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Report

Retail Supply Chain: Transport Dashboard

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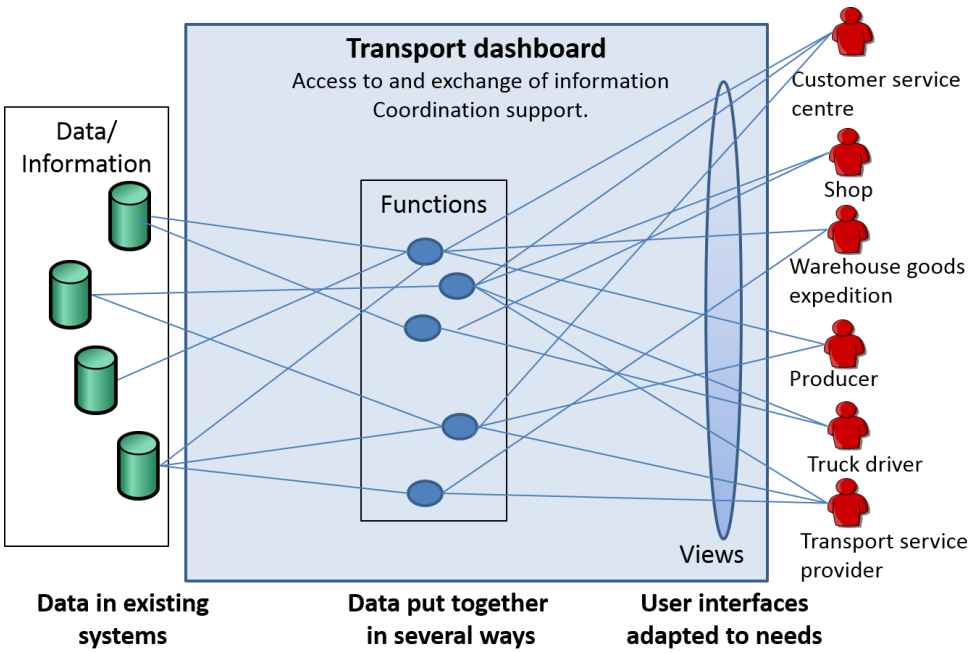

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Report

Retail Supply Chain: Transport Dashboard

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ABSTRACT

The report addresses a user centered approach for the elaboration of user needs and the related functional requirements for collaboration and coordination support in the supply chains of one of the largest retailers in Norway.
The user needs are defined by paper prototypes of a transport dashboard, co-created with and validated by actors in the supply chain during an iterative incremental process. Representatives from all relevant actors have participated (producers, transport service providers, retailers and various roles in the wholesaler's organisation).
In general, more robust and automated solutions for coordination and collaboration in the supply chains were requested. The paper prototypes suggest unified solutions that 1) provide easy and automated access to the right information at the right time for all actors in the supply chain by means of a dashboard providing the relevant views on the supply chain; 2) support easy detection of deviations; and 3) support decisions that can improve efficiency and deviation handling. Based on the users' needs, functional requirements to a transport dashboard with different views on information and statuses are identified.

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1 Introduction

Supply chains can be more efficient and deviations can be handled in a smoother way if relevant information is provided automatically and in time to all actors involved in a retail supply chain. This report incorporates the perspectives of the different actors as well as the needs for coordination and collaboration to arrange for more efficient and sustainable transport by means of what we have defined as a transport dashboard for coordination and collaboration support. The transport dashboard concept was defined in collaboration with the supply chain actors, and this report summarises:

- The user needs as seen from the perspective of different actors in the whole retail supply chain, from the producers to the stores.
- The functional requirements derived from the user needs.
- Overall requirements for ICT enabling the required information collection and coordination of tasks directly and indirectly related to the transport operations.

The results presented in this report are based on an iterative approach with user-centered design with close collaboration with actors in the retail supply chains of one of the largest wholesalers in the retail sector in Norway (Natvig & Wienhofen, 2016). Personnel employed in different positions in the wholesaler's organisation, producers, shops, transport service providers and truck drivers have been involved.

1.1 Motivation

Retail supply chains involve many actors, and such supply chains handle large volumes of cargo with short lead times and different requirements with respect to handling and temperature. The actors are typically producers, wholesalers, transport service providers, truck drivers and retailers.

In general, wholesalers have central and distributed warehouses and departments working together, assisted by internal information and communication technology (ICT) systems. These systems communicate with external systems to support efficient coordination and communication for purchasing, order management, replenishment, invoicing, etc. This retail supply chain is getting more advanced as new technology is deployed. ASR (Automatic Store Replenishment) for example, simplifies the replenishment process, GPS and temperature sensors are commonly used in trucks to enable continuous tracking and monitoring of the distribution process, and RFID tags on pallets and other load units facilitate automated registration of shipped and received goods. The solutions also support data collection that can support prognosis and decisions.

Today, ICT for transport operations usually support single actors and not all actors in the supply chain. Transport management systems do for example support actors responsible for the transport. (Wong, Lai, Cheng, & Lun, 2015) address the role of IT in collaborative decision making in supply chains and shows positive effects on customer service performance, but states that further research on this issue and dyadic relationships in supply chains are requested, among others between shipping and transport service providers. Tracking technology is commonly used, though (Hinkka, Främling, & Tätilä, 2013) points out that the use of such technology so far is mainly motivated by the needs of the wholesalers. Suppliers have in general adopted tracking technology to strengthen the relationship towards their main customers (e.g. wholesalers) and not for the sake of their own production process. The importance of an actor perspective is highlighted since there are different needs and motivations among the parties in the supply chain, and more research with such an actor perspective is requested, among others the perspective of transport service providers.

Because of the above, this report addresses on the needs of the different actor types in a retail supply chain, and how a transport dashboard can support the collaboration and coordination needed between the involved actors. The aim is to facilitate 1) more efficient access to just in time and just enough information; 2) better handling of deviations; and 3) more informed decisions by all parties involved.

1.2 Content

The next sections provide an overview of the work and the results.

- Chapter 2 describes the research method and the user-centered approached used
- Chapter 4 provides an overview of the current situation
- Chapter 6 provides an overview of the unified transport dashboard concept and the associated viewpoints that are the basis for the paper prototypes
- Chapter 7 describes the user needs and functional requirements by means of the paper prototypes addressing the specific viewpoints
- Chapter 7 summarises the findings and points out the direction for further work.

2 Method

To address the challenges described in the introduction section, the following research questions have to be answered:

- RQ1: What are the information needs of the actors involved in the transport chain in order to enable better handling of and adaption to deviations?
- RQ2: What are the information needs of the actors involved in the transport chain in order to take more informed decisions?

