different actors interact rather than to how big or how many they are".
## 5. Snapshots from policy frameworks

This chapter provides some snapshots from the policy frameworks of the European Commission and the U.S Department of Transport in regard of intermodal transports in general and information issues and public private cooperation in particular. Please note that the overview has no ambition to provide a comprehensive picture of the complex policy frameworks but only to highlight some small parts of the policies that are of relevance to the research.

### **European Commission**

#### Freight transport policy, from intermodality to co-modality

In 2001, the European Commission submitted a white paper on the future transport policy "European Transport Policy for 2010: Time to Decide" (European Commission, 2001). The white paper promotes an increased usage of intermodal transports, which is identified as an approach to utilise existing infrastructure more efficiently and to achieve sustainable transport.

The mid-term review report "Keep Europe moving - Sustainable mobility for our continent" (European Commission, 2006 a), is an evaluation of the white paper and what has been achieved since its publication. The review points out that the policy goal regarding modal-split, i.e. moving transport from road to other transport modes, and a de-coupling between transport and GDP has not been reached. It also forecasts a 50% growth of freight transport (in terms of tkm) between 2000 and 2020. The report also – more clearly than the white paper – recognises that the overall efficiency of the transport system is an important factor in order to support economic development and provide jobs. Mobility and innovation is given more attention in the report, thereby creating a clear connection to the policy goals of the Lisbon agenda<sup>23</sup> for jobs and growth. In the mid-term review the notion of *co-modality* is introduced and defined as: *the efficient use of different modes on their own and in combination will result in an optimal and sustainable utilisation of resources*. The main difference between co-modality and intermodality is the new focus on the total efficiency of the transport sector instead of the transfer of goods from road to rail and maritime transport. The co-modality shall be supported through public policies and match the trend towards integrated logistics. One of the identified public policies is to promote standardisation and interoperability across modes.

In the communication Freight Transport Logistics in Europe – the key to sustainable mobility (European Commission, 2006 b), it is stressed that Europe's transport system needs to be optimised by means of advanced logistics solutions and that logistic thinking needs to be integrated in the Commissions transport policy. It is further stated that the development of freight transport solutions primarily is a business related activity and a task for the industry. The authorities however, have a role to play to keep logistics on the agenda and to create appropriate framework conditions and improve the preconditions for logistic innovations. One of the areas addressed in the communication is information and communication technology where tracking and tracing is mentioned as a prerequisite for efficient logistics. An easy access for companies to ICT is requested which requires open systems. Common and widely accepted standards are viewed as important and it is stated that all development should be geared towards interoperability and common messaging within an open architecture between the players.

<sup>&</sup>lt;sup>23</sup> The Lisbon Agenda from 2000 is an action plan for the European Commission with the aim to "make Europe, by 2010, the most competitive and the most dynamic knowledge-based economy in the world".

During an interview<sup>24</sup> with two officers at the European Commission, DGTREN/Directorate G – Logistics, Innovation and Co-Modality, the concept of e-Freight was presented. e-Freight is the European Commission's vision of a paper-free, electronic flow of information associating the physical flow of goods with a paperless trail built by information and communication technologies. It includes the ability to track and trace freight along its journey across transport modes and the automatic exchange of content-related data for regulatory and commercial purposes. On an "on-need basis", information would be available on-line. Interaction between administrations and private parties and between administrations themselves is a way towards a simplified reporting of data for regulatory requirements that could also be used for business-to-business communications. The officers stressed that a necessary condition for e-Freight is that standard interfaces between the various transport modes are put in place and interoperability across modes is assured. A number of measures were mentioned to achieve the realisation of e-Freight, e.g. a standard data set to describe freight including regulatory requirements and standardisation for electronically descriptions of services offered by freight transport operators. Further, consensus is needed on open, robust data architecture for business-to-administration and administration-to-administration data and information flows.

In autumn 2007 the Commission presented a policy initiative, the freight transport agenda, (European Commission 2007, a) with the objective to improve the efficiency and sustainability of freight transport in Europe. The initiative includes a number of elements and the Freight Transport Logistics Action Plan (European Commission 2007, b) is one of them<sup>25</sup>. The action plan focuses on the e-freight as discussed with the officers as well as a five other main strands of action:

- e-Freight and Intelligent Transport Systems
- Sustainable quality and efficiency
- Simplification of transport chains
- Vehicle dimensions and loading standards
- "Green" transport corridors for freight
- Urban freight transport logistics

The action plan stresses that advanced information and communication technology can greatly contribute to co-modality (ibid) but points out a number of obstacles that needs to be overcome. In the action plan the e-Freight concept is described as start for an "Internet for cargo" that would include the capability to view and compare on-line information on services provided by freight transport operators. For this a sub action is suggested that will develop a roadmap till 2009 together with the stakeholders

"for the implementation of e-freight, expanding on the concept of the "Internet for cargo" and identifying the problem areas where EU action such as standardisation is required".

<sup>&</sup>lt;sup>24</sup> The interview was an open structured 2 hours discussion. My goal with the meeting was to get information about the Commissions policy work and its connection to research in general. Further the RIS system was discussed, these results are presented in Part C. The interview took place in Brussels June 20<sup>th</sup> 2007. Astrid Schlewing and John Berry participated from the Commission.

<sup>&</sup>lt;sup>25</sup> Next to the logistic action plan it includes a proposal for a rail network giving priority to freight and European ports, as well as two proposals on the barrier-free European maritime transport area and the motorways of the sea.

The action for e-Freight shares elements with the action for simplification of transport chains, such as: administrative simplifications and the usage of administrative data for business-to- business communication. This will be explored in the following sub-actions:

Work towards a standard for information flows to ensure the integration and interoperability of modes at data levels and provide and open, robust data architecture primarily for business-to-administration and administration-to administrations data flows. Deadline 2010

Mandate work on a standard data set to describe freight, including for regulatory requirements (while taking into account the current requirements for hazardous goods, live animals, etc) and technologies such as RFID. Deadline 2010

The action plan further introduces the plans of the Commission for a detailed ITS road map for development and deployment and the following three sub actions are suggested in the context of the ITS action plan:

Establish a framework for the development of ITS applications addressing also freight transport logistics, including monitoring of dangerous goods and live animal transport, tracking and tracing, and digital maps. Deadline 2009

Establish a regulatory framework for the standardisation of functional specifications for a single interface (on-board unit) for the provision and exchange of business-to-administration and administration-to administrations information. Deadline 2010

Accelerate work towards interoperability in Electronic Fee Collection and incorporate the necessary components into the single interface. Deadline 2008

Thereby a strong link between freight transport/logistics and ITS is suggested that has not, so clearly, been promoted before. In the freight transport agenda (European Commission 2007, a) it is even stated that the European freight transport policy is constructed on the principles of ITS next to c-modality, green corridors and user orientation. The link between freight transport/logistics and ITS can also be found in the project "EasyWay"<sup>26</sup> where ITS is suggested to be further deployed for supporting: information services for freight transport, freight traffic management services and intermodal freight (Chairs of the Euro Regions, 2007).

#### The Commission's means to support an harmonised European approach

The Commission has a number of instruments to support its policies. One is by regulation through directives. There are a number of examples of initiatives to create a European consensus for information management systems through directives: The work on creating a harmonised river traffic information system (European Commission, 2005) and a joint European system for road user charges for heavy vehicles (European Commission, 2003). In the railway sector, another example is the work on TSI (Technical Specification for Interoperability), which prescribes a number of essential requirements for individual subsystems to enable information exchange (European Association for Railway Interoperability, 2004). Another instrument is the usage of accreditation systems. During the interview that is described in the paragraph above, it was discussed how an accreditation systems

<sup>&</sup>lt;sup>26</sup> A proposal from the Chairs of the Euro Regional ITS Projects within the MIP 1 TEMPO Programme to continue their collaborative work within the TEN-T MAP programme in 2007-2013. The aim of the EasyWay project is the continued coordinated deployment of European Traveller Information and Traffic Management Services and measures supporting Freight transport and Logistics, based on an efficient ICT infrastructure.

could be used to promote logistic service providers offering good information services. Parallels were drawn to NCAP<sup>27</sup> and its system for indicating cars traffic safety levels. Such an approach leaves room for creativity and enables the industry to develop new solutions compared to a situation where legalisation would be the instrument. Mandating standardisation and promoting best practices are other alternatives as well as promoting research.

The policy of the Commission is guiding the research programmes financed by the Commission. The ongoing programme is the 7<sup>th</sup> Framework programme and the 2<sup>nd</sup> call claims to take a holistic transport system approach by considering the interactions of vehicles or vessels, networks or infrastructures and the use of transport services. Such an approach will necessitate the integration of new concepts, knowledge and technologies within a socio-economic and policy context (European Commission, 2007 c). Cooperation between different stakeholders is requested with established networks like the Technology Platforms<sup>28</sup> and ERA-NET<sup>29</sup>. Cooperation with non established networks is also requested. One call (SST.2007.2.1.4) is asking for the creation of an innovative forum with the task of developing a vision for a future innovative, energy efficient and sustainable European transport system. The forum should involve stakeholders and researchers. In this context I interpret stakeholders as players involved the freight transport domain representing both private and public actors. A call on advanced RIS-based transport management solutions (SST.2007.2.2.2) requires that the action should "bring together all relevant actors including possibly shipper/cargo owners".

### U.S

#### A national framework

The U.S. department of Transportation has identified a number of challenges for the freight system connected to increased congestion and capacity constraints. The Department of Transportation claims that it doesn't have the tools-or the authority-to remedy all of the problems on its own and has proposed a *Framework for a National Freight Policy* to bring together public and private stakeholders around a common vision (U.S Department for Transportation, 2006). The proposed framework includes the following vision statement: *The United States freight transportation system will ensure the efficient, reliable, safe and secure movement of goods and support the nation's economic growth while improving environmental quality.* 

<sup>27</sup> Euro NCA is an independent organisation carrying out assessment of the safety performance of cars, see www. euroncap.com

<sup>&</sup>lt;sup>28</sup> The Technology Platforms are set up in the Transport sectors (ACARE for aeronautics and air transport, ERRAC for rail transport, ERTRAC for road transport, WATERBORNE for waterborne transport, Hydrogen and Fuel cells). The Platforms have elaborated long-term visions and strategic research agendas as a complement to the needs of policy makers and expectations of society.

<sup>&</sup>lt;sup>29</sup> ERA-NET is a cooperation between national authorities responsible for the national programming of transport research

The four overreaching themes of the framework:

- 1. It is a national framework meaning that the strategies and tactics draws upon not only the U.S. DOT, but also many other public and private sector organizations.
- 2. Investment in the freight transportation system is important and both public and private financing will be required.
- 3. Private sector efficiencies and expertise is needed in the construction and operation of freight infrastructure. Therefore the framework focuses on facilitating freight transportation through collaborative action between the public and private sectors.
- 4. The framework must be a living document.

The framework has identified seven top objectives. The number 1 objective is: Improve the operations of the existing freight transportation system as. To each objective a number of strategies are suggested which is further divided into tactics. Objective 1 includes the strategy 1.1: Improve management and operations of existing facilities, which includes Tactic 1.1.2.: Pursue information technology initiatives to improve freight operations. Promotion of establishment of international data standards through the International Standards Organization (ISO) is addressed by tactic 4.4.1.

Improved cooperation with the private freight sector has a separate strategy point, Strategy 5.3. Maintain dialogue between and among public and private sector freight stakeholders, which includes:

- Tactic 5.3.1. Coordinate freight policy strategies and tactics with the work of the SAFETEA-LU-mandated commission(s): the National Surface Transportation Policy and Revenue Study Commission and the National Surface Transportation Infrastructure Financing Commission,
- Tactic 5.3.2. Increase public sector awareness of trends in private sector freight operations and investment,
- Tactic 5.3.3. Strengthen interagency dialogue (DOT, DOD, EPA, DOL, Corps of Engineers, etc.) on freight issues,
- Tactic 5.3.4. Continue dialogue between DOT and stakeholder associations (AASHTO, TRB, Waterfront Coalition, AAR, ATA, etc.),
- Tactic 5.3.5. Endorse/establish freight advisory boards for public agencies,
- Tactic 5.3.6. Raise awareness of best practices for freight operations and investment.

The other six top objectives are as follows:

- Add physical capacity to the freight transportation system in places where investment makes economic sense,
- Use pricing to better align all costs and benefits between users and owners of the freight system and to encourage deployment of productivity-enhancing technologies,

- Reduce or remove statutory, regulatory, and institutional barriers to improved freight transportation performance,
- Proactively identify and address emerging transportation needs,
- Maximize the safety and security of the freight transportation system, and
- Mitigate and better manage the environmental, health, energy, and community impacts of freight transportation.

To better understand the complex processes related to goods movements and the exchange of information between multiple entities, U.S. DOT worked closely with the private sector to create a freight process map. By evaluating the process map U.S. DOT could determine that the exchange of freight information is an area where improvements in speed accuracy and visibility could result in large rewards for the freight transport industry. This is addressed in the Electronic Freight Management program (EFM) that sets out to improve operational efficiency and productivity but also is concerned about security. EFM is an activity run by the Office of Freight Management<sup>30</sup> and Operations in cooperation with U.S. DOT's ITS program. The aim of EFM is to provide access and linkage to shipment information throughout the supply chain partners in real time (Fitzpatrick et al, 2006) and the information should serve the private sector and public agencies.

The EFM initiative addresses the need to provide information transfer opportunities to a broad user community. The target is to provide also small and medium sized companies with limited IT facilities with opportunities for good information exchange and visibility. The following is expressed: "Using the Internet to make data broadly available to any authorised and authenticated user in real-time is key to improving the exchange of information along a given supply chain and to ultimately making freight transportation more efficient and secure"

A more detailed description of the EFM initiative can be found in Part C.

#### **Discussion**

The policies of the European Commission and the U.S. DOT share the basic conviction that an efficient freight transport system is vital for the economic development. Both policies address the problems of congestion, non-sustainability and capacity constraints in the existing infrastructure. The European policy has a stronger emphasis on achieving modal change whereas the US policy stronger points at the need for more investments in infrastructure. Efficient usage of the existing infrastructure is common goal for both policies. In Europe the main approach is co-modality and in U.S. the number one objective of the proposed a *Framework for a National Freight Policy is:* Improve the operations of the existing freight transportation system. Both policies points out the importance of cooperation between public and private players.

When looking into the problem analysis and the identified ways to improve the efficiency of the freight transport the similarities are striking. Improved information exchange and communication possibilities are high on both agendas. Standards, common messaging, open architectures are notions that can be found in both policies. Both policies give special attention to small and medium sized companies to promote that they get access to the new solutions. The vision for the e-Freight concept

<sup>&</sup>lt;sup>30</sup> The Office of Freight Management and Operations is run by the Federal Highway Administration which is a part of the U.S. DOT.

of the Commission seems to overlap with the EFM initiative. Both are looking for paper-less solutions where the information connected to the supply chain is harmonised and accessible to all authorised (public and private) players, automated and in real time.

It is further interesting to see that both policies stress that freight transport is in the domain of commercial players but still clearly acknowledge the responsibility of the public. The US policy speaks of DOT as a facilitator and reducer of barriers and the European policy of creating appropriate frameworks. The national framework approach recognises that public and private interaction is required in terms of content and financing. Through US DOT, a highly committed organisation is in the driving seat with sufficient sustainability to maintain a continuous process of development. The Commission has a more ambiguous position having to rely on Member State consensus.

The e-Freight concept focuses on finding consensus for an open architecture with the future users and promotes work on standard data and standardisation for electronically descriptions of services offered by freight transport operators. The EFM initiative also has standards high on the agenda and aims at demonstrating its advantages, cooperate with standardisation bodies and to develop standards when they are missing.

The EFM initiative goes further in its ambitions to develop and demonstrate a technical solution. This can be compared to a number of research projects in earlier European research projects in the 4<sup>th</sup> and 5<sup>th</sup> Framework Programmes. One example is from the Infolog project from 1999 where a web based information management system was discussed. These projects has surely served to build up a knowledge basis but have not resulted in an internet based service widely accepted by the European freight industry. Maybe the US DOT with its strong commitment will have power enough to get the EFM initiative generally accepted by the industry. User acceptance is crucial. Will there be consensus and will the freight industry implement such systems? The description of the EFM initiative puts a strong focus on the adoption of EFM and a deployments strategy that I find promising and the DOT seems to be willing to take a strong responsibility throughout the process.

In parallel with the demonstration, EFM seeks to build awareness of the initiative with industries that will benefit from improved information transfer. It is also interesting to see that the government is prepared to support the companies that are willing to follow the champions from the demonstrations. I believe that one of the strongest incentives for the industry to join is to get other authorities on-board and to enable harmonised reporting procedures where the EFM could be used as a single window for reporting to e.g., U.S. Customs, Homeland Security and Port Authorities. To reach a cross authority/agency agreement will probably be one of the major challenges for the initiative and if succeeding it would bring high value to the users. Possibly, also the agencies (depending on how the reporting is carried out today) would profit from real-time and high quality reporting.

The EFM initiative seems to be more top-down driven then the e-Freight concept. An approach that might be difficult in Europe, where the Commission does not have the same mandate as a national government. The US initiative is initiated by the federal government and federal agencies are in charge of managing the project, running the demonstrations and showcase the benefits. There is a close cooperation with the commercial players both through the one involved in the demonstration and through the guidance from IFTG<sup>31</sup>. However, it is a quite limited number of commercial players involved. The strategy seems to be to make it work with a limited number of players, identify

<sup>&</sup>lt;sup>31</sup> The Intermodal Freight Technology Working Group (IFTWG) is a public-private partnership focused on the identification and evaluation of technology-based options for improving the efficiency, safety, and security of intermodal freight movement.

champions and then go for a broader group. This is an approach that probably enables a fast development path and rapidly leads to results but risks missing user needs and requirements which can lead to a lack of acceptance.

Given the similarities in policy but also the different approaches towards solutions it should be of great interest to see experiences being shared between the continents, and as recognised both in the US and in Europe, the freight industry is global and so should the harmonised information be as well.

Improved information exchange and communication possibilities, standards, common messaging, open architectures, access to all players, public private partnership including sharing the same information, business cases for third party service providers and level playing fields. These are all issues central to my definition of *Interaction Infrastructure* and will be further discussed in the next chapters.

## PART B: TRANSPARENCY AND INTERACTION

Using my project experiences to illustrate and discuss the importance of information in transport chains and to define transparency and interaction

## 6. Information in transport chains and information models

*Transparency* and *Interaction* are two central notions within my research and my understanding has developed and matured from participating in a number of projects.

In the next chapters, experiences and findings from the projects described under the following names; INFOLOG, D2D, BANINFO KombiTIF and PGCS will be presented and discussed. All projects have, from different angles, contributed to my understanding on how important information is for efficient freight transport systems, or to put it simple, *information is as important for the quality of a transport chain as the physical movement of the freight*. This is the foundation on which I base the notion of transparency. The projects have also, some implicit and some explicit, contributed to the understanding on how different players outside the traditional transport chain management domain influence the quality of the transport, i.e. the infrastructure operators and the institutional settings. This is the foundation on which I base the notion of interaction.

This section will be finalised by a discussion on the findings from the projects as well as on the definition of the two notions. Please note that Part G includes papers that focus on Baninfo, KombiTIF and PGCS:

- "Interaction Infrastructure for Improved Information Experiences from an Initiative Carried out by the Swedish Traffic Administrations". The paper describes KombiTIF, a project carried out by the Swedish traffic agencies with the goal to improve access to infrastructure and traffic information.
- "Perceived benefits of improved information exchange a case study on rail and multimodal transport". The paper describes Baninfo, a research project commissioned by the Swedish Rail Administration.
- "Interaction between Transport, Infrastructure and Institutional Management, A case Study on a Port Community System". The paper describes the ambition of Port of Gothenburg to implement a port community system for creating a closer integration with its customers.

In addition, KombiTIF and PGCS will be further analysed in Part D and used as input for defining the notion of *Interaction Infrastructure*.

In Part A, a short overview of supply chain management is provided including a discussion on viewing transport chain management as a sub-process of the supply chain management. Transport chain management organises the movement and handling of goods between two specific points through the deployment of a possibly intermodal transport chain and by involving added-value services. I am using a model consisting of five high level processes to describe a generic transport chain, see Figure 3



#### Figure 3: Five high level processes of a generic transport chain

During the planning processes, transport services are combined to an acceptable solution based on the given requirements for timing, speed, reliability and price. During production, the transport is managed and monitored and in the post production the performance is evaluated against the original planning.

Traditionally an intermodal transport chain is organised and monitored by a number of actors leading to multiple information flows, see Figure 4. The concept of sending information along the transport chain is very vulnerable - if one actor fails to send the correct information in time, the performance of the complete chain can be endangered. In addition the decentralised concept does not enable up- and downstream visibility.



Figure 4: Traditional organisation of an intermodal transport chain

An alternative way to organise intermodal transports is to introduce the function of a transport chain manager<sup>32</sup>. The transport chain manager implicates an entity responsible for the complete transport chain.

The model of Källström (2002), see Figure 5, illustrates the relationships within a transport chain, the transport actors and the interaction with the management of infrastructure. The lower part of the model illustrates the traffic system which consists of the physical infrastructure and its management. TMS and VTMS are traffic management systems used for traffic management.

<sup>&</sup>lt;sup>32</sup> The concept of an transport chain manager is discussed in more detail in the chapter on INFOLOG



Figure 5: Interaction between transport and traffic management with focus on the transport chain (Källström, 2002)

The upper part of the model illustrates the transport operators and the sharing of responsibilities. The generic transport chain is made up by a rail, sea and truck leg. Terminal handling, i.e. movement of goods and load units as well as added value services, combines the modes. A transport chain manager – normally the shipper or a player with the mission of transporting the shipper's goods from door to door - has the overall responsibility of the chain, but has delegated the logistic related activities between supplier and terminal and between terminal and terminal to other organisations. Those organisations, e.g. forwarders or operators either carry out the operation with their own assets or co-operate with different operators.

The model reduces the real world complexity by taking a horisontal view following the transport chain and not the complex pattern of resource management of, e.g. load units, and transport means, handling equipment or infrastructure slots. The resource management is hidden behind the different actors and could be described as a vertical optimisation. The resource management is an important topic and it will decide if a business will generate win or loss. However, I argue that it is of secondary importance from a transport chain context. The decisions regarding the planning of the resources are taken by the players at the lower levels of the transport system – who are depending on access to high quality information to be able to take efficient decisions. The advantage of the model is that it can be used to understand how the responsibilities are distributed and it enables a discussion about cooperation between the players including the exchange of information. Each player remains responsible for their own operation and their own management of resources but it is important to define which transport or handling service as well as which information has to be exchanged, when and in which format.

A player in the transport chain has two basic tasks to fulfil:

• providing the required physical service and

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• to providing information related to the service.

That makes the players not only to users of information but also to important producers of information, which is of key importance for the required transparency of the transport chain.

## 7. INFOLOG

Infolog was a demonstration project within the 4<sup>th</sup> Framework research programme of the European Commission with the objective to show how information and communication technology can be used to make transports more effective. In Infolog the basis for the case studies were Stora<sup>33</sup> and Avesta Sheffield<sup>34</sup>, two major shippers both in the process of changing their distribution concepts. SJ Gods<sup>35</sup>, the Swedish national goods railway operator and Port of Gothenburg were the two most important operators in the project. At the kick off meeting in the beginning of 1998 it was decided that Infolog should deliver (in order of priority):

- 1. a common data model for intermodal transport chains
- 2. a generic systems architecture on which the cases (intermodal transport chains with the industrial partners as leading actors) could be mapped
- 3. a common library of EDIFACT messages for each function in the transport chain
- 4. "add-ons" which facilitate the exchange of information related to data base concepts.

Although the three first priorities were fulfilled in the project, the main focus turned to the fourth priority. Three main driving forces can be identified for the change of project focus:

- 1. the interest of the participating industry partners,
- 2. the emergence of Internet and
- 3. the findings made in the first period of the project, which indicated that many problems in an intermodal transport chain relate to the absence of an overall coordinator.

*The interest of the participating industry partners.* Three of the main industry partners in the project were in the process of re-defining their information systems. SJ Gods, the rail transport operator, wanted to improve the interfaces for information exchange between the information systems covering the whole process between signing the contract and invoicing. Stora wanted to combine its internal information flow with information about the goods flows and get an added value. Their idea was based on a "data warehouse", which in principle should be able to provide all information needed for Stora to manage the transport tasks and monitor the transport. For communication with external partners, standardised EDIFACT messages should be available as well as some other means for more "soft information". Also Avesta Sheffield as a shipper was interested in a database solution ("yellow box" was the working name of the database), which would allow the responsible department in Avesta Sheffield to co-ordinate and manage the transport on a group level and monitor the physical flow. Communication was to be done by EDIFACT messages, but Internet/Extranet type of solutions should also be used as additional support.

*The emergence of Internet.* The industry partners in the project used, to a different extent, electronic information exchange for exchange of messages, either by closed flat-files or EDIFACT messages. Although EDI allowed fast and reliable communication between systems, it had some major drawbacks. The usage of EDIFACT was expensive and time consuming to implement. Although the messages were defined there was still much to agree upon. The differences within the standards were

<sup>&</sup>lt;sup>33</sup> Today trading as StoraEnso after a merger between the Swedish company Stora and the Finnish company Enso.

<sup>&</sup>lt;sup>34</sup> Today trading as Outokumpu

<sup>&</sup>lt;sup>35</sup> Today trading as GreenCargo

compared to dialects within a language. EDI was therefore only used between partners with whom much information was exchanged and the relation was stable. The emergence of Internet provided less complicated methods for exchanging information electronically, and opened up new possibilities for access to information. During the kick-off meeting the project partner Fraunhofer<sup>36</sup> introduced a concept they called the IMS-system (Information Management System) which included web-based communication.

*The absence of an overall coordinator.* The analysis of the user requirements indicated that many problems in the intermodal transport chain were related to the absence of an overall coordinator with ability to consider and act on the complete chain instead of each single leg. To address these problems the project defined the concept of a "Transport Chain Manager". The transport chain manager implicates an entity responsible for the complete transport chain. One of the main legacies of Infolog is a model which illustrates the required information exchange in a generic transport chain, with the transport chain manager in the middle, see Figure 6. The model can be used as an illustration of the complexity of organisation of an intermodal transport. Another issue is the usage of different messages. One can see that the transport chain manager carries out a booking for the train, the sea leg and the land transport. These booing messages contain more or less the same kind of information, all being a booking for a specific consignment. However, for the rail and road transport, EDIFACT messages from the IFT-family are used and for the sea leg a message from the CO-family is used. The IFT-family messages have been developed for land transports whereas the CO-family has been developed for the shipping industry.

<sup>&</sup>lt;sup>36</sup> A German research institute





To support the transport chain manager the functionality for a database IT system was defined – the Transport Chain Management System (TCMS). In brief, the idea of the TCMS was to provide administrative support customised to the needs of the users and their organisation and to provide the necessary functions to plan, book, carry out, monitor and follow up the transport. In total 31 forwarding functions were identified to be included in the TCMS concept, see Table 4.

	Manage Terminal Stock			
Order Goods	Stock Control			
	Supplies Forecasting			
	Supplies Ordering			
	Build Transport Chain			
Description	Select Actors			
Prepare Transport	Contract Actor Services			
chain	Report on Forecasts			
	Customs Clearance			
	Book Transport			
Prepare Transport	Prepare Joint Booking			
	Prepare Joint Loading			
	Plan Transport			
	Plan Distribution			
	Deliver Certificates			
	Report on Loaded Goods			
Perform Transport	Report on Unloaded Goods			
	Report on Delivery			
	Report on Deviation			
	Report on Arrival / Departure			
	Report on Unloading			
	Report on Damage			
	Transfer Invoice			
	Track Load Unit			
Monitor Transport	Track Goods Item			
	Display Document			
	Control Entry / Exit			
	Control Loading			
	Control Unloading			
	Control Yard Locations			
	Control Stuffing / Stripping			

Table 4: Forwarding functions included in the TCMS concept

The TCMS was designed to cover the whole part of the transport chain or parts thereof so that it could be hosted by various actors in the transport chain.

A number of actors in the cases were small and EDIFACT was not an option for communication. The TCMS was therefore enabled to support web based communication. The usage of Internet was however critically questioned by members of the consortium. Not only the security but also the performance was believed not to be high enough and therefore Internet was not an option for business related information exchange but it could eventually be used for "soft-information". The concept of "soft information" was developed in the beginning of the project and defined as:

- Information not sensible for the business process, and
- today not exchanged with EDIFACT

Both Stora and Avesta Sheffield focused on systems transport and sought to improve customer service and efficiency with improved transport to their distribution points. One of the main benefits from the implementation of the TCMS would be a closer cooperation between business units within the company group, e.g. between different production units (the mills) in regard of the planning of the transports. Within the project it was stressed that all involved actors could see their own advantages; otherwise the mills would have little interest in using the system, especially since the implementation would require reconstruction of the internal work at the mills.

The implementation of the TCMS system was expected to provide the following benefits:

- Making intermodal chains accessible, that is, showing "all" available alternatives for transport from a given origin to a given destination combining transport means in the most effective way.
- Simplifying the booking of intermodal transport. This means that all transport services necessary for bringing the goods from origin to destination in an intermodal operation are booked in one operation.
- Making best possible use of available transport resources.
- Automatically communicating documents and information between those taking part in the door-to-door intermodal transport.
- Making the status of the transport visible and thereby providing higher quality.
- Provide better trained staff.
- Providing a better transport logistic control along an intermodal transport chain.
- Making the performance carried out by the transport operators transparent.
- Offering a flexible solution for the transport management; due to the open communication structure it is possible without major software changes to co-operate with new operators.

During the demonstration phase of the project it became clear that the functionality of the system did not completely satisfy the user requirements. This can be explained by a lack of involvement of the end-user in the design process.

Stora implemented their successful Baseport logistic concept in which the information system is one of the building blocks. During the Baninfo project<sup>37</sup> an interview was made with one of the logistic managers at StoraEnso who stressed the importance of information for the transport management and stated

## "What can't be measured does not exist – the main building blocks of transport management are: measure, control and handle deviation"

The main results from the Infolog can be summarised as:

- Improved understanding of the concept of a transport chain including a data based approach for collection of information see Figure 6 and definition of functionality required for a transport chain management system.
- High quality monitoring requires information along the complete chain, including the small players.
- Web based communication is an option and it makes it possible to include the smaller actors. At the beginning of the project (1998) the solution was viewed with scepticism by the industry partners, but as the emergence of Internet continued the scepticism faded.
- All players (also within the same organisation) must see the advantage of using an ICT system to accept them.
- The end users are to be included in the development phase of ICT systems in order to reach robust solutions.

