Behavioral Logistics – Analysis of behavioral routines and governance structures in the interorganizational maritime transport chain

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Abstract

The strong improvements in information and communication systems as well as better transhipment technologies provide the platform for more efficient transport within interorganizational transport chains. Nevertheless these technologies do not automatically optimize systems based on routines and behavioral patterns, established over the last decades. Logisticians – in theory and practice – have to consider the field of behavioral science to describe and analyse transport problems regarding to involved actors' strategic behavior and social embeddedness, too. The objective of this paper is to illustrate behavioral aspects of supposed technical problems in interorganizational transport chains. Therefore, this paper analyses behavioral routines and governance structures in the interorganizational maritime transport chain using a case study, dealing with the generation and circulation of transport information at the earliest point available, so called "estimated time of arrival" (ETA).

Keywords: Behavioral Logistics, maritime transport chain, terminal and rail operator

1. Behavioral Science – A new aspect in logistics research?

Behavioral science involves the systematic analysis and investigation of human behavior through controlled and naturalistic experimental observations and rigorous formulations.[1] Behavioral accounting for instance is an interdisciplinary approach of accounting to integrate the effect and usage of information on or from the information receiver. From the decision oriented perspective "behavioral", e.g. within behavioral accounting, stands for assumptions about the behavior of

[1] See Klemke; Hollinger; Rudge; Kline (1998).

recipients or users in the considered behavioral field varying from standard economic assumptions like the homo economicus.[2] Behavioral finance takes its view on anomalies both on the market and the individual levels, concerning all processes of selection, acquisition and processing of decision-relevant information and downstream decision-making of market participants.[3] Like all behavioral sciences, finance assumes bounded rationality instead of rational behavior, limited by the human capability in information acquisition and processing capacity. Cognitive limitations prevent decision makers acting rational, as is assumed in Neoclassical Economic Theory. Furthermore, the aim is not the optimal solutions but offering a satisfying result.[4] Including capacity restrictions and process errors in information handling emphasizes the interdisciplinary approaches in behavioral fields. Thus actor's behavior is not only explained with economics, but above all with means of psychological and sociological approaches. Besides the two named fields, behavioral science also includes approaches in the fields of economics, corporate finance, controlling, law and marketing.[5] Logistics – as an interface in management and business administration – can be added to these fields and enrich the agenda of behavioral science. Transferring the approach and views to the field of logistics and especially interorganizational transport chain significantly is advancing both theory and practice of logistics and supply chain management.

For logistics and supply chain management – also for interorganizational transport chains – one aspect seems to be significant: Bounded rationality.

Taking a look to behavioral assumptions regarding to organization theories, relating to New Institutional Economics, bounded rationality – as bridge to cross functions within logistics and especially transport chains – is one of the similarities in theory of collective action, property rights theory and transaction costs theory, explaining the existence of market, organizations, governments, and contracts (see figure 1).[6]

Characteristics	**Theory of collective action**	**Property right theory**	**Transaction cost economics**
Perspective	Economics	Economic	Economic
Behavioral assumptions	*Bounded rationality*	*Bounded rationality*	*Bounded rationality* *Opportunism*
Problem orientation	Conditions for incentives under which firms make joint actions	Conditions for incentives for efficient coordination	Variables for an efficient governance structure
Time dimension	Static	Static	Static

2 See Gillenkirch; Arnold (2008).

3 Rapp (2000), pp. 95ff.

4 Compare Müller (2003), p. 98.

5 Compare Gillenkirch; Arnold (2008), p. 128.

6 Compare Van der Horst, De Langen referring Hazeu (2000).

Unit of analysis	Joint action	Property rights, externalities	Transactions

Figure 1: Organization theories with their behavioral assumptions[7]

The behavior of one actor affects the behavior and business models of the others and vice versa, even if not in direct transport interaction. Due to its international configuration, for behavioral aspects especially the maritime transport chain is suitable as an example for interorganizational transport chain.