2.1 Research Method

The design science research method described by (Hevner, March, & Park, 2004) is used, as depicted in Figure 1. The research *environment* consists of the processes and stakeholders involved in the retail supply chain, starting from the producer, to a wholesaler with different departments and warehouses and further to the final selling point, all by means of transports delivered by transport service providers. The research is driven by the need to better coordinate and share information in this environment, with the assumed outcome a more optimal operation and therewith cost reductions. The *knowledge base* is the existing literature on the use of technology in retail supply chains as well our own findings.

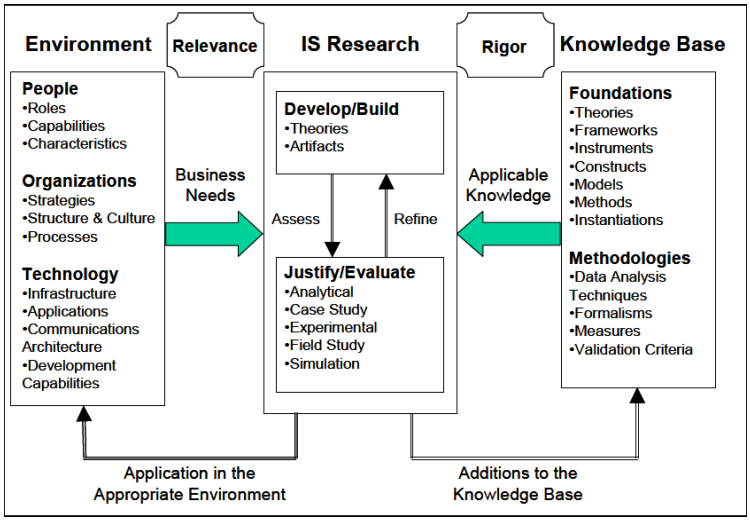

Figure 1 Conceptual framework for IS research (Hevner, March, & Park, 2004)

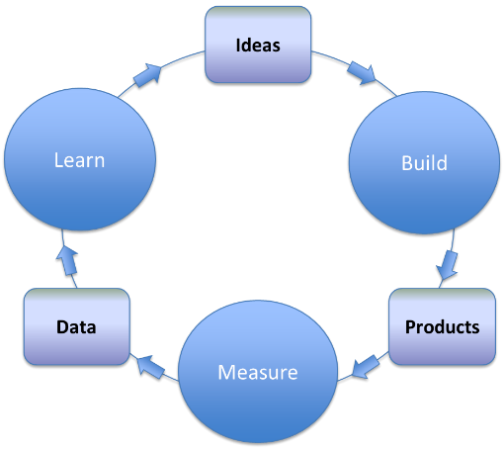

Figure 2 The Lean Startup process, (Ries, 2011)

The information system (IS) research *Develop/Build* and *Justify/Evaluate* processes, as depicted in Figure 1, is carried out according to a design methodology inspired by the Lean Startup product design approach described by (Ries, 2011) (see Figure 2). To explore the transport dashboard concept, the product we build is however paper prototype artefacts, not actual software. The detailed approach is quick cycles through three distinct activities (learn, build and measure). Each activity aims at creating a result (ideas, products and data) where the fidelity of the results improves gradually towards an artefact as we iterate through the whole process.

The first *ideas* were based on and understanding of the business needs established through an initial case study of the current situation (see description in Chapter 3) and an initial mapping of the user needs. We also studied previous trials. The *build* activity designed a set of products, in our case paper prototypes of software solutions. These paper prototypes were tested on relevant stakeholders in workshops (*measure*) who provided input on the usability (*data).* The input was evaluated (*learn*) to create new insights and new *ideas*, which are input to a new build activity which refined the paper prototypes. These were tested on relevant stakeholders in workshop, etc. in an iterative process.

2.2 User-centered design

As pointed out by (Hinkka, et al., 2013), there is an asymmetry in the needs of the actors in the supply chain, and it is not obvious that solutions that are beneficial to the wholesaler also will be useful to the other actors in the supply chain. Thus, a user-centered approach was taken to ensure that the perspectives and needs of the different actors are emphasised. In general, a user-centered design is conducted prior to the development of complex systems to ensure deep understanding of user and stakeholder roles. User-centered design was applied in the activities in the iterative cyclic process described above to ensure that the daily work of end users and the role of stakeholders are supported by the designed system. Various methods for data collection were used, as described in the sections below. The aim was to uncover

- sub-optimal information sharing practises;
- information that is not available at all; and
- information that it is inconvenient to get hold of.

2.3 Steps taken

Table 1 summarises the iterative steps taken to identify user needs and to elaborate the functional requirements. For each iteration, we summarize the stakeholders involved, the methods used and the results.

Table 1 Steps taken and results

Iterations	Stakeholders involved	Method	Results
As-is situation mapping	- Wholesaler (misc. roles) - Fleet operator - Shops - Producers	Case study - Workshop with presentations - Observation - 5 semi structured interviews	- As-is situation mapping (see Chapter 3) - Awareness of challenges - Input to initial user needs and paper prototypes
Transport dashboard concept definition	- Wholesaler (misc. roles) - Fleet operator - Shop - Producers - Technology provider - Scientists	Workshop with innovation games: - World cafe - Cover story - Product box	- Common understanding of concept - Concept definition (see Chapter 4) - Input to initial user needs and paper prototypes

Evaluations of previous trials	- Driver - Fleet operator	- 2 semi structured interviews	- Input to initial user needs and paper prototypes
Build-measure-learn loop for elaboration and refinement of user needs and requirements	- Fleet operator - Wholesaler (misc. roles) - Technology provider	- Paper prototyping in 4 workshops	- Initial user needs (see Annex Annex A) - Identification of viewpoints (see Chapter 5) - New/refined paper prototypes for the viewpoints reflecting user needs and functional requirements (see Chapter 6)
	- The above - Shop - Producers	- World cafe - 2 semi structured interviews	

The *as is situation* was mapped by a case study where semi-structured interviews and observations were used to collect data. This provided an overview of the current situation and insight in the specific needs and challenges of the different stakeholders (see Chapter 3). We catered for an open dialogue to understand user expectation from the sought-after solution. Questions therefore primarily start with how, what and why, e.g. "How do you do your work today?" followed up with trigger questions such as "what irritates you during a working day?"

To define the overall *transport dashboard concept* (see 4) and as a part of the user-centered method, we played innovation games (Brown, 2010; Gray, Brown, & Macanufo, 2010) such as world café, cover story and product box together with stakeholders involved in the transport chain.