<sup>&</sup>lt;sup>37</sup> A presentation of Baninfo can be found later in this chapter

## 8. D2D

## **Project design**

The D2D project was running within the 5<sup>th</sup> research framework of the European Commission. In D2D the findings from Infolog was further developed with a focus on demonstration. The project included a set of users forming the following five intermodal transport chains:

- John Deere farming equipment from Mannheim (Germany) to dealers in Australia.
- VW cars from Wolfsburg (Germany) to Istanbul.
- Elkem containers from Salten (Norway) to customer in Rheinfelden (Germany)
- PAMESA general cargo from Pamesa (Spain) to warehouse in Cegrisa (Las Palmas).
- UNIFAC general cargo from Lisbon and Tagus Valey (Portugal) to customers in Azores Islands.

The TCMS developed in Infolog for supporting the management of contracts and administrative tasks was one building stone for D2D. In D2D the notion for the logistics management and communication system was changed to the D2D system in which the TCMS is a major module. The other two modules are the FTMS which provide status information and the communication platform that handles the exchange of messages. Figure 7 illustrates an overview of the D2D system design.



Figure 7: The D2D system.

## Functionalities of the D2D system

The main functionality of the D2D system can be summarised as:

*Organising transport.* This is facilitated by enabling the definition of a transport chain through describing a set of services that must be executed in order for the transport to be performed smoothly. In practice this means handling of contracts, quality indicators, time- tables etc. The services thus defined and linked may or may not be involved in the physical handling of cargo (a customs office is an example of an actor in the transport chain that is important to the success of smooth transport, but that does not handle the cargo, only the documentation related to the transport). When the chain is defined, the services may be booked automatically through the exchange of electronic booking and

confirmation messages. Booking can be triggered by an internal system, by a stock-control system in a warehouse, or by a client application designed for booking.

*Providing documents*. The different service providers along the Transport Chain need different forms of documents in order to ensure that the transport is performed efficiently and legally. These documents are distributed to the different actors when they are needed. Product documents may also be transmitted to the receiver of the cargo. One example is a certificate documenting the quality of the product.

*Monitoring and controlling* the transport. It is important that the Transport Chain Manager (TCM) has a complete understanding of the status of the transport and the cargo at all times, even if it might not always necessary to inform the cargo owner. It is particularly important that information regarding irregularities in the transport chain compared to the agreed schedule is made available as soon as possible. If the deviation from the schedule is unacceptable, the transport must be reorganised, by using the same functions that was used to organise the transport in the first place. If the deviation is acceptable, information about it should still be communicated to the actors in the remaining part of the chain, and to the consignee .

*Visualising the status.* As indicated in the previous paragraph, many people may be interested in learning the status of the transport. In order to make the multi-modal transport chain more transparent, this status is made available to the authorised people. Such visualisation may be achieved through exchanging messages or through WEB technology. The D2D system has both capabilities.

#### Analysis of the chains and further user requirements

In the D2D project a more structured and complete analysis of the user requirements was carried out, using a workflow methodology. This work was carried out through a number of workshops for each case where members of the D2D research team met with the transport chain players. For all chains an "as is" description was carried out. This included a mapping of all activities, information exchanges and use of IT systems. All main processes were identified and again broken down into sub-processes that were broken down into work flow diagrams. As a second step the as-is situation was analysed and weaknesses derived. Based on the findings a re-engineering took place and the "to-be" situation was mapped using the same methodology as for the "as-is" mapping. In the "to-be" models the transport chain manager role was introduced as well as the D2D system and its functions. Figure 8 illustrates examples from the business modelling, ELKEM case.



Figure 8 Example from the business modelling. The process "Manage discharge and customs clearance" "as-is" and "to-be"

The exercise showed that there were major differences in IT maturity both between the transport chains as whole and in some cases between the players within each single chain. The understanding of the role of a transport chain manager concept also varied. Below some examples illustrate the differences.

ATG is the transport chain manager of the *Volkswagen chain* and their customer segment is car manufacturers with which they have long term contracts. ATG's business contains of: fleet management, provider of rail service and transport chain management. The fleet management and the providing of rail service are the core business and also the main driver for the profitability of the company. However, ATG has clearly recognised that their customers require a service provider that is prepared to take responsibility for the door to door transport. ATG shows a high level of understanding of the transport chain manager concept and strives for a management of the processes on a chain level, not within individual organisations. ATG has integrated IT solutions with their customers for forecasts and transport orders and well developed tracking and tracing concepts for their own fleet, which to a large extent is equipped with positioning devices. The Volkswagen chain is identified as having *high maturity of IT* and shows *high level of understanding of the transport chain management concept*.

In the *Elkem transport chain* a number of players show a high level of IT maturity, the shipper has a well developed ERP system, the terminal a system for the terminal activities and ENL, the transport chain manager, an IT system for container handling. But the transport chain manager, ENL lacks an overview of the whole transport chain and no interaction exists between the IT systems in the chain. The only system to system communication in the chain today is the EDI communication between ENL and the customs. All other communication is done by fax or mail. For example when containers arrive in Rotterdam, ENL produces a discharge list from their internal system. The system is updated to the terminal operator who enters it manually into his IT system. The system is updated with information about what was actually unloaded and a discharge report is produced which is sent as an e-mail attachment back to ENL who manually updates its system. The Elkem chain is identified as having *high level of IT maturity per organisation but lack interaction and a clear understanding of the concept of transport chain management*.

The *Nutasa chain* is characterised by the absence of a transport chain manager. Today, the transport chain is built up by a number of services and no actor has a complete overview. This leads to situations where for example a container can arrive at the terminal in the Azores and wait for three days before pick-up. The receiver is responsible for the last leg of transportation but is not informed in a structured way of the arrival at the terminal. The workflow analysis showed that all information in the transport chain is exchanged by fax, phone or by documents handed over from one actor to the next. The Nutasa chain is identified as having *low maturity of IT as well as a lack of understanding of the transport chain manager approach*.

For all transport chains the processes were re-engineered to include the concept of a transport chain manager and the D2D logistics management and communication system. The different starting points and maturity of the transport chains indicate high requirements on the D2D system: a generic solution is required that is able to fulfil those different requirements.

The user requirements formulated in D2D stress some topics not addressed in Infolog:

- In the production phase the handling of deviations is a challenge and a time consuming activity. Deviation handling requires good monitoring abilities a functionality identified in Infolog but not conceptually developed.
- Support for the other processes of the transport chain management, i.e. during the strategic and tactical planning as well as the post-production.
- The role of the Transport Chain Manager was extended to ensure that existing information can be shared to benefit all actors in the transport chain provide transparency

*Deviation handling* The logical starting point for deviation handling is that a mature monitoring system detects and alerts deviations or exceeded pre-defined levels of tolerance. The monitoring concept suggested for the D2D system is a top down drill approach. The idea is that the transport chain manager will be able to follow all consignments, also from different customers, on a top level. If a transport chain is under alarm the next level of information is to look into the status per service provider in the transport chain. At this level it will be possible to see which services are active and inactive, how the consignment is spread over the services and which service to a transport means level, e.g. each rail wagon is illustrated for a rail service. The next level of information is a drill down of a transport means level to a cargo item level which has the same structure as the transport means level.

The deviation handling and monitoring is dependent on access to status data from all critical points along the chain. During the re-engineering phase required status points were identified for each chain. Figure 9 illustrates the identified status points from which a status report was required by the D2D system to achieve a minimum visibility standard.



Status updates, Salten - Rheinfelden

#### Figure 9: Identified status points in the ELKEM chain

The status data points identified gives example of different type of information that can support the transparency of the transport chain. The following types are identified:

- Transport service status report
- Transport means position, e.g. ETA (estimated time of arrival) and ATA (actual time of arrival)
- Load unit position, e.g. loading and unloading reports

Given the low IT maturity of some actors a low cost concept with a low implementation barrier was developed. The basic idea is that for each consignment an information trail is defined in a database. This trail is manually updated in real-time at pre-defined status points during the transport for which the actors will use a mobile device. One possibility is to send a message from the TCMS, e.g. a discharge list based on container numbers to the device. The actor confirms the message or when deviation occurs creates an error message. The other possibility is that the actor uses the device to log on directly to the trail and confirms the status in a predefined way. Such a solution is expected to have a good chance of being accepted by the users in the transport chain since it will be low cost and not require any major changes of the actors' internal processes.

*The D2D system as support during other processes* The deviation handling described above is an example of extended functionality during the transport execution/production. During the work with the user requirements the discussions showed that there is a need for support during the strategic and tactical planning as well as for tracking compliance to contract in the post production phase. These tasks are not necessarily carried out by the same members of the staff responsible for the day to day management of the transport chains, on the contrary it is likely that it is done in other departments.

Once a D2D system is up and running it will include the contractual agreements and the planned performance of a transport chain. During the execution status data is collected and stored. This information provides a good start for supporting additional value adding processes.

One prerequisite for an economically sustainable business is the design of contracts (both with the customer and sub-contractors) that successfully balance performance and risk levels of the services provided. E.g., what service level regarding reliability can a transport manager offer without risking penalties while still offering an attractive service?

*The D2D system as distributor of information to the players in the chain:* The success of the D2D system depends on the access to the status information along the transport chain. The re-engineering process included discussions with all partners in the chain. The main objective is to include their local knowledge into the re-engineered model and to support the players in understanding their role in the transport chain.

When the re-engineered model was presented to the players in the Nutasa transport chain it triggered extensive discussions. All players accepted that in a future situation they would have to deliver not only their physical service but also the information related to it. However, what they found interesting was the visibility that the TCMS would provide and they declared interests in the possibility of getting access to the information. It would not only support them in their internal work planning but also enable for performance checks. Similar reactions also came from the other chains. By providing the players, who originally were information providers and task receivers, access to information of interest for, e.g. internal planning of resources and work, control of sub-contractors, et cetera the cooperation would be enhanced and improved.

### **Main results**

The main results from D2D can be summarised as:

- Benefits of a logistics management and communication system must be clear from each actor in the transport chain and the system must be suitable for actors with different IT maturity.
- The functionality of a logistics management and communication system depends on access to status information. A realistic approach is to provide low cost and low barrier solutions for reporting the status messages.

• When implementing logistics management and communication system it is not only new way of reporting feedback or receiving instructions – it opens up new possibilities and new threats, i.e. provides a new transparency which will have implications and consequences on the business, beyond the technical aspects. Access to information is power!

## 9. BANINFO<sup>38</sup>

The outline of the Baninfo project is quite different from the Infolog and D2D projects, which were driven by a combination of explicit user problems and high level policy goals of the European Commission. In Baninfo, the Swedish Rail Administration – Banverket - and its existing information policy were in focus. The Baninfo project was a research project financed by Banverkets research programme and was carried out 2001-2002.

Results from earlier projects had shown that information is as important to a successful transport chain as the actual transport and handling services. Further, technology had matured as well as the mindset in regard to sharing information and using Internet as a communication means. In many of the projects I had been involved in, infrastructure and traffic management were treated as a black box. The Baninfo project aimed at opening the black box to see what was inside.

The following hypothesis was formulated and used as a starting point for Baninfo: *Information* available at Banverket can, through an intelligent exchange with its different customers help to promote rail transport by improving the total quality of the transport chain, and creating a platform for further applications and information exchange with different customer segments.

To test the hypothesis it was crucial to understand the complex interplay between rail administration and their customers and to identify the customers' needs of improved information exchange. For this purpose, the project chose to take a broad definition of freight customers including; shippers, forwarders, transport operators, line agents, wagon owners, information brokers and terminal operators. The project included 11 face to face interviews with the direct and indirect users of the rail system see Table 5.

In the interviews, the notion of information was given a broad definition to include real-time status data on a specific transport as well as amount of slots available when planning a transport concept, and several other types. The interviews consisted of discussions concerning the customers' different business processes ranging from a strategic to a post-operational level, and the use, benefits and lack of information within each process. The results from the interviews were written down and sent to the respondents for confirmation and opportunity for revision in order to avoid misinterpretation and possible bias by the interviewers.

In addition to the interviews, relevant information systems and their content at Banverket were studied, as well as potential improvements and possibilities to satisfy the identified customer demands.

Company/Organisation	Role/-s
Green Cargo	Transport operator/Forwarder
Transwaggon	Wagon owner/Forwarder
Danzas ASG Rail	Forwarder

Table 5.	Customers	included	in	the i	interview	groun.
Lable S.	Customers	menuueu	ш	une i		group.

<sup>&</sup>lt;sup>3838</sup> The paper in Part G "Perceived benefits of improved information exchange: A case study on rail and intermodal transports", is based on the findings from Baninfo and provides additional information.

IKEA Rail AB	Shipper
DFDS Torline	Transport-/Terminal operator
Tågoperatörerna	Trade organisation
Akzo Nobel	Shipper
Railcombi	Operator for combined transports
Banverket	Infrastructure manager
Stora Enso	Shipper
ELOG	Information broker

The material from the interviews was used to identify the customers' main functions and map them into processes. For each function, the information required was identified. The following main information groups could be identified:

- Product information (product, price, accessibility and quality)
- Performance indicators (a route's reliability and quality)
- Infrastructure information (including planned network maintenance)
- ETA, including reliable forecasting of deviations
- Positioning data
- Structured deviation reporting

For the planning of the transport e.g., when deciding if to use rail or not, the product information as well as the performance indicators are important. The lack of this kind of information was mentioned as barrier for choosing rail. This can be compared with the more well-defined services provided by the road transport operators and forwarders. The more detailed planning requires also information about the infrastructure. The infrastructure information must be made available and accessible in different versions, i.e. when planning a transport that will take place in six months the infrastructure information used must contain data for that particular time.

The demand for information during the transport varies between the customers. Some customers require only information regarding deviations, while others demand continuous position reporting, which implies that a future solution must be flexible in terms of information delivery. One of the cornerstones of transport management is information about where the goods are. Also access to ETA is highly requested information that forms the basis for the transport chain management. It is very important for a customer to know when a deviation occurs. For the customer to make a rational decision concerning possible counter measures, information is also needed regarding what consequences a deviation will have at the end of the transport chain.

Not only access to information was required by the customers. There is also a need for better cooperation between the customers and the rail administration. The process of applying for slots was criticised for being time-consuming and to have a too long decision lead-time. For the customers, the need for slots often changes after the timetable has been defined and additional slots must be requested. An improved slot allocation process is probably one of the most important issues that need to be solved to improve the railway's possibilities to become stronger in the competition of freight operations with the road. Another criticised process was the deviation handling. Today the customers can not influence the actions that Banverket takes when deviation occurs, and therefore it would be beneficial if discussions regarding how to prioritise between trains could be enabled.

The project provided the following conclusions:

- Attractive information crucial for the customer's business is available at Banverket. The Administration has access to information (from long term infrastructure planning and operative traffic information to follow up statistics) for direct and indirect customers.
- *The needs of the customers must be in focus.* The accessibility to this information is an important success factor for the railway sector and can only be achieved by focusing on the needs of the customers
- *Flexible solutions are required.* The need for information is largely common for all transport chains but vary from customer to customer depending on the role of the customer in the chain. The market is changing, which among others means that certain actors take over new roles. This leads to Banverket having to offer flexible solutions.
- *Banverket must become clearer in their different roles.* Banverket has different roles: responsible for the general development of rail transport, infrastructure manager and traffic manager. The market (mainly the indirect customer of Banverket as forwarders, wagons owner and shippers) has difficulties in understanding how this affects the behaviour of the Banverket. In addition, the difference between a train operator and the infrastructure manager is also unclear to some.
- A central contact point is required. In certain cases customers don't know from whom the information can be received; from the department for infrastructure management, traffic management or market. A central and common contact point is missing. Today informal networks replace insufficient routines.
- *System support must be further developed.* With present internal organisation and system support Banverket can not fulfil a number of the customers' demands satisfactorily:
  - o Network-covering deviation reporting and forecasting time of arrival
  - o Faster timetable process
  - Performance per route (for planning and follow-up of improvement measures)
  - o Updated infrastructure information
- *Improved marketing efforts of existing services.* The information and the services that are available are for different reasons not used.
- *Improved quality requires better in-data from the customers*. Banverket has to make clear demands regarding the reporting from the customers in order to fulfil their undertakings in a better way.

The project clearly showed that the customers' need for information is not fulfilled. Banverket traditionally deals with infrastructure (to build and maintain) and the usage of the infrastructure with focus on safety. They have little tradition of having customers which lead to a lack of customer orientation. There is also a lack of knowledge of the customers' needs and why they need the information and what the implications are for the customers due to lacking or low quality information.

The situation has lead to informal networks of information exchange. DFDS TorLine stresses that their business was very dependent on information about deviations. If they are informed in good time they are capable of re-planning the assets and services in the terminal but if not high expenses result. Today the quality of the formal information exchange is low and as one of the employees stated:

"It is good to know some important people along the transport chain".

The weak connection with the customers has led to that Banverket to some extent is seen with scepticism. When asked for their view in regard to Banverket as a service provider for information

exchange, StoraEnso stressed that it is doubtful if they would have full confidence in getting into a situation where they are depending on Banverket to get information that is crucial for their business.

As mentioned above Banverket is by tradition a builder and maintainer of infrastructure. This has caused limited levels of investment in IT systems for customer care. One exception is the system OPERA, that uses information existing in other internal IT systems and also stores information about dangerous goods per wagon as well as other train related information. The system stores information for statistical analyses, calculation of fees for the usage of the infrastructure and performance analysis. What distinguishes OPERA from other systems is the approach of letting the train operators use OPERA as a channel for exchanging information to Banverket either through XML messages or manually via a web interface which also opens up the possibility of receiving information from Banverket through OPERA.

The system was implemented in 2002 and the users' reaction was partly negative. There were discussions on how to exchange the information and who should pay for the interfacing. One possible explanation for the negative reaction is that the development of the system was oriented towards the internal needs of Banverket's traffic management without involving the future users (the train operators). The operators were also against reporting all their goods mainly due to the risk that this information could spread to competitors.

The system functionality has since then been extended and more oriented toward the operators' needs. The operators are now starting to show an increased interest, i.e. in getting access to information about the traffic situation and trains in the surrounding area.

Parts of the results from the Baninfo project were recommendations on how to improve the situation. The recommendations included improved IT systems but the focus was on improving the customer relationships, i.e. enable a communication between the customer and Banverket. It was also stressed that the existing information and systems should be oriented towards the customers' needs which require a solid knowledge of the customers and their requirements.

The main results from Baninfo can be summarised as:

- Attractive information crucial for the business of the customer, is available at Banverket which has several information systems for development, maintenance and operation of infrastructure and traffic management. The information systems are well integrated with the internal procedures, but complexity makes changes slow when new tasks are introduced (e.g. new types of user destined information).
- Soft infrastructure, i.e. information describing the physical transport networks and the traffic situation on the physical networks (present, past and future) should be treated with the same priority as hard infrastructure.
- Customer orientation is crucial for a successful information exchange.

## 10. KombiTIF<sup>39</sup>

In the beginning of 2003 the Swedish government commissioned the rail administration to co-operate with the other traffic administrations<sup>40</sup> in the uptake of electronic information as a facilitator for intermodal transport, e.g. the planning and execution of intermodal transports. The work was to result in a common strategy and action plan with the goal of introducing the use of electronic information for supporting intermodal transports. Both the vision and the action plan was to address the administrations. The project was named KombiTIF, an abbreviation for combined transport electronic information supply.

The driving force behind KombiTIF was to improve the cooperation between the traffic administrations for enabling an improved supply of infrastructure and traffic information to its customers. For the customers access to this information is vital and needed throughout the different processes of transport management, during planning, production and post-production. During a workshop with the customers it was stated that access to the right information and well-defined communication paths provide, among several other advantages, a possibility to achieve:

- Improved utilisation of production means
- More robust transport concepts
- Reduced transportation time
- Improved quality of the logistics service through increased transparency
- Improved customer service and customer satisfaction

Supplying harmonised information from the administrations requires a close cooperation between the administrations. Due to the administrations traditional thinking and acting in internal vertical processes it was very difficult to create an understanding for horizontal processes were the activities of the own administration would constitute just one element. Two administrations (the rail and the road administrations) were positive towards increased cooperation and criticised the project for not being explicit enough regarding the way forward. The other two administrations (civil aviation and maritime) on the other hand, saw less value in the suggested cooperation and stated mistrust in the actions and solutions recommended by the project. This issue is described in more detail in the article in Part G.

The objective of the project was limited to providing infrastructure and traffic information. However, the projects reference group, consisting of the customer of the administrations, stressed the need for simplified reporting processes. This need was acknowledged within the project but not discussed in detail.

KombiTIF suggested an arena for providing and exchanging information with the users, see Figure 10. Data available from the different systems at the transport administrations is secured, co-ordinated and packed within each administration. In the next step it is extended to include information from all administrations as well as from other identified actors. Added value information is achieved and the users have the possibility to access the information at different levels. The basis for the arena concept

<sup>&</sup>lt;sup>39</sup> Part G includes a paper that describes the project in more detail: "Interaction Infrastructure for Improved Information - Experiences from an Initiative Carried out by the Swedish Traffic Administrations".

<sup>&</sup>lt;sup>40</sup> Sweden has four traffic administrations who are responsible respectively for the road, rail, civil aviation and maritime sector.

includes agreement on how to ensure the quality of the data, which interfaces to use, and when required which standards to follow. A basic principle is that the harmonisation focuses on the interfaces – not on the internal databases. Throughout the project it was evident that each administration feared changes in their internal systems that are mostly well developed and robust.



Figure 10: Arena for providing information

The sharing and distribution of the information relay on that the information is available within the administrations internal systems. Within the project an analysis was carried out where the required information was compared with the existing situation at the transport administrations. It turned out that some of the information is already being exchanged between the administrations and the users today and some information exists at the administrations but is not exchanged with their customers. One example is that the administrations have access to historical data about the traffic situation but do not have the technical and organisational possibility to make it available. The analysis also showed that some of the information required is lacking and would need to be developed, e.g. an overview of the performance of a specific infrastructure link.

One returning issue was how far the responsibility of the administrations should and could stretch. From the administrations there was a fear of intruding on the business of the customers and other players in the transport chain, i.e., to directly compete with commercial players or to cause an unfair playing field between them.

The findings from KombiTIF show that initiatives like the establishment of an arena require a strong vision and commitment. The concept of the arena has not been accepted as a way forward and it has not been further promoted in the actions that have been taken after the project was finalised. The arena concept has been seen as threatening towards existing initiatives, e.g. freight portals or door to door travel information portals. It has to be more clearly communicated that the arena would be a support through providing better basic data and not a competitor to existing initiatives. It is crucial to respect that information has potentially a high commercial value for some players. Interestingly, the results from the project show that the transport and shipping industry both accept and welcome public initiatives. The industry also expressed their surprise in regard of the low level of cooperation

between the administrations. This indicates that the administrations fear to disturb the market might be overstated and needs to be further investigated.

Throughout the project it was stressed, both by the transport industry and the administrations, that freight transport is international. This leads to a potential conflict between using international standards and to develop national solutions that would work only within Sweden.

The project was criticised for not pointing out which administration (or other organisation) should be responsible for the further development towards intermodal information. The critics stressed that one should not relay on "voluntarily initiatives". It was also discussed that stronger guidelines would be needed from the government to make sure that the development was carried on.

In January 2004, the final report was presented to the Government. The report included the vision and the action plan that the administrations was able to agree upon. As a result of the project an organisation was established with representatives from each traffic administration with the goal to continue the work.

In 2005, Moderna Transporter, a proposition from the Swedish government was presented (Ministry of Industry, Employment and Communication, 2005). In the proposition it is stressed that the work of KombiTIF should be carried on. Thereby an increased customer adjustment can be achieved both of the each traffic agencies services and of a mode crossing service.

The proposition further state that information services are of great importance to increase the efficiency of transport systems. It is also in line with the governments overall ambition to apply a customer oriented approach. To support intermodal door-to-door transports it is important that information is available about the transport possibilities.

Throughout the proposition it is stressed that the role of the public is limited to create fundamentals for the players on the free freight transport market and when the public is working with the establishment of the fundamentals it is important to have a dialog not only with the transport operators but also with the shippers and the business community.

The main results from KombiTIF can be summarised as:

- Access to traffic and infrastructure information from the traffic administrations increases the quality of intermodal transport as well as the quality within each transport mode
- There is an acceptance in the private transport sector for public actions to support transport management
- To establish operative cooperation between the traffic administrations is not trivial but requires strong initiatives and resources

# 11. PGCS – a Port Community System for the Port of Gothenburg<sup>41</sup>

The Port of Gothenburg on the Swedish west coast is Scandinavia's biggest container port. In 2004 the port decided to carry out a pre-study on which needs and interests the ports' customer and other related actors have in an improved IT support for transports via Port of Gothenburg. The port management view information and IT support as crucial in the process of developing the port. The port has a well developed and efficient system for the terminals with a web interface as well as a public domain for market related information. To enable a more unified interface to the customer and having the possibility of creating a deeper integration with a wider community of users, the concept of a port community system (PCS)<sup>42</sup> is of interest to the port.

The pre-study included two sets of interviews. The objective with the first set of interviews was to identify the overall interest of an improved information exchange and to identify problems and unutilised possibilities. The results pointed out a need for improved information exchange in the processes related to the arriving and departure of the vessel as well as services to the vessel including administrative reporting to authorities. The results from interviews and workshops with the potential users of a port community system made it possible to define two main functionalities with a port community system:

- co-ordinate reporting to authorities
- provide operational support to the vessel arrival and departure process

The interviews also showed that improved information related to the handling of the goods in the terminal was a priority. Both railway and truck operators pointed out that they lacked information about the status of their containers which made it difficult to plan their operations. The decision to focus on the vessel process instead of the terminal handling was partly taken due to that the vessel process is viewed as less commercial sensible by the port cluster since it does not include freight information in the same detail level as the terminal handling. By starting with less sensible information trust could be built up for future developments.

Today a number of reports are sent to different authorities, the Coast Guard, the Customs, the Port Authority and the Swedish Maritime Agency. The authorities have different requirements on the report formats and how they are to be sent, e.g.: on-line to portals, fax, email or mail. However much of the information in the reports is the same. In the interviews, captains, agents and shipping lines all stressed that the demands on reporting are increasing and is getting more difficult to handle. The authorities (the Swedish Maritime Agency, the Coast Guard and the Customs) described a joint project under development during the interviews. The goal of the project is to enable a common authority report that would substitute a number of reports and notifications. The authorities stressed

<sup>&</sup>lt;sup>41</sup> Part G includes a paper that describes the project in more detail: "Interaction between Transport,

Infrastructure and Institutional Management, A case Study on a Port Community System".

<sup>&</sup>lt;sup>42</sup> A port community system can have different objectives and features. It can be a tool and process for improving cooperation within the port cluster including an electronic medium for communication between the actors in the cluster, a basis for collaborative work environment, on-line access to port related information and re-use of data and information. Goals can be to: improve service levels, lower transactions cost, increase transparency, improve planning material, and achieve higher security.

that this is a difficult task because technological, economic, and regulatory (e.g. regarding integrity and privacy) differences must be addressed. In parallel, the authorities were deeply involved in their own internal developments and those were not being co-ordinated between them. The Swedish Maritime Agency was still developing its ship reporting system (FRS<sup>43</sup>) within the SafeSeaNet initiative of the European Commission. With the vision: "FRS shall become a portal collecting all reporting from the maritime sector to the Swedish Maritime Agency and other Swedish authorities as well as becoming a node for information exchange for parts of the commercial maritime sector". The Coast Guard had received a governmental mission to create an IT system to co-ordinate the civilian maritime information and to distribute it to nine other authorities, including the Swedish Maritime Agency and Customs. The plan included adding different added values to the system. Streamlining vessel notification reporting is an added value that has been repeatedly identified. Although the authorities were working on a common authority report, which would simplify the reporting routines for the shipping community, it was decided to proceed with a co-ordinated reporting to authorities as one of the main functionalities of the Port Community System. The arguments behind this decision were that the efforts of the authorities were not to be implemented in the close future and once it would be in place the Port Community System could be adapted to fulfil the new requirements.

The establishment of an application to support reporting to the authorities will have a focus on identifying the data elements as well as formats and time restrictions required by the receivers of the different reports. A way forward discussed in the project was to develop a "basic message" that fulfils all receivers' needs. The vessel or its agent would send the "basic message" to the port community system, which work as a broker and provides the required reports to the different receivers. A basis for this is that the public receivers, who have a legislative right to require the reports, accept that the report is channelled by the port community system. Further, the members of the port community system will have to agree on strict rules regarding responsibilities, e.g. the message to be sent to PGCS has to be complete and sent at the right time. Also different possible abnormalities will have to be discussed and rules set on how to solve them.

The other core objective with the port community system was to support the vessel arrival and departure process. The findings from the project show that many different activities take place when a vessel arrives and departs from the port as well as when vessel and crew service at quay are carried out. Many of the activities are interrelated and require co-ordination for a smooth process. During arrival, pilot, tug boat and quay slot need to be co-ordinated and the terminal resources allocated. When one of the services is delayed the other services need to be re-booked which causes additional costs. It is also a risk that the other services are not available at the later time which leads to further delays and disturbances to the vessels timetable. Both agents and service provider asked for increased cooperation between pilots, tug boats and the terminals instead of the existing situation where the planning and allocation is carried out without knowledge of the other actors' situation.

When the vessel is at quay, waste and bunker services are carried out as well as other services. This requires information about when and where the vessel is at quay. In addition some of the services need to be co-ordinated, e.g. it is sometime not possible to carry out bunker and loading in parallel.

Estimated Time of Arrival (ETA) and Estimated Time of Departure (ETD) will be central pieces of information for the operational co-ordination. Since ETA and ETD are difficult to forecast other rules will have to apply regarding "true" and "false" information. For the quality of the system it will be important to be updated with the best possible estimates. Today good estimates are available in

<sup>&</sup>lt;sup>43</sup> FRS is a portal for reporting ship notification, dangerous goods and waste

different internal systems but they are not made available to the other actors in the transport chain. Examples can be found both among agents and the terminal. Agents do not update today's system for vessel notification since they view it as a pure administrative system and also are of the opinion that they conduct reporting in many other systems. During an interview with the terminal, one of the production planners said that they have the best available estimate of the loading and unloading operations - an important element for the ETD – but it is only an estimate. Today they are reluctant to give away this piece of information since they do not want to be blamed in case of any deviations. How to make best possible use of this kind of information, e.g. making both confirmed information and estimates available and to use earlier experiences to evaluate the estimates will be one major challenge for the further work.