2. Behavioral aspects in interorganizational transport chains

2.1. The maritime transport chain – A behavioral view

In maritime transport chains locally acting, economically independent actors that are partially in competition with each other, and operate in different business models (e.g. Carrier's Haulage and Merchant's Haulage) on the market, have to make decisions about infrastructure with high fixed cost. Neither one integrated service provider can cover the entire transport chain, nor a cooperation between actors is sufficient enough, to ensure efficient processes along the chain and secure a coordinated behavior.
Figure 2 shows the maritime transport chain and the environment (macro level) covering the actors. The respective business models of the actors (as partial models) are in mutual interaction for customer service (e.g. transport capacity, price and lead times) and cannot be combined in a total model. However, the different business models also have an effect on the other actors involved and thus form dynamically changing cause-effect relationships depending on actors' reactions and behavior. With a combination of dynamic and explanatory methods, such as agent-based modelling and system dynamics, these dependencies can be captured, but have to be complemented with behavioral aspects.

[7] Compare Halldorsson; Kotzab; Skjott-Larsen (2005).

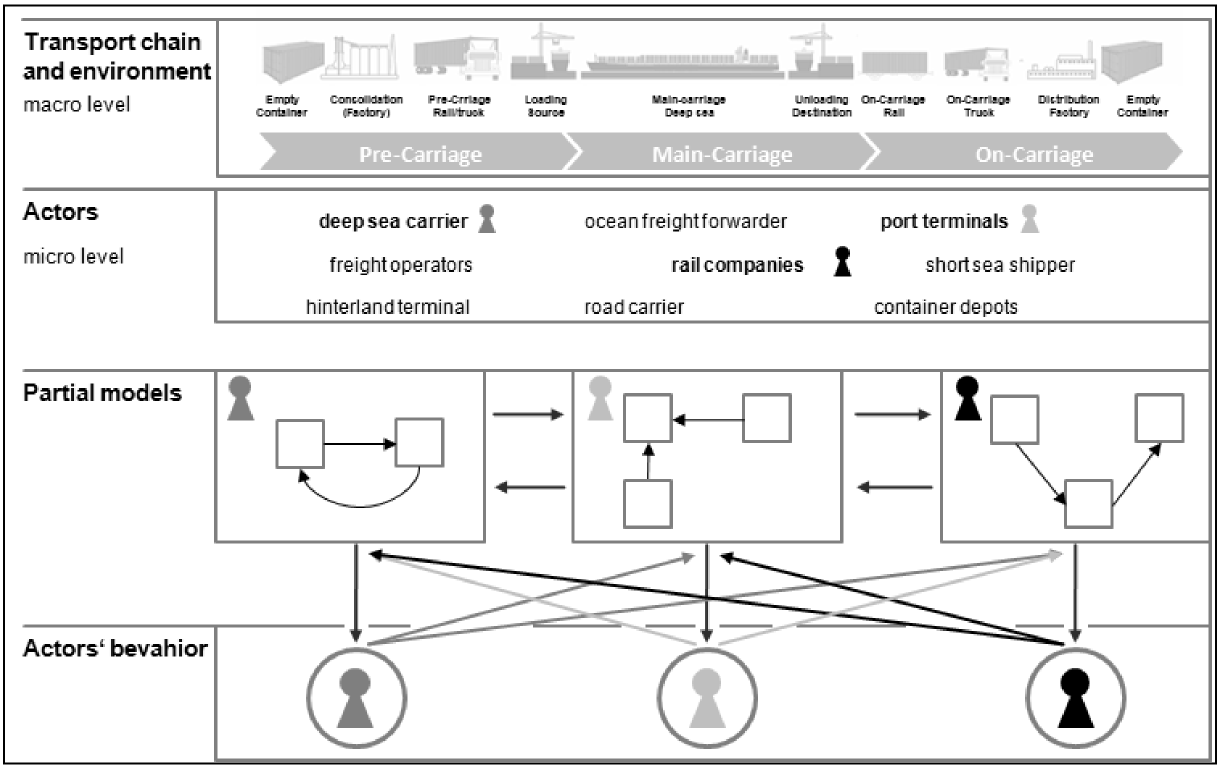

Figure 2: Maritime transport chain and its environment

2.2. „ETA" in interorganizational maritime transport chains

The maritime transport chain has a heterogeneous structure in nature. The various actors – deep sea carrier, short sea shipper, ocean freight forwarder, port terminals, freight operators, rail companies, hinterland terminals, road and barge carrier and container depots – could be named as agents who their inevitable functional role in the logistics chain must be coordinated without interfere with their target self-interest and business concepts.[8] This structure has effected high distribution of tasks and thus needs seamless flow of information leading to a very high demand on inter-organisational coordination between the actors.