- The World Café game was used to identify challenges faced in the transport chain. This game facilitates a structured conversational process with an open discussion. Groups of participants, representing different stakeholder groups, visited the "café table" where they continued to discuss partly based on the results from the previous group.
- We used the Cover Story game to identify and elaborate on the long-term vision of the work on a transport dashboard. The participants wrote the headlines that they would like to see in the newspaper after a successful implementation of the dashboard.
- In the Product Box game, the participants were asked to present and "sell" the transport dashboard as a product by creating a physical cardboard box with printed slogans about the features of the product. In this way, the main features that are of importance for the participants get highlighted, which again gives insight in the desired outcome.

We have also carried out *evaluations of previous trials* carried out by the wholesaler in collaboration with a transport services provider and shops. This was trials with use of RFID to support automatic registration of pallets received by the warehouse and automatic registration of pallets in trucks; and notifications of shops 30 minutes in advance of the arrival of the truck. The data collection was carried out by means of semi-structured interview.

The elaboration of the actual user needs for the transport dashboard was done with different stakeholders in a *build-measure-learn loop* facilitated by paper prototyping. Layout and visual effects were not emphasized. The focus was on user needs related to functionality and the information to be presented and shared. This was an iterative process starting with the identification of initial user needs (see Annex A) and the identification of relevant viewpoints (see Chapter 5). Initial paper prototypes were established based on the above, and these were refined in several workshops with relevant stakeholders. We also used the World Café

and semi-structured interviews at a later stage to verify and to get further input on the paper prototypes from stakeholders other than those participating in the initial work. The work resulted in the user needs and functional requirements described in Chapter 6.

3 As-is Situation

The coordination between the transport operations and the various operations of the stakeholders in the retail supply chain is currently done by verbal communication (face-to-face or by phone), communication through documents (such as freight papers) and communication through various ICT systems.

A case study was carried out to capture information about the current processes and information flows. The overall findings are depicted in the BPML (Business Process Modelling Language) diagrams in Figure 3 and Figure 4. Each actor involved is represented by a pool, which contains the processes involved. The processes directly involved in the transport tasks are green, and information flows (black dashed lines) and status flows (red dashed lines) to and from these processes are shown. The other processes show the context in which the transport tasks are executed. The solid arrows are control flows between processes.

The actors directly and indirectly involved in transport are the retailers, the transport service providers, the truck drivers, the wholesaler's local distribution centre, the wholesaler's central warehouse and producers delivering products to the wholesaler. The focal point is the wholesaler's distribution centre, which is represented by two of its main units – the customer service centre and the warehouse.

3.1 Outgoing Transport

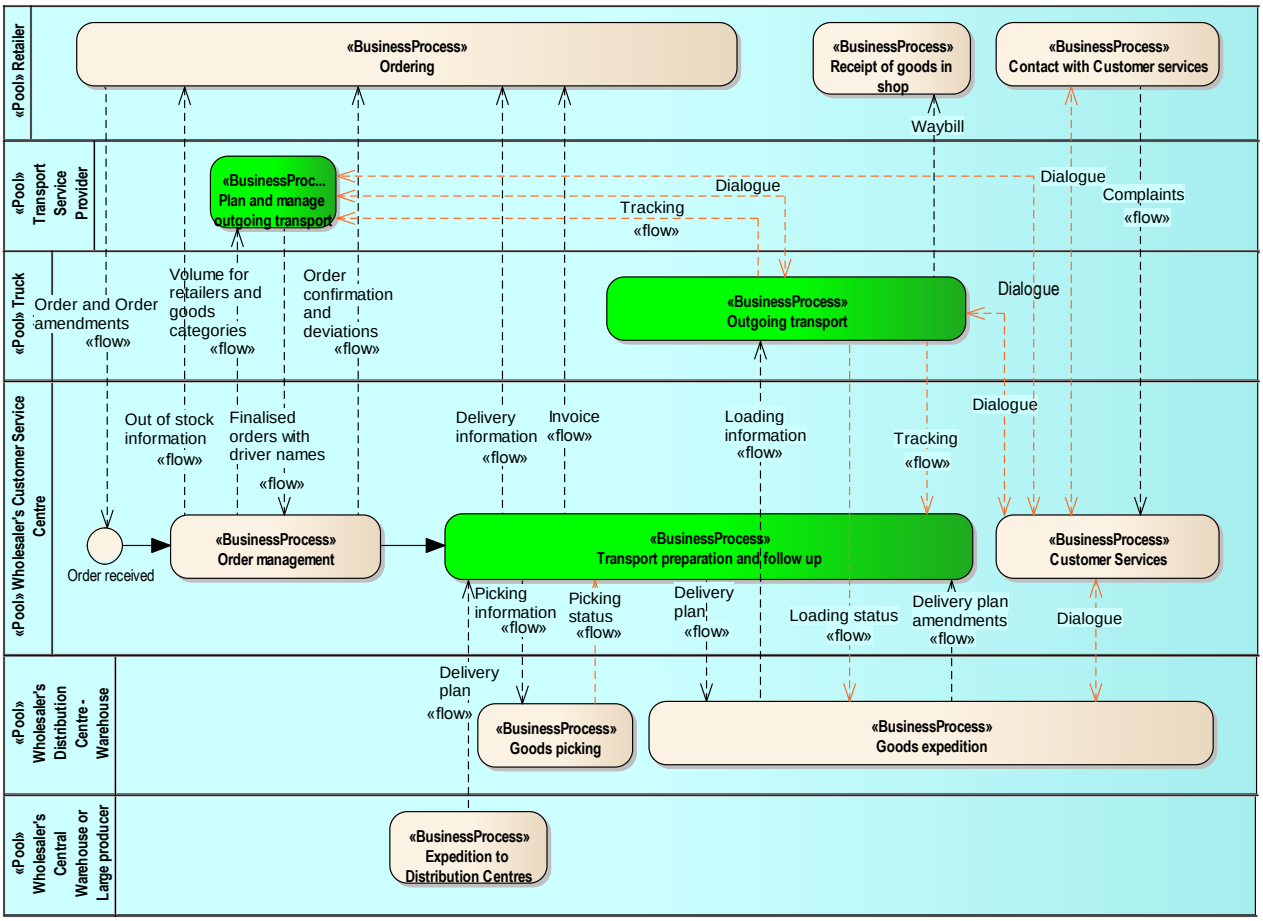

Figure 3 As is situation - Outgoing transport processes and information flows

A somewhat simplified diagram for outgoing transport is depicted in Figure 3. Outgoing transport from the wholesaler's local distribution centre to the shops is based on orders coming from the retailers. Information on the volumes to be provided to each shop is transferred to the transport service provider, which in turn initiates the transport planning. The transport planning is done using route plan templates optimized based on prognosis as the starting point. The route plan templates (previously received from the wholesaler) are adapted to the actual volumes ordered by each shop, and finalized orders assigned to drivers, routes and trucks are generated. The shops will get access to information that confirms or rejects (e.g. in case of out of stock) the delivery of the products listed in the orders.