An implementation of a port community system will require strong elements of formalisation and structure and a close cooperation between the different players. One of the core ideas is to agree on a structured method to exchange information and thereby replacing the main part of today's informal channels. The next steps towards an implementation of the port community will include agreements on what information shall be accessible and to whom, which routines shall be followed for the updating and retrieving of information, which communications channels are to be used, push and/or pull solutions etc.

The Port of Gothenburg's initiative for a pre-study for a port community system addressed the problem of the actors focusing on their own processes and not on the overall performance of the port cluster. The Port of Gothenburg has the motivation, commitment and resources to strive for overall improvements. As the port initiated the pre-study for a port community system, the port cluster not only accepted it but also welcomed it.

To be able to avoid mistakes, the Port has decided to carry out the development and implementation in close cooperation with the relevant actors in the cluster respecting the different actors' requirements. For each actor is it also important to think outside their own system and to realise and accept that information crucial for their own operation can be of high value also for other actors in the port cluster. Someone taking the responsibility is crucial but also very difficult. The port community system is positioned at the heart of the market and will impact the commercial operations of the involved organisations. It is highly political involving issues of power, trust, vulnerability and accountability. The results from the interviews and the workshops indicate that participation is a prerequisite both to develop robust solutions as well as acceptance.

The main results from PGCS can be summarised as:

- The vessel arrival and departure processes involve different players and sub-processes that are strongly dependent on each other. Today there are limited possibilities to share basic information such as estimated time of arrivals and departure and status of service bookings. Access to information that would support the operations is one of the core functionality of a port community system for the Port of Gothenburg.
- There is no harmonised reporting to the different authorities although the information requirements are similar. Although efforts are put into a common authority report, parallel intra authority developments are ongoing that are not being coordinated between them. An application to support reporting to the authorities is the second core functionality of a port community system for the Port of Gothenburg.

## 12. Discussion on Transparency and Interaction

## **Transparency**

In the Oxford English dictionary "transparent" is defined as: *Having the property of transmitting light, so as to render bodies lying beyond completely visible; that can be seen through; diaphanous.* In my research context I have chosen transparency to imply:

- controllability of the common task,
- focusing actions on a common goal,
- defining the players' tasks (e.g. required input and output) in the framework of a common goal,

all enabling a high quality transport chain. The notion of transparency does not mean that every player should know everything at all times - instead transparency should be viewed as *knowledge* accessible to the relevant players in the transport chain. The production of this knowledge depends on that all players are aware of their role in the transport chain including an understanding of the impact their actions and lack of actions have on the player up- and downstream in the transport chain. The findings from my research indicate that the expertise in the transport chain is distributed among its players, who all have their own internal agenda. The players possess local knowledge - situated knowledge - which seems to go beyond any knowledge applications on a central level.

One of the main contributions from Infolog and D2D is an increased level of knowledge regarding the complexity of intermodal transport chains but also an awareness of that the complexity needs to be simplified - from the users perspective - if intermodal transport chains are to be a competitive transport alternative. This is an alternative way on approaching the notion of transparency.

Findings from the projects show that the development of ICT over the last years has opened up for new technical solutions for information exchange. However, the projects also provide a picture that is far away from fully integrated transport chains with extensive visibility. An illustrative example from the D2D project is the handling of the discharge list at the port of Rotterdam in the Elekem case. The list is first printed out from an ELKEM system, than entered into the terminals system where it is updated with discharge information, printed out and finally entered again into the ELKEM system. Another example is the NUTASA transport chain where containers are waiting at the terminal in the Azores for three days before pick-up since the player responsible for the last leg of transportation is not informed in a structured way of the arrival at the terminal.

To reach visibility in transport chains information must be collected, reported and evaluated over multi actors business processes. This requires close cooperation between the actors in the transport chain. The findings from Infolog and D2D show that transport chains require an overall co-ordinator and the success of the chain depends on the ability of the co-ordinators to involve the different players in the game. It is necessary to focus on a common goal and play the game by the rules.

The projects indicate major differences in level of IT maturity between the players. This leads to that flexible IT solutions is required. One way to enhance the cooperation is to make the information providers also information users, i.e. to give them access to selected parts of the information that has been collected, thereby enabling them to retrieve benefits out of the system.

Results from the projects show that the information that is needed for transparency can be partly gained as a bi-product from internal systems and processes of the different players, e.g. from transport or traffic management systems or from processes implemented to fulfil legal requirements.

In Infolog, the Transport Chain Management System was developed. It started out as a pure management and communication tool with a limited number of functions of an administrative nature. The user requirements were focused on the management and monitoring of a transport chain. During the D2D project the understanding of the requirements increased. It became clear that organising and monitoring are only the starting points – the main value driver is to detect deviations and support deviation handling. This requires up to date status information, which makes it possible to understand consequences and to get decision support on how to minimise the consequences.

In the PGCS project it was illustrated that information on the status of the goods in the terminal, e.g. when it would be ready for pick-up was asked for by the players responsible for that leg in the transport chain. Although the port has no business relationship to the truck operators their information would provide an overall benefit for the logistic situation around the port.

For the visibility of a transport chain a mature monitoring system is evidently the best option but when it is not available, other sources of information can be highly valuable as identified in D2D. The projects show that it is not enough to know where and in what condition a consignment is, it is also crucial to know that the next player in the chain is aware of the upcoming task.

One driving force for the players in D2D to move up the value chain and become transport chain managers is the pressure from their customers. The customers require them to take an overall door to door responsibility and are requesting higher quality including control of the consignments under a high cost pressure.

For the Port of Gothenburg, an implementation of a port community system is driven by the strategy to establish a closer connection with its customers.

The advantages of transparency in transport chains are stressed throughout the projects but there are also a number of disadvantages for different players as well as circumstances that make the striving for transparency difficult. Information has potentially a high commercial value for the player in a transport chain. Traditionally transport service providers consider themselves as exclusive owners of transport related information and do not easily see the benefit of sharing information, or co-operating with others to improve the quality of information. To some players the lack of information is even the business idea and basis for their existence, e.g. different agents in the transport chain.

Transparency also highlights lack in quality for transport and service operators transparency also includes the risk that their performance indicators are revealed to competitors.

Given the potential impact of information it is important that the following quality aspects are respected:

- Accuracy ensuring that the information is correct and that it is provided on time. "Precise information" provided at the inappropriate time can be considered false information, and could easily be detrimental to critical processes related to transport and logistics.
- Confidentiality ensuring that the information provided is not distributed to people or organisations that are not allowed to have access to the information.
- Security ensuring that no unauthorised access to information is "possible".
• Authenticity – ensuring that the information has not been manipulated.

The understanding of the importance of information but also the complexity related to sharing it is the foundation on which I base the notion of transparency. It is not a question of a total visibility where all players know everything. It is a question of knowledge, of the players having access to the information they need and as well as having understanding of the consequences of their actions and lack of actions.

## Interaction

In my research context I am stressing that a broader set of players - public and private – needs to be included in the establishment of transparency and I have chosen to use the notion of *interaction* for this approach. Wikipedia, the free encyclopaedia defines interaction as: "*Interaction is a kind of action which occurs as two or more objects have an effect upon one another. The idea of a two-way effect is essential in the concept of interaction instead of a one-way causal effect. Combinations of many simple interactions can lead to surprising emergent phenomena."* I find that this broad and to some extent diffuse meaning of interaction suits my research.

Infolog and D2D had a strong focus on the management of transport chains and the players involved through contractual agreements, i.e. what is illustrated in the upper part of Figure 5. However interaction with other players was implicitly present and influenced the development of the projects. The interaction to the traffic management, i.e. what is illustrated in the lower part of Figure 5 was hidden within the players' processes. It was not displayed in the business modelling but still influenced matters like calculations of ETA. The interaction to other public players was more perceptible. The complex reporting, e.g. the different requirements on hazardous goods reporting depending on mode of transport was an issue discussed and the TCMS should be able to support the reporting and handle the complexity. Although not in focus, there were signals to see that a broader set of players had impact on the management of the transport chains.

In Baninfo, the focus was on the interaction between the Swedish Railway Administration and the transport chain management. The findings from Baninfo show how important information from the railway administration is for the quality of the transport chains, i.e. an interaction between the players are of significant value.

The interaction topic is further developed in the KombiTIF project where it was possible to define a number of advantages to be achieved for the management of transport chains through improved access to the information of the infrastructure operators, e.g.:

- Improved utilisation of production means and infrastructure
- More robust transport concepts
- Reduced transport time
- Improved safety
- Improved quality of logistic services through increased transparency
- Improved customer services and customer satisfaction

It also became clear that the establishment of such an interaction by no mean is trivial. The findings from KomiTIF as well as PGCS stress how extensive such an establishment of interaction is.

The understanding of the need of involving a broader set of players outside the traditional transport chain management domain when discussing transparency forms the basis for my notion of interaction.

Transparency and interaction are difficult issues requiring mindset changes. In the thematic network THEMIS,<sup>44</sup> 33 projects in the area of Supply Chain Management, E-Logistics and E-Fulfilment were analysed and the following conclusion could be drawn, (Fischer, 2004) "*In a competitive environment, the optimisation of processes seen from the perspective of one particular commercial actor is often in conflict with the perspective and interest of other actors. Total supply chain visibility is therefore an unrealistic holy grail.*"

We have seen that there are diffuse relations and contradictions between transparency, security and competition which need to be acknowledged. Transparency is a prerequisite for security, i.e. information on the origin and the handling of the consignments is required for auditing. However, non authorised access to information can be dangerous. For the players striving for transparency it is a competitive advantage enabling both better customer service and improved performance. At the same time transparency can bring an end to business areas and highlight bad performance.

One way to enhance transparency is to bring the relevant players to the same table and enable them to bring in their local knowledge. Through a common effort a map and a vision of the transport chain, i.e. the approach of work flow modelling an integration of local knowledge is enabled which lays the foundation for cooperation and distribution of responsibilities.

When ICT systems are implemented to support the transparency the players in the transport chain should not be viewed solely as partners contracted to use a pre-defined system to receive tasks and send feedback. Instead the players and their situated knowledge should be involved in the development and implementation phase to achieve a socially robust system.

Each player needs to understand its role and how its performance impacts the other players and the total quality of the transport chain. Throughout the projects it is possible to see that increased transparency is both a possibility and a threat since it reveals issues earlier hidden.

Where a lack of transparency exists and formal networks fail their task, informal networks are established. Informal network can probably never be completely replaced by formal networks but it is important to be aware of them and their vulnerability.

The results from the projects indicate that trust, mutual benefits, incorporation of situated knowledge and respect of all players' business contexts are key factors for achieving socially robust solutions.

<sup>&</sup>lt;sup>44</sup> THEMIS – thematic network within the 5th Framework research programme of the European Commission.

# PART C: LEARNING FROM APPROACHES TO TURN TRANSPORT POLICY INTO ACTION

# 13. Introduction

The focus of Part C is to describe four initiatives with the common objective to turn transport policies into action, i.e. no analysis is carried out in Part C. The following initiatives are presented:

- The EFM program initiative by the US Department for Transport to support the information exchange within the supply chain.
- RIS, an initiative of the European Commission on improving the information exchange for inland waterways.
- Freight Transport Telematics Architecture, a national system architecture commissioned by the Finnish Ministry of Transport
- FREIGHTWISE, a research project within the European Commission's 6<sup>th</sup> research framework program.

In Part D two of the initiatives, EFM and RIS, are analysed and used for the definition of the notion of *Interaction Infrastructure*. All four initiatives will be used in Part E where *Interaction Infrastructure* is further discussed.

# 14. EFM - Electronic Freight Management program

The US DOT initiative, Electronic Freight Management, was introduced in the chapter "Snapshots from policy frameworks" and what follows is a more detailed description.

The aim of EFM is to provide access and linkage to shipment information throughout the supply chain partners in real time (Fitzpatrick et al, 2006). Thereby freight productivity and transportation efficiency can be enhanced and supply chain security improved. The information should serve the private sector and public agencies. The following description of the EFM initiative is based on articles from Fitzpatrick (ibid), Sedor and Onder (2006), Battelle and Transentric (2006), information from the website of U.S. DOT's ITS<sup>45</sup>, FHWA<sup>46</sup> Columbus Electronic Freight Management<sup>47</sup> and email correspondence<sup>48</sup> on specific questions with Michael P. Onder at US DOT FHWA.

To better understand the complex processes related to the goods movements and the exchange of information between multiple entities, U.S. DOT worked closely with the private sector to create a freight process map. By evaluating the process map U.S. DOT could determine that the information transfer during a freight exchange is an area where improvements in speed, accuracy and visibility could result in large rewards for the freight transport industry. The EFM initiative is targeting this information exchange.

The EFM initiative addresses the need to provide information transfer opportunities to a broad user community. The objective is to provide also small and medium sized companies with limited IT facilities with opportunities to good information exchange and visibility. The following is expressed:

<sup>&</sup>lt;sup>45</sup> www.its.dot.gov/efm/index.htm

<sup>&</sup>lt;sup>46</sup> www.ops.fhwa.dot.gov/freight/intermodal/index.htm

<sup>47</sup> www.fih-dot.gov

<sup>&</sup>lt;sup>48</sup> The email correspondence took place in July 2007

"Using the Internet to make data broadly available to any authorised and authenticated user in real-time is key to improving the exchange of information along a given supply chain and to ultimately making freight transportation more efficient and secure". (Fitzpatrick et al, 2006, pp 9)

EFM is believed to accelerate the e-business environment in transportation by:

- Developing a specification for the Web services and a true Service Oriented Architecture (SOA) as the means for exchanging information.
- Demonstrating a platform for commercial interests in hope that the private sector will want to implement similar technologies for information exchange, as well as for potential government users.
- Extending and applying emerging efforts within international standards development to use data-level standards that are applicable globally and in many different contexts of freight movement.
- Demonstrating the packaging of standards with the technology architecture by conducting various tests.

To solve the problem of players in the supply chains using many different IT systems and applications that are incompatible and not able to communicate, EFM has chosen to build on SOA, Service Oriented Architecture. SOA includes Web services and data standards to enable players to seamlessly and dynamically exchange needed information. A SOA is essentially a networked collection of services that communicate with each other. It can be considered an architectural style for building software applications using services available in a network such as the World Wide Web. SOA is said to offer:

- Access to existing customised database formats.
- Computing platform independence.
- Customisable services.

This means that a simple way to join the EFM is to implement a web-facing read-only SOA front end to the existing internal systems. The SOA software will translate Web-service requests to the internal database query and return the requested data as an XML document. For this to work the following key functions are required:

- User authentication and authorisation.
- Encryption of data in transit.
- A uniform data dictionary so that the same terms are used by each supply chain partner.

The core of SOA is a Publish-Subscribe-Discover model with the service producer, a service consumer and a service enabled infrastructure. The ultimate goal of the SOA environment is to facilitate the exchange of information between partners. The service provider makes a service description via the functionality discovery agent. The discovery agent can be hosted by the Service Provider themselves or a third-party provider. The third-party approach allows for a single repository of multiple partner offerings in a single location. Moreover, the third-party approach allows a single partner to have a broader exposure for the services they offer. The service consumer can search the content of the service provider and pull the information.

The service enabled infrastructure includes messaging, data, transformation, monitoring, registry and security services. With this approach, no central data repository is needed. Instead data is maintained and stored by the participating players system. For a level playing field, it is important that an information provider should be able to offer the same basic services as another to thread messages through the system. Thereby allowing supply chain partners public bodies to use the system for their purposes.

The EFM includes demonstrations with a number of commercial partners<sup>49</sup>. The supply chain to be demonstrated is a truck-air-truck chain and it runs under the name "The Columbus Electronic Freight Management (CEFM) Deployment Test". For the demonstration test, the web services and SOA will be referred to as the "Freight Information Highway" (FIH<sup>50</sup>), a mechanism for sharing supply chain freight information. For CEFM, a detailed design has been developed that provides a system-level architecture and design parameters (web services, messages, data schemes etc) that will guide the development and implementation. Please refer to the separate information box for more details and to Figure 11for illustrations.

The test is expected to deliver a "FIH package" that will be available to the public which includes Data Messages and Schemas, WSDLs for Web Services and Code Examples. The test will also be evaluated and disseminated.



Figure 11: A Use case, a database scheme, publish – subscribe – discover model and an overview of interacting web services, all figures are from the Columbus Electronic Freight Management (Battelle and Transentric 2006).

<sup>&</sup>lt;sup>49</sup> e.g. Limited Brands, a shipper of apparel and personal care items based in Columbus, OH; freight forwarders Hellmann Worldwide Logistics and StarTrans International, Ltd.; customs broker Barthco International, Inc.; trucking company ODW Logistics, Inc.; and several airlines that deliver goods from China to the United States, including Evergreen and Atlas Air.

<sup>&</sup>lt;sup>50</sup> FIH is defined as: An innovative non-proprietary standards-based architectural specification that defines a Service Oriented Architecture to support business process coordination and secure real-time data exchange. FIH utilises standard processes, schemas, and definitions that are specific to the freight transportation industry.

# Information box on the Detailed Design Document for CEFM

### The DDD includes:

50 use cases that describe scenarios on how the system will interact with the users to achieve a specific goal or function. Example of use cases are: send purchase order, update consignment with customs status, send dispatch advice, data authentication, send – receive consignment etc..

Functional requirements related to the FIH, the CEFM-specific components and general requirements associated with each partner. Example: "The CEFM shall provide a standardised, uniform method to uniquely identify and label a consignment."

An overview of the FIH and CEFM, e.g. an introduction to web services and SOA as well as different implementations of web services.

Detailed design for: the FIH portal components, the CEFM specific components and the CEFM website.

*FIH portal components* - includes a description of the different role players and the components. One role player is the service provider and it is described which responsibilities it has, e.g. to publish a list of the services to provide and list the methods with which those services can be interacted. The components consist of an application server, hardware, registry, security and services.

*CEFM specific components* - includes a technical overview, the physical architecture, partner applications, data model and connectivity plan, evaluation and web services. The technical overview provides a list of components to be included, e.g. processes to make requests to the other partner's web-services. The physical architecture includes a description of the hardware components. The partner application includes a matrix that describes which components to be implemented at each partner. The components include database tables, extract and load processes, web interfaces and web services. The data model and connectivity plan describes the shadow database which will be used by partners in the supply chain who do not directly expose their internal database to the system. The shadow database includes the information from the partners that are required in the test. It is described how to put data into the database. Web services define in total 21 web services, e.g. publish purchase order, book consignment or receive dispatch advice. The web services will be used to pass information between the partners in the supply chain. Also, the business rules are presented. Each web service is presented with a description, input and output, error values, triggers, authorisation, basic flow and log values.

*CEFM website* – includes an overview, language, security and screen descriptions. Language shall be English, User ID and password will be required. For the screen descriptions a user interface hierarchy is defined and functional list provided for the web sites (functional description, screen content, trigger, flow, database and web service). During the demonstration, efforts will be put into building awareness about EFM. Furthermore a plan will be developed to promote adoption of EFM candidate best practice. Implementation guides to facilitate the roll out will be developed and the government is willing to support industry as it moves forward to adopt best practices. It is believed that such collaboration between US government and industry could enable the adoption of EFM information transfer techniques. This could signify a fundamental change in how intermodal freight would be handled in the future.

The role of the federal agencies is clearly described "For the commercial sector, DOT acts as a facilitator, trying to reduce barriers that prevent supply chain partners from achieving operating efficiencies that have positive effects on transportation networks". The role is further described as: "the role is clearing institutional barriers and demonstrating the way ahead through standardising data sets, building public-private partnerships that showcase operational improvements, identifying criteria that move the industry toward implementation of freight technologies employed in EFM and developing associated operational best practices. Although it is through the private sector that the EFM will be implemented, governmental barriers must also be addressed, such as replacing paperwork now required".

In the future, the federal agency would not be involved any more. There will be no main system to run and maintain since the concept is based on that each player relies on their own legacy system. However, the communication takes place through a web-service that will be supported by a 3rd party, which opens up a new business opportunity. Within EFM, there is a vision of the industry and the local governments coming together in a trade development node interacting with other trade development nodes in the US as well as throughout the world. Rules of governance would then be developed and maintained by a user group.

The lack of agreed standards is recognised as one of the hurdles to increased collaboration between non-integrated players in the supply chains. Therefore, the EFM initiative has a strong component of standardisation. It has an ambition to demonstrate the advantages of harmonised data elements and messaging standards. It will also cooperate with standardisation organisations, i.e. the International Organisation for Standardisation, the United Nations Centre for Trade Facilitation and Electronic Business, WCO, and the Organisation for the Advancement of Structured Information Standards. Where standards are missing, EFM has the ambition to build such standards and deliver them to standards institutions. The unique consignment reference (UCR) is viewed as a key enabling element of EFM and the goal is to keep it maintained throughout the supply chain. Within the EFM demonstrations, it is planned to adopt the UCR from WCO (World Customs Organisation).

The implementation barriers are addressed and it is recognised that the success of the EFM depends on acceptance from the commercial user community and that they actually start using the concept. A key to overcome the implementation barriers is that EFM sets out not to affect the commercial players existing legacy systems. It is further stressed that the EFM concept shall harmonise with existing initiatives that are being adopted by the commercial sector, e.g. web portals for booking or IATAs eFreight efforts towards reduction of paper requirements.

# 15. River Information Services

# The concept of River Information Services

Inland waterways are given special focus in a white paper of the European Commission on the future transport policy "European Transport Policy for 2010: Time to Decide" (European Commission, 2001). It is recognised that the waterways have a capacity that is not fully exploited and that it offers an environmentally-friendly mode of transport. It is proposed to link inland waterways into the transport system of rail and short sea shipping. To increase the quality and thereby making the transport mode more attractive, the paper prescribes "the installing of highly efficient navigational aid and communication systems on the inland waterway network".

National stand-alone telematic services have been deployed on various European inland waterways, mainly for traffic management. These services are not compatible, which forces the users to relate to different services. To achieve efficient cross-border waterway transports and effective interaction between different services the individual systems needs to evolve in a harmonised way.

To ensure a harmonised, interoperable and open navigational aid and information system the European Commission decided to support the development of common requirements and technical specifications (European Commission, 2005).

River Information Services, (RIS) is defined as: "a concept of harmonised information services to support traffic and transport management and inland navigation, including interfaces to other modes of transport" (European Commission, 2006 a). The main objective for the River Information Services is to increase safety and efficiency by providing reliable navigation conditions. Furthermore, improved information exchange will increase the attractiveness of waterway transport as an element in door-to-door transport chains.

The RIS concept was detailed in the European research project INDRIS within the 4<sup>th</sup> Framework Research Program of DG-VII. The project included partners from national public authorities, industry and academia and lead to a European wide acceptance of the RIS concept (Willems, 2002).

The concept of river information systems is based on the idea of sharing information between different actors involved in the inland water traffic. Thereby, it brings different worlds together, i.e. the worlds of traffic and transport related services and the world of public and private actors. Figure 12 illustrates the traffic and transport related services, (Seitz 2006). As the figure shows, the traffic related services are:

- Fairway information geographical, hydrological and administrative data used by skippers and fleet managers to plan, execute and monitor a journey. RIS will provide standardised and machine readable electronic charts and Notice to Shippers. It is a one way communication from the traffic management to the ship and or the office.
- Traffic information the traffic information supports the vessels in their navigational planning. It is divided into tactical and strategic images. The tactical level supports the ongoing navigation in the actual traffic situation by providing information about position, speed and heading of vessels in the close area. The information is displayed on an electronic chart. The strategic level provides a general overview of the traffic situation over a larger area and thereby supports planning and monitoring.

- Traffic management is carried out by the waterway administrations. Local traffic management interact with the vessels mainly by radar and can respond to traffic situations. The lock and bridge management is using RIS for an overview of the traffic situation and for planning its operations. The vessel can also be informed about the expected time of service and can adapt the planning.
- Calamity abatement registers vessel and transport data for providing it to rescue teams in case of accidents.



#### Figure 12: River Information Services (Seitz 2006).

To meet the information requirements of door to door transport chains, a number of transport services have been established:

- Information Transport Logistics voyage planning, transport management, intermodal port and terminal management and cargo and fleet management. This includes providing information to actors not involved in the navigation or traffic management segments. Typical users are freight brokers and terminal operators.
- Waterway charges and harbour dues the travel data of the vessels can be used to calculate fees.
- Information for law enforcement supports law enforcement in the area of cross border management. This also includes providing information to public actors like immigration service and customs.
- Statistics supports the collection of statistics and reuses information already provided.

By addressing both the traffic and transport segment, a number of different actors are viewed as potential users of the system, e.g. authorities, lock and infrastructure operators, fleet managers, skippers and terminal and port operators.

# The directive "Harmonised River Information Services (RIS) on Inland Waterways in the Community"

The RIS directive was published in the Official Journal of the European Union on 30 September and came into force on 20 October 2005. The directive requires the establishment of RIS on the waterways in Member States based on the RIS technical guidelines (European Commission, 2006).

The directive's main text consists of 13 articles, which are followed by two annexes, annex 1 on "Minimum Data Requirement" and annex 2 on "Principles for RIS Guidelines and Technical Specifications".

The directive has a high level content defining which member states that are to follow the directive and how it shall be put into force. It includes the subject matter, scope and definitions, e.g. 'interoperability' is defined as: "services, data contents, data exchange format and frequencies are harmonised in such a way that RIS users have access to the same services and information on a European level". The RIS users shall be supplied with the relevant data and messages in an electronic format and the competent authorities shall be able to receive the electronic reporting.

It further states (article 5), that to support RIS and to ensure interoperability, the Commission shall define technical guidelines and specifications that shall be based on the technical principles set out in Annex 2 as well as take account of work carried out in this field by relevant international organisations. The Commission shall be supported by a committee composed of the representatives of the Member States and chaired by the representative of the Commission. This is the same committee that was established by directive 91/672/EEC. A separate article recommends the usage of satellite positioning. The directive further defines that type approval of the RIS equipment will be necessary and that it should be carried out by national bodies. The approval shall be valid also in the other relevant member states.

Annex 1, "Minimum Data Requirement" defines which data that shall be provided by the RIS Services:

- Waterway axis with kilometre indication.
- Restrictions for vessels or convoys in terms of length, width, draught and air draught.
- Operation times of restricting structures, in particular locks and bridges.
- Location of ports and transhipment sites.
- Reference data for water level gauges relevant to navigation.

Annex 2, "Principles for RIS Guidelines and Technical Specifications" sets the framework for the development of the *technical guidelines* and *technical specifications*. It states that the RIS guidelines shall respect the following principles:

- The indication of technical requirements for the planning, implementation and operational use of services and related systems.
- The RIS architecture and organisation.
- Recommendations for vessels to participate in RIS, for individual services and for the stepwise development of RIS.

The *technical guidelines* shall serve as a support for planning, implementation and operational use of RIS and it includes the following chapters: introduction, definitions, participating vessels, RIS architecture, recommendations for individual services, planning of RIS, stepwise introduction of RIS and RIS standardisation procedures. It also includes terms and definitions that shall be used in further standardisation work and application design to ensure mutual understanding. One of the chapters provides an architecture to be used when developing services, systems and applications. The architecture describes among other things, how the RIS services are built up by different functions and who the users are. It also describes the relation between services and systems. Systems refers to different technological systems like Internet, Light Signals, Shore based cameras and radars, etc. A

service is normally built up by a number of systems and a system is often used to serve more than one service. Vessel based radar for example, is used for Fairway information, traffic information and calamity abatement support. Each service is given special recommendations with emphasis laid on services. Furthermore, the guidelines provide support on how to plan for RIS.

The *technical specifications* shall cover the following four areas: Inland ECDIS, Electronic ship reporting, Notices to skippers and Vessel tracking and tracing systems. For each of the four areas, Annex 2 defines a number of principles to be followed, e.g. usage of standards and internationally accepted codes and classification when available. Below follows a short description on the technical specifications for Notices to skippers and Vessel tracking and tracing systems. The technical specifications for Inland ECDIS and Electronic ship reporting have not yet been issued<sup>51</sup>. The technical specifications go into detail and describe for example the structure of the messages.

The technical specification for Notice to the Skippers defines that the notice shall be available via Internet and provides rules for the data transmission of fairway information. Both the structure and the specification of XML message are described, see Figure 13. Further the meaning of different subject codes is explained. An annex is attached with reference table that explains the XML tags and different values in the different languages to be used.



Figure 13: Message structure for Notice to shipper and XML scheme for ice condition

The technical specification for vessel tracking and tracing systems includes both a functional and a technical specification. Three groups of information are distinguished; dynamic, semi-dynamic and static information. Dynamic information is defined as information changing in seconds or minutes. Vessel tracking and tracing systems are identified as exchangers for this dynamic information. The dynamic information is needed by all the RIS services. The functional specification provides an overview of which tracking and tracing information is needed for each of the different services. There is also an overview of accuracy requirements of the dynamic data for the services, e.g. lock operation requires a position accuracy of 1 m whereas long term lock planning is fine with 100m - 1 km.

<sup>&</sup>lt;sup>51</sup> Status August 2007

The specification stresses that the inland AIS<sup>52</sup> (Automatic Identification System) shall cover the main functionality of the AIS that is used in maritime navigation and be fully compatible with it. The technical specification defines the information the AIS shall transmit, it is generally only tracking and tracing information and safety related information. The information is divided into: static ship information, dynamic ship information, voyage related ship information and traffic management information. Where IMO AIS standards are available they are to be used. For other information, e.g. ETA at a lock an Inland AIS extension is required. The specification provides protocols that define how those messages are to be designed. It is further defined when the transmission of information shall take place, i.e. the reporting interval.

In Figure 14, the structure of the directive, the annexes, the technical guideline and the specifications is illustrated. It also indicates what the different elements define. The most detailed level can be found in the technical specifications.



Figure 14: Structure of the directive Harmonised River Information Services (RIS) on Inland Waterways in the Community its annexes, technical guidelines and specifications.

## RIS as an element in intermodal transport chains

For the European Commission, the RIS initiative is a consequence of transport policy development. It is stated that European research, especially within the Framework Research Programs, has contributed to the development and the deployment (European Commission, 2006 c). Parts of the research have been carried in cooperation between national public authorities, the transport industry, the ICT industry and the academia. In the 7<sup>th</sup> research framework program the integration of RIS and transport management is further supported through a call with the topic "Advanced RIS-based transport management solutions for the IWT sector". The call asks for a project that focuses on how RIS

<sup>&</sup>lt;sup>52</sup> AIS is a ship-borne radio data system exchanging static, dynamic and voyage related vesel data between equipped vessels and between equipped vessels and shore stations. It broadcast the vessels idendity, position and other data in regular intervals.

information can be integrated into transport management solutions and how to solve collection, distribution and exchange of information between authorities and commercial actors.