Production industry already implemented planning and simulation concepts such as Manufacturing and Enterprise Resource Planning (MRP I/II and ERP) and Supply Chain Management (SCM).[9] In trade Efficient Consumer-Response (ECR) and Collaborative Planning, Forecasting and Replenishment (CPFR) was implemented for information at the point of sale in real time.[10] One of the important information that is missing along maritime transport chain is "estimated time of arrival" (ETA) of containers.

Sufficient and well structured freight flow information makes daily operations such as transport, transfer, handling and storage services which performed by logistics agents become more efficient.

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[8] See Roorda et al (2010), p. 18.

[9] See Rönkkö et al (2007), p. 815.

[10] See Corsten; Gabriel (2004), p. 227.

Established communication behaviors within the maritime transport chain are preventing a transparent information flow.[11] Besides agents which have roles in the beginning of the transport chain do not benefit directly from providing valuable information such as ETA and prevent innovation processes.[12]

2.3. Model of the maritime transport chain

Beside seaborne and inland waterways, the maritime transport network includes the junctions with other transport modes in the ports and the port's hinterland. In main-carriage, containers are moved by deep sea container vessels from a source to a destination terminal, in general from one continent to another. These terminals connect the hinterland with the seaports. The hinterland traffic includes all traffic of the pre- and on-carriage in maritime transport. These services are handled by rail, road and barge carriers. Intermodal transport in hinterland is a successful value adding concept, combining the strengths of different transportation modes.

In a model view the complex divided interorganizational maritime transport chain can be reduced to discrete events, where queuing, batching and unbatching of containers as well as transport time are the main events. Figure 3 shows the transport of import containers from a source to a sink regarding the model design. From a source several smaller entities are batched into one container, a so called full container load (FCL). This procedure can be seen as a queue-and-batch-process, when certain entities form a newer larger one. The transport (here Carriage) is always symbolized by a certain time delay. After arriving at the terminal, this time the container is queued and batched with others to a container vessel load. In the destination terminal the container will be unbatched or unloaded and re-batched with others to a train, which transfers them into the port's hinterland. Unloaded, the container is transported over the last mile by truck and finally the smaller entities are unbatched in the sink.

The model shows, problems or delays in queuing on upstream level always take effect on the downstream queuing or batching. For instance, if a container won't reach the terminal in time, it can not be loaded on the container vessel as planned on bay plan. The bay plan – plan for the stowage of containers, in which each bay on a container vessel is represented in a cross-sectional plan of the ship from bow to stern – sets in which order containers are to be stacked and how these stacks are spread along the vessel. Usually containers arriving too late will be stacked on top, but here weight restrictions and security problems, especially with dangerous goods possibly conflicting with neighbouring containers, are a significant problem.

[11] See Schuh (2006), p. 3.

[12] See Reichwald; Piller (2006) p. 96.