The transport is controlled by the wholesaler's transport preparation and follow up process. On arrival to the warehouse, the trucks are assigned a loading gate. Outgoing transport is composed of 1) pallets picked from the warehouse at the local distribution centre and 2) pallets delivered for cross-docking from the wholesaler's central warehouse or from large producers of fresh food. Information about the latter is received from the shippers. The first is established by the picking process of the local warehouse, which is done according to received picking information. The picking is monitored so that the transport preparation and follow up process is aware of the status with respect to the picking for each shop and each outgoing truck.

For each truck, the goods expedition process in the warehouse has access to information about all the pallets to be delivered to each shop and the associated temperature requirements. This includes pallets picked at the local warehouse as well as cross-docked pallets, and the loading information is provided to the respective truck drivers, who are responsible for the loading. The loading status is monitored. It may happen that pallets cannot be loaded due to space limitations. In such cases the customer service centre is informed, and the customer (i.e. the retailer) must approve that the delivery of some of the pallets is postponed. If there is space available in the truck, the shop may be asked to approve that the wholesaler pushes goods to fill up the truck. In case of changes (postponed deliveries or pushed goods), the delivery plan is amended, and the final delivery information is made available to the retailer. An invoice will also be sent to the retailer based on this information.

The truck is tracked during the transport, and the transport service provider can follow the progress. On arrival to the shop, the truck driver will present the waybill to the retailer and collect a signature.

Several challenges were discovered during the work on the process description.

- The trucks may arrive to the shops in a 3-hour time slot, but the shops do not know the exact arrival time in advance.
- The local distribution centre does not get the exact arrival time of incoming trucks, which for example may carrying pallets for cross-docking.
- Most of the coordination, status reporting and deviations are handled manually. This means that actors communicate by phone. Usually this works well, but it is resource demanding, and in some cases the procedures fails. The shops may for example not get information about delays and cargo that cannot be delivered due to space limitations in the vehicles.
- It takes time to detect that pallets are delivered to other shops than planned.
- Tracking information is available, but is normally not used.

3.2 Incoming Transport

A simplified diagram for incoming transport is depicted in Figure 4. The wholesaler orders deliveries from producers and these deliveries are produced and delivered according to agreed time slots. In this study, the

incoming transport to the wholesaler is booked by the producers to facilitate the best possible coordination with the production process. However, all transport service providers used have contracts with the wholesaler. As for the shops in the study of the outgoing transport, the producers do not know the exact time of arrival for the vehicles.

Whenever possible, the incoming transport is organized as return load. On the return trip, the truck used on outgoing transport will pick-up deliveries from producers and transport the deliveries to the wholesaler's warehouses. The warehouses expect the deliveries within a time frame, but does not know the exact time of arrival in advance.

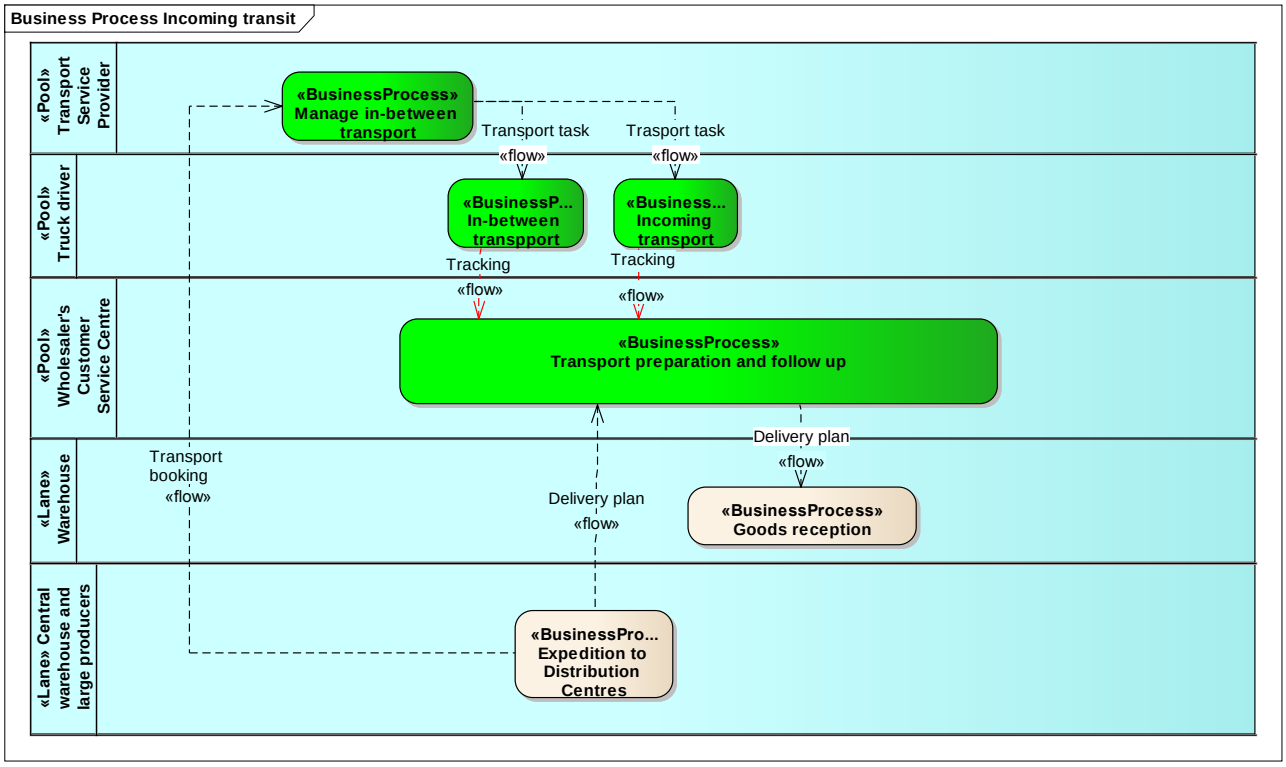

Figure 4 As is situation - Incoming transport processes and information flows

The warehouse of the wholesaler's local distribution centre will in addition to incoming transport from producers also get deliveries from the wholesaler's central warehouse. The latter may be pallets for cross-docking as well as deliveries that are to be stored. As in the above case, they do not know the exact time of arrival in advance.