One major challenge for the implementation of RIS is the existing systems. Throughout Europe systems are already in place, partly since decades. These systems are surrounded by traditions and views on how to run the systems which leads to complications in regard of harmonisation of procedures.

RIS is built up to enable information exchange with different players in the transport chain. Thereby RIS can be used as one element for increasing transparency of intermodal transport chains. One important issue though, is to get users – especially the one outside the navigation segment - to accept and to start using the system and to find a robust business model. Seitz (2006) identifies the need for two business models. One for a Traffic Service Provider, who provides real-time traffic information for logistic planning. This service should be supplied by the infrastructure operators. The other business model is for a Logistics Information Service Provider, who would be an independent broker of information. For Seitz, the way forward is to use European lead projects to develop and implement the information network to gain knowledge on best practice in business and technology.

The RIS initiative is being further supported by the European Commission through the action program NAIADES, (European Commission, 2006 d). The main focus of the program is to increase the competitiveness of inland waterway transport and to make it an element of door-to-door logistics chains. It includes recommendations for actions to be taken between 2006 and 2013 by EU member states, industry, social partners, river commissions, the European Commission and other EU institutions. To "support and co-ordinate the development and implementation of RIS" is defined as one objective. The suggested actions can be classified in legislative, coordination and support measures. One support measure is deployed through a call within the 7<sup>th</sup> research framework program. The topic is: "Promotion of inland waterway transport" and the objective is to establish a knowledge/expertise network involving all relevant actors in support of the implementation of the NAIADES action program. This approach enables the setup of a project that can act as an executive unit that can turn the policy goals of NAIADES into action.

# 16. Freight Transport Telematics Architecture

To support the national development of transport telematics the Finnish Ministry of Transport and Communication commissioned a national architecture system (Granqvist et al, 2003). Freight Transport Telematics is defined as "the production, processing and distribution of information needed in shipment, transport, terminal, and receipt operations as well as the planning and management of these operations utilising information and data transfer technology". The architecture focuses on intermodal door-to-door transport including both the physical movement of the goods and the associated information. The architecture has a close connection to policy, i.e. the objective with the architecture is to provide organisations the opportunity to improve their competitive ability on the market through more efficient operations, a wider range of services or better compatibility. Thereby the Ministry sets out to facilitate information within the freight industry. The architecture focuses on the interfaces between the actors and not on their internal systems.

The following vision outlines the future state of freight transport processes after a total implementation and deployment of the architecture:

- Real-time information about the location, contents and conditions of identified shipments, goods items, parcels and transport vehicles can be collected in a controlled manner.
- The collected information can be combined with planning information and refined appropriately to be used during various parts of the process and distributed efficiently and timely to actors.
- By collecting, refining and distributing information efficiently, organisations can boost their goods transport logistics processes, lower their operational costs and improve their portfolio of logistics services.

The architecture consists of process descriptions and a logical architecture. The process descriptions are limited to four main processes: planning, management, delivery and tracking and tracing. Each main process is divided into sub-processes, e.g. planning consists of supply chain planning (see fig Figure 15) and transport planning. There are process maps both for main and sub-process. Roles and actors are defined and data flows between the processes are named.



# Figure 15: Example of a detailed descriptions of sub-processes: Process components and data flows of the Supply Chain Planning process.

The logical architecture includes an information model and a list of data set descriptions, see Figure 16. The data sets are mapped against real world concepts of information that contains several data sets. The information is given different confidentiality levels where the most confidential bits of information are goods order information and prices of the transported goods. Further the logical architecture includes:

- Description of the information system services including a distribution model that shows where the information systems will be located within various organisations.
- Description of data storages

Name	Description	
Transport plan	General information about a transport plan.	
Transport plan for leg	The plans for one leg of a transport, including timetables.	
Leg realisation information	Information on the carrying out of a transport on a leg.	
Shipment information	General information about a shipment.	
Transport licence	Details on the transport licence for one leg of a transport.	

#### Figure 16: Example of a data set description.

Within the project, shortcomings and developments needs were identified, i.e. things missing or needed to be developed further to reach the objectives set in the architecture. The shortcomings and needs were rated according to significance and how hard it would be to implement a solution. Examples of high significance and hard implementations are:

- Development of an automatic identification.
- Information technology connections between actors (technology and message formats, i.e. standardisation).
- Reducing the number of transferred documents
- Standardised "messages" between different kinds of supply chains.
- Development of operating methods to ensure that correct and relevant data is distributed to all actors who need it within the network.

The initiative showed that many of the issues that make information sharing hard are of organisational nature. Improved cooperation between the players will be needed to agree on messages and how to share the information. The reduction of documents requires a harmonisation process where the involved actors accept getting the information in an alternative format. It was stressed that agreements should be made on the use of standardised or best practice type forms of data transfer. The development of operating methods to ensure that the information is distributed to the actors was recognised as a true challenge requiring big changes in established operating practices (Granqvist, ibid). The development of an <u>information infrastructure</u> was viewed as an essential prerequisite for reaching the goals defined by the architecture. The information infrastructure would include the construction of data banks and registers, agreements on common operating methods and practices and development of data security. The project further suggests that a development program for an information infrastructure should include:

- Planning and development of information registers.
- Product data bank (product and package data) for use in logistics.
- Product code and shipment ID registers.
- Compatibility of parcel ID`s.
- Hierarchy: the minimisation of tracking events.
- Heterogeneity of logistics terminology.
- Harmonisation of consignor and consignee ids (unique pick-up and delivery addresses, customer address).
- Improved data security.

Participants in the project should be trade and industry branch organisations, major logistics actors from all transport modes, large companies and administrations.

One of the main challenges for the development of the information infrastructure is to find a responsible body for this task. ITS Finland is named as a possible part along with trade and industry branch organisations. It is also stated that the development of the information infrastructure is relevant both to the Ministry of Transport and Communication and the Ministry of Trade and Industry.

# **17.FREIGHTWISE**

FREIGHTWISE is an integrated project within the EU's 6<sup>th</sup> Framework Program. Its aim is to support the modal shift of cargo flows from road to intermodal transport by improving management and facilitation of information access and exchange between large and small, public and private stakeholders across all business sectors and transport modes. FREIGHTWISE recognises that intermodal transport is not limited to technical and organisational interoperability, but also to economic, environmental and social issues, like customs, supply chain security and the handling of dangerous goods.

FREIGHTWISE addresses the problem that information about intermodal transport services is not easily available. There is no web site to visit and ask for a list of possible intermodal services between point A and B. FREIGHTWISE argues that transport service providers could be interested in publishing their services to a wider group of users by using the Internet as a publishing channel. Within FREIGHTWISE a standard specification on how to describe a transport service is developed which is defined as Virtual Transport Services. This would enable a unified format for transport services that would be searchable for transport buyers.

A framework architecture will be developed within FREIGHTWISE that builds on the existing system architecture ARKTRANS. ARKTRANS was developed within a Norwegian project with the objective to establish a system framework architecture that provides a framework for the design, implementation and operation of ITS for multimodal transport of freight and personnel. The focus was on interoperability and integration, i.e. not to provide system architecture for specific systems (Natvig, et. al. 2005). In this approach ARKTRANS, is different from the approaches of FRAME<sup>53</sup>. ARKTRANS has suggested that it could be used as the overall architecture supporting multimodal interoperability between stakeholders, while FRAME could be used when specifying the inner parts, with the ITS solutions of stakeholders (Petersen, 2007). The architecture defines functionality, information, and interfaces in such a way that integration and interoperability is gained and enabled. To indicate its validity beyond Norway the development within in FREIGHTWISE is called ArchTrans.

Petersen (ibid) describes how ArchTrans is built up by the following four levels: transport policy, overall concepts, logical aspects and technical aspects, see Figure 17.

<sup>&</sup>lt;sup>53</sup> The European ITS Framework Architecture, known in its original version as KAREN





The overall concept is divided into a reference model and roles. The reference model is divided into five sub-domains and each sub-domain relates to a set of roles, objectives and responsibilities. A role can only belong to one sub-domain and represents all stakeholders with the same set of responsibilities. A stakeholder can fulfil a number of roles. The approach of the reference model makes it possible to deal with the complexity that characterises intermodal transport, which, according to Petersen, is one of the main challenges for successful intermodal transports (ibid).

The ArchTrans reference model consists of five sub-domains, valid across all transport modes, see Figure 18.



#### Figure 18: The ArchTrans reference model (Petersen 2007).

ArchTrans also defines the following four superior roles, valid across the transport modes: the Transport User, the Transport Service Provider, the Information Service Provides, and the Transport Controller. Petersen (ibid) provides an overview, see Figure 19, of the superior roles and the sub-domains that they are related to.



#### Figure 19: Superior roles in the transport (Petersen 2007).

Notice in Figure 19, that the sub-domain On-board Support and Control is not a responsibility of any of the superior roles; it is hidden in the background. This is an example of the approach to hide complexity within FREIGHTWISE.

The Transport Service Provider is a key actor who will use the Virtual Transport Services to publish the services and thereby making it more easily accessible to the transport users. By addressing all modes and enabling a method of "hiding" complexity, ArchTrans becomes a tool to support intermodal transports.

FREIGHTWISE has a strong policy approach and the ambition to provide the European Commission with input for a future directive for intermodal transport. The framework architecture and the definition of Virtual Transport Services can constitute a basis for such directive.

PART D: INTERACTION INFRASTRUCTURE

# **18.** Discussing Interaction and Interaction Infrastructure

# Arguments for interaction within a broader set of players

There is a growing understanding of the need for a more efficient use of available transport capacity. On the European policy agenda this is approached through a number of initiatives with the goal to support co-modality. My research shows that co-modality requires improved transparency in the transport chains. As a consequence, a national or European policy aiming at improving the conditions for co-modality must not only take responsibility for infrastructure in the conventional sense, but also for the processes performed on the infrastructure. There are various initiatives pointing in this direction, although not all with the complete understanding of the full concept. A lack of this understanding might be the reason for the slow implementation and lack of success of "open" system architectures.

I have pointed out that transport chains are often characterised by heterogeneous usage of ICT solutions and that proprietary solutions dominate the market. The systems are often well developed and efficient but mainly applied to support vertical processes. Information is still treated much according to a "silo approach". To reach transparency it will be important to apply a horizontal view when thinking about information. Such approach can be found within highly integrated supply chains. But even in these kinds of chains the focus is on cooperation between the commercial players; they do not make use of the benefits which might be derived from cooperation with other kinds of players such as infrastructure operators or public bodies.

The development and wide dissemination of the Internet, web services, XML messages etc. provides technically less complicated methods and low cost solutions for exchanging and sharing information. One of the main challenges for sharing and exchanging information is the issue of harmonisation. What the information stands for and how it shall be expressed in terms of data elements has to be agreed upon. It is wise to build on existing standardisation results but there still need to be agreements on which standards to use. Beyond these technical issues, it is still necessary to define the business rules that determine with whom to share information, what information to share, and the conditions of sharing.

In Part B, I discuss and define transparency and interaction. Transparency is the key notion throughout my research implying an improved level of knowledge and information sharing in the freight transport system. Transparency includes having access to the right information at the right time as well as to understand the consequences actions and lack of actions would have. I argue that transparency can be improved through *interaction* with a broader set of players.

I further argue that the interaction between the domains needs to be facilitated, i.e. formalised and structured. For this I introduce the notion of *Interaction Infrastructure*. The notion indicates that interaction is not merely a question of being able to communicate from a technical point of view, but there is also a need for commonly agreed definitions, basic principles, rules for cooperation and communication.

I have chosen to cluster the extended group of players into the following three domains:

- Transport management (including the relevant commercial players in the transport chain). The transport management domain is commercial and characterised by business conditions where contracts are established between customer and service providers.
- Infrastructure management (public and private traffic management networks and traffic information systems). The traffic and infrastructure management includes both public and private players. One core objective is to provide safe and efficient usage of the infrastructure. For the infrastructure in hand of public players, e.g. national administrations, safety and security are often paramount targets before commercial considerations.
- Institutional management (legislation for, e.g. safety and security requirements, customs, etc.). The institutional domain stands for administration and legislation and includes a variety of objectives, e.g. efficient, sustainable and safe transport systems. It defines the conditions governing transport and traffic and the use of the infrastructure. This domain consists of public bodies and processes where directives, regulations, policy documents and laws set the scene.



# Figure 20: Interaction between transport, infrastructure and institutional management, supported by Interaction Infrastructure

Freight transport is traditionally viewed as an issue for the private transport market but it normally includes elements of the three domains as illustrated in Figure 20. I therefore argue for a broader view of freight transport beyond the private market. In this chapter I will discuss the interdependency between the domains and the need for a closer interaction between them, which can be supported by what I have defined as *Interaction Infrastructure*.

The transport is planned and executed in the transport management domain and it is carried out on infrastructure. To be able to use the infrastructure, information about it is needed. It is necessary to know if the infrastructure is accessible, what the capacity, the topology and geometry is. For the planning and production of a transport it is also important to have information about the traffic situation, e.g. average travel times. Results from my projects show that access to information on infrastructure and traffic is vital for an efficient management of transport. This information is needed

for different time horizons to be able to match the different planning phases for transport, i.e. strategic, tactical and production planning. Some infrastructure requires a slot allocation for access to the infrastructure during a specific time window. These are examples of interaction between the domains of transport management and infrastructure management. In addition, information about the transport is also of great importance for infrastructure management and planning, e.g. what types and numbers of vehicles are using the system, where are hazardous goods being transported, historically, at present, and tomorrow.

Freight transport is regulated; permits are needed to carry out the transport, e.g. a licence for the company and the driver/captain, further also vehicles/vessels must have a permit. For the transport of dangerous goods specific permits are required. Air and maritime transports are characterised by strong reporting requirements to different public bodies. We have seen that there are increasing requirements on reporting<sup>54</sup>, among others due to safety and security reasons. To avoid these increasing demands from slowing down the development of logistic concepts, the development of easy to follow solutions for fulfilling the requirements is needed. A closer cooperation between administrations and other involved bodies for solutions across the transport modes is essential.

My experience from working with the different domains is that there exists a lack of trust or a lack of understanding between the domains (as well as within the domains) and I argue that increased interaction would benefit all players in the long run. Below, a number of examples of mistrust will follow. Seen as separate events they can be interpreted as anecdotic, but in my opinion they are symptoms of a deeply rooted lack of understanding between the domains.

The findings from Baninfo<sup>55</sup> indicate that the Swedish Rail Administration has a limited tradition of viewing the users of the rail infrastructure as customers which leads to a lack of customer orientation. There is a lack of knowledge of the customers' needs, e.g. why they need information and what the implications are for the customers due to low quality or even not existing information. Findings from Baninfo also indicate mistrust from the transport management domain towards the infrastructure domain in regards to being dependent on the infrastructure operator to get information crucial to the business. It was also indicated that informal networks are established to get access to information where routines for information exchange failed to fulfil the requirements or did not even exist. See description in Part B, chapter Baninfo for details.

When analysing the routines connected to a vessel call at the Port of Gothenburg in the PGCS project we learnt that the new reporting portal FRS<sup>56</sup> of the Swedish Maritime Agency requires usage of broad band Internet, which most vessels do not have. Instead of carrying out the reporting from the vessels, land based agents have to continue to do the reporting. In parallel the interviewed represents from the shipping industry stressed their efforts of making as much as possible administrative tasks from the vessel. We also found that the business rules of the new pilot booking system of the Swedish Maritime Agency makes it less expensive to let the pilot wait than to make a new booking in case of limited delays. In the shipping community distress was expressed towards that the Coast Guard

<sup>&</sup>lt;sup>54</sup> One example is the new European Customs legislation is being developed which might lead to increased reporting demands.

<sup>&</sup>lt;sup>55</sup> Please note that the findings from Baninfo originates from 2001-2002 and the Swedish Rail Administration has a more customer oriented view today.

<sup>&</sup>lt;sup>56</sup> FRS (Vessel Reporting System) is the Swedish system for mandatory reporting of vessel notification and reporting of dangerous goods and waste. FRS is part of the European Commission's initiative to improve safety and efficiency for maritime transports

reported to the police when vessels failed to submit the "Schengen"<sup>57</sup> report in time even in cases when there was no possibility<sup>58</sup> to fulfil the time requirements.

In addition to the exemplified mistrust between the domains, findings from PGCS also indicate lack of cooperation and strategic planning from the central level in Sweden. The Swedish Maritime Administration has developed FRS with the vision: *"FRS shall become a portal collecting all reporting from the maritime sector to the Swedish Maritime Agency and other Swedish authorities as well as becoming a node for information exchange for parts of the commercial maritime sector"*. In parallel the government has commissioned the Coast Guard to create an IT system to coordinate the civilian maritime information and to distribute it to nine other authorities, including the Swedish Maritime Administration and the Customs. The plan is to add different "added values" to the system and vessel notifications are one of the identified added values. Through those developments the needs of the administrations and the national level might be fulfilled but it is not clear how the policy goal of creating fundamentals for the players on the free freight transport market is supported<sup>59</sup>.

The idea of interaction suggests that the infrastructure management domain as well as the institutional management domain should be recognised as natural parts of the concept when applying a process oriented view of door-to-door intermodal transport chains. What I have defined as *Interaction Infrastructure* contributes to support these processes.

#### Interaction Infrastructure

Seitz (2006) points out that an open intermodal information network needs to be established to support the attractiveness of intermodal transports. Such an information network requires reference information architecture to support and simplify information exchange between modes. Further, advanced multimodal logistic software applications are needed to stimulate operators to extend and make their logistics management applications compatible. Data standards, system interfaces, availability of traffic data, logistics decision support and harmonised documentation are modules required for the network.

From the Finnish work on a "Freight Transport Telematics Architecture" for improved information sharing in intermodal transports, the need for an information infrastructure is identified. The information infrastructure would include the construction of data banks and registers, agreements on common operating methods and practices and development of data security (Granqvist et al, 2003).

Other references that I have presented throughout this thesis indicate that policies for achieving transparency in transport chains often result in strategies for creating "open" architectures and actions for creating such architectures including supporting standardisation. System architecture and standardisation are crucial for the development of information exchange. However, my research indicates that there is a gap between the formulation of policy for information exchange and the technical aspects of realising this exchange, which I consider as a reason for the slow progress in realising transparency.

<sup>57</sup> Schengen is a mandatory report on crew and passenger on board lists which have to be submitted before arrival in port according to the IMO and Schengen agreements

<sup>&</sup>lt;sup>58</sup>The Schengen report shall be delivered 24 hours prior to arrival. In short sea shipping there are trips that starts less than 24 hours for arrival and there is also the case of changed destinations during a tour.

<sup>&</sup>lt;sup>59</sup> The Swedish transport policy is described in Moderna Transporter , Ministry of Industry, Employment and Communication (2005)

My definition of *Interaction Infrastructure* addresses the needs as identified by Seitz and Granqvist as well as my findings from the other references. I propose *Interaction Infrastructure* as a holistic approach which - through supporting interaction - gradually translates the high level objectives of a policy into business related, organisational and technical details.

I want to stress that the aim of *Interaction Infrastructure* is not to change existing legacy systems or internal processes but to focus on the interaction between the systems, the information exchange and sharing of information. Thereby the domains can be viewed as black boxes<sup>60</sup> enabling a focus on what is/could be going on between the domains, hence focus is on interaction not on integration.

My definition of *Interaction Infrastructure* is inspired by the ideas of Honneth (1996) and Jassanov (2003). In the call for recognition of Honneth, I can see one of the main challenges for a successful *Interaction Infrastructure*. The driving idea of the social theorist philosopher Honneth (1996) is that recognition is crucial both for knowledge and moral development. Applied to the *Interaction Infrastructure* this would imply a clear intention from the different domains to establish a closer interaction based on mutual respect and with the objectives to understand, respect and take into account the needs and starting points of all players.

Jassanov (2003) suggests a way forward on how to promote meaningful *interaction* among policymakers, scientific experts, corporate producers and the public. She introduces a concept of Technologies of Humility to complement the predictive approaches;

- To make apparent the possibility of unforeseen consequences.
- To make explicit the normative that lurks within the technical.
- To acknowledge from start the need for plural viewpoints and collective learning.

Trust will be a key factor for the concept of *Interaction Infrastructure* to be accepted and used as a platform for sharing information. Furthermore, it has to be clear advantages for all participating players. The request of Jassanov to include all players in the earliest stages of the development and to focus on their participation can be a way of establishing trust. It also ensures that new ideas – beyond the traditional definitions - can be incorporated, leading to more innovative solutions.

Wilding et al (2006), use the notion of  $C^3$  (cooperation, co-ordination and collaboration) and stress that is it essential to maintaining a successful business partnership. In their case study on collaborative supply chain relationships, an overwhelming majority of the respondents placed strong emphasis on personal relationships and culture matching (relating to the way the other side does things). This supports the idea that an *Interaction Infrastructure* also needs to include ideas, principles and agreements on how to cooperate and to enable further development of the relationships within the cluster.

A further argument for *Interaction Infrastructure* is that it will help develop a common understanding of the way that the business is done and define the information which is exchanged. This will also increase market transparency and provide interfaces for building standardised, interoperable applications and providing services for such applications. Improved market transparency, lower cost

<sup>&</sup>lt;sup>60</sup> Latour (1999) refers to blackboxing as "when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity"

for software, easier access to information and better opportunities for networking with other companies would promote a breakthrough of ICT in freight logistics and more specifically for intermodal transport management.

My understanding of *Interaction Infrastructure* originates from studying the projects and initiatives presented in Part B and Part C. This chapter will further explore KombiTIF, PGCS, RIS and EFM to provide examples of how Interaction Infrastructure can be constructed and maintained.

# Exemplifying Interaction Infrastructure through KombiTIF, PGCS, RIS and EFM

In this chapter the four projects and initiatives from Part B (KombiTIF and PGCS) and Part C (RIS and EFM) are closer described and compared with the aim of exemplifying the notion of *Interaction Infrastructure*. In Table 6 a first overview is presented.

	KombiTIF	PGCS	RIS	EFM
Overall objective	To support intermodal transport by providing electronic information from the traffic agencies.	To create a closer information integration with the customers, focus on making the vessel process more efficient.	To support the attractiveness of inland waterway transports. Focus on traffic and transport management in inland navigation.	To increase the efficiency of supply chain management by supporting the information exchange.
Initiated by	The Swedish Ministry of Industry, Employment and Communications	Port of Gothenburg	European Commission	US DOT
Stakeholders to be involved	Traffic administrations as provider and transport industry as users.	Cooperation between authorities, infrastructure operators and transport industry. Stakeholders can be both providers and users of information.	Cooperation between authorities, infrastructure operators and transport industry. Stakeholders can be both providers and users of information.	Transport industry and authorities. Stakeholders can be both providers and users of information.
Element of interaction infrastructure	Suggests an arena where information is secured, coordinated and packed. Enables access to the administrations information.	Suggests a system for cooperation with a structured method for sharing information.	Detailed guidelines and technical specifications on architecture, data formats messages and business rules.	Detailed design document on architecture, message type, data elements, communication protocols and business rules.

Table 6: An overview of initiatives for interaction

## Overall objective, initiators and geographical scope

The projects and initiatives share a vision of improving transport quality through better access to information, which in my context corresponds to improving transparency. The main goal of KombiTIF is to simplify planning and production of intermodal transports through improved access to information which would increase the attractiveness of intermodal transports. For PGCS the overall attractiveness of the Port is in focus and improved information exchange is one important tool for providing efficient service. Also for the RIS initiative the attractiveness is in focus, in this case of the inland waterways which is in line with the European Commission's policy for sustainable transport systems. The two main goals of the EFM initiative are the efficiency of the freight system and its security.

Three of the initiatives have an authority as main initiator. KombiTIF was initiated by the Swedish Ministry of Industry, Employment and Communications, RIS by the European Commission and EFM by the department of transport in the US. PGSC was initiated by the Port of Gothenburg which is owned by the city of Gothenburg.

The RIS project has a trans-national approach through addressing a number of member states within the European Union. EFM and KombiIF have a national approach although especially EFM stresses the importance of cooperating on standards at an international level. PGCS is initiated on a local/regional level focusing on the port cluster in Gothenburg but the international nature of shipping was acknowledged throughout the discussions.

#### Stakeholders involved and focus of the initiatives

In the KombiTIF project providers of information are separated from the users of information. The traffic administrations are the main providers of infrastructure and traffic information. An extension would be to create cooperation with other infrastructure operators, i.e. ports, municipalities and terminals to also make their information part of the supply. The users are the direct and indirect customers of the infrastructure, e.g. transport operators, forwarders and shippers. KombiTIF proposes a one way exchange of information, which is reflected in the design of the arena<sup>61</sup>. Information from the providers is coordinated and secured at different levels and can be retrieved by the users. Notice that the information flows are only going from the arena, not the other way around.

The Port Community System approach addresses a wide group of stakeholders. The idea of PGCS is that all stakeholders who are involved in the direct or indirect vessel arriving and departing process shall be able to gain access to the information they need and at the same time contribute with information that is of value for the other stakeholders. The participants are both producers and users of the information. With an implemented system, the Port of Gothenburg would be a participant of the system at the same level as all other participants. The idea of the port community system is driven by a strong "us-view", based on the port community system to be developed and used jointly by the members of the port cluster. The system also has an element of cooperative planning<sup>62</sup>. The port community system is promoted as a tool to increase the overall attractiveness of the port of Gothenburg which will benefit all members of the port cluster.

Also the RIS initiative addresses a wide group of stakeholders. Its main focus is traffic management with a safe and efficient navigation on the infrastructure (the inland waterways) as core objective. This includes harmonised information exchange between the vessels and the traffic management and infrastructure operators. The vessel gets improved access both to the infrastructure and the traffic situation and the operators get a better overview of the traffic. Like in the case of PGCS there is an element of cooperative planning with the lock planning as an example. Further, customs and other authorities are foreseen as users of the information and there is a strong ambition to support also transport management processes.

The EFM initiative has a strong focus on the private transport sector and the supply chain. The core is to provide access and linkage to shipment information to the supply chain partners in real time and thereby enable more efficient and secure freight transports. The actors involved in the information system would be both producers and users of information. The initiative also includes ideas about using the information to produce reports to the authorities. A possible interaction with traffic and infrastructure operators is not mentioned. Further the public has a clear role as a facilitator of the initiative – at least in the initial phase.

<sup>&</sup>lt;sup>61</sup> Please refer back to Part B for a description of the arena.

<sup>&</sup>lt;sup>62</sup> I use the notion cooperative planning when different entities coordinate their planning of activities. In the case of PGCS the planning of pilots, terminal activities, tug boats and boat men would be coordinated. By having access to updated information it will be possible to carry out better operational planning, e.g. make sure that all services that are required in parallel are available at the same time

An alternative way to view the initiatives is to see which segment of information sharing they address. I have identified the following information segments:

- Information exchange within the transport chain management (B2B, business to business).
- Harmonised routines for fulfilling administrative requirements and enabled cooperation between institutional domains (B2A, business to administration and A2A administration to administration).
- Improved access to information about infrastructure and traffic information and enabled common information structures between infrastructure domains (B2I, business to infrastructure and I2I, infrastructure to infrastructure).

When applying the cases on the different information segments Figure 21 appears. KombiTIF is limited to improving the access to information on the infrastructure and the traffic situation. PGCS has the broadest scope addressing the efficiency within the transport chains as well as the interaction with the infrastructure mainly through the interaction with the traffic management and the institutional domain through improved reporting routines. RIS is starting out with a focus on improving the access to information on the infrastructure and the traffic, but has a clearly stated vision on extending its focus to support the freight management and to include reporting to some public bodies. EFM has its starting point in the information exchange within the transport chains but suggests that public bodies should be able to collect the information they require.



Figure 21: An overview of the focus of the cases

#### Elements and structures for sharing information

The initiatives have quite different levels of describing how to improve access to and sharing of information. The pre-study for PGCS only suggests a system for cooperation with a structured method for sharing information, how this should be established is a task for future work.

KombiTIF developed a plan for an arena where information would be secured, coordinated and packed. This should be done within the agencies, between the agencies but also with other stakeholders such as terminal operators. The plan was on a conceptual level and did not describe system architecture in detail. The importance of harmonised formats and usage of standards was stressed.

Both the RIS and EFM initiatives include detailed guidelines, specifications and design documents that describe how to implement the systems. For RIS a high level directive has been developed which is supported by detailed guidelines and technical specifications. Within the EFM initiative a detailed description has been developed for the Columbus Electronic Freight Management (CEFM), a deployment test within the EFM program.

#### **Discussion**

KombiTIF, PGCS, RIS and EFM show a number of differences; they address partly different areas, have different initiators and different levels of details regarding how to support the transparency. However, the initiatives also show a number of similarities.

- Policy is the starting point.
- They all take a customer oriented process view and place the flow of freight <u>and</u> the accompanying information in focus.
- They demonstrate thinking "outside the own box" by opening up for information that today is available in the internal systems of the organisations to other players in the transport chain whom it can benefit.
- They do not require changes of the internal legacy systems, all initiatives address interaction as the method to exchange information, integration is not the goal.
- They all in include interaction between public and private partners.
- They all recognise the need for harmonising or even coordination of the public's requirements for reporting. In PGCS it is one of the main objectives, in KombiTIF it is identified as requirements although not further elaborated. EFM suggests that US government stakeholders uses EFM as a window for interaction with the trade community and RIS opens up for cooperation with customs and immigration service.
- They all use and promote existing standards, e.g. for data messages, architecture and technology. RIS and EFM even support the development where standards are lacking.

The initiatives that include descriptions on technical approaches are based on standard Internet techniques and use XML for message exchange, there is no need for the players to change their legacy systems and it only requires minimal changes of the existing business processes.

# **19.** Defining Interaction Infrastructure

The discussion in the previous chapter aims at building up an understanding of what I have defined as *Interaction Infrastructure*; this chapter aims at making the notion more tangible.

Based on my recognition of situated knowledge, it is important to stress that the *Interaction Infrastructure* will have different characteristics depending on the context and the intended level of interaction.

I would like to anchor the definition to Figure 1. In this figure, *Interaction Infrastructure* is positioned in the centre, supporting the interaction between the domains of transport management, infrastructure management and institutional management. At the most basic level, *Interaction Infrastructure* helps develop a common understanding of mutual benefits of transparency, leading to a willingness to share information. It helps negotiate the different points of view and vested interest of the players involved and leads to the commitments needed for the implementation of information sharing across the domains. *Information Infrastructure* can be seen as a guide throughout the entire process. It thereby addresses one of my main arguments for an improved information sharing: that the players from the different domains need to meet to gain a better mutual understanding, to increase the shared pool of knowledge regarding information and transport chains, and by implication, appreciate the value of transparency.