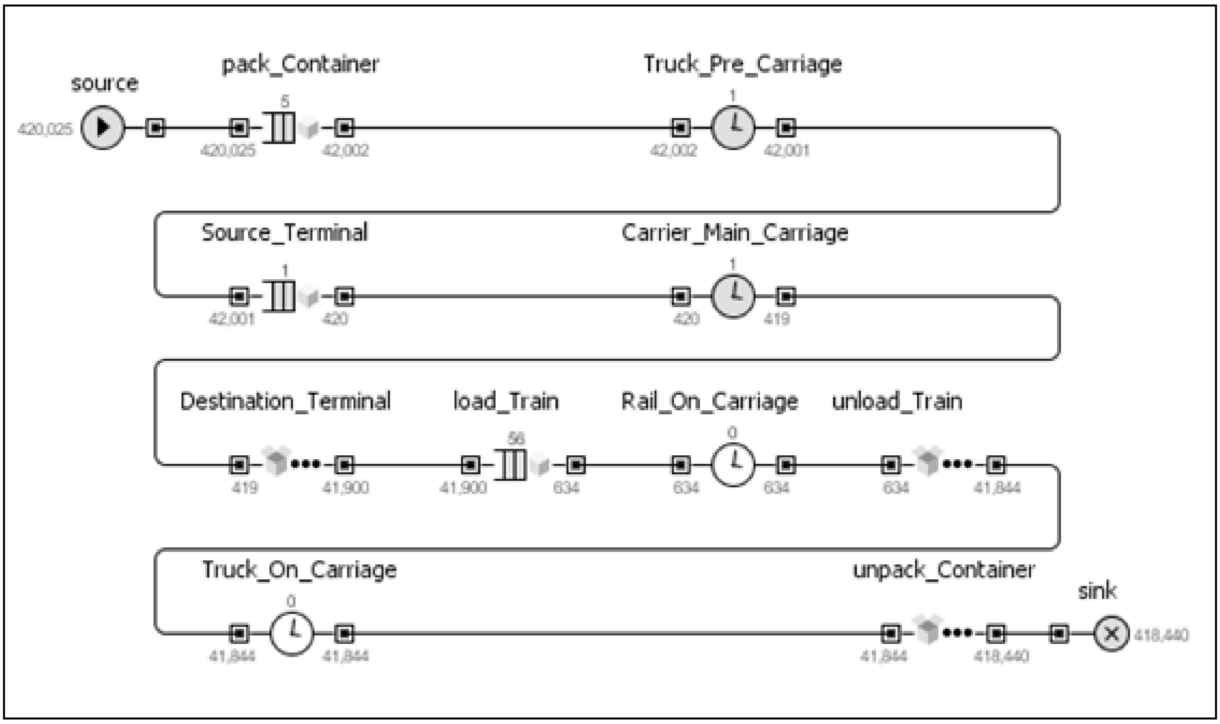

Figure 3: Simplification of the maritime transport chain as a discrete event model

2.4. Research question

As mentioned in the model of the maritime transport chain, queuing and batching processes are major parts in the whole chain. When certain actors are directly working together, without having a third party in between, their behavior and the combined transportation processes are forming *routines*.

Routines or multiple queuing processes are basing on common behavior, established over time. These implemented processes are already hard to split up and rebuild in newer more fitting processes, when according only two actors. In heterogeneous interorganizational structures the grade of complexity is increasing the problem. Capacity restrictions and delays are crucial factors, when building efficient transport networks. These networks have to be understood as well in their total size from source to destination, where the sink is the source for the next transportation launch, as in the individual chain links with different business models of actors. Here normal economic approaches are not capable to cover the whole complexity of existing problems.

Thus the first research question can be formulated like: Which routines enable the generation of an ETA-information in the transport chain?

The problem of providing downstream status information and notifications to all involved actors for their capacity and handling planning has to be addressed by understanding the sociological and psychological aspects in maritime transport. Therefore *governance structures* have to cover the individual behavioral aspects by increasing company's control, e.g. by setting up integrated concern structures, or using multi-client enabled technical solutions as an incentive, such as neutral platforms.

The second research question is: With which governance structures the generated ETA-information can be circulated along the maritime transport chain?

3. Case Study – Networking of sea ports and rail-bound hinterland traffic

3.1. Research Design

For understanding the individual communication behaviors and needs, expert interviews, workshops with the involved actors and especially round-table discussions with bringing all partners together at one table, were conducted. These processes are building the foundation for workshops to identify further problem fields and steps in developing the target concepts for later verification. In a first of two phases, interviews were already conducted. Further interviews are planned in a pending follow-on project. Although ETA-information was claimed by the involved partners' experts as highly valuable and needed for more efficiency within maritime transport chain, it took multiple round-table discussions to start the research work. The reason was that some actors were seeing ETA only as an benefit for others – at least in some cases.

3.2. Case – Hamburg maritime transport chain

As a initial situation the long-term projected container handling volumes in the German seaports required improvements in resource management along the entire transport chain. Necessary participating actors such as deep sea carrier, a terminal, a rail operator and a railway company was needed. For this reason the Hapag-Lloyd, Hamburg Harbour Logistics Cooperation (HHLA), TFG Transfracht and Deutsche Bahn were brought together. The project focus was set on the performance improvements in the transport chain by increasing the reliability in the operational planning, based on a standardized and reliable data exchange at an early point. Primarily the ability of actors for creating, providing and using advancing notifications regarding anticipated ship arrivals and containers as well as initiating signal-based iterative check loops is being analysed. As a research topic the requirements for and benefits of ETA messages, for data exchange at the earliest point within a heterogeneous multi-modal transport chain, from a behavioral science view are addressed in the interviews.