Several challenges were discovered during the work on the process description.

- As for the shops in the study of the outgoing transport, the producers do not know the exact time of arrival for the trucks.
- The warehouses expect the deliveries from the producers within a time frame, but do not know the exact time of arrival in advance.
- As in the above case, the local warehouses expect the deliveries from the central warehouse within a time frame, but do not know the exact time of arrival in advance.

- Tracking information is available, but is normally not used.

3.3 Existing ICT Solutions

The wholesaler and the shops use comprehensive ICT systems offering forecasting and replenishment, warehouse management, vendor managed inventory, order management, etc. The wholesaler also has expert users who know how to look up and manually combine information from many different sources to get an overview over situations and to manually take decision on how to handle deviations. It is however quite common for other users to ask for information via manual communication.

The wholesaler provides information to transport service providers, producers and retailers via dedicated portals. The information is however not complete, and they frequently contact each other by phone. The producers and retailers also communicate with the transport service providers and their truck drivers to handle deviations and to coordinate their activities.

The trucks are equipped with temperature sensors and GPS tracking equipment so the transport service providers can locate the trucks and check the temperature for the different temperature zones in real time. The wholesaler has in previous trials used GPS tracking to implemented SMS notifications to retailers 30 minutes in advance of the actual arrival of the trucks. Previous trials have also tested the use of RFID in incoming and outgoing transport. Pallets equipped with RFID and RFID readers in warehouse gates and in trucks enable automated registration of receipts of goods in warehouse and goods loaded onto trucks.

4 The transport dashboard concept

The case study and the requirement elicitation through innovation games carried out with stakeholders in the initial phase of the work (see Table 1) provided input to a conceptual view upon the transport dashboard related tasks supporting:

- A holistic view on the transport operations
- Information access on all types of transport
- Coordination between actors and processes involved in and affected by the transport
- Decision support in case of deviations.

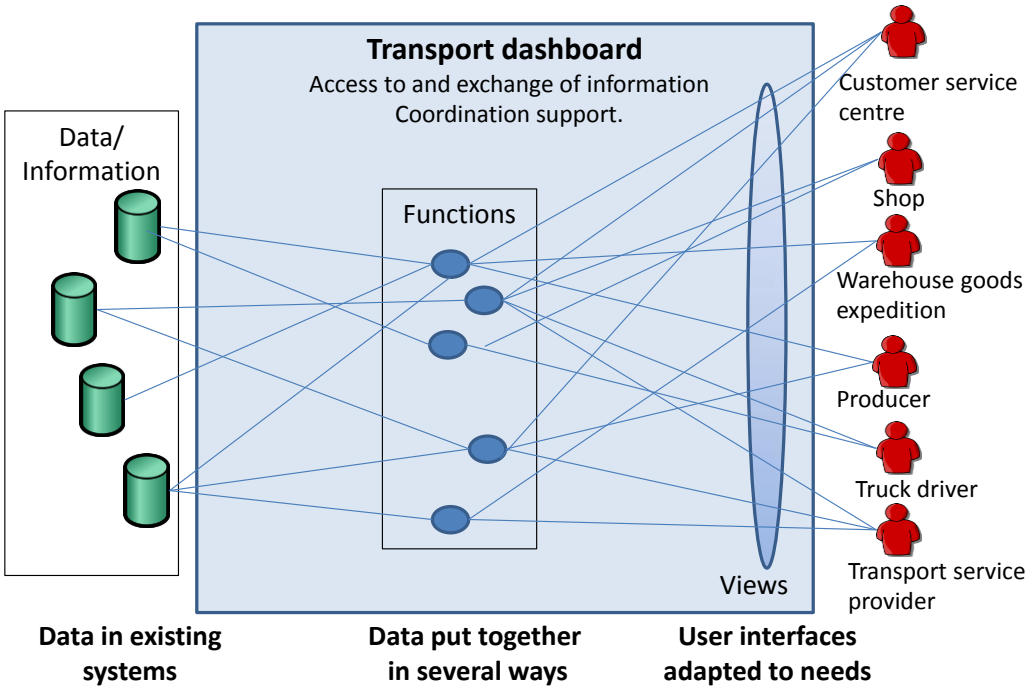

Figure 5 The transport dashboard concept

Figure 5 provides an overview of the concept. The different stakeholder types will have access to the information they need via customised viewpoints. When realised, these views will be user interfaces adapted to the needs of each stakeholder type. An important observation was that many of the different stakeholders requested the same information or functionality. The wholesaler already has existing systems with relevant data sources and data elements. In addition, there may be other data sources, e.g. real-time tracking and temperature data from trucks. The functions will access, combine and process the data to provide the required information and functionality to the stakeholders.

5 Viewpoints targeting user needs

Based on the initial user needs and together with the stakeholders, the viewpoints serving the needs of the different actor types in the supply chain were identified. These viewpoints required are listed in Figure 5 provides an overview of the concept. The different stakeholder types will have access to the information they need via customised viewpoints. When realised, these views will be user interfaces adapted to the needs of each stakeholder type. An important observation was that many of the different stakeholders requested the same information or functionality. The wholesaler already has existing systems with relevant data sources and data elements. In addition, there may be other data sources, e.g. real-time tracking and temperature data from trucks. The functions will access, combine and process the data to provide the required information and functionality to the stakeholders.

. As illustrated, some viewpoints may support several actor types.

Paper prototypes for these views are defined in Chapter 6.

Table 2 Requirements for transport dashboard viewpoints

Paper prototype viewpoints	Actor types						Viewpoint descriptions
	Fleet manager	Customer support	Shop	Producer	Wholesaler incoming	Wholesaler outgoing	
Map	x	x					Provides overview with clickable routes, trucks, shops, warehouses.
Routes	x	x					Provides statuses for all routes/ trucks (foreseen delays, available capacities, etc.).
Truck – in/out		x					Supports follow up of transport operations by providing truck status (foreseen arrivals, delays, faulty deliveries, temperature, etc.).
Warehouse - in		x			x		Supports cargo reception and cross-docking.
Warehouse – out		x				x	Supports goods expeditions from warehouse.
Shop		x	x				Supports goods reception in shops.
Producer		x		x			Supports the producer's goods expedition.

6 User needs and requirements related to viewpoints

The case study described in Chapter 3 showed that central experts in the organisations involved are able to get access to information from the existing systems and through manual communication, and they can solve problems by combining information from various sources and by taking the right actions. There is however a need for more robust and automated solutions that:

- Provide easy and automated access to the right information at the right time for all actors in the supply chain.
- Provide notifications about statuses and deviations to support easy detection and handling of deviations.
- Supports decisions that can improve efficiency and exception handling.