Without risking its flexibility to be applicable in different contexts the concept of *Interaction Infrastructure* may be captured in the following definition:

*Interaction Infrastructure* is a conceptual framework that supports the definition of the appropriate processes needed for achieving interaction in a particular context.

Interaction Infrastructure spans over three levels:

- <u>The contextual level governs interaction between the domains and provides a statement for a partnership and a definition of success factors. It supports the understanding of the context and shared goals. An important element of the contextual level is visualising the context so that what is externalised becomes a shared object to be negotiated and improved in a consensual manner.</u>
- <u>The protocol level</u>, where protocol should be understood as a mutually agreed way of running an activity. On the protocol level, *Interaction Infrastructure* can be viewed as a roadmap for improving information sharing in a specific case with the objective to simplify the information exchange regardless of the mode(s) involved. This can involve, for example, the agreement of a common view of the basic business processes, the definition of a suitable legal framework, or the definition of information elements and attributes under an appropriate syntax. The protocol level can include the definition of cases, situated conditions and appropriate responses.
- <u>The implementation level</u> guides the implementation of the agreed protocols, i.e. actions and communication is implemented using a choice of proper technologies. At this level, *Interaction Infrastructure* materialises, and requiring technical expertise and the translation of agreed concepts into a concrete system architecture. Importantly, it becomes tangible and testable and thereby subject to feedback and recursive improvements.

Possible tools to be used for at the contextual and protocol level include interviews, round-table brainstorming, visualisation through different process maps, and collection of feedback on data collected and draft concept, etc. These activities require a moderator that – again depending on the context – can be the main stakeholder of the whole process or a neutral actor.

To further characterize *Interaction Infrastructure*, the following content will typically be defined and agreed upon in the process:

- The driving forces which policy objectives should be supported.
- The concrete aims of the specific agreement.
- What should be included in the cooperation, e.g. which processes need to be supported.
- Who is responsible for the initiative and on which mandate.
- Which players are to be involved, in what roles.
- The business rules governing information exchange.
- Framework conditions:
  - o Legal
  - o Contractual
  - o Institutional issues
- The system architecture and standards to be used.

Figure 22 illustrates the triangle from Figure 20 but now with the identified levels and the set of agreements that define *Interaction Infrastructure*.



Figure 22: Suggested aspects of Interaction Infrastructure.

To further visualise the *Interaction Infrastructure*, I apply the suggested content on the PGCS project and its focus on harmonised reporting routines to governmental bodies, i.e. an example of *Interaction Infrastructure* used to support administrative requirements (B2A) focused on a harmonised reporting for the vessel call. Table 7 illustrates the results.

Content of Interaction Infrastructure	Applied on the reporting module in PGCS		
The driving forces – what are the policy objectives to be supported?	Establishing and implementing a shared vision of increased transparency of the reporting routines from vessels to the port and public bodies. Enable a single window approach.		
What are the expected improvements	Less administration for the shipping industry and improved quality of the reports to the public bodies.		
What is to be included in the cooperation, e.g. which processes to support	An agreement between the players on exchanging and sharing the information. An agreement on which information to be provided by the shipping industry. An agreement between the authorities to accept the information provided where each public body gets access to its required information.		
Who is responsible for the initiative and on which mandate	Port of Gothenburg through its role as initiator of the port community system.		
Players involved	The shippers, the shipping lines, vessel services the port and relevant public bodies (customs, coast guard and maritime administration)		
Which business rules shall be applied	Agreements on partnership roles (e.g. who is responsible for providing the information, time limits, accuracy). Agreement on a business model (cost and revenue distribution)		
Framework conditions	Changed requirements for vessel reporting. Membership rights and duties, access rules.		
	Security rules for ensuring confidentiality, integrity and authenticity.		
System architecture and standards	Focus would be on the interfaces with the port community system, applying existing message formats where applicable.		

 Table 7: Applying the Interaction Infrastructure content on PGCS

This exercise is carried out corresponding to the contextual level and it indicates that the focus of the *Interaction Infrastructure* is to facilitate agreements on what is to be done and to elucidate the conditions for the participating players and the interaction between them.

It is my hope that my introduction to and definition of *Interaction Infrastructure* provides an outline on how the creation of interaction can be approached and which issues need to be addressed. I further argue that *Interaction Infrastructure* can be viewed as an *agora* as defined by Nowotny et al (2003), characterised as "*the problem-generating and problem-solving environment in which the contextualisation of knowledge production takes place*" (*ibid, pp 192*) and thereby provide a platform for reaching a common level of knowledge and stability among and between the players and the domains.

Part D has focused on the content of the Interaction Infrastructure. Part E will discuss how *Interaction Infrastructure* can be promoted in different contexts and by whom.
PART E: A WINDOW OF OPPORTUNITY

#### 20. Introduction

The previous chapter delivered arguments on why an increased interaction is needed and suggested what I have defined as *Interaction Infrastructure* as a tool to support the process.

In the next chapters I will stress that increased interaction between the domains is an extensive task that requires initiative, commitment, resources and governance throughout the process. Findings from my research will be used to illustrate the need of a leadership and the role of policy. I will also point out a number of driving forces that in my opinion opens a window of opportunity for the required steps.

#### 21. A Call for Strong Leadership

Commercial actors like UPS or DHL who control transport chains through strong contractual agreements can define rules and proprietary solutions, to some extent also for the information exchange with public infrastructure operators and authorities. We have seen that this is much more difficult in environments that are built on occasional relationships. Intermodal transport chains are characterised by being inter-organisational lacking natural leaders which makes it more difficult to implement solutions for interaction than when implementing solutions within one organisation. It is possible that an increased level of knowledge within the freight transport community including a clearer perception of the advantages generated by improved information sharing will lead to bottom up initiatives for interaction. However, I have found few signs in that direction. Instead the need of a strong commitment can be derived from a number of the references presented in the previous chapters:

- The Finnish initiative for a Freight Transport Telematics Architecture<sup>63</sup> suggest the . development of an information infrastructure but state that it is a major challenge to find a responsible body for this task.
- In FREIGHTWISE one of the main issues is how to make the commercial players participate • and implement harmonised solutions for the transport management domain<sup>64</sup>.
- O Sullivan and Patel (2004) show that the lack of integration within transport modes as well • as across transport modes generates externalities to the users of the system. They argue that it is the task of the authorities to promote efficient integrated transport network. They also suggest that a supranational Strategic Authority or Regulator in close connection to the European Commission could be a solution.
- Lawson (2004) calls for a strong leadership from the authorities to enable the access of information on freight movements.
- The Committee on Freight Transportation Data (2003) calls for a freight data framework and • stress that strong leadership is required to coordinate the data collection. They further draw the conclusion that no single organisation by itself has the resources and expertise necessary

<sup>&</sup>lt;sup>63</sup> See chapter 16 in Part C for more information<sup>64</sup> See chapter 17 in Part C for more information

to develop and implement a national freight data framework. US DOT is identified as the player to take on the leadership.

Furthermore, the projects and initiatives that form the foundation for my definition of *Interaction Infrastructure* show that it is critical for someone to take the responsibility for initiating and developing it as well as later on ensuring the operation, i.e. some form of governance is needed throughout the process. The responsibility in the development phase can be different from responsibility in later phases when roles and responsibilities have been settled and widely accepted, an approach taken both by the Port of Gothenburg with the initiative of the Port Community System and the US DOT with their EFM initiative. Port of Gothenburg clearly states that a future ownership and responsibility for the operation need to be further investigated. For US DOT the developing phase includes a transition of responsibility to other players. One of the main challenges for what I have defined as *Interaction Infrastructure* is that a strong, widely accepted and sustainable organisation is driving the development phase.

When comparing the projects and initiatives used to define *Interaction Infrastructure* it is interesting to see how different basic conditions are influencing who has the possibility to take the lead and how to ensure that the players are using the services. This will be discussed in the next paragraphs.

For RIS and KombiTIF who are mainly addressing public bodies, legislation is an option to make public bodies act as information provider as well as to get the transport domain to carry out administrative reporting using defined systems.

The development of RIS has been driven by the European Commission and who is still strongly involved<sup>65</sup> in further development both regarding extended functionality and the take up by the market. The RIS directive exemplifies that the Commission has good possibilities to legislate on harmonisation of information and pointing out responsible players for the operation of public services. There are acceptance for these measures both from the member states and the transport market.

In KombiTIF one of the main problems with the further development is the issue of responsibility and the lack of a natural candidate to lead and coordinate the work. The ministry appointed the rail administration to coordinate the work and they did within the KombiTIF project. Although the governmental transport policy points out KombiTIF as a good initiative (Ministry of Industry, Employment and Communication, 2005) and stresses that it should be further developed, there is a slow development ongoing. Possible explanations for the lack of interest from the administrations are the perceived complexity, the lack of experience of working together with the other administrations, a fear of disturbing the market forces and unclear benefits for the users.

RIS and KombiTIF illustrate the importance of leadership and access to resources for turning the policy into action. The European Commission has applied a focused policy for years in regard of increasing the attractiveness of inland waterway with improved communication systems as one identified measure to reach the policy. The Commission has financed integrated research where national public authorities, the transport industry, the ICT industry and the academia have cooperated to develop robust solutions. The Commission also promotes a RIS platform that aims to foster RIS harmonisation (European Commission, 2006 c). The RIS implementation is transnational and stretches both over country and traffic management borders. The existing traffic management organisations have different maturity levels but also different views on how to run the activities. The

 $<sup>^{65}</sup>$  see the NAIADES initiative and projects within the  $6^{\rm th}$  and  $7^{\rm th}$  framework research programme as described in Part C

strong commitment from the Commission has been, and still is, necessary for overcoming the local differences and paving the way for a successful implementation of RIS. For KombiTIF to become reality a stronger governmental commitment<sup>66</sup> is required which can trigger the corresponding instructions to the traffic administrations, which are the relevant bodies, each by themselves and/or together, to turn the policy into action.

PGCS is a local/regional initiative that addresses all domains but the driving force has its roots in the transport management domain. The Port of Gothenburg has a leading role as initiator and developer but leaves open which role to have in the future. The Port possesses competence, knowledge and resources to be responsible for the development of the port community system and even more important there are clear strategic advantages for the Port to gain through its implementation. The Port will be one of the main users of the port community system and will have direct benefits through increased transparency and higher service level towards its customers. For a port, improved information handling is a competitive advantage. It is interesting to notice that the commitment of the Port was not only accepted but also welcomed by the port cluster.

Besides being a commercial player responsible for the terminals, the port is also a public player through its role as a port authority and as a company which is 100% owned by the city of Gothenburg. This opens up for different possibilities for the port to enhance a usage of a port community system. As a port authority binding guidelines can be developed that prescribe the usage of a port community system for administrative related issues, e.g. vessel notification. As a commercial player the Port has the possibility to use contractual agreements, e.g. to define that booking of terminal services are carried out through the port community systems. Throughout the pre-study of a port community system the Port was very clear that they were looking for a solution and development in close cooperation with the future users and that their participation is a prerequisite both to develop robust solutions and to create the necessary acceptance.

The examples above illustrate different approaches for promoting interaction and improved information sharing. Administrations and other public bodies are part of the public sphere and are to follow political decisions and serve the public which opens up for legislative measures, as we have seen a successful approach for the implementation of RIS. When addressing the private market players and their businesses these measures are limited. The development of PGCS shows that market driven initiatives can be successful when a natural leader makes a commitment. However it is not always the case that a natural leader exists given the heterogeneity of the market and different driving forces.

Leadership and responsibility of the operation of logistic related services is still an open issue for the further development of RIS. For the operation of RIS, Seitz (2006) identifies the need for two business models, one with a "Traffic Service Provider" that allows for real-time traffic information for logistic planning and one with a "Logistics Information Service Provider" who would be an independent broker of information.

Seitz suggests that the service of the "Traffic Service Provider" should be supplied by the infrastructure operators. When limited to providing information and services from the infrastructure

<sup>&</sup>lt;sup>66</sup> One example of intention for closer cooperation between the transports modes can be found in an ongoing (November 2007) Swedish governmental investigation on how to reorganise transport supervision activities that today are spread between different authorities and to join them into one new administration covering all transport modes, Kommittedirektiv 2007:105, www.sou.gov.se/kommittedirektiv/2007/dir2007\_105.pdf.

and institutional domain the service can and possibly should be viewed as one public service among others. Providing information about infrastructure should be as natural as providing physical accessibility to the infrastructure. The Finnish Ministry of Transport and Communication commissioned a study on the role of government and the pricing of the services of authorities that concluded: "*State authorities under the Ministry of Transport and Communications should particularly take into account the goals of the national transport policy and price the data they produce so that the development of ITS services is supported. Thus, a price level below cost price, covering only the actual transmission costs, or there being no charge at all, should be the point of departuree", (Airaksinen J et al, 2003). The report also stated that this starting point was becoming more predominant throughout the European Union.* 

When a "Logistics Information Service Provider" is required according to Seitz model, the business model is not that evident anymore. The responsibility cannot be legislatively put on a private actor. Instead a market is required, where someone is willing to pay for the service or where the service is substituted by the public. For Seitz (2006), the way forward is to use European research projects to develop and implement the information network to gain knowledge on best practice in business and technology.

Public bodies can support by promoting solutions efficient enough for the market to cooperate on a voluntary basis. EFM is a good example of such an approach where a public body invests money and knowledge to establish a system that is interesting enough to attract commercial players to use it and at the same time is beneficial to the society. EFM is initiated and implemented by a public player, the US DOT, but addresses mainly the transport management domain and its commercial actors. EFM has the vision of the industry and the local governments coming together in a trade development node interacting with other trade development nodes in the US as well as throughout the world. Rules of governance would then be developed and maintained by a user group. The players addressed by EFM are mainly within the transport management domain and therefore it is neither an option to use legislation as a means of getting users of the system nor is there a possibility to apply contractual agreements. The success of the EFM will depend on acceptance from the commercial user community and that they actually start using the concept. The strategy of US DOT is to act as a facilitator in the development and through different demonstration and dissemination activities encourage the market to implement similar technologies for information exchange. Further, US DOT will provide implementation support. Another strong driver to increase the attractiveness of EFM would be the functionality of a single submission of data for regulatory requirements as demonstrated in PGCS. The strong commitment of the US DOT as well as its support to the market in the implementation might be enough to convince the intermodal market that is built up by occasional relationships to enter the game. However, as a parallel activity, the DOT could ensure that legislation is gradually adapted to support transport applying the EFM-scheme.

The FREIGHTWISE<sup>67</sup> project provides an example of how legislative measures could address the transport management domain. The ambitions of FREIGHTWISE include the development of generic system architecture for intermodal transport management. This will include a harmonised way to describe transport services and thereby make the intermodal market open to a broader group of users. To enable transport services to be connected location codes are needed, each service will have to include its start and end location. The project is suggesting that instead of establishing an internal

<sup>&</sup>lt;sup>67</sup> FREIGHTWISE is an integrated project within the EU's 6<sup>th</sup> Framework Program with the aim to support the modal shift of cargo flows from road to intermodal transport by improving management and facilitation of information access and exchange between large and small, public and private stakeholders across all business sectors and transport modes. It is also described in Part C.

location code register it would be more flexible and user friendly to have an open register. The register would need to be open to all service providers who wish to add any new location. To enable this, the register must include rules on how to name the locations. Such a register needs to be both established and maintained and its value will depend on how accepted and used it will be. So who is to be responsible for such a register and how should it be designed to be broadly accepted? FREIGHTWISE is discussing the possibility of the turning it into a task for authorities, e.g. the European Commission could use its legislative measures and include system architecture for such a register in a directive. These ambitions can serve as an example of the possibilities to establish an *Interaction Infrastructure*.

A third way to promote interaction and information sharing is through accreditation and trust building. One example and best practice of accreditation and trust building can be found in the Swedish customs work with "The Stairway"<sup>68</sup>. The Stairway is a system based on risk management, compliance history and building trust and verifying the belief that the majority of actors involved in the import and export business wants to adhere to the customs regulations. The philosophy behind the Stairway is that compliance, simplification and better use of resources will benefit the law-abiding and save resources for efficient control of the remaining few. Companies can join the Stairway and agree on certain processes and depending on the companies' preferences and ability to comply different levels of the Stairway can be reached which brings advantages to the companies, e.g. one stop shop, paperless reporting and self declarations. The higher the level in the Stairway the more trust is required. A number of benefits are achieved through the Stairway:

- Improved quality of customs declaration.
- Simplified processes for the companies.
- Resources are being set free for the Customs that can be used on freight flows that are not integrated into the staircase which has increased the hit rate from 5 to 44%.
- Decreased compliance costs.
- Increased service and predictability.

To conclude, we have seen three different approaches to supporting harmonisation and information sharing all needing a strong leadership:

- Legislation mainly used when addressing public actors but FREIGHTWISE indicates a possibility for addressing the private market on non commercial issues (the location codes)
- Establish (by investing money and commitment) a good example that provides the incentive to join as demonstrated by EFM.
- Accreditation and trust building, as demonstrated by the Swedish customs with the Stairway

<sup>&</sup>lt;sup>68</sup> This information is based on a presentation held by Mats Wictor at the Swedish Customs, May 22<sup>nd</sup> 2007. The presentation is available at www.arena-ruc.se.

#### 22. The Role of Policy

I have pointed out a need for transparency and stressed that interaction between different domains is a starting point for achieving it using *Interaction Infrastructure* as a tool. I now want to add the role of transport policy to the discussion.

From a societal point of view, safe, efficient and secure freight transports are needed and the argument to leave freight transport to the market to solve is in my opinion no longer valid.

An urgent argument for improved transparency and interaction is the overriding issue of global warming. It is not an option to ignore the overall demand for reducing CO2 emissions; hence a major responsibility is placed on freight transport systems due to their large and increasing share of the carbon emissions.

Increased efficiency of freight transport systems is also necessary to fight congestion on our infrastructure and to meet safety and security requirements. Information management is considered as tool to reduce the need for more infrastructures but to utilise this potential, information issues need to get as high a status in a policy as the issue of infrastructure in its classical meaning. We can return to a statement connected to the EFM programme of US DOT:

"Using the Internet to make data broadly available to any authorised and authenticated user in real-time is key to improving the exchange of information along a given supply chain and to ultimately making freight transportation more efficient and secure" (Fitzpatrick et al, 2006, pp 9).

Not only will improved information exchange for transport chains increase the efficiency of the freight transports, in addition it will provide means to address the security threat that is connected to freight transports. This should be viewed as legitimate arguments for stronger policy objectives and increased public involvement in the freight business. By placing freight issues higher on the policy agenda and to unleash resources it should be possible to stronger facilitate a connection between transport chain management and information.

The policy goals that are defined by society, need to be stronger connected with actions that support the development of freight transports. Overall objectives aiming at e.g. reduction of CO2, sustainability, safety and security etcetera already impact the logistics market through policy and regulatory framework. Society must dare redefine its role in the area of freight transports and to extend its involvement by starting processes that will lead to a better interaction between the domains and in turn, a higher overall efficiency and a reduced environmental footprint of freight transport. Transparency needs to be included into the policy agenda, both on a regional, national and international level and a strong public commitment is required if radical improvements are to be achieved.

Policy should strive for connecting freight transportation systems with information systems<sup>69</sup> and support the establishment of different facilitating systems that are open and flexible enough to create

<sup>&</sup>lt;sup>69</sup> One promising policy tendency of connecting freight transportation systems with information systems is the increased focus on a connection between ITS and logistics. This can be seen both in the European and the US transport policies. The EFM program is a joint initiative between the Office of Freight Management and Operations and the ITS programme, both units under US DOT. In Europe it

efficiency and to enable development. This ought to be done with the needs of the users in mind as well as with an integrated view of freight transport, i.e. a strategic planning is required both within the transport modes where different agencies and public bodies are involved and between the modes to support co-modality.

I have compared policy approaches between Europe and the US and demonstrated similarities in policy but also different approaches towards solutions. I recommend sharing of experiences between the continents, and as recognised both in US and Europe, the freight industry is global and so should be the harmonised information.

is expressed through the preparations of the European Commission of a road map for the implementation of ITS. This is done in cooperation between the Directorates TREN and INSFO.

#### 23. A Window of Opportunity

My request for a closer interaction between the different domains is a challenge. It is mixing private and public players and issues coloured by their internal traditions. However, I can see a number of driving forces that opens up a window of opportunity for improving interaction and information sharing in freight transport.

Efficient freight transport is a corner stone for the economical development but there is an *increased awareness* among public and private players of the problems related to the negative sides of freight transports, e.g. congestion, pollution, traffic safety, security and the fact that transport is one of the major contributors of greenhouse gases. It is my belief that the increased awareness both will provide the public with a stronger legitimacy for getting involved in freight issues and a stronger acceptance from industry towards this involvement.

Today, new and *simplified communication possibilities* are available through the wide use of the Internet, web services, XML messages etcetera. As some levels of technology and information integration become ubiquitous (for example, messaging and the syndication of news across platforms and devices), the operational competence of engaging in cross-organisational systems and new technologies will grow.

Trust is a returning issue in the discussions and I argue that the relationship between trust and transparency is of an amalgam nature with trust being a command for transparency as well as transparency being a requirement for trust. Both trust and transparency in the way it has been discussed in this work builds on a change of mindset with *a new culture of information sharing*, in which selected parts of information is not viewed as exclusive but something to be shared for the common good. The new culture of information sharing includes a move from:

- Viewing information from a silo or vertical perspective to a horizontal perspective.
- A "we and them view" to an "us view".
- Viewing the players as "providers or users" to "providers and users".

Changing mind sets is an extensive task but there are signs from other areas in this direction. Web 2.0, the open source movement and approaches towards open peer reviews<sup>70</sup> provide examples of sharing information and participation when developing content.

I would further like to point at the trend of an increasing blurring of the boundaries between public and non-profit tasks, and commercial tasks: commercial actors assuming monitoring, safety or security tasks formerly the domain of public bodies, and public bodies acting commercially, e.g., in PPPs. That is a material basis for increased interaction.

In The World is Flat (Friedman, 2005), the author addresses the issue on how to agree upon norms of behaviour and rules of commerce in a world that is increasingly turning into a "new global collaborative society". The author stresses that we need agreed-upon ways of establishing authority and building communities, doing work, protecting copyrights and determining who to trust. He partly

<sup>&</sup>lt;sup>70</sup> My reference to Open Peer Review is connected to the shift of ideology of peer reviewing as described by Giger and Trojer, http://feministtechnoscience.se/journal. The shift includes a movement away from the traditional and closed method towards a method that allows an author to publish an article that can be freely accessed and peer reviewed.

criticises the approach of the open-source movement that claim that "the network" will establish the norms. The answer of Friedman on who to set the norms and standards is a call for collaborative models with a mixture of players. "*Traditional nation-states, governments, corporations, and news organisation will have to work together with emergent networks, virtual companies, superempowered individuals and companies to hammer out the new norms, new boundaries, new mechanisms for operating in the flat world" pp 239.* 

The concept of *Interaction Infrastructure* is suggested as tool to support improved interaction between the domains. It includes interpretation between private and public partners who are used to work alone, focusing on their own domain. Thereby it is possible to address the lack of knowledge and understanding between the domains that has been illustrated throughout the cases. It is my belief that a movement towards increased interaction requires a strong leadership. This needs to be promoted through a stronger connection between logistics and transport policy.

We can learn from good examples, if we look for the pioneers and champions who have been able to achieve changes, e.g. the US DOTs EFM initiative or Swedish Stairway initiative. The European Commission's approach of applying integrated research as demonstrated in connection with RIS and the ongoing FREIGHTWISE project is a good example of how policy can support knowledge production and in return realise the findings in different measures.

The knowledge production as described by Nowotny et al., (2001), where the development is carried out in the context of the practical application and in a mixed environment can be a step forward to a common understanding which is a crucial prerequisite for a mental change.

Finally, it is important to remember that a development of an *Interaction Infrastructure* must take the local conditions as well as the high commercial value of the information into account. Throughout the projects, the players in the transport chain stressed that all development should respect that information has potentially a high commercial value. I do not view this as a counterforce towards *Interaction Infrastructure* but as a reminder of the highly sensitive environment that we are positioned in. It is also a reminder of how important it is to build trust and make benefits of sharing information apparent.

## PART F: LISTING OF REFERENCES FROM PART A TO PART E

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### PART G: THE SCIENTIFIC PAPERS

- Interaction Infrastructure for Improved Information Experiences from an Initiative Carried out by the Swedish Traffic Administrations. Gustafsson I., (2006), Proceedings from TRA, Gothenburg June 2006
- Interaction between Transport, Infrastructure and Institutional Management, A Case Study on a Port Community System. Gustafsson I., (2007), Published in Transportation Research Record (2007), TRR 2033, pp. 14-20
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#### Interaction infrastructure for improved intermodal information experiences from an initiative carried out by the Swedish traffic administrations

This paper is a modification of: Gustafsson, I. (2006), A framework for customer oriented intermodal information - interaction between authorities and their customers, proceedings, European Road Transport Research Conference, Gothenburg, June 2006

Inger GUSTAFSSON Project manager and PhD student BMT Transport Solutions GmbH and Blekinge Institute of Technology Karpfangerstr. 14, 20459 Hamburg, Germany ig@bmt-ts.com

#### Abstract

Efficiency of transport solutions requires well functioning information flows running in parallel with the physical transportation. This paper provides an introduction to an ongoing research project on the usage of information in transport chains. The research focuses on interaction between public and private partners and introduces the notion of interaction infrastructure as a support for sharing and exchanging information.

Empirical material is presented from "KombiTIF", a Swedish project where the traffic administrations investigated their possibilities to support intermodal transport by providing high quality information. It includes an approach on how the Swedish traffic administrations could cooperate to improve the information exchange with their users. The project also identified which information about infrastructure and traffic situation that is needed by the administrations users.

One of the main conclusions from the project is that cooperation between the traffic administrations as well as with the transport industry by no mean is trivial. The results also indicated a need to further define which role the traffic administrations are to play – hand in hand with commercial actors and other public players - in creating the conditions for improved usage of information and the development of related services.

#### Introduction

Increased usage of intermodal transport is on the European policy agenda and identified as a mean for utilising the existing infrastructure more efficiently in order to make transport more sustainable. In 2001, the European Commission submitted a white paper on the future transport policy, "European Transport Policy for 2010: Time to Decide" (European Commission, 2001). Halfway through the time, evaluations indicate that the policy goal regarding modal-split and a de-coupling of transport and gross domestic product growth cannot be reached. The critics claim that the overall efficiency of the transport system is the most important factor in order to support other more important goals as economic development, creation of jobs etc.

In the mid-term review report "Keep Europe moving - Sustainable mobility for our continent" (European Commission, 2006), mobility and innovation is given more attention. Thereby, a clear connection to the policy goals of the Lisbon agenda for jobs and growth has been created. In the review, the notion of co-modality is introduced and the assertion is made that the efficient use of different modes on their own and in combination will result in an optimal and sustainable utilisation of resources. The main difference between co-modality and intermodality<sup>1</sup> is that co-modality focus on the total efficiency of the transport sector instead of the transfer of goods from road to rail and maritime transport. Co-modality shall be supported through public policies and support the trend towards integrated logistics. One of the public policies identified is the promotion of standardisation and interoperability across modes.

One obstacle for combining transport modes is the increased complexity through the number of players and processes involved. To overcome this complexity, efficient information exchange is required. One way to promote intermodal transport is to instigate a more effective information exchange, and a number of European, national and regional initiatives can be identified with this focus. This is a challenge due to the heterogeneous nature of the players involved; a transport chain can include both major companies with sophisticated information systems as well as small and medium sized players with much less developed usage of information technology.

#### Transparency, interaction and interaction infrastructure

In my research, the role of transparency in the management of intermodal transport chains has been explored (Gustafsson, 2004). The results show that transparency does not mean that every player should know everything at all times; instead, transparency should be viewed as specifically relevant information accessible to the different players in the transport chain.

Experiences from the rail sector indicate that infrastructure operators and authorities influence the quality of the transport chain through the way they execute their responsibility of providing information for planning, information on status and disturbances as much as by contributing to the reduction of the consequences of disturbances, (Törnquist et al, 2004).

<sup>&</sup>lt;sup>1</sup> ECMT – the European Conference of Ministers of Transport define intermodal transports as: movement of goods in one and the same loading unit or vehicle that use successively several modes of transport without handling of the goods themselves in changing modes:

The thematic network THEMIS, funded by the European Commission, examined the status of the interaction between traffic management systems and freight transportation management systems and concluded that at this moment, the integration of traffic information with the freight transportation management tasks is still in its infancy, (Giannopolous, 2002).

Based on these findings I focus the research on three basic ideas. The first, (1) is to include a broader set of players - public and private - to be included in the establishment of high quality information. I argue that information for transparency and high quality intermodal transport requires *interaction between the following three domains:* 

- Transport management (including the relevant commercial players in the transport chain). The transport management domain is commercial and characterised by business conditions where contracts are established between customer and service providers.
- Infrastructure management (public and private traffic management networks and traffic information systems). The traffic and infrastructure management includes both public and private players. One core objective is to provide safe and efficient usage of the infrastructure. For the infrastructure run by public players, e.g. national administrations, safety and security are often paramount targets before commercial considerations. Also the notion of users and service provider is not especially clear and perhaps not of relevance.
- Institutional management (legislation for, e.g. safety and security requirements, customs, etc.). The institutional domain stands for administration and legislation and includes a variety of objectives, e.g. efficient, sustainable and safe transport systems. It defines the conditions governing transport and traffic and the use of the infrastructure. This domain consists of public bodies and processes where directives, regulations, policy documents and laws set the scene.

(2) I argue that interaction needs to be formalised and structured. Therefore the notion of *interaction infrastructure* is introduced. The notion indicates that interaction is not merely a question of being able to communicate from a technical point of view, but also there is a need for commonly agreed definitions, basic principles, rules for co-operation and communication. The interaction infrastructure is a framework for information which is agreed on to be important enough to be subject to common definitions, formats and quality targets.

The transport market is fragmented and heterogeneous so (3) I believe that there is a need to facilitate the interaction infrastructure. I believe that it is critical that "*someone*" takes the responsibility for the interaction infrastructure, facilitates the agreements and also maintains it.

I have chosen to use the notion interaction as defined in Wikipedia, the free encyclopaedia: "Interaction is a kind of action which occurs as two or more objects have an effect upon one another. The idea of a two-way effect is essential in the concept of interaction instead of a one-way causal effect. Combinations of many simple interactions can lead to surprising emergent phenomena." This broad and also to some extend diffuse meaning of interaction suits my research approach since one of my main goals is to describe the landscape where the interaction of the domains is situated. It is my belief that a common understanding based on a common description is the starting point to any structured attempts for improvements. I am arguing for the need of interaction infrastructure to structure the interaction and it is also my ambition to provide a set of criteria for a workable interaction infrastructure. My earlier research concluded that much work has focused on technical solutions whereas models for interaction between commercial and public players have been neglected.