For full consideration of the effects of ETA-messages both the import and export side have to be considered within the research project.

The partners of the joint project consider recent developments in the port environment and focus on the continuous synchronization between digital (e.g. status messages) and real (e.g. events along the transport chain) world. As a central challenge here the production, provision and use of advancing notifications are identified in the interviews. This situation results in a potential development of optimized business processes, including both import and export container streams.

On the import side a more reliable and faster advancing notification of the ship's ETA by the deep see carrier to the quay operators (terminal) is planned (see figure 4). Furthermore, a provision of the unloading intervals for import containers is provided by the quay operators. In addition, participation in the adjustment of standards for a port-IT platform is intended.

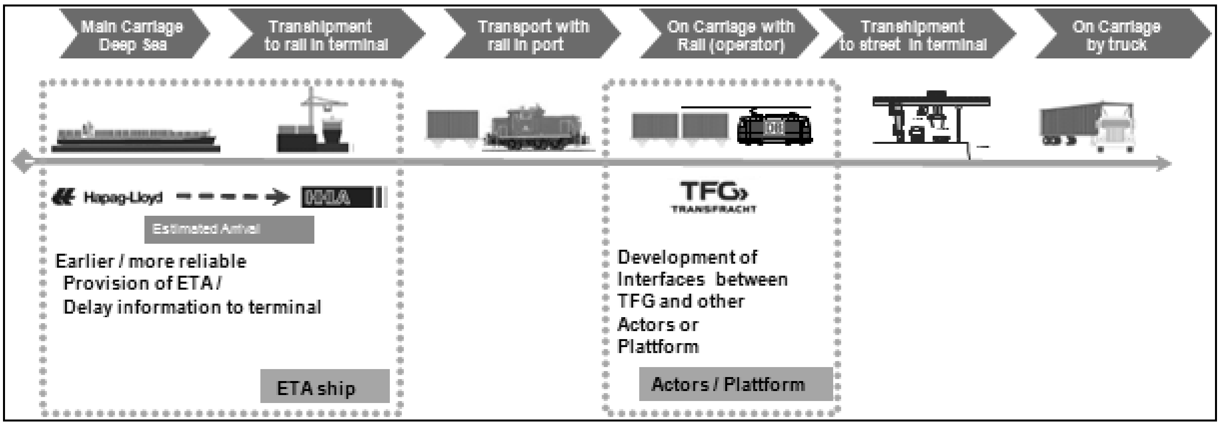

Figure 4: Projectscope: Import direction

On the export side, the introduction of constant, timely and reliable reporting on the expected time of arrival of the train (ETA-rail) in the port (the port railway infrastructure) by the railway company to the quay operators, the shipping company and the port railway are planned (see figure 5).
Furthermore the railway company plans to submit the train mirror to quay operators with container data for exporting trains. This allows a match with the ship's departure and minimizes the time for the train data enrolment.