The user needs with respect to the above were elaborated through paper prototyping for the respective viewpoints (see Table 2). Actors from the retail supply chain participated in the prototyping. This chapter describes these paper prototypes and the functional requirements derived from them. Please note that the layout and visual effects are not emphasized in the paper prototypes. The focus is solely on the user's information needs and functionality requirements.

6.1 The Map view paper prototype

The stakeholders requested easy access to information in an overview picture or just a click away from such a picture. The use of a map with clickable objects representing warehouses, shops and routes as well as the real-time position of trucks was suggested.

The table below provides requirements with reference to the map view.

ID	Requirement
M1	The map should provide an overview over the geographical area of relevance to the user
M2	The relevant routes must be depicted as clickable objects in the map with links to the Route view.
M3	The relevant warehouse must be clickable objects in the map with links to the Warehouse in and Warehouse out views.
M4	The relevant shops must be clickable objects in the map with links to the Shop view.
M5	The relevant trucks must be clickable objects in the map with links to the Truck in/out view.
M6	The truck objects should be displayed in a way that shows their origin, i.e. the logo of the providers, a logo indicating that it is coming from the central warehouse, and a logo indication the route (for outgoing trucks)
M7	It must be indicated which trucks that are delayed or have other deviations
M8	It must be possible to limit the view to the objects of relevance (e.g. incoming truck, outgoing trucks, trucks from specific origins, trucks that are delayed or have other deviations, etc.)

6.2 The Route view paper prototype

The wholesaler and the transport service provider must have access to details on the progress on all outgoing routes in one single view with indications on statuses and foreseen delays. The paper prototype for the route view is depicted in Figure 6. The view provided to the transport service providers will be limited to the routes they operate. The purpose of the view is to give a full overview of all outgoing vehicles with a route that start at a warehouse. The view shows all routes, the vehicles responsible for these routes and all shops along the routes. The estimated and actual departure from the warehouse and the actual and the current status is indicated (*delayed, possible delay, on time*) to facilitate early detection of delays.

Truck should always be as full as possible (within the volume and weight limits imposed) in order to use the resources in an optimal manner and to contribute to fewer vehicles on the road and reduced fuel consumption. To address such issues, the view provides information on space utilisation. The foreseen amount of return load from each shop (input in the shop view) is provided, and the total availability of empty space after the visit to each shop is presented to support the planning of return load.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	**Routes from warehouse XYZ**														
2	**Current time 09:10**														
3									**# pallets**						
4	**Truck**	**Planned dep.**	**Actual dep.**	**Shop**	**Planned arrival**	**Expected arrival**	**Actual arrival**	**Devia-tion**	**Dry**	**Cold**	**Frozen**	**F&V**	**Sum**	**Return**	**Free space (pallets)**
5	VH12345	05:30	06:15						**50**	**4**	**3**	**2**	**59**	**30**	**7**
6				Shop A	06:00-08:00	07:05	07:06		20	2	1	1	24	30	1
7				Shop B	10:15-12:15	11:20			10	2	2	0	14		15
8				Shop C	16:30-18:30	17:45			20	0	0	1	21		36
9	VH23456	06:00	07:00						**13**	**4**	**7**	**7**	**31**		**35**
10				Shop A	08:00-10:00	10:00			1	1	1	1	4		39
11				Shop D	10:15-12:15				2	2	4	0,5	8,5		47,5
12				Shop E	16:30-18:30				10	1	2	5,5	18,5		66
13	VH34567	06:00	08:00						**6**	**15**	**24**	**15**	**60**		**6**
14				Shop X	07:00-09:00	09:30			1	4	7	6	18		24
15				Shop Y	10:15-12:15				2	5	8	5	20		44
16				Shop Z	16:30-18:30				3	6	9	4	22		66
17												Delayed/deviation			
18												May be delayed			
19												As planned/delivered			

Figure 6 Overview of routes

The table below provides requirements derived from the paper prototype.

ID	Ref	Requirement
R1	-	The view provided to the transport service providers must be limited to the routes they operate.
R2	A1	The warehouse addressed must be identified
R3	A2	The current time must be provided
R4	A5 - An	The trucks must be identified

R5	A5 - An	There must be a link towards more details on the individual routes, i.e. the Truck - in/out view
R6	B5 - Bn	The planned departure time from the warehouse must be provided
R7	C5 - Cn	The actual departure time from the warehouse must be registered
R8	D5 - Dn	The shops on the route must be identified
R9	D5 - Dn	There must be a link towards more details on the individual shops, i.e. the Shop view
R10	E5 - En	The planned time slot for arrival to the shop must be provided
R11	F5 - Fn	The expected arrival time must be provided and updated whenever it is changed.
R12	G5 - Gn	The actual arrival time to the shop must be registered
R13	H5 - Hn	Deviations with respect to arrival slot time must be registered
R14	I5-M5	For each route, the total number of pallet for each cargo category (dry, cold, frozen and fruit & vegetables (F&V)) as well as the total number of pallets on board on departure from warehouse must be provided.
R15	N5	For each route, the total amount of return load must be provided (as pallet slots)
R16	I6 - M6	For each shop, the number of pallets of each cargo category (dry, cold, frozen and fruit & vegetables (F&V)) must be provided as well as the total number of pallets
R17	N6	For each shop, the amount of return load must be provided (as pallet slots)
R18	O5-O	For each route, the free capacity (in pallet slots) on departure from warehouse must be provided
R19	O6-O8, O10-O12, O14-O16	For each shop, the free capacity (in pallet slots) on departure from the shop must be provided
R20	D14 L17	Actual or upcoming delays/deviations and the routes and the shops and pallets that are affected must be indicated to support the exception handling and/or mitigating actions.
R21	D12 L18	Deviations may occur and the routes and shops that may be affected must be indicated to support preparations for exception handling and/or mitigating actions.
R22	D6 L19	It must be easy to identify the routes, shops and pallets that are handled according to plan.
R23	A13	When actual or foreseen deviations are indicated, there should be a link to more information
R24	-	The vehicles must be tracked
R25	-	Based on the actual position of the vehicle and estimated travel times, estimates arrival times, delays and possible delays must be predicted
R26	-	The actual content of vehicles (#pallets, and which pallets) at any time must be managed

6.3 The Truck in/out view paper prototype

The wholesaler and the transport service provider must be able to follow the progress of individual trucks. The information needed for incoming, intermediate and outgoing trucks is depicted in Figure 7.