The research focus is on the interaction between the domains, therefore I have chosen to to view the domains some extend as black boxes, see figure 1, and focus the research on what is/could be going on in-between the domains. Latour refers to blackboxing as "when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity". With the blackbox approach I also stress that the internal systems of the different players are not in focus since the basic idea about interaction is not to change existing systems and processes.



Figure 1: A framework for interaction between the domains of transport, infrastructure and institutional management

#### **Research approach**

In order to build up a body of evidence against which the concept of interaction infrastructure can be verified, I have chosen to study a number of existing initiatives that all have the objective to improve transparency. This base should also provide examples of how transparency can be supported. The identified initiatives are carried out on European, national and regional levels. This paper is focused on the national level. It is concerned with a Swedish project called KombiTIF which addressed issues on how the Swedish traffic administrations can co-operate to improve access to information needed to support intermodal transport.

The findings from KombiTIF originate from my own involvement in the project as a consultant responsible for the area of freight transport. I worked in the project for nine months, supported the process of defining visions and missions, organised workshops, collected user requirements, and developed solutions. I had the privilege to get firsthand experience on how the different players reacted during the process.

Through the close involvement in the project I achieved an insider perspective of the processes in contrast to the outsider position of a common academic research setting. This is an approach different from the positivism that is dominant in logistics research, (Mentzer and Kahn, 1995). The dominant role of the positivistic approach and its use of mainly quantitative research methods have been challenged by a number of researchers. Mangan et al point out that the discipline of logistics can be enriched by the application of more qualitative methodologies. They urge logistics researchers to think about the paradigm through which they view the world and to explore the use of alternative methodologies (Mangan et al 2004). Näslund argues that logistic problems often are ill-structured and need to be tackled in the absence of a firm definition of the problem. One of the qualitative methods he recommends is action research, with the core idea that the researcher does not remain an observer outside the subject of investigation but instead participates in the project and even in a change process (Näslund 2001). For Gummesson, who is active in the research area of marketing, action research is where the researcher contributes to science and helps to solve a practical problem. By being involved, the object of study "creeps under the skin" of the researcher in a way not possible in the study of documents or interviews (Gummesson, 2005).

#### KombiTIF - experiences from a Swedish initiative

#### Starting point for the project

In Sweden, a division of about 30 civil servants at the Ministry of Industry, Employment and Communications is responsible for transport and infrastructure issues. This fairly small organisation is supported by strong, independent and to high degree self-governing traffic administrations for road, rail, maritime and air traffic. The administrations have a threefold responsibility; as authority, as operator of the network and as promoter of transport in their domain.

In the beginning of 2003 the Swedish government commissioned the rail administration to co-operate with the other administrations in the uptake of electronic information as a facilitator for intermodal transport, e.g. the planning and execution of intermodal transports. The work was to result in a common strategy and action plan with the goal of introducing the use of electronic information for supporting intermodal transports. The project was named KombiTIF and included both passenger and freight transport. This paper is focused on freight transport.

#### Project design

The project was lead by a project manager employed by the rail administration who was supported by consultants managing three working groups focusing on the areas freight transport, passenger transport and geographical information. The project manager and the consultants formed the project's core team and were responsible for the progress of the project. The project manager reported to a steering committee consisting of one senior representative from each traffic administration and chaired by the marketing manager of the Rail Administration. The steering committee met on a regular basis both through physical meetings and through telephone meetings.

The working groups consisted of representatives from each traffic administration. The representatives were appointed based on their general competence and knowledge of the

operational work. Their task was both to support the project with their own knowledge and existing material but also to make sure that the result from the project was transferred back to the administrations. The project planning and the project time plan were based on the assumption that the representatives would spend one day per week on work within the project.

Throughout the project a reference group was involved. The reference group was composed of a number of the administrations' customers, in total 39 participants representing shippers, operators, system providers, universities, and different interest and lobby organisations. Their involvement included both participations in the workshops and in the referral process.

The project started in mid May 2003 and was finalised in February 2004. The work was carried out in two phases: phase 1 – Analysis of requirements, and phase 2 - Strategy and Action Plan. Phase 1 investigated requirements, described the as-is-situation as well as planned activities within the administrations and identified a number of requirements. The reference group was gathered at a workshop where the requirements were presented and tested. The reference group was also asked to prioritise the requirements. Based on the results from the workshop, three reports (one per project area, Gustafsson 2003, Hammarström, et al 2003, Höjsgaard et al 2003) were finalised.

The prioritised results from the workshop served as input to Phase 2 – Strategy and Action plan. In phase 2, the focus was on how the requirements should be met. A vision, a strategy and an action plan were developed.

The final report was subject to a referral process. The draft final report was distributed to the members of the reference group, who were given time from mid December to mid January (19 Dec 03 -16 Jan. 04) to comment on the report. 12 companies provided official written feedback to the report, which was collected into an additional report (Larsson, 2004). The feedback was thoroughly discussed and reflected in the final report. The following chapters will provide an overview of the work carried out within the project as well as of the results.

#### The required information

One of the first activities of the project was to identify which information the users required and to identify what kind of improvements they were interested in. To carry out the identification of requirements and desired improvements, five high-level generic transport chain processes: strategic planning, tactical planning, production planning, production and post production, were used as a tool to structure the discussions and to group the information needs, see figure 2. These processes are results from the research project "Baninfo" commissioned by The National Rail Administration, Gustafsson et al.(2002). Below follows a short description of the processes:

• During strategic, tactical and production planning, transport services are combined to form an acceptable solution that can meet the requirements for timing, speed, reliability and price. This requires accurate information describing the infrastructure, e.g. roads, rail, ports, airports and terminals. Access to performance indicators on parts of the networks, characteristics, and status of the different parts of the network for a specific time frame increases the possibilities for effective planning. Based on such information, comparisons of different transport concepts can then more easily be done and their robustness may be evaluated.

- During production, the transport is managed and monitored; this requires real time data about the traffic and the infrastructure.
- During post production the performance is evaluated against the original planning and services are invoiced.



**Figure 2: Generic transport processes** 

The reference group played an important role when identifying the information needs, both when participating in discussions during two workshops and by providing existing material. The information requirements are illustrated in a mind-map, c.f. figure 3. The requirements are sorted by the generic high level processes and in addition, *administration* and *integrator* have been added. Administration includes services, information and reporting which occur during different transport processes as well as those not directly related to the transport, e.g. applying for permission to act as an operator. Integrator includes requirements that are today not connected to the traffic administrations but relevant for commercials players, i.e. forwarders and 3PL players.



#### Figure 3: Overview of information requirements

The requirements connected to the generic high level processes include information related both to the infrastructure and to the traffic process with respect to historical, real time and forecast information. Within the project the notion of "soft infrastructure" was established for information describing:

- the status of the infrastructure (topology, geometry, restrictions etc), including the total road and rail network as well as the infrastructure at seaports and airports and
- the traffic situations, i.e. real time information about the traffic that is using the infrastructure as well as historical data and forecasts.

When comparing the required information with the existing situation at the transport administrations it turned out that:

- Some of the information is already being exchanged between the administrations and the users today, but the information channel may need to be improved. Also, a harmonisation between the administrations would be valuable for the users. For example, currently permissions to transport dangerous goods require different procedures depending on the mode of transport.
- Information exists at the administrations but is not exchanged with their customers, e.g. the administrations have access to historical data about the traffic situation but do not make it available.
- Some of the information required is lacking and would need to be developed, e.g. quality related information.

During the workshops it was stated by the users that access to the right information and welldefined communication paths provide, among several other advantages, a possibility to achieve:

- Improved utilisation of production means
- More robust transport concepts.
- Reduced transportation time.
- Improved quality of the logistics service through increased transparency.
- Improved customer service and customer satisfaction.

#### The vision

Within the project's working groups the following vision was formulated for the transport administrations to strive for:

The traffic administrations shall – by themselves, together and in cooperation with other actors – with electronic information contribute to create good conditions for sustainable transports for citizens and commercial transports.

#### The strategy

A strategy was developed with the main focus on improved co-operation between the traffic administrations and other relevant players in order to support the provision of electronic information and other supporting conditions for intermodal transport. The following three points summarises the central part of the co-operation:

- Organisation of a joint task force with clear responsibilities and sufficient resources
- Agreement on common goals with the work on information across the transport modes
- Willingness and commitment

The main focus should be on improving the content and quality on the traffic and infrastructure information from the administrations. To improve the accessibility to the

information of the administrations, a common arena should be established for information exchange.

# Introducing the concept of an arena – a way to enable access to information

The idea of an arena for accessing information was identified by the reference group and the concept was developed during workshops with the working group. The basic idea of the arena is to enable access to information that allows the co-use between the different modes, e.g. infrastructure information for an intermodal transport chain should be accessible in a harmonised way. Openness, harmonised formats and usage of standards was viewed as key issues and a challenge for the administrations requiring co-operation.

Figure 4 provides an illustration of the arena on a conceptual level.



Figure 4: An Arena for providing information

Figure 4 illustrates the different levels of the arena as well as the interaction with commercial actors who can use the information from the arena to provide customised information services. The different levels of the arena are:

- Level 0 represents the administrations' supply of information as it already exists within each administration, however often distributed between different systems and departments.
- In level 1, the information within each administration is co-ordinated, e.g. the user can access the information from one single point at the administration. At the time of the project, none of the administrations had reached this level of providing infrastructure and traffic information at one single point. Some initiatives were ongoing that could be used as a starting point for further development.
- In level 2, a co-ordination of information between the administrations take place, e.g. it would be possible for the user to gain access to intermodal information from all

administrations via one single entry point. This requires co-operation between the administrations.

• In level 3, the information is co-ordinated not only between the administrations but also with information from other public and private actors, e.g. ports, terminals or municipalities.

The figure further illustrates that the information from the different levels shall be accessible for different users, e.g., transport operators and information application providers.

The project stressed that the most important topics related to the arena are:

- quality-assured information,
- harmonised interfaces
- use of standards.

This approach suggests that each actor can use their own preferred internal systems and the harmonisation is carried out on the interface level.

It is important to point out that the arena provides basic information. The information is not customised to support specific transport chains or traveller needs. The interfaces to the endusers are the responsibilities of other actors who can use the arena as a tool to get access to basic information.

The project made suggestion on how to get from a vision of the arena to an implementation. Much discussion was focused on the responsibilities of the administrations and the borders to commercial players. It was the opinion within the project that level 0 to level 2 was within the responsibility of the administrations in their role as infrastructure operators. For level 3, which require co-operation with other public as well as commercial actors it was argued that it could be seen as a responsibility of the administrations in their role as promoter of transport. Another possibility would be to search for public private partnerships. Within the project it was a shared belief that the administrations should not provide customised services to the end-users. However, the administrations could very well play a role in supporting the establishment of such services.

#### The action plan

The project resulted in an action plan identifying major areas where the traffic administrations should act to support intermodal freight solutions:

- Develop an agreement on the content and quality of the traffic and infrastructure information from the administrations.
- Improve the access to traffic and infrastructure information.
- Take an active role in increasing the intermodal transport quality by providing correct information for planning, providing real time information on status and disturbances, and reducing the consequences of disturbances.
- Simplify administrative prerequisites. In intermodal transport chains different administrative documents, e.g. reporting of dangerous goods or consignment notes, are required for the different modes of transport. Often the same information is required in different formats, hence the need for harmonisation. Increased efficiency can be reached with electronic documents that are accepted across the transport modes.

• Take an active role in international initiatives. Freight transport is to a high extent an international issue. Documents, reporting routines and standards should therefore be developed on a European or even on an international level.

#### Reflections on the Kombi-TIF project

The initiative to start the project was top driven from the ministry, i.e. an instruction was sent to the administrations to carry out the project. Throughout the project it was partly a painful process to get the top level management of the traffic administrations who were represented in the management team to recognise the value of the project. This can partly be explained by a lack of a common notion of what could be achieved and resources to carry out the required work. The project was further complicated through different levels of maturity of traffic administrations' customer focused information systems, and different ways of funding.

For the first version of the final report the Swedish Civil Aviation Administration required to have a separate chapter in the report where they stated that the conditions for air transport on decisive issues are distinguished from other modes of transport. Therefore the possibilities to implement the suggested actions would be limited for them. This statement was one of the reasons for the project to state in the draft final report that a strategy and action plan addressing all transport administrations is not possible.

The draft final report was submitted to a referral process (Larsson, ibid) where a number of actors including the reference group and the traffic administrations were asked to give their view on the report. The four traffic administrations commented on the report and provided quite different views. The report in which the comments are published is available only in Swedish and all citations that follows are the result of the authors own translations.

The Road Administration clearly stated that they disagree with the conclusion that a strategy and action plan addressing all transport administrations is not possible and suggests that the text is replaced with the following strategy: *There is a need for continues cooperation between the administrations to promote the issue of intermodal information. Therefore the administrations wish to establish a common forum that can further carry on the work by defining a vision and common goals with the work on intermodal information and that each traffic administration gradually commit to implement these actions to achieve the goals. Focus the next years should be on improvement of content and quality on the traffic and infrastructure data that the administrations supplies. A common arena for the supply and exchange of the traffic administrations data shall be implemented within some years to increase the accessibility.* 

The Rail Administration supported the idea of increased cooperation and that the project should be viewed as a beginning of further cooperation but points out that the report is not clear in regard of who shall make sure that the work actually is continued: *The report do not address the question of which administration shall have the coordination responsibility. The rail administration do not believe in "voluntarily initiatives" in these issues, instead someone has to be appointed as responsible, e.g. to make sure that work with interfaces and standards is carried on.* 

The Swedish Civil Aviation Administration continued to criticise the suggestions in the report and stated that one should be careful with the suggestions regarding division of responsibilities of the administrations: *The Swedish Civil Aviation Administration consider* 

that one should be careful when defining areas of responsibility without having full knowledge of the structural conditions that exists within the transport modes and within the specific traffic administrations.

In line with the statement in the draft final report from the Civil Aviation Administration, the Maritime Administration also stresses their specific conditions and that it makes it hard to implement the suggested actions: *The Swedish Maritime Administration has to stress that the possibilities to implement the different suggestions and point of views that are presented in the report, especially the more detailed parts, are difficult to evaluate and limited in a number of areas for the maritime sector.* 

The above citations indicate a situation with two administrations (the rail and the road administrations) that are positive towards increased cooperation and who criticises the report for not being explicit enough regarding the way forward. The other two administrations (civil aviation and maritime) on the other hand, see less value of a cooperation and states mistrust in the suggested actions and solutions. This attitude is partly hard to understand given that the project was commissioned by the ministry to whom the administrations have to answer. This issue was addressed in the comments from SIKA<sup>2</sup> - Swedish Institute for Transport and Communications Analysis.

SIKA: It is clear from the report, both directly and indirectly, that some of the traffic administrations do not see any strong reasons for participating in a common strategy and action plan. ....In practice this means that what the government has asked for cannot be fulfilled without a more legible – and for all concerned traffic administrations common – guidelines from the government. It is SIKAs point of view that this is the main finding and that it should be clearly communicated in the report to the commissioner......All traffic administrations are state administrations and established to serve the interest of the public. They do not exist for their own sake or for a limited group of customer. Neither are they actors of the market but parts of a political-democratic system.

The Swedish International Freight Association<sup>3</sup> - SIFA, addressed the problem of cooperation between the administrations: *SIFA has no principal arguments against the suggested strategy but wants to raise a question mark on how the cooperation problems that experience show often appears in praxis will be solved in this context. The chapter from the civil aviation administration indicates that these problems still exist.* 

Customers stated their surprise in regard of lack of cooperation between the administrations. Tågoperatörerna<sup>4</sup>: It is with an amount of surprise that I read about the lack of coordination between the governmental administrations. That the only concrete result, so far, is an informal network feels very diffuse.

Green Cargo<sup>5</sup> supports the paragraph in the draft report that suggests that a basic strategy for the improvement of intermodal information should be that the traffic administrations exchange data and information with each other: *The paragraph is good and stresses the need* 

<sup>&</sup>lt;sup>2</sup> SIKA is an agency that is responsible to the Ministry of Industry, Employment and Communications. It carries out studies for the Government, develops forecasts and planning methods and is the responsible authority for official statistics

<sup>&</sup>lt;sup>3</sup> Trade organisation for Swedish companies in goods transport, logistics and freight forwarding

<sup>&</sup>lt;sup>4</sup> A trade and industry branch organisation for the railways operators in Sweden

<sup>&</sup>lt;sup>5</sup> The major rail freight operator in Sweden

## for the administrations to really communicate with each other and we assume that this will be done in the future.

During the project the awareness within the traffic administrations increased regarding the need to take responsibility beyond the role of managing the own network and being an authority. One possible reason for this was messages from the workshops and the referral process that stressed that the administrations should make a stronger commitment. It was further stressed that all development should respect that information has potentially a high commercial value. Traditionally transport service providers consider themselves as exclusive owners of transport related information and do not easily see the benefit of sharing information, or co-operating with others to improve the quality of information.

One of the main conclusions from the project is the need to further define which role the traffic administrations should play – hand in hand with commercial actors and other public players - in creating the conditions for improved usage of information and the development of related services.

Central to the creation of such conditions are:

- Co-operation between the administrations in a common organisation where one part has the overall responsibility to make sure that the work is continuous and that the required resources are made available.
- Agreement on common goals for the provision of information across the modes with a focus on facilitation of soft infrastructure

Furthermore, it is important that the traffic administrations continue to work on broadening the access to their internal customer-related information. The quality of intermodal information can never become better than the information it is combining. This implies the understanding that the provision of information about the status of the infrastructure and the traffic is as equally important as the task of developing and maintaining traditional infrastructure.

The final report was presented to the ministry in January 2004 (Lindqvist et al, 2004). The message from the ministry was that the project should not be viewed as finalised but as the start of a process. This was an informal message and the ministry did not submit a formal document.

Based on the recommendations, an organisation with representatives from each traffic administration was established with the goal to continue the work. In April the same year, a number of activities were prioritised for the future work, e.g. increased co-operation with the freight market, improved data and information quality and a portal for transport information. A number of meetings have been held with the transport industry and project plans have been established, e.g., regarding the improvement of descriptions of the physical infrastructure.

#### **Conclusions**

The main idea of this paper is to verify my research ideas on interaction and interaction infrastructure and below a discussion will follow were the results from the KombiTIF project is applied on the research ideas.

(1) Interaction between the domains of transport management, infrastructure management and institutional management. The driving force behind KombiTIF was to improve the cooperation between the traffic administrations and the transport market. Throughout the project, no structured differentiation was made between the administrations' role as infrastructure manager and institutional manager.

Due to the administrations traditional thinking and acting in internal vertical processes it was very difficult to create an understanding for acting in horizontal processes were the activities of the own administration would constitute just one element. I believe this contributed to the problem of getting a common understanding of what the project was aiming for.

One issue always returning in the discussions within the working groups was how far the responsibility of the administrations should stretch. There was a fear of intruding on the area of the commercial players, i.e., to directly compete with the commercial players or to cause an unfair playing field between them. I believe one of the reasons for these concerns is that the administrations lack an internal organisation and structured competence for dealing with the issues of intermodal information. The area is new and the roles and responsibilities not yet set.

Access to infrastructure and traffic information is vital for the transport management for planning and production of transport chains. Although the project was initiated with the goal of supporting the transport industry, information about the transport is also of great importance for infrastructure management, e.g. what types and numbers of vehicles are using the system, historically, at present, and tomorrow. It is possible to think that once a well-structured information exchange from the traffic administrations to the transport domain is established it could be possible to utilise the existing trust and channels to exchange information also in the reverse direction.

(2) Interaction infrastructure. Already today a basic interaction infrastructure is in place – information is exchanged between the administrations and their users - however within the project it was not really recognized as such.

The concept of the arena is an example of an interaction infrastructure. The data available from the different systems at the transport administrations is secured, co-ordinated and packed within each administration. In the next steps it is extended to include information from all administrations as well as from other identified actors. Added value information is achieved and the users have the possibility to access the information at different levels. The basis for the arena concept includes agreement on how to ensure the quality of the data, which interfaces to use, and when required which standards to follow. A basic principle is that the harmonisation focuses on the interfaces – not on the internal databases. Throughout the project it was evident that each administration feared changes in their internal systems that are mostly well developed and robust. It is further evident that building an interaction infrastructure has to consider the different starting points in the administrations due to e.g. differences in their customer orientation and also differing needs and ambitions as well as the way they are financed.

The arena concept developed in the project contributes to the understanding of the notion of interaction infrastructure and the industries requirements on a solution are very straightforward and valid on a generic level: solutions shall be easy to understand, access and use. The industry also stressed that it is important to find the correct balance between

supporting the market and respecting the commercial value of information and customer relationships.

(3)Someone takes the responsibility. The topic of someone taking the responsibility is crucial but also very difficult. The suggested arena is highly political involving issues of power, trust, vulnerability and accountability. The concept of the arena has not been accepted as a way forward and it has not been further promoted in the actions that have been taken after the project was finalised. The arena concept has been seen as threatening towards existing initiatives, e.g. freight portals or door to door travel information portals. Apparently, it has to be more clearly communicated that the arena would be a support through providing better basic data and not a competitor to existing initiatives. It is crucial to respect that information has potentially a high commercial value for some players.

One of the main problems is the lack of a natural leader to drive the work. The ministry appointed the rail administration to co-ordinate the work and they did within the KombiTIF project. Possible explanations to the lack of interest from the administrations are the perceived complexity and a fear of disturbing the market forces and the unclear benefits for the users.

Through the KombiTIF project, the traffic administrations, for the first time, had a common discussion on topics related to intermodal information. This was an important first step and a prerequisite for further co-operation. The results show that the transport and shipping industry, e.g. the domain transport management both accept and welcome public initiatives.

Further, the project discusses that to support the access to information, i.e. facilitating the interaction infrastructure is an extensive commitment – things do not just happen. Public initiatives require more than a top driven ambition pointing out the responsible actors. It is still up to the new organisation with representatives from each traffic administration to prove if it can shoulder the responsibility as a facilitator. If the development continues to be slow it will be necessary with stronger and more specific guidelines from the ministry.

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# INTERACTION BETWEEN TRANSPORT, INFRASTSRUCTURE AND INSTITUTIONAL MANAGEMENT

### A CASE STUDY ON A PORT COMMUNITY SYSTEM

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INGER GUSTAFSSON BMT Transport Solution GmbH, Karpfangerstr. 14, D-20459 Hamburg Tel: +49-40-36 47 80, e-mail: <u>ig@bmt-ts.com</u>

### ABSTRACT

This paper is a contribution based on an on-going research on how to support high quality information for intermodal transport. The research approach suggests that interaction between the domains of transport, infrastructure and institutional management is a step forward. This kind of interaction needs to be formalised and structured through an interaction infrastructure and someone needs to be responsible for the maintenance and development.

The results from a prestudy for a port community system in the Port of Gothenburg, Sweden are used as the empirical data for this paper. In total 54 semi-structured interviews were carried out. The research shows that co-operation and sharing of information within the port cluster is far away from a highly integrated supply chain management solution. Further the research indicates major gaps in the recognition of each others situation, especially between authorities and the shipping industry.

By viewing a port community system as an interaction infrastructure, the approach of Port of Gothenburg stresses the need for interaction between the different domains and the need of a strong initiator and developer. For the system to become a success it has to get the status as useful and trusted by the different actors who are required to update the system in a timely manner. To build in trust in the system, the development and implementation need to be done in close co-operation with the different actors. For each actor it is important to think outside ones own system, i.e. to recognise that information crucial for the own operation can be of high value also for other actors.

### INTRODUCTION

### Background

Increased usage of intermodal transports is on the European policy agenda and identified as a mean to utilise existing infrastructure more efficiently and to achieve sustainable transport. In 2001, the European Commission submitted a white paper on the future transport policy "European Transport Policy for 2010: Time to Decide" (1). Evaluations indicate that the policy goal regarding modal-split and de-coupling between transport and GDP growth can not be reached and critics claim that the overall efficiency of the transport system is the most important factor in order to support other more important goals such as economic development, jobs etc. In the mid-term review report "Keep Europe moving - Sustainable mobility for our continent" (2), mobility and innovation is given more attention, thereby creating a clear connection to the policy goals of the Lisbon agenda for jobs and growth.

In the mid-term review the notion of co-modality is introduced and defined as: *the efficient use of different modes on their own and in combination will result in an optimal and sustainable utilisation of resources.* The main difference between co-modality and intermodality is the new focus on the total efficiency of the transport sector instead of the transfer of goods from road to rail and maritime transport. The co-modality shall be supported through public policies and match the trend towards integrated logistics. One of the identified public policies is to promote standardisation and interoperability across modes.

The work on creating a harmonised river traffic information system (3) and a joint European system for road user charges for heavy vehicles (4), provide interesting examples on how to contribute to European consensus by addressing among others, the lack of co-operation between different systems. In the railway sector another example can be found; the work with TSI (Technical Specification for Interoperability), which lays down a number of essential requirements for individual subsystems to enable information exchange (5).

#### Rationale

The supply chain normally contains intermodal elements and research on Supply Chain Management (SCM) and can provide good insight in the problems of intermodal transport chains. Sanders and Premus (6), points out that the philosophy of SCM is founded on collaboration between the supply chain partners and that the collaboration includes exchange of large amounts of information. They further refer to information as the "glue" that holds the business structures together. In a literature review on supply chain management integration, Power, (7) provides examples of the significance of inter-company relationships. It is emphasized that technology and physical transfer elements are understood, but that the issue of relationships is more difficult and less well understood and therefore more fundamentally important as a topic for further research. He further discusses the challenging situation when benefits "pool" with some members at the cost of others.

Humphries and Wilding (8) provides a brief review of literature with focus on the importance of relationships within SCM and show that research results stress that successful SCM depends on co-operative relationships throughout the supply chain in order to achieve benefits for all participants. This involves closer relationships between members including trust, commitment and collaboration. Although suppliers recognise the need to integrate with their customers, it is apparent that full SCM implementation is not being achieved for a number of reasons. The importance of long-term partnering relationships are acknowledged, but the need to base these arrangements on openness, shared risks and rewards that leverage the skills of each partner to achieve competitive performance not achieved by the individual, is a step that firms find difficult to take. They conclude their review with the following statement: "the importance of improving relationships to achieve successful SCM implementations appears to be well known to academia and businesses alike and, after more than a decade, it is still actively pursued as a strategy by the private and public sectors."

Traditionally, SCM research focus on the commercial actors involved, i.e. the consigner and consignee and different operators along the chain. However, also the infrastructure operators and authorities influence the quality of the supply chain. Törnquist et al (9) discusses interaction between transport management and traffic and infrastructure management within the rail sector. The research showed that traffic and infrastructure management play an important role in the transport chain, responsible for providing information for planning, information on status and disturbances as well as contributing to the reduction of the consequences of disturbances. The thematic network THEMIS funded by the European Commission, examined the status of the interaction between traffic management systems and freight transportation management tasks is still in its infancy. However, awareness is growing, but real applications and service providers are still in the first stage of development, see Giannopolous (10). The question is how joint solutions and cooperation should be supported when the responsibilities and benefits are blurred and who or what should take on the role of a facilitator?

In 2005, Finland's ministry of Transport and Communication took an initiative of preparing a communication on logistics that was handled during the Finnish EU presidency in 2006. A group of experts were gathered to support the preparation of the "Communication on transport logistics to facilitate intermodal transport" (11). In the communication it is stressed that co-operation is a strategic issue in the network society, that efforts must be put in the international standardization work of information exchange in logistics and good practices need to be shared through electronic platforms. Electronic platforms for easy information exchange and e.g. e-administration is seen as an important driver for a sustainable and efficient transport logistics. Another driver is intelligent regulations that are transparent and includes dialogue with stakeholders and follow- up of effects. The communication also stresses the need for co-operation between business, public administration and regulators and academia.

The examples above indicate the importance of efficient information sharing and collaboration within supply chain management. They also broaden the picture to include public administrations, regulators and academia. This approach forms part of the fundament in the research described in this paper and it will be explored closer in the following chapters.

### TRANSPARENCY, INTERACTION AND INTERACTION INFRASTRUCTURE

Organisations often have internal process descriptions, job instructions et cetera which, from the local perspective, are considered as the natural state of the art. But "translation" problems occur when confronted with other similarly "natural" systems. Transparency, i.e. knowledge accessible to the relevant players in the transport chain is one way of approaching information access and exchange in transport, see Gustafsson (12). The production of this knowledge depends on all players being aware of and respecting their role. Trust, mutual benefits, incorporation of situated knowledge and respect of all players' business contexts are key factors for achieving socially robust solutions for transparency. This paper is a contribution from an on-going research that includes the following thoughts:

(1) Information for transparency and high quality intermodal transport requires interaction between the following three domains;

- transport management (including the commercial players in the transport chain, from consigner to consignee including the involved service providers),
- infrastructure management (public and private traffic management networks and traffic information systems) and
- institutional management (legislation for, e.g. safety and security requirements, customs, etc.).

(2) The interaction needs to be formalised and structured. For this the notion of interaction infrastructure is introduced. The interaction infrastructure can contain basic principles, rules of the game or a language. The interaction infrastructure is not the content but a frame-work for information which is agreed on to be important enough to be subject to common definitions, formats and quality.

(3) It is critical that "someone" takes the responsibility for the interaction infrastructure, facilitates the agreements and also maintains and develops it.

In this paper the results from a pre-study for a port community system in the Port of Gothenburg will serve as empirical material for the discussions. The work is well known since the author was the prime consultant of the study. The empirical data are used to describe a landscape in which the three domains interact and to provide first ideas for criteria for the interaction infrastructure and what is needed to support the processes.

### A PORT COMMUNITY SYSTEM FOR THE PORT OF GOTHENBURG

### The Port of Gothenburg

The Port of Gothenburg on the Swedish west coast is Scandinavia's biggest container port. The vision of the port is: "Göteborg is the obvious hub for sea transports in northern Europe". Göteborgs Hamn AB (GHAB), is the port operator and is owned by the city of Gothenburg. The port management at GHAB view information and IT support as crucial in the process of developing the port. This view also includes commercial and public organisations outside the port authority and the port terminal operation. The port has a well developed and efficient system for the terminals with a web interface as well as a public domain for market related information. To enable a more unified interface to the customers and having the possibility of creating a deeper integration with a wider community of users, the concept of a port community system (PCS) is of interest to the port. In 2004 the port decided to conduct a prestudy to determine whether the port's customers and other related actors needed or were interested in improved IT support for transports via Port of Gothenburg.