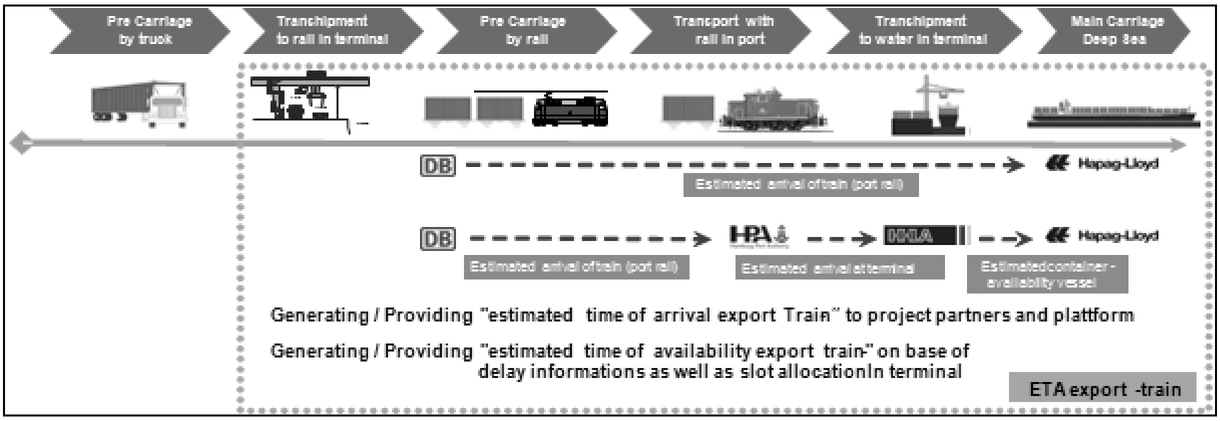

Figure 5: Projectscope: Export direction

The provision of these messages has to end up in a check, using iterative loops between the railway company, the port railway and quay operators, to determine whether the container on the export train will reach the vessel in time or not. In addition, corporate decisions based on a guideline for process control (a design target sequence) can be developed, that rests on the reported data (ETA-ship and ETA-rail). The guideline intends to support the cooperation of actors (partners) within the

implementation and evaluation of activities and processes in supply chain. It also helps detecting exceptions and enabling quick responses in cooperation with the other actors.
The early recognition of critical states opens a small window of opportunities for additional actions. The strength of the guideline is particularly evident in the ability to detect whether train or ship delays can be classified as critical within the logistics process. This control improves capacity utilization.

3.3. Conclusion and Outlook

After conducting the first interview rounds, it could be shown, that ETA already can be provided within a concern structure or between independent partners. But concerning actors in a competitive relationship ETA could not been realized. This can be explained on the one hand by established centralised information structures, preventing lean communications, and on the other, that ETA generation will not be implemented by one actor, if the other is not implementing ETA, too. The fear of costs for implementing a solution, which seems useless at a moment when not or not already been established by other actors, leads to individual bounded rationality and thus still to a miss of valuable ETA-information. These behavioral aspects are as challenging as technical ones.
Regarding to the discrete model of the maritime transport chain on a first phase the import scope of the project ETA-ship is relevant. Both terminal and rail operator now have the information and can adjust their capacities when the containers will reach the terminal. The quay operator also gives unloading intervals to the rail operator (see figure 6). This further increases the control on production planning of the train in on-carriage.