The purpose of this view is to give detailed information on deliveries and pick-ups. Details about the vehicle are also provided, such as license plate number, available pallet slots for 1 height and available pallet slots

for 2 heights. The purpose of this information is to support decisions on use of available capacity. Contact information for the driver (name, phone number) support direct contact in case this is needed. The vehicle status with respect to the driving is also provided (driving/stopping) as well the temperatures per temperature zone.

The waypoints to be visited by the truck are listed. This may be warehouses, shops, producers and checkpoints. For each location, the planned, expected and actual arrival and the actual departure are provided. The number of pallets in the cargo categories (dry, cold, frozen, F&V) is provided as well as planned returned loads and statuses with respect to deliveries.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Truck registration number:**		**VT 12345**						Click for m3				
2	**Current time 14:10**												
3	**Route**	**Planned**	**Expected arrival**	**Actual arrival**	**Departure**	**Deviation**	**Dry**	**Cold**	**Frozen**	**F&V**	**Sum**	**Return**	**Free space**
4	Local warehouse xyz	11:00			11:20	0:20	4	5	4	2	15		51
5	- Shop B	11:30-13:30	13:15	13:15	14:00		-2	-2	-1	-0,5	-5,5	10	46,5
6	- Shop C	12:00-14:00	14:30	14:30		0:30	0	-2	-2	0	-4	0	50,5
7	Checkpoint K	12:30-14:30	15:00	15:00								0	50,5
8	- Shop A	13:00-15:00	15:30	15:30			-1	0	0	0	-1	20	31,5
9	- Shop F	16:00-18:00					-1	-1	-1	-1	-4	0	35,5
10	- Shop Y	17:00-19:00					0	0	0	-0,5	-0,5	0	36
11	-Producer A	19:30-21:30					10	20			30	0	6
12	Local warehouse abc	05:00-07:00					-10	-20			-30	-30	66
13	Faulty deliveries/pick ups (yes/no): No				**Measured temperature**		N/A	4C	-23C	4C			
14	**Status (driving/stoped): Driving**												
15	**Driver**		Tine Maarudsson						According to plan				
16	**Phone**		95776848						Delayed				
17	**No of pallets - 1st hight**		33						May be delayed				
18	**No of pallets - 2nd hight**		66										

Figure 7 Overview of incoming and outgoing trucks

The table below provides requirements derived from the paper prototype.

ID	Ref	Requirement
T1	C1	The truck that is addressed must be identified
T2	G1	It must be possible to switch between information in pallet slots and cubic metres
T3	A2	The current time must be provided
T4	A4 - An	The waypoints must be identified. This may be warehouses, shops, producers and checkpoints. It must be possible to define checkpoints in different ways (location, geo fence, etc.)
T5	A4 - An	There must be a link towards more details on the shops, i.e. the Shop view
T6	B4	The planned departure time from the warehouse must be provided
T7	B5 - Bn	The planned time slot for arrival to the waypoints must be provided

T8	C5 - Cn	The estimated arrival time to the waypoint must be provided and updated whenever it is changed
T9	D5 - Dn	The actual arrival time to the waypoint must be registered
T10	E5 - En	The actual departure time from the waypoint must be registered
T11	F5 - Fn	Deviations with respect to the plan must be registered
T12	G4–Kn	For each waypoint, the number of pallet/cubic metres for each cargo category (dry, cold, frozen and fruit & vegetables (F&V)) to be loaded or unloaded must be provided as well as the total number of pallet/cubic metres.
T13	G4–K4 – Gn-Kn	It should be easy to access more information about the pallets to be delivered/picked up (e.g. to click at them)
T14	L4 - Ln	For each waypoint, the total amount pallet/cubic metres to be returned must be provided.
T15	M4 – Mn	For each waypoint, the free space (in pallet spaces/ cubic metres) on departure must be provided
T16	A13	It must be easy to detect that there are faulty deliveries/pick-ups
T17	H13 – J13	The temperatures for the different cargo categories must be provided
T18	A14	The status of the truck must be provided (driving, stopped for a longer period, ...)
T19	C15+C16	Contact information to the driver must be provided
T20	C17+C18	The number of pallet slots ion the truck must be provided
T21	I15	It should be easy to identify the waypoints and pallets that are handled according to plan.
T22	I16	It must be easy to identify the waypoints, pallets and temperature zones that have or will be affected by deviations
T23	I17	It must be easy to identify the routes and shops that may be affected by deviations.
T24	F4, F6	When actual or foreseen deviations are indicated, there should be a link to more information
T25	-	The vehicle must be tracked
T26	-	Based on the actual position of the vehicle and estimated travel times, delays and possible delays should be predicted
T27	-	The actual content of the vehicle (#pallets, and which pallets) at any time must be managed
T28	-	The temperatures in the different temperature zones of the vehicle must be tracked

6.4 The Warehouse in view Paper Prototypes

The wholesaler needs an overview on incoming truck and goods types to each warehouse. Figure 8 provides an example of a list of all incoming trucks. The purpose of this view is to support the planning and prioritizing of the reception of the cargo.

All arrivals are grouped according to the shift plan, and the amount of cargo of different categories, including cargo for cross docking, is provided. To facilitate prioritizing, goods scheduled for short connections for further transport are highlighted.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Local warehous XYZ								Click for m3					
2	Current time: 04:00								# pallets					
3	Planed arrival	Depar-ture	Devia-tion	Expected arrival	Actual arrival	Truck	From	From location	Cross-dock	Dry	Cold	Frozen	F&V	Total
4	00:00-06:00	23:00		05:00		DL12345	Central warehouse	Oslo	66					**66**
5	00:00-06:00	23:24		05:20		DL23456	Central warehouse	Oslo	15	10			30	**55**
6	00:00-06:00			N/A		N/A	Pizza producer	Stranda		16	50			**66**
7	00:00-06:00			N/A		N/A	F&V wholesaler				10		50	**60**
8	00:00-06:00			N/A		N/A	Dairy ABC	Verdal			63			**63**
9	06:00-12:00			N/A		N/A	Dairy ABC	Heimdal			20			**20**
10	06:00-12:00			N/A		N/A	xxx							**0**
11	12:00-18:00			N/A		N/A	Producer BCD							**0**
12							...							
13								Will be transshiped in less than 2 hours						

Figure 8 Overview of incoming transport

The table below provides requirements derived from the paper prototype.