### The pre-study and the methodology used

For the pre-study the port appointed an internal project manager from the IT department and established a steering group with members from different departments within the port. The executive vice president was appointed chairman and BMT Transport Solution was hired as consultants to carry out parts of the work.

#### Interviews

Two set of interviews were carried out, interviewed companies are listed in Table 1. The character of the interviews was semi-structured. Robson (13) defines semi-structured interviews as containing predetermined questions where the order can be changed based on the interviewer's conception. Further, wordings can be changed and explanations given and questions can be added and omitted.

TABLE 1: List of Interviewed	Companies and	Organisations
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First round of interviews:	Coast Guard Gothenburg
ACL	GHAB
DFDS TorLine	GHAB
Cobelfret	GHAB
GreenShip Sweden	GHAB
TEAMLINES	Shell
SCT Transporter	Preem
Lundby Container Service	Sannes
Röda Bolaget (tug service)	Gullmartank
Klippans Boat men	RECI
IKEA	GHAB
Volvo Logistics	Tibnor
Maersk Logistics	Ektank
Swedish Customs	ACL
Swedish Maritime Agency	Cobelfret
Green Cargo	Cobelfret
Cityvarvet	ACL
Business Region Göteborg	Unifeeder
TradEasy (customs support)	TorLine
Second round of interviews:	TorLine
Stena Line	Readarföreningen
Röda Bolaget	Mäklarföreningen
Klippans batman	Transweco
Swedish Maritime Agency	Valdemar Andersson Skeppsmäkleri AB
Swedish Maritime Agency	Segerhammars Skeppsmäkleri AB
Customs	Tanker Shipping TSA
Coast Guard Karlskrona	Ektank Rederi AB
August Leffler & Son AB	Tärntank rederi AB

In the first round the objective was to identify the overall interest in improved IT support and also identify ideas, critics, process improvements and unutilised possibilities. The Port applied a wide definition of users and identified 18 organisations to be involved in the pre-study. The Port sent out a letter to the organisations informing them about the pre-study and that they would be contacted by a consultant for an interview. The letter was followed up by a call by the consultant asking for an interview. All contacted organisations chose to participate. A guideline for the interviews was prepared that included questions covering the following areas: description of today's process, areas of problem, general critics and opportunities. In total 18 interviews were carried out. The interviews took place in personal meetings, lasted between one and two hours and were carried out in Swedish. The interviews were carried out between December 2004 and January 2005. For each interview meeting minutes were produced that summarised the discussions.

The second round of interviews had a more narrow approach and the goals were to map the existing situation, describe and analyse problems related to the vessel process, i.e. vessel arriving and departing the port including reporting and supporting processes. Again a number of semi-structured interviews were carried out. This time the selection of companies to interview was narrowed down to those involved in the vessel process. A process oriented view was applied and the interviewees were asked to describe their activities in the vessel process, e.g.: which activities are carried out, when in time and what information is being exchanged.

In total 36 interviews were carried out. All but one interview were carried out in person (the interview with Coast Guard in Karlskrona was done by phone). The interviews lasted between one and two hours and were carried out in Swedish. The interviews were carried out between June and November 2005. For each interview meeting minutes were produced that summarised the discussions.

To secure the quality of the interviews the minutes were sent out to the interviewees who had the chance to correct mistakes and add missing information. This was done in both set of interviews.

### Workshops, workflow diagrams and problem list

The second set of interviews was followed up by three workshops to which a selection of the interviewees was invited. The objectives of the workshops were to ensure that the analysis of the interview material was correct and to start a process of co-operation between the port and its users.

The process descriptions from the interviews were combined and it was possible to define a number of main processes. For each main process a work flow map was developed. This is a method used to clarify the relationship between the actors and the information exchange in the process. A work flow map includes the involved actors, the activities carried out and the information exchanged between the activities. The activities are arranged by time after they are carried out.

During the interviews, the actors were asked to name problems connected to the process as well as suggest improvements. Each single problem mentioned was collected in a list which at the end included more than 100 problems. Problem duplicates were deleted and for the remaining problems a problem tree approach was applied were problems are differentiated according to 'causes' and 'effects,' joined by a core, or focal, problem.

#### State of the art studies

Parallel to the interviews a literature studies were carried out with the objective of highlighting the development of port community systems in other ports. The intention was not to provide an in-depth analysis of existing port community system, instead the aim was to provide some ideas on how port community systems can be organised and financed.

#### **Pre-study analysis**

One of the main issues to clear from the first round of the interviews was the overall interest of improved ITsolutions. The interviews indicated a positive attitude towards improvements and a number of needs and requirements were mentioned.

The interviews also indicated trends and initiatives in the marine transport sector that could influence an implementation of a port community system. The following three initiatives were identified as important influencer since they will change the existing reporting routines connected to the maritime transport sector:

- The Swedish Maritime Administration is implementing a ship reporting system (FRS) within the SafeSeaNet initiative of the European Commission. The FRS system is a portal for reporting ship notification, dangerous goods and waste.
- The European Commission has the ambition of developing a "single window concept. The goal with the "single window concept" is to simplify administration and reporting connected to the commercial maritime sector in Europe. The idea is that a reporting should only have to be done once and that all relevant authorities share this information.
- Driven by increased safety and security requirements, an amendment to the European customs legislation is being developed. The main difference is that not only the vessel needs to be reported 24 hours prior to arrival but also the freight it is carrying.

The literature study on port community systems in other ports showed that the form of ownership varies. In some cases, e.g. Barcelona, Rotterdam, Antwerp and Klaipeda the port authorities play a major role whereas in other ports the ownership is distributed among different private actors, e.g. DAKOSY in Hamburg. When comparing the different Port Community Systems it turned out that the idea of improving the co-operation within the port cluster was common and the following elements were often included: an electronic medium for communication between the actors in the cluster, a basis for collaborative work environment, on-line access to port related information and re-use of data and information.

The question of ownership of the Port Community System was important to the port. Although the port was the initiator of the study it was neither clear if it should continue with the initiative nor which role it should have in a future port community system. To support the decision process a SWOT analysis was carried out with focus

on the implementation of a port community system with the port as the system owner. The result of the SWOT analysis is illustrated in figure 1.

Strengths:	Opportunities:
<ul> <li>The port is viewed as the "natural" principal of the system</li> <li>The port has the financial strength and competence to run the development</li> <li>Good starting point through the existing IT systems</li> <li>Good position towards authorities</li> <li>Timing is right due to increased safety and security regulations that requires good information access</li> </ul>	<ul> <li>Attracting more freight over the port</li> <li>Closer customer attachment</li> <li>Cost reductions</li> <li>Increased internal efficiency for the port</li> <li>Improved service for the cluster</li> <li>Preparation for future authority regulations</li> <li>Preparations for increased customer demands</li> </ul>
Weaknesses:	Threats:
<ul> <li>The port is not a neutral actor</li> <li>The port is running other IT initiatives that requires resources</li> <li>Relatively few potential users of the system compared to the bigger ports</li> <li>Strong competition within the cluster</li> </ul>	<ul> <li>Confidentiality issues (real and perceived)</li> <li>Competition from other systems, e.g. FRS of the Swedish Maritime Administration.</li> <li>Difficult to communicate benefits of investments in "soft infrastructure"</li> <li>Lack of usage among future users</li> <li>A failure would cause bad will</li> </ul>

## FIGURE 1 SWOT Analysis on the Implementation of a Port Community System with the Port as the System Owner

The SWOT analysis indicates that the port is an actor with enough strength and knowledge to be responsible for the development of a port community system, but it also indicates that it would be a foregone conclusion that they shall be the future owner and operator of the system. The analysis resulted in the recommendation to continue the work with the port community system. The results from the interviews as well as the input from other ports and ongoing initiatives indicated user interest and future advantages for the port.

Responses from the second round of the interviews were presented at workshops. Ensuing discussions led to the identification of two main causes of most of the mentioned problems:

- Reporting to the authorities
- Operational co-ordination

Below descriptions will follow on how those problems affect the vessel process.

### Reporting to the authorities

Already during the first round of the interviews it was mentioned that the reporting to the authorities was an administrative burden. During the interviews in the second round, agents, shipping lines and captains stressed that the demands on reporting were increasing and becoming more difficult to handle. When a vessel is to arrive at a Swedish port, a number of reports have to be carried out to the national authorities and to the local port authority. Table 2 lists which reports to do when arriving to the port of Gothenburg, to whom they are reported and how. This list does not claim to be complete or to use the correct names of the reports. It is purely based on the results from the interviews.

TABLE 2. List of Reports When Arriving to the Fort of Gothenburg				
REPORT	REPORT RECEIVER	MEDIUM		
Vessel notification	Port authority	Online to portal (TRAFO)		
Vessel notification	Swedish Maritime Agency	Online to portal (FRS) or XML-		
		message		
Dangerous goods declaration	Swedish Maritime Agency	Online to portal (FRS) or XML-		
		message		
Waste list	Swedish Maritime Agency	Online to portal (FRS) or XML-		
		message		
ISPS	Coast Guard	Fax or e-mail		
Schengen	Coast Guard	Fax or e-mail		
Vessel declaration	Customs	Fax followed by original by post		

#### **TABLE 2: List of Reports When Arriving to the Port of Gothenburg**

All vessels that arrive at Port of Gothenburg have to report a vessel notification to the Port Authority. This is done via the portal TRAFO. Another vessel notification is to be sent to the Swedish Maritime Agency. As mentioned earlier, the Swedish Maritime Agency has implemented FRS, a vessel traffic monitoring and information system for vessel notification and reporting of dangerous goods and waste. FRS is part of the European Commissions initiative to improve safety and efficiency for maritime transports (11). Reports are to be made 24 hours prior to arrival; however they can be done later under certain conditions, (e.g. if the port of arrival is unknown 24 hours before arrival). During the interviews it was stressed that a trend within the shipping community is to let the vessel handle as much administration as possible. The vessel has good access to information about goods and crew as well as the best information about estimated arrivals and vessel service requirements. Both the reporting to TRAFO and FRS is internet based but today very few vessels have the possibility of using internet. However, most vessels have satellite communication and can send e-mails. Instead of being able to carry out the reporting directly to FRS and TRAFO from the vessel, the vessel has to send the information to agents at shore who log into the systems and do the reporting. To FRS it is also possible to report by using an XML message but in the beginning of 2006 this possibility was not used. Lack of information from the Swedish Maritime Administration about the possibility to use XML messages can be one explanation. Another possible explanation is that the organisations that are supposed to carry out the reporting lack competence on how to implement the messages.

To customs a vessel declaration is to be sent by fax and later amended by originals per post. Two reports are to be sent to the coast guard, ISPS (based on the International Ship and Port Facility Security Code) and Schengen (a report on staff on the vessel). The Coast Guard is not the official receiver of any of these reports; the Swedish maritime Agency is responsible for ISPS and the police for Schengen. Both organisations have chosen to outsource the receiving of reports to the Coast Guard. The ISPS shall be reported 24 hours prior to arrival but as for the vessel notification reports it is allowed to be done later under certain circumstances. The Schengen report however has to be reported 24 hours prior. This is not always possible, e.g. for short sea shipping and oil transports where vessels get changed transport instructions on short notice. The coast guard has chosen to report captains of vessels to the police in some cases where the 24 hours reporting limit was violated which caused major distraction in the shipping community.

Within the pre-study no detailed analysis was carried out on the data elements in each report but a high level comparison shows that much information is the same. A comment from the shipping community was "why don't the authorities co-operate and agree on one report and then share the information" and the most important need for improvements was: a co-ordinated reporting for the authorities that could be carried out directly by the vessels.

In interviews, the authorities (the Swedish Maritime Agency, the Coast Guard and the Customs) described a joint project under development. The goal of the project is to enable one common authority report that would substitute: ISPS, Schengen, vessel notification and vessel declaration. The authorities stressed that this is a difficult task because technological, economic, and regulatory (e.g. regarding integrity and privacy) differences must be addressed. According to one actor the co-operation was additionally complicated through the authority's different kind of financing structure. No one was able to predict if the project would be successful and if so, when. It was also clear that each authority was deeply involved in their own internal developments and that those were not co-ordinated between the authorities. The Swedish Maritime Agency are still developing FRS and the vision is: "FRS shall become a portal collecting all reporting from the maritime sector to the Swedish Maritime Agency and other Swedish authorities as well as becoming a node for information exchange for parts of the commercial maritime sector". In parallel the Coast Guard has received a governmental mission to create an IT system to co-ordinate the civilian maritime information and to distribute it to nine other authorities, including the Swedish Maritime Agency and Customs. The plan is to add different added values to the system. Streamlining vessel notification reporting is an added value that has been repeatedly identified.

#### **Operational co-ordination**

The workflow maps illustrated the many different activities that take place when a vessel arrives and departs from the port as well as when vessel and crew service at quay are carried out. Many of the activities are interrelated and require co-ordination for a smooth process. During arrival, pilot, tug boat and quay slot need to be co-ordinated and the resources allocated. When one of the services is delayed the other services need to be re-booked which causes additional costs. It is also a risk that the other services are not available at the later time which leads to further delays and disturbances to the vessels timetable. Both agents and service provider asked for increased co-operation between pilots, tug boats and the terminals instead of the existing situation where the planning and allocation is carried out without knowledge of the other actors' situation.

When the vessel is at quay, waste and bunker services are carried out as well as other services. This requires information about when and where the vessel is at quay. In addition some of the services need to be co-

ordinated, e.g. it is sometime not possible to carry out bunker and loading in parallel. Special problems occur in the oil terminal due to the higher safety regulations.

A number of actors also complained about the low quality of the estimated time of arrival (ETA) and estimated time of departure (ETD). In theory good ETA and ETD should be available in the port system TRAFO. The problem today is that the agents provide an ETA when reporting the vessel notification but in most cases fail to update when more accurate information is available. The agents claim that due to other extensive reporting they de-prioritise the updating in TRAFO. Further, there is a low trust in TRAFO – the system is viewed as a reporting system and not as an operational tool. The positions: "ship entering the traffic area" and "ship placed at quay" and vice versa when departing was updated in the ports TRAFO system by the Maritime Agency. Due to changes in co-operation the port decided to carry out the updating on its own by using AIS technology (Automatic Identification System, a system that enables identification of vessels and their position), starting 1st of July 2005. This development was delayed and a last minute prolonging of the agreement was closed. After the prolonging of the contract the quality of the updating of the ship positions decreased. The absence of reliable ETA and ETD leads to different informal information exchange, e.g. calls to the vessel traffic control or to the terminals. One of the actor stated "once someone knows that you have good information they will keep calling".

### Discussion and next steps

Below, a number of problems revealed during the pre-study are listed:

- The Swedish Maritime Agency introduces a new reporting portal that requires usage of broad band Internet– which most vessels do not have. Instead of carrying out the reporting from the vessels, land based agents have to fulfil the task.
- Failure to report the Schengen report in time can lead to that the captain of the vessel is reported to the police by the Coast Guard.
- The Port of Gothenburg's information system has low quality on information related to vessel movements in the traffic area and at the quay.
- Ship agents ignore updating estimated time of arrivals. The lack of high quality ETA and real time position about the vessels makes it difficult for a number of service providers to plan their business,
- According to the new pilot booking system, in the event of a short delay, letting the pilot wait is preferable, from a cost point of view, to rebooking.

These are not problems requiring rocket science solutions. These are problems that origin in of a lack of understanding or even worse ignorance of the neighbouring actor's situation in the transport chain. The situation in the port cluster is far away from highly integrated supply chain management solutions where contractual agreements support the co-operation even though some of the cluster members are actors in complex supply chains, e.g. the terminals and shipping lines.

Given that the same vessel and its goods is the basis for the business of all actors, there should be good prerequisites for creating co-operation and attractive solutions and this is the landscape where the port community is to be established.

The work with a port community system for Port of Gothenburg is most likely to continue and the port community system will start by addressing: reporting to the authorities and operational co-ordination. The port community will co-ordinate a general vessel reporting and distribute the information to the respective authority. However, this requires that the authorities accept this solution.

Further, the port community system will address the operational co-ordination by supporting bookings, confirmations and provide high quality information to the users of the port community system. High quality ETA and ETD are crucial information for these kinds of improvements but ETA and ETD are difficult to estimate: ETA due to weather, vessel conditions and access to quay slots, pilot and tug boats. AIS can provide good support by revealing the position of the vessel and the vessels own ETA. Today the AIS do not include information about the status of booking of services. ETD is difficult to estimate due to the production in the terminal as well as the access to pilot and tug boats. To support the operational co-ordination is a challenging task and it requires that the system is viewed as useful and trusted by the different actors who should both update the system on a timely manner and use it for their internal activities.

The port community system will need to build trust and enable the actors to feel involved. A robust development process needs to be established to involve relevant actors, set up common goals and provide foundations for the product development. It is further important to define a business model that enables acceptance and user value. This work should be based on a profound understanding of the forces pro and contra a port community system.

Any solution that is chosen will need to be robust for future developments and closely follow the development on national and international level to ensure that the work is positioned in an ever changing environment.

A further challenge is the high number of actors involved as well as their heterogeneous character. A major shipping line with an internal IT department has quite different prerequisites, needs and interests than a one person service provider company equipped with a mobile phone.

### CONCLUSIONS

Returning to the statements from the beginning of the paper, the following question is urgent: Can the experiences from Port of Gothenburg provide any input to the research ideas?

(1) Interaction between the domains of transport management, infrastructure management and institutional management. The potential success and usefulness of a port community system for Port of Gothenburg will require a co-operation and interaction between the three domains. It should be clarified that the domains describe activities and functions not organisations, i.e. an organisation can be part of more than one domain. This can be exemplified by the Swedish Maritime Agency, whose activities are distributed between: infrastructure management, e.g. their responsibility of the sea routes and sea safety through vessel traffic control and institutional management, e.g. their role as sectorial responsible for the development and support of the maritime sector. The goal of the port community system to improve the reporting system requires that an agreement can be closed between the involved partners, i.e. the shipping industry who is obliged to carry out the reporting, the authorities who have a legal right to demand reporting and the port who is willing to act as a broker. To fulfil the goal to support the operational co-ordination it will be necessary to find ways to combine information from the infrastructure and traffic management with the transport management information.

(2) Formalisation and structure. The port community system can be viewed as an "interaction infrastructure" and its implementation will include strong elements of formalisation and structure. One of the core ideas is to agree on a structured method to exchange information and thereby replacing the main part of today's informal channels. The next steps towards an implementation of the port community will include agreements on what information shall be accessible and to whom, which routines shall be followed for the updating and retrieving of information, which communications channels are to be used, push and/or pull solutions etc. The two topics: reporting to the authorities and operational co-ordination put different demands on the agenda.

The reporting will have a focus on identifying the data elements as well as formats and time restrictions required by the receivers of the different reports. A solution could be to agree on a harmonised message and one way of communication. A more realistic way forward is to develop a "basic message" that fulfils all receivers' needs. The users, the vessels or their agents, would send this "basic message" to the port community system, which will work as a broker and provide the required reports to the different receivers. As mentioned above, a basis for this is that the receivers accept that the report is channelled by the port community system. Further, the members of the port community system will have to agree on strict rules regarding responsibilities, e.g. the message has to be complete and sent at the right time. Also different possible abnormalities will have to be discussed and rules set on how to solve them.

ETA and ETD will be central pieces of information for the operational co-ordination. Since ETA and ETD are difficult to forecast other rules will have to apply regarding "true" and "false" information. For the quality of the system it will be important to be updated with the best possible estimates. During an interview with the terminal, one of the production planners said that they have the best available estimate of the loading and unloading operations - an important element for the ETD – but still it is only an estimate. Today they are reluctant to give away this piece of information since they do not want to be blamed in case of any deviations. How to make best possible use of this kind of information, e.g. making both confirmed information and estimates available and to use earlier experiences to evaluate the estimates will be one major challenge for the further work.

Wilding et al (14) uses the notion of  $C^3$  (co-operation, co-ordination and collaboration) and stresses that is it essential to maintaining a successful business partnership. In his case study on collaborative supply chain relationships, an overwhelming majority of the respondents placed strong emphasis on personal relationships and culture matching (relating to the way the other side do things). This support the idea of that the interaction infrastructure also needs to include ideas and principles on how to co-operate and to enable further development of the relationships within the cluster.

(3) Someone takes the responsibility. The Port of Gothenburg's initiative for a pre-study for a port community system can be seen as an example of "someone taking the responsibility". Thereby addressing the fragmented approach towards improvements caused by the fact that the main parts of the actors look after their own issues and spend few thoughts on the overall performance of the port cluster. The Port of Gothenburg has the motivation, commitment and resources to strive for overall improvements. As the port initiated the pre-study for

a port community system, the port cluster not only accepted it but also welcomed it. To be able to avoid mistakes the development and implementation needs to be done in close co-operation with the relevant actors in the cluster respecting the different actors' requirements. For each actor is it also important to think outside their own system and to realise and accept that information crucial for their own operation can be of high value also for other actors in the port cluster. Someone taking the responsibility is crucial but also very difficult. We can never forget that the port community system is positioned at the heart of the market and will impact the commercial operations of the involved organisations. It is highly political involving issues of power, trust, vulnerability and accountability. The results from the interviews and the workshops indicate that participation is a prerequisite both to develop robust solutions as well as acceptance.

To conclude, the initiative of introducing a port community system exemplifies the ideas of interaction between different domains and how it can be supported through an "interaction infrastructure" as well as the need of someone taking a responsibility. Although interaction is required one needs to remember that the different actors involved in the port community process express heterogeneous views on what the system is and which needs it should fulfil. One of the main challenges for a successful port community system may lie in the concept of recognition. The driving idea of the social theorist philosopher Axel Honneth (16) is that recognition is crucial both for knowledge and moral development. Applied to the port community system this would mean that all partners' requirements must be understood, respected and taken into account. The situation in the port cluster today seems quite far away from this idea.

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Inger Gustafsson

### PERCEIVED BENEFITS OF IMPROVED INFORMATION EXCHANGE: A CASE STUDY ON RAIL AND INTERMODAL TRANSPORTS

Johanna Törnquist and Inger Gustafsson

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### ABSTRACT

The interest in achieving more effective railway freight transports in Europe and increasing the railway's market share, has grown the past few years. The use of railway is, however, often rather complex in many aspects and needs to become more flexible and reliable if it will be able to compete with other modes of transport. A study was carried out to investigate if and how improved information exchange between the Swedish National Rail Administration, Banverket, and its customers, can facilitate the use of Swedish railway freight transports. The primary aim was to identify the customers' needs for improved information exchange as well as to understand how they would benefit from it. The results showed that the accessibility to information has a significant impact on the whole planning process and that there already exists substantial information that will benefit the customers if synthesised and made available.

### **1** INTRODUCTION

### 1.1 Background

Companies in many nations are continuously changing their production strategies in order to stay competitive and satisfy the customers. Factories located in one part of the world need supplies produced in another part, while the consumers are located all over the globe. The importance of optimised transportation networks is an obvious and accepted fact – particularly in the light of the current economic pressure and when logistics is becoming a prime source of strategic advantage (Stock and Lambert, 2001; Mobert et. al., 2002). To handle these activities in an efficient manner with time constraints and forces to keep costs down, an advanced logistics function is required within the companies' supply chains.

A transport system, outsourced or not, constitutes one important part of that logistics function since transportation often is the single largest cost in the logistics process (Stock and Lambert, 2001). Since transportation also is the channel for flows of products, there are high demands on reliability (e.g. damage risk and punctuality). Rarely, a company is independent of its surroundings, which forces it to alter or adapt to them. The ability to adapt within a specific time frame is often called agility. In the term agility lies the degree of flexibility, i.e. if the company is able to act according to the changes. Degree of flexibility in a transport system refers to the extent of how a transport concept can be changed within a short time frame; for example, volumes of goods can be re-routed. In many cases, it is necessary to take some actions, but an increase in agility may lead to a more complex system.

In International supply chain agility – Tradeoffs between flexibility and uncertainty, (Prater et. al, 2001), several factors of supply chain exposure are identified and explained.

- Extent of geographic areas covered by the supply chain.
- Political areas and borders crossed.
- Number of transportation modes and their speed.
- Technical infrastructure and its degree of use.
- Random occurrences.

As the authors point out, these factors are interrelated to some extent. Another significant factor, of course, is the type and volume of goods transported. Transporting hazardous goods, for example, increases the complexity. Furthermore, which types of transport modes that are used is also an influencing factor. The saying that "a chain is no stronger than its weakest link" is important to consider in this context. Often, railway transports are considered to be a weak link, which in part may very well be true.

When considering the characteristics of railway as a transport mode and comparing it to the other transport modes, it becomes obvious that railway traffic and transportation are quite complex. Railway transportation does, however, offer several advantages (e.g. high capacity, possibilities for high speed and considered by some to be environmentally friendly), and in order to increase its attractiveness, the selection criteria for modal choice must be considered as well as possibilities to fulfil them. We believe that an improved information exchange can facilitate the use of railway transportation and its performance, and thereby strengthen the railway's position as an alternative link in an intermodal transport chain. Intermodal transport is defined to be the movement of goods using several modes of transport without handling the goods per se.

Since the situation differs between countries, this paper focuses on Swedish railway traffic and transports. In the European Union (EU), there has been a process of deregulating and liberalising the railway transport market for quite some time. The aim of the liberalisation is to create competition and thereby achieve a better supply of services that will attract customers. In Sweden, the deregulation of the railway was initiated in the late eighties. In its first phase, the deregulation led to a split of the national railway into a public service enterprise, SJ, responsible for the rail transports and a rail administration responsible for the infrastructure, the Swedish Rail Administration (i.e. Banverket). In 1996, the deregulation was extended, resulting in an opportunity for anyone who conform to the requirements, specified by the responsible authority (i.e. Banverket), to operate on the state owned railway network. Since then, Banverket is the authority responsible for the railway infrastructure and for planning and managing the railway traffic on the state owned network. Thus, traffic

management, including slot allocation, is strictly separated from railway transportation.

### 1.2 Motivation

Experience from earlier projects regarding management of transport chains e.g. INFOLOG (Källström, 2000), shows that there are high requirements on reliable information to support the process of planning, monitoring and controlling intermodal transport chains. Recent results from the project THEMIS (Källström, 2002) have shown that by integrating traffic information in the transport management process, a higher quality can be achieved. Traffic information refers to information that concerns the traffic network and its flow of transport units while transport information is associated with a specific transport unit or shipment, which can be a part of several traffic networks (e.g. air, road, rail). Based on the findings and the current situation described above, the project Baninfo was initiated by TFK Transportforschung GmbH1 and Banverket with Blekinge Institute of Technology (BTH) as part of the project group. The project aimed at identifying if and how railway transportation in Sweden can be a more attractive and reliable part of a transport chain through improved information exchange. By being responsible for the traffic management, Banverket has the possibility and authority to collect all kinds of traffic information, and is thus a key actor in this context.

### 1.3 Methodology

In order to identify the required information exchange, a study was made by conducting qualitative analysis of the customers' opinions and desires within the project Baninfo. Interviews were carried out with a group of customers (see Table 1) including shippers, forwarders, transport operators, line agents, wagon owners, information brokers and terminal operators in order to cover as many relevant aspects as possible.

In the interviews, the term "information" was given a broad definition to include real-time status data on a specific transport as well as amount of slots available when planning a transport concept, and several other types. The interviews consisted of discussions concerning the customers'

<sup>&</sup>lt;sup>1</sup> After the project TFK Transportforschung GmbH has been sold to BMT and trades under the name BMT Transport Solutions GmbH.

different business processes ranging from a strategic to a post-operational level, and the use, benefits and lack of information within each process. The results from the interviews were written down and sent to the respondents for confirmation and opportunity for revision in order to avoid misinterpretation and possible bias by the interviewers.

In addition to the interviews, relevant information systems and their content at Banverket were studied, as well as potential improvements and possibilities to satisfy the identified customer demands.

Company/Organisation	Role/-s
Green Cargo	Transport operator/Forwarder
Transwaggon	Wagon owner/Forwarder
Danzas ASG Rail	Forwarder
IKEA Rail AB	Shipper
DFDS Torline	Transport-/Terminal operator
Tågoperatörerna	Trade organisation
Akzo Nobel	Shipper
Railcombi	Operator for combined transports
Banverket	Infrastructure manager
Stora Enso	Shipper
ELOG	Information broker

Table 1. Customers included in the interview group.

### 1.4 Outline

This paper will first put the findings from the study in Baninfo in a context by describing the railway's status as an option to other means of transport within a transport chain. Furthermore, the relevant characteristics of railway traffic and transportation will be outlined as well as the importance of thorough planning and the necessary access to accurate information. The presentation of the results from the study in Baninfo will then follow and be argued for by connecting the information demand to the business processes of the different customers and Banverket. Costs and benefits of the realisation of the information will be discussed in the next chapter. Discussion and conclusions will also be presented along with a description of future research in the last sections.

### 2 RAILWAY TRANSPORTS AS AN OPTION IN TRANSPORT CHAINS

In 1970, railway freight transportation constituted 31% of the total transport work (in tonne-km) in Europe, and by 1995 the market share had decreased to 15 %. During the same period, the overall freight transport work increased by approximately 75 %, which shows that the railway have not managed to keep its market share (Nelldal et. al., 2000). In Sweden, the corresponding market share is 43 % for 1970 and 32 % for 1995. In 2001, the market share was 24 % (11 % of transported tonnes) (SIKA, 2003).

### 2.1 Selection criteria for choice of transport mode

Several studies have been made during the years to capture the selection criteria of freight transport buyers (Transek, 1992; Nelldal et. al., 2000; Bruzelius, 2001; Golog and Regan, 2002; SIKA, 2002; Vanneiuwenhuyse et. al., 2002) and analyse the distribution of freight over the different modes. The most important selection criterion for transportation mode choice, beside the transportation costs, is quality, which most often refers to transportation time and reliability (NellIdal et. al, 2000). A study was made in 1999 asking 1530 shippers and logistics provider to weight the importance of factors influencing the selection of transport mode (Vannieuwenhuyse, 2002). The results from 500 respondents ranked transport cost, reliability, flexibility (i.e. possibility to influence) and transport time to be the most important factors. Results from a study made by Banverket in 1999 (Nelldal, 2000) showed also that transport cost was ranked most important and that the influence on the environment made а significant difference indicating increased environmental awareness (Nelldal, 2000). In the same study, transport time was ranked second, but if a shipment takes three or four days makes a minor difference - the most important is that it arrives on time (Nelldal et. al., 2000). There are also studies investigating how to quantify the utility of certain transport variables more specific, see further e.g. (Transek, 1992; Bruzelius, 2001; SIKA, 2002).