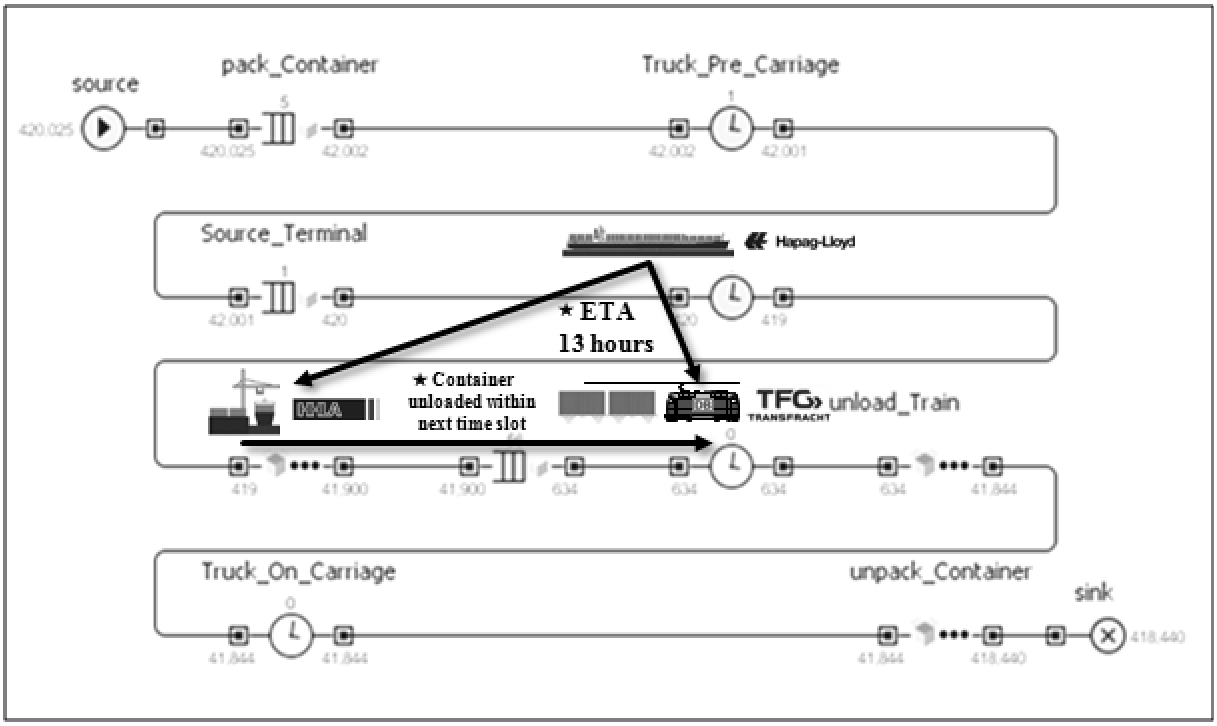

Figure 6: ETA container vessel in import scope

According to the first research question, routines for enabling the generation of an ETA-information for the import container vessel have to be developed involving the project partners. If the deep sea carrier leaves the previous sea port in liner service the arrival or a possible delay in form of ETA-information has to be submitted. Together with other routines, all behavioral guidelines will be consolidated with business cases. Concerning the second research question; For circulating ETA-information along the maritime transport chain, the project partners have to discuss and constitute possible common shared governance structures, because ETA of a ship is also valuable for the customer or container depot. In conclusion regarding above mentioned discussions, a structure for an implementation project plan will be developed.

The project plan and business cases for realisation of ETA will be implemented in an advanced model. Alternative actions and further recommendation also will be discussed.

Literature

[1] Klemke, E. D.; Hollinger, R.; Rudge, D. W.; Kline, A. D. (1998): Introductory readings in the philosophy of science. 3rd ed.; Prometheus Books; Amherst New York.

[2] Gillenkirch, M. R.; Arnold, C. M. (2008): State of the Art des Behavioral Accounting.

[3] Rapp, H.-W. (2000): Der tägliche Wahnsinn hat Methode, Behavioral Finance: Paradigmenwechsel in der Kapitalmarktforschung; In: Jünemann, B.; Schnellenberg, D. (ed.): Psychologie für Börsenprofis – Die Macht der Gefühle bei der Geldanlage; Stuttgart.

[4] Müller, S. (2003): Die Bewertung junger Unternehmen und Behavioral Finance: Eine experimentelle Untersuchung, Reihe Finanzierung, Kapitalmarkt und Banken, Bd. 23; Eul-Verlag; Köln.

[5] Gillenkirch, M. R.; Arnold, C. M. (2008): State of the Art des Behavioral Accounting; In: Wirtschaftswissenschaftliches Studium, 37. Jg., Heft 3.

[6] Hazeu, C. A. (2000): Institutionele economie. Een optiek op organisatie en sturingsvraagstukken, 1st edition, Coutinho, Bussum.

[7] Halldorsson, A, H. Kotzab, J. H. Mikkola; Skjott-Larsen, T. (2005): How interorganisational theories contribute to supply chain management, theoretical foundation and application; In: De Koster, R.; Delfmann, W. (ed.): Supply Chain Management in European perspective, Copenhagen Business School.

[8] Roorda, M. J.; Cavalcante, R.; McCabe, S.; Kwan, H. (2010): A conceptual framework for agent-based modeling of logistics services; Transportation Research Part E; pp. 18-31.

[9] Rönkkö, M.; Kärkkäinen, M; Holmström, J. (2007): Benefits of an item-centric enterprise-data model in logistics services: A case study; Computers in Industry; pp. 814–822.

[10] See Corsten, Daniel; Gabriel, Christoph (2004): Supply Chain Management erfolgreich umsetzen. Grundlagen, Realisierung und Fallstudien; mit 20 Tabellen. 2., verb. Aufl.; Springer; Berlin.

[11] Schuh, G. (2006): Sm@rt Logistics: Intelligent networked systems; CIRP Annals - Manufacturing Technology; pp. 505-508.

[12] Reichwald, R.; Piller, F. (2006): Interaktive Wertschöpfung – Open Innovation, Individualisierung und neue Formen der Arbeitsteilung; Gabler; Wiesbaden.

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