ID	Ref	Requirement
I1	A1	The warehouse addressed must be identified
I2	A2	The current time must be provided
I3	I1	It must be possible to switch between information in pallet and cubic metres
I4	A4 - An	The arrivals must be grouped according to shift plans
I5	B4 - Bn	The planned departure time from the origin must be provided
I6	C4 - Cn	The deviations with respect to the planned departure time must be provided
I7	D4 - Dn	The expected arrival time must be provided and updated
I8	E4 - En	The actual arrival time must be registered
I9	F4 - Fn	The trucks must be identified
I10	F4 - Fn	There must be a link towards more details on the individual routes, i.e. the Truck - in/out view
I11	G4 - Gn	The cargo provider must be identified
I12	H4 - Hn	The origin location of the cargo provider must be provided
I13	I4 – Nn	The number of pallet/cubic metres for cross docking and for each cargo category (dry, cold, frozen and fruit & vegetables (F&V)) and the total number of pallet/cubic metres must be provided.
I14	H13	It must be easy to identify the transports that carry cargo that is to be transhipped in less than 2 hours.
I15	-	The vehicles must be tracked
I16	-	Based on the actual position of the vehicle and arrival time must be estimated
I17	-	The actual content of the vehicle (#pallets, and which pallets) at any time must be managed
I18	-	Data on which vehicles that transports cargo for immediate transhipment must be manged

6.5 The Warehouse out view paper prototype

The wholesaler's warehouse goods expedition needs an overview of outgoing trucks. Figure 9 provides an example of such an overview. The purpose of is to give the expedition employees in the warehouse an overview of the picking and loading status of the pallets per shop and per vehicle.

The sequence of the shops should match the desired loading sequence, and the field in which the cargo for the different shops is placed is also provided. It must be easy to follow the status of the picking of goods in each goods category for each truck. In case of delays, decisions that facilitate more efficient picking can be taken. The overview also facilitates that trucks can be assigned gates according to the picking status, and the time the trucks spend by the loading gates can be minimized.

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Local warehouse xyz**						Click for m3					
2	**Current time: 05:30**						**# pallets**					
3	**Planned dep.**	**Actual dep.**	**Deviation**	**Truck**	**Shop**	**Field**	**Cross-dock**	**Dry**	**Cold**	**Frozer**	**F&V**	**Total**
4	**05:30**			VH12345			**0**	**22**	**11**	**12**	**6**	**51**
5					- Shop B	2		2	2	1	0,5	5,5
6					- Shop C	2		3	8	6	0	17
7					- Shop A	3		7	0	0	0	7
8					- Shop F	3		10	1	5	5	21
9					- Shop Y	3		0	0	0	0,5	0,5
10	06:30			VH2345			**8**	**20**	**10**	**10**	**7**	**55**
11					- Shop Z		8	20	10	10	7	55
12											Picked	
13											Loaded	
14											Deviation	

Figure 9 Overview of outgoing transport

The table below provides requirements derived from the paper prototype.

ID	Ref	Requirement
O1	A1	The warehouse addressed must be identified
O2	A2	The current time must be provided
O3	G1	It must be possible to switch between information in pallet and cubic metres
O4	A4 - An	The planned departure time from the warehouse must be provided
O5	B4 - Bn	The actual departure time must be registered
O6	C4 - Cn	The deviations with respect to the planned departure time must be registered
O7	D4 - Dn	The trucks must be identified
O8	D4 - Dn	There must be a link towards more details on the individual routes, i.e. the Truck - in/out view
O9	E4 - En	The shops on the route must be provided in the loading sequence
O10	E4 - En	There must be a link towards more details on the individual shops, i.e. the Shop view
O11	F4 – Fn	The fields assigned to the pallets for the individual shops must be provided
O12	G4 - Ln	The number of pallet/cubic metres for cross docking and for each cargo category (dry, cold,

		frozen and fruit & vegetables (F&V)) as well as the total number of pallet/cubic metres must be provided for each shop.
O13	K12	It must be easy to identify the pallets that are picked
O14	K12	It must be easy to identify the shops for which all the pallets are picked
O15	K13	It must be easy to identify the pallets that are loaded
O16	K13	It must be easy to identify the trucks that are loaded and ready for departure
O17	K14	It must be easy to identify trucks with deviations
O18	-	When actual or foreseen deviations are indicated, there should be a link to more information
O19	-	The vehicles must be tracked
O20	-	Deviations must be registered and managed
O21	-	The picking process must be tracked
O22	-	The loading into the vehicle must be tracked
O23	-	The status with respect to picking must be managed
O24	-	The status with respect to loading must be managed

6.6 The Shop view paper prototype

The example of the shop's view in Figure 10 lists the expected arrivals of trucks. The purpose of the view is to give the shop easy access to the delivery plan, the associated vehicles, and an overview of the number of pallets to be delivered within each goods category. The latter will support the planning of the cargo reception, space allocation, etc.

The overview of the pallets to be delivered will also include deliveries of extra goods pushed by the wholesaler to the shop, for example based on upcoming campaigns. In such cases, the shop may accept or refuse the extra goods.

The shop will also be able to request return loads.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**Shop XYZ**													
2	**Current time:**	**Monday 1/2**	**10:30**		**Arrival**				**# pallets**					
3	**Date**	**Plan**	**From**	**Truck**	**Expec-ted**	**Act-ual**	**Devi-ation**	**Order**	**Dry**	**Cold**	**Froze**	**F&V**	**Sum**	**Return**
4	**Monday 1/2**	10:30-12:30	Warehouse A	VH12345	11:00			12345	1	1	1	1	5	
5								12346	1					
6								22222	1	1	1		3	5
7	**Wednesday 3/2**	14:00-16:00	Dairy ABC	VH23456	Delayed			56789	0	1	0	0	1	
8	**Friday 5/2**	07:00-09-00	Warehouse A					23456	2	2	1	2	7	2
9	**Address**	xxx						Extra goods offered by wholesaler						
10	**Phone**	xxx						Approved						
11	**Contact**	xxx						Refused						
12	**Opening hours**	08-23(8-21)						Deviation						
13	**Unloading of pallet in minutes**				5			Colunm for input						
14	**Storage capasity in m3**				6									

Figure 10 Overview of incoming trucks to shops

When working with the view for the shops, we discovered that in some cases an information demand from one part of the supply chain can cause dissatisfaction in other parts. In this case, the shop wanted to know the exact location of the truck, which is going to deliver the goods, though the drivers consider this a breach of privacy. The provision of such information to the shop may also cause misinterpretations since the shop neither knows the driving and traffic conditions nor the status with respect to the obliged resting hours of the driver. In fact, a GPS location close to the shop might also be misleading as the shop does not know the delivery route, and the shop may not be the first stop on the route. In order to cater for the needs of both parties, notification with the expected arrival time were submitted