It is difficult to separate the factors from each other. Logically transport cost is one of the determining factors, since transport constitutes a significant part of the logistics costs (Stock and Lambert, 2001), and so is

transport time. However, a low transport cost and short transport time do not provide any benefits if the reliability is low. Reliability is the cornerstone in effective planning and use of strategies such as Just-In-Time (JIT). In order to make it worthwhile to substitute pure road transports by intermodal transports, including railway, the modal integration must become efficient and each transport relation reliable.

### 2.2 Status of European railway traffic and transport

Cross-border railway traffic has for a long period of time struggled with ineffective regulations for customs clearance, low priority on trains far from original destination and different standards on the infrastructure (Banverket, 2003). The work towards a European deregulated market and other efforts have resulted in improvements such as establishment of Freight Freeways by using the concept of OSS (One-Stop-Shop). Freight Freeways is a concept that aims to facilitate the use of freight transports on railway through Europe by providing access to certain slots, ensuring an average speed of minimum 60 km/h and a high priority through the whole railway transport. One key to such a concept is the co-operation between the authorities of different nations, which there is a great need of considering that the average speed of cross border freight trains within the EU is as low as 18 km/h. One outstanding exception, however, is the socalled IKEA<sup>2</sup> trains, which operate as a pipeline between Älmhult, Sweden and Duisburg, Germany with an average speed of 70 km/h and a punctuality of 85 %. The reason for being able to achieve such high performance is, according to IKEA, the close contact with the different infrastructure/traffic managers, which ensures access to high quality traffic information (Transport Idag, 2003).

The lack of established co-operation between railway companies is considered to be one of the major limitations for international railway transports (Nelldal et. al., 2000). One example given by Nelldal shows that in order to create a railway transport between Sweden and Spain, six different companies of varying nationalities have to be involved and manage the part of the transport that occupy their railway network. Beside organisational difficulties, caused by involvement of many companies, the

<sup>&</sup>lt;sup>2</sup> IKEA Rail was included in the customer group in Baninfo. However, in the fall of 2003, IKEA Rail decided to stop its operations and instead outsource the services.

cross-border railway transports also suffer from a complex set of different traffic management rules as well as technical interoperability problems.

Independent of whether it is national or international traffic, there are additional constraints beside regulations and technical differences. Railway transports are less robust and therefore more easily affected by changes in the surrounding traffic than the other modes due to the characteristics of the network and related regulations (Wiklund, 2002). This issue reduces the flexibility to adapt ad-hoc solutions when something unexpected occurs and the possibilities to re-establish original plans. During the whole trip, a train has one slot for each part of the network (i.e. for every block) so if a delay occurs new slots have to be allocated to the train by the traffic manager in real-time. This will either make surrounding traffic suffer to some extent, or the delayed train will only be allocated available slots in between the other already occupied slots, possibly fragmenting its timetable and generating significant delay comparing to its original ETA (Estimated Time of Arrival). This vulnerability affects the reliability immensely. However, by using thorough planning with access to accurate and sufficient information, disturbances can be prevented to a greater extent and punctuality increased just as the reliability.

Railway transports often need to be complemented with road transports since the infrastructure is very limited. When combining railway transports with other modes into intermodal transport chains, the complexity increases further (D'Este, 1996). Intermodal transports are often associated with higher costs than unimodal transports due to the need for terminal operations in the process of changing transport mode. The terminal operations constitute a large part of the total intermodal cost (Cardebring P, et. al., 2001; Nelldal et. al., 2000) and they are also timeconsuming. Furthermore, an increase in the number of involved parties increases the complexity of the transport chains (Heller, 1999). Therefore, the possibility to plan and control by integrating relevant and reliable information from different transport and traffic systems becomes even more important. Figure 1 illustrates an intermodal transport chain consisting of rail, waterborne and road transport. To be able to perform transport operations with high quality (i.e. expectations are fulfilled to a satisfying level regarding e.g. punctuality) in such a chain requires the traffic managers to consider their tasks also from the perspective of their customers and the customers' customer. The traffic management needs to

understand the logistic importance of the transport chain from consignor to consignee. This means that also traffic network managers will have to consider what is happening upstream their network and anticipate what is going to happen downstream their area. In addition to their tasks of maintaining safety and providing reliable services and optimal use of capacity, the traffic managers must be able to support customer planning and operational decisions (e.g. by providing accurate information on ETA). This creates new incentives for:

- Interactive planning and communication
- Short planning cycles
- Reliable, accurate and sufficient input data during planning
- Preventive exception handling

In addition, transport operators have a liability to act supportive by using adequate tools to provide the traffic manager and others concerned with the requested information.



Figure 1: Interaction between traffic and transport management (S-TCM = Sub-Transport Chain Manager, TMS = Traffic/Transport Management System), source Källström (2003).

# *3 INFORMATION: A KEY TO SUCCESSFUL DECISION-MAKING*

To perform efficient intermodal transport chains including any kind of transport mode, high co-ordination is obviously necessary and can, in part, be achieved by intelligent use of information. However, the benefits are not always so obvious. Results from the thematic network THEMIS (Källström, 2002) have shown that the awareness of the advantages in using both transport and traffic information increases, yet the possibilities for implementations are poorly developed. In contrast, information is widely considered to be a key component of successful supply chains (Moberg et. al., 2002; Gustin et.al., 1995). One reason for the unawareness of the potential of improved information exchange and use of information, is the lack of research and research publications regarding implementations and their effects (Moberg et. al., 2002).

In The Logistics Footprint – Creating a Road Map to Excellence (Herbert, 2002) five key capabilities are defined as important to achieve competitive advantage:

- Performance management collect and use logistics information to measure the performance of internal logistics functions, as well as external providers, e.g. carriers and 3PLs.
- Shipment planning activities like load consolidation, mode selection, carrier selection, and routing.
- Documentation and compliance understanding and creating the appropriate documentation for a shipment as well as complying with the regulations of all countries involved.
- Shipment visibility proactive and reactive visibility of shipments at the load unit level using multiple query points.
- Event management alerting and reporting actual transport events in relation to the planned ones.

Information exchanged, or not exchanged, before, during and after the operations has a significant impact on the performance of the operations. Using inaccurate information as input for planning will most likely not generate the best possible prerequisites for the operations -a phenomenon more commonly known as GIGO (Garbage In, Garbage

Out). Being able to monitor and control the flow of transports in realtime, puts high demands on access to status information and reliable prognoses if unexpected events occur. Gaining knowledge about the performance of past operations, such as punctuality statistics, is also important. With this in mind, the project chose to investigate the customer's information requirements during the following five processes; strategic planning, tactical planning, production planning, production and post-production. The processes are illustrated in Figure 2, where strategic planning refers to planning on relatively long term, while tactical is midterm and production planning short term. Production refers to the level where operations are carried out in real-time and post-operation is the level where information collected during operations is evaluated and synthesised. There is no strict line of separation between the different processes.



Figure 2: Generic business processes at the customers.

The customers' generic processes together with Banverket's internal processes (one process for traffic management and one for infrastructure management such as maintenance) were the basis for a model used in Baninfo. The model is depicted in Figure 3 below.



Figure 3: The relations between the processes of Banverket and its customers. From the top: processes of the customer, the traffic management at Banverket and the maintenance for the infrastructure at Banverket. During the project the customers' main functions were identified and mapped into the processes (illustrated in the upper part of Figure 3). For each function, the information required was identified as well as where this information could be found within Banverket. In the model, this is illustrated by the arrows connecting the activities. Each information type/functionality is described by a number according to the list below:

- 1. Product information (product, price, accessibility and quality)
- 2. Performance indicators (a route's reliability and quality)
- 3. Running time calculation
- 4. Simplified slot allocation process
- 5. Infrastructure information (including planned network maintenance)
- 6. ETA, including reliable forecasting of deviations
- 7. Short term slot requests (additional slots)
- 8. Positioning data
- 9. Structured deviation reporting
- 10. Prioritisation during disturbances
- 11. Statistics for financial administration
- 12. Statistics reporting

Below follows a description of the activities within each process and examples on what information is demanded by the customers. The benefits that the improved information would provide have also been described as well as the problems that poor access to and low quality of information may cause.

### 3.1 Strategic planning

In the strategic planning, the mode of transport is selected (Select mode of transport), i.e. a strategic consideration regarding how to transport the goods is made. In order to make this activity function properly Product information (nr.1) (access to information about possible services, prices, quality etc) and Performance information (nr.2) (a track's reliability and quality, e.g. punctuality at a certain track) are required. Improved access to this kind of information would lead to decreased transaction costs. The barrier to choose railway as a part of a transport chain will remain high as long as this kind of information is not made available in an easy way (cf. the many named and well-defined services provided by the road transport operators and forwarders).

### 3.2 Tactical planning

The tactical planning consists of the activity build transport chain, including route planning and slot inquiry. In the tactical planning, the detailed transport alternatives are defined. This activity also requires access to reliable and relevant information regarding the Performance (nr.2), since operations on tracks with low performance need higher security margins for route planning. If the security margins could be decreased, the transport time may be reduced, which in turn could reduce the costs.

For the route planning, Running time (nr. 3) is required, i.e. how long time a train (given vehicle type, load and other influencing characteristics) needs to make a certain trip (given detailed information about the tracks' physical condition). Major operators own internal system for running time calculations. For minor operators it would be an improvement if they could calculate running time via the system that Banverket internally uses today for running time calculations. This would also improve the prerequisites for traffic management since the customers would have an incentive and possibility to provide Banverket with reliable data.

The tactical planning is depending on a flexible slot allocation process (nr. 4). Today, the process between train operators and Banverket is complicated, time consuming and inflexible. Planned track maintenance may affect the slot request process and, thus, timetable planning. Unawareness of planned maintenance leads to unnecessary slot requests from customers. Today the access to information of planned track jobs is unclear. A valuable service for the customers would be to be able to subscribe to changes on defined links, see Infrastructure information (nr. 5). Furthermore, the infrastructure information must be made available and accessible in different versions, i.e. when planning a transport that will take place in six months the infrastructure information used must contain data for that particular time.

From a customer's point of view, the time and the problems related to the slot request process are not acceptable, especially compared to the situation on the road transport market. The process is time-consuming and has a too long decision lead-time. Improved slot allocation process is probably one of the most important issues that need to be solved to

improve the railway's possibilities to become stronger in the competition of freight operations with the road.

### 3.3 Production planning

During the production planning, supply and demand are matched and the allocation of the production means is carried out (e.g. staff, wagons and locomotives). An optimal allocation of production means requires correct information, or at least good estimates, on arrival times and possible deviations. A good ETA (Estimated Time of Arrival, nr.6) is required to be able to plan further utilisation of wagons and locomotives. In addition, access to performance information (nr.2) is required for this function. As mentioned earlier, operations on tracks with low performance need higher security margins for the allocation planning.

An optimal allocation of the transport means can make the difference between profit and loss for a transport operation. This is especially true for the allocation of locomotives since the locomotives constitute the major part of the production costs.

For the customers, the need for slots often changes after the timetable has been defined and additional slots must be requested (nr.7). From the customers' point of view, the time to get an additional slot is not acceptable, especially not if compared to how easy it is to hire additional trucking capacity.

### 3.4 Production

Production is the process where the need for information exchange is most obvious. Information to operators, forwarders and shippers about the goods' status (in certain cases limited to deviation reporting) is the basis for the logistics management. Within this area the most dominating customer demands have been identified.

Transport management requires information on Position data (nr.8), Deviation reporting (nr.9) and ETA (nr.6). The demands for this type of information vary. Some customers require only information regarding deviations, while others demand continuous position reporting, which implies that a future solution must be flexible in terms of information delivery. One of the cornerstones of transport management is information about where the goods are. This information has to be reliable and easily accessible, e.g. via system-to-system solutions.

Deviations from the timetable have to be reported to the customers in a structured way. Today the reporting is done by e-mail, but incompleteness often requires additional information acquired through informal networks over the phone.

ETA can be described as high value information. It is very important for a customer to know when a deviation occurs. For the customer to make a rational decision concerning possible counter measures, information is also needed regarding what consequences a deviation will be at the end of the transport chain.

Today the customers can not influence the actions that Banverket takes when deviation occurs, and therefore it would be beneficial if discussions regarding Priority (nr.10) between trains could be enabled.

The access to and the quality of information have a major impact on the customers' operations. Many customers have access to alternative transport systems; however, selecting the optimal alternative requires that the problems can be detected in an early stage.

### 3.5 Post-production

The post-production consist of financial administration and reporting of statistics. Today, payment of track fees is based on a system where the users of the railway network specify themselves how much they have used the network. An automatic billing system (nr.11) would reduce the administrative costs. The customers of Banverket have a certain reporting duty, and smaller customers would appreciate if Banverket could support this reporting (nr.12) by, e.g. a portal solution, which also could lead to reduced administrative costs.

### 4 COSTS AND BENEFITS OF INFORMATION EXCHANGE

When deciding on whether to invest in e.g. an IS (Information System) or not, it is important to measure and determine the monetary net value of the investment. The net gain can be assessed by subtracting costs (i.e. the resources required to create the necessary prerequisites, maintenance and training) from benefits (i.e. utility generated by the investment). An analysis of costs and benefits is often merely an approximation, but should be a good one if decisions are based upon its value. Some methods that are widely accepted are the various kinds of Cost-Benefit Analysis, CBA (Cronk and Fitzgerald, 1999). Methods such as CBA require that costs and benefits can be quantifiable and turned into monetary terms. Thus, the purpose of the investment must be defined along with its desired and expected outcome, i.e. the utility function must be identified. The investment referred to in this paper is the effort to collect, synthesise and make information accessible to the different customers of Banverket as well as Banverket itself. The underlying reason for using information in transports (to support the decision-making and management process) seems, however, to be neglected from time to time in favour of the rapid development of new technology. Hence, the question posed by Hultén and Bolin (Hultén and Bolin, 2002) is significant to consider:

"Is the information exchange improving the controllability of the logistics system?"

One important aspect of the study was to understand how the requested information at Banverket would bring value to the customer, i.e. we set out to understand the customers' utility functions. The study was, however, limited to understand the utility function at the customers without conducting an in-depth quantitative cost-benefit analysis.

### 4.1 Understanding the utility function

A utility function, or a pay-off function, is often associated with a mathematical formula describing the correlation between a state with certain properties and the value this state would generate. In this context, a utility function merely refers to a description and argumentation of the importance of different properties, i.e. access to certain types of

information and ability to use them, for the users of the information, i.e. the customers<sup>3</sup>. Despite the lack of precision, the utility functions reflect the magnitude of certain needs for information exchange.

To provide good customer service, it is important that the service provider fully understands the customers' different requirements, and also has an organisation to react upon them. For instance, a train with goods that are to be transferred onto a ship for further transportation, on a tight schedule, is more sensitive to delays than a train with goods that are scheduled with a waiting time in a terminal. However, this type of information is neither available to the traffic manager (Banverket), nor able to be included in the manager's decision-making process. In order to pinpoint the need for e.g. this kind of prioritisation information during traffic management, it is, however, desirable to achieve a more quantitative description of the usefulness of the information for the different actors, including Banverket. As will be mentioned below, this is associated with making difficult assumptions and delimitations on what to include and exclude.

### 4.2 Identifying and evaluating costs and benefits

The European project ROSETTA (Giannopoulos, 2001) addresses obstacles hampering ITS (Intelligent Transport Systems). One of the major obstacles is that ITS applications are developed without addressing the user needs. The other main obstacle is a lack of end-users' knowledge about ITS development. In the Baninfo study, focus has been on the endusers, and their understanding regarding the need for information to support their business.

In several research papers and project reports in the transport and logistics domain, including this one, benefits of information technology and information exchange are mentioned and advocated for. Rarely, an overview of the costs and the benefits is presented (Irani, 2002; Moberg et. al., 2002). The difficulties lie within the task of quantifying benefits and costs, and this is one of the reasons why many companies run into

<sup>&</sup>lt;sup>3</sup> In this paper, the expected utilities for the customers are described together in the following chapter. A more customer-specific presentation can be found in the Swedish project report.

problems when trying to justify investments in IS (Information Systems) and IT (Information Technology) (Irani et. al., 1998).

The costs can be difficult to estimate, but the main challenge, though, is the calculation of benefits. The benefits need to be estimated since they are not always obvious and the positive effects may not appear right away. It is also hard to isolate the effect of one action from another as well as quantifying the cost for not doing the investment. While analysing the financial implications of an IS, decision-makers have realised the need for considering multiple criteria such as competitive advantage and future growth (Stewart and Mohamed, 2002). When the benefits are distributed to such an extent, as in the case for customers of Banverket, a deeper analysis for each party might be necessary in order to gain understanding of how valuable the information is considered to be. This also pinpoints the significant difference between user's perception of usefulness and the "true", or more objective, opinion. Hence, it is not only difficult to calculate the benefits. There is also a lack of understanding regarding the notion of benefits. In the article Understanding "IS business value": derivation of dimensions (Cronk and Fitzgerald, 1999) this issue is addressed. Several different ways on how to look upon the business value added by an IS are described with comparisons. The methods vary between basing the value on user satisfaction, system objective fulfilment or ROI (Return On Investment) while others base it on the measured effect of information on the receiver or a combination of several evaluation methodologies. There are thus several ways to attack this.

The focus of this study is primarily on the customers' demands on improved information exchange and their benefits. Banverket, on the other hand, will also benefit from an increased and improved information exchange. Traditionally, the primary task of the rail traffic management is security maintenance, and the second is the optimisation of capacity. The user needs identified in the study stress that a third task is highly important for the traffic management, i.e. to support the customers' planning and operational decision-making. However, this is still a controversial view and before it has been fully accepted, it will be very difficult to quantify the customers' benefits. As mentioned earlier, there have been some major structural changes within railway transportation due to deregulation and the players are trying to adapt.

Since techniques such as CBA are not always applicable, there are other techniques that also tries to capture the net gain but in a different way. One such technique is Cost-Effectiveness Analysis (CEA) that tries to quantify the gain in other tailored units (Belli et. al., 2001) than money. A pure CEA is not appropriate either at this point, but if the impact of some of the information types can be modelled and simulated (e.g. earlier access to accurate disturbance information and ETA), then it would be possible to get a hint on the usefulness in terms of e.g. reduced total delay in the transport chains and increased robustness.

### 4.3 Overview of potential effects identified in the study

The results from the study show that improved exchange of information can lead to a number of benefits for the customers. Having routines and automated information systems for data collection and data filtering tailored to customers' need, would take less effort from Banverket to satisfy immediate information demand. Furthermore, information inconsistencies can be reduced and to some point replace the need for personal contacts and informal networks, which are one of the primary sources of information for some actors today (Gustafsson and Törnquist, 2002).

Access to accurate information regarding performance indicators on parts of the network and characteristics, and status of the different parts of the network for a specific time frame, would increase possibilities for effective planning. Comparisons on different transport concepts can then more easily be done and their robustness may be evaluated. Furthermore, redundant request for impossible slots can be avoided to some extent and the planning can be carried out according to the conditions that apply to that specific time frame. The prerequisites for a shorter and more effective slot allocation on both long and short term are then improved, which is necessary to make railway transportation more flexible to use.

The ability to perform reliable transport plans within a short time frame is necessary, but being able to monitor and control the transports are also crucial. Receiving accurate data is useful for follow-ups and feedback to following planning cycles, but more important is to know if anything unexpected occurs and if so, what the consequences will be. Tracking one train set can be done in several ways, but getting information about the consequences (i.e. new ETA) about a disturbance in the timetable can only the traffic manager be responsible for.

Access to the right information and well-defined ways of communication provide, among several other advantages, a possibility to achieve:

- Better use of capacity in the railway network.
- Reduced need for iterative slot requests and decision lead-time.
- Improved utilisation of production means and more robust transport concepts.
- Reduced transportation time.
- Improved quality of the logistics service through increased transparency.
- Improved customer service and customer satisfaction.

All of the above benefits would support the overall competitiveness of rail transportation, which serves the goal of supporting intermodal transportation.

### 4.4 Possibilities to meet identified demands

As mentioned earlier, not only the desires of the customers in the interview group were considered, but also to what extent the wishes and demands can be satisfied with existing conditions and what adjustments need to be carried out to meet additional requirements. In Appendix A, an overview can be seen of the customers' demands as well as a rough description of the required changes at Banverket to fulfil those. The table describes both the changes that are related to organisational changes as well as those of a more system-related technical nature. The requirements are also connected to their functionality in the management process of the actors as described in Figure 3. Nr. 11 and 12 are already under investigation at Banverket within the process of implementing a system named OPERA.

Nr. 4 and 6 have been identified by the project as more challenging to achieve than the others. The main reason why timetable production and ETA have been classified as difficult to satisfy is their complex nature. Timetable production is complex from an organisational point of view due to a decentralised traffic management and planning process, and with regard to the large size of the problem. Creating ETA is, primarily, a technical challenge, but also depending on organisational issues of e.g. coordination between decentralised traffic management centres, and the access to and presentation of the required traffic information.

In Figure 4a-c, an illustration is presented to show how sensitive the train traffic system is to disturbances, and why there is a need for support in calculating ETA. The illustration shows three time-node charts with three train routes and how they all become affected when one (train B that is starting at city B) is deviating from its timetable. This is a very simplified example, but it shows how complicated it is to decide which train to go first and how the system as a whole suffers. Between two vertical lines is one block, which only one train at a time is allowed to occupy. Thus, two train paths can only cross each other at a vertical line – not in between two lines. So, when train B is delayed, it is deviating from its original timetable (the straight line) and the traffic manager is forced to re-plan the timetable. Since several trains share the same railway network, they also get affected since their timetable is depending on the other trains' timetables.

Train B is allocated a new timetable that generates the dotted train path. Since that path is interfering with the other non-deviating train paths, also these start deviating and each gets an alternate dotted train path. So, one delay of two time units at one block for one train, is causing two non-deviating trains a delay of 2,5 time units each if the disturbance is solved in that way. Imagine a larger network with additional trains, less meeting possibilities between blocks and a decentralised traffic management where one part is handling the network between city A and B, another between B and C, and so forth.



Figure 4a. Initial timetabe for the trains.



Figure 4b. Resulting outcome due to a disturbance.


Figure 4c. Comparison between initial plan and real outcome.

The need for a possibility to calculate ETA and simulate consequences of different potential measures, is obvious for several reasons:

- An accurate ETA given in an early stage of the disturbance can provide information for the transport operators to take measures and limit their negative impacts that may propagate into their intermodal transport network and their customers' production plans.
- The traffic management can evaluate different measures and to some point predict the propagation of the disturbance to other parts of the railway network by the simulation.
- Strategies can be evaluated at a strategic level to determine how to prioritise different types of trains and simulate the effect of one single disturbance.

The overall quality of intermodal transports is depending on several activities in the transport chain. A delayed train can, among other things, as part of an intermodal transport chain generate:

- Overtime for the staff
- Unavailable resources due to failed schedule of resource allocation
- Propagating disturbances in other parts of the traffic network or transport system
- Customer dissatisfaction

As mentioned, a realisation of such a decision support system (DSS) would be quite complex and require several challenging issues to be addressed and solved. A more detailed outline of this challenging area can be found in (Törnquist and Davidsson, 2002)

### 5 CONCLUSIONS

The results from Baninfo show that the current situation is far from ideal. Banverket is not yet able to provide its customer with the information available in their internal systems (e.g. position of train, priority decisions, and performance indicators), well-defined information exchange is not possible between the actors, and there is no clear organisation at Banverket to support the customers. The customers have designed their operations to work with poor access to information, i.e. within the transport chain large inefficiencies are built in, and informal networks substitute a proper information exchange. However, these conditions are the heritage from the time when each country regulated its own railway traffic. When SJ and Banverket was one and the same company with common information systems and had monopoly, the prerequisites were different. Today, competence, as well as information systems, is split up due to the liberalisation. A study made by NIM (Nordic Infrastructure Managers) from 2001 concludes it:

"The current processes and arrangements were developed at the time of monolithic national railways and are not intended to be commercial. The weaknesses of these arrangements in the changing environment are becoming increasingly clear" (NIM, 2001).

It is difficult to determine which information that is most important of the ones listed, since all processes affect the outcome. In best cases, could improved planning reduce the numbers of disturbances to such an extent that large deviations can be avoided and thus, information during operations becomes redundant. One hint of the customers' view,

however, can be derived from a workshop arranged by Banverket for the main operators in Sweden, on October 8, 2002. Banverket presented ongoing and planned efforts for improving the access to information. The operators were asked to prioritise which improvements should be carried out next. The production of timetable, quality of production data and improved descriptions of the railway infrastructure were given highest priority by the operators.

The results from the project showed that a number of the customers' needs regarding an improved information exchange and access to services can be satisfied with relatively small changes (organisational as well as system related) within Banverket. An example of organisational changes is to create clear structures about where/by whom the information can be received. A new information system (OPERA) developed by Banverket opens up new possibilities for a number of applications (e.g. positioning data, external production system for smaller customers, statistics and performance) that correspond to some of the needs of the customers. Such information should be accessible to the customers via different channels (web interface and system to system).

A prerequisite for the fulfilment of other customer demands is improved access and quality of the internal information. Information about the traffic situation has to cover the entire network of tracks, and systems for decision support are required in order to be able to calculate arrival times and forecast the consequences of disturbances. Yet, this assumes that the operators deliver accurate information, e.g. regarding vehicle characteristics. Responsibility of information accuracy and confidentiality are two issues that will rise. Such considerations, however, are beyond the scope of the project Baninfo and this paper, but need to be addressed in the future.

All the identified customer demands have to be fulfilled in the long run in order to make the railroad a competitive alternative to road transport. The selection criteria outlined earlier pinpointed the importance of price, transport time, reliability, flexibility and degree of environmental impact. Railway transports are not expensive per se. There are, however, additional costs due to terminal handling and other attendant costs. Regarding transport time, railway transportation could become better if the average speed would increase, which in turn depend on the strain in

the network, the interoperability between systems of different nations and time spent on e.g. shunting, etc. The reliability can also be significantly improved, as pointed out before, if more accurate planning is made as well as if there are decision support working at both a strategic level to simulate and evaluate the network and create appropriate principles for managing the traffic, and in real-time receive information on network forecasts. Flexibility can also be improved if the contact towards customers becomes clearer as well as if the customers are able to access information by themselves and evaluate different concepts. This can also reduce the inertia for considering and comparing new transport concepts as well as increase the possibility for new customers to get information about what the railway can offer.

The railway has for a long time and by many, not all, being considered to have less impact on the environment than road transports. The railway is not involved in accidents with personal injuries like road transports, and does not contaminate in the same way by noise and pollution. This, in parallel with its ability to carry large and heavy amount of cargo, have been the railway's main advantages.

The benefits of using information to co-ordinate transport chains have been studied in several projects. An increase in the number of involved parties makes use and sharing of information more complex. In railway traffic, however, the infrastructure manager plays an important role as neutral and within the authority of control. In road transports, for example, an equivalent and central role is missing which makes it more difficult, but not less important. To promote intermodal transports, effective information flow in all transport modes is important for the whole chain.

Even though this paper, and the research behind it, has limited the study of benefits to a qualitative analysis of the customers' demands and without quantifying their utility, we find it most important to turn the results into comparable and practical units. An increased and improved information exchange is only one measure to improve the competitiveness of railway and intermodal transports. A more market-oriented approach with e.g. product differentiation by offering high value slots to a higher price with higher priority during operations could be another step in the right direction. Other problems that need to be addressed are insufficient

capacity in parts of the train traffic networks, technical differences and conflicts between public and freight railway transports. Policies and regulations need also to be adjusted. As mentioned earlier, there is an outspoken and declared desire of increasing the use of railway transportation by the EU, and at the same time there are problems managing the existing traffic.

#### 6 FURTHER RESEARCH

The EU has decided to financially supported research within this area and one of these research projects is INFOLOG (Källström, 2000), whose results have been further used in the ongoing EU-project D2D<sup>4</sup>. D2D (Door-to-Door) has the intention of implementing a transport chain management system in five European intermodal transport chains to show that intermodal transportation can achieve the same level of efficiency and quality as pure road transports. One important issue is how existing information can be shared to benefit multiple actors, and the importance of integrating traffic information with transport information from various parties. However, as expected, the characteristics of the infrastructure management and the railway transport business differ among the European countries on different levels. Hence, the varying prerequisites have to be studied as well as how these can be integrated to make international railway and intermodal transports smoother to use.

Furthermore, robustness of railway traffic networks and transport systems will be investigated. The robustness can be evaluated on different levels by exposing the traffic and transport system to disturbances and simulating the effects. Considering robustness from a transport perspective would be to analyse a transport's impact on the traffic flow and vice versa. From a traffic point of view, the relationship between and magnitude (in time) of primary and secondary disturbances will be investigated as well as the effects of the principles used during traffic management of disturbances, see (Törnquist and Davidsson, 2002).

<sup>&</sup>lt;sup>4</sup> Further information can be found at http://prosjekt.marintek.sintef.no/d2d/.

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# 9 APPENDIXA

Table from Baninfo presenting customer demands and required changes.

Nr	Information type	Organisational changes	Technical changes
1	Product information	Key account; a person who co- ordinates price with product characteristics and conditions, and communicate it to the customers.	Updated infrastructure information in different versions (nr. 5)
2	Performance indicator	Key account.	Accessibility to statistics with ability to filter and sort depending on several parameters.
3	Running time calculation	System manager for a transport scenario simulator.	Transport scenario simulator with access to time-dependent infrastructure information (nr. 5), performance indicator (nr. 2), etc.
4	Simplified slot allocation process.	Key account. Clearer decision-making. Better contact between traffic management and network maintenance unit.	Infrastructure information (nr. 5) Communication systems Reliable data from customers'
5	Infrastructure information.	Better contact between traffic management and network maintenance unit.	Infrastructure information in different versions depending on time frames in focus.
6	ETA (Estimated Time of Arrival).	System manager for decision- support system.	Decision-support system for calculation/simulation of ETA of different parts of the network.
7	Short term slot requests.	Routines for quick decision- making. See also nr. 4.	See nr. 4.
8	Positioning data.	Marketing of existing information.	Adjustments and improvements of existing information collection and accessibility.
9	Structured deviation reporting.	Key account (co-ordinator of information and intermediary). Formalised agreement on what to report and when.	Development of existing system to include more specific information regarding causes and consequences (see nr. 6).
10	Prioritisation during disturbances.	Routines for efficient co- operation and communication between traffic management centres and customers.	System for analysis of consequences (nr. 6). Platform for discussion of priorities.
11	Statistics for financial administration.	Key account.	Possible adjustments to OPERA and standardised tailoring possibilities for all customers. Possibilities to collect the information required.
12	Statistics reporting.	Key account.	See nr. 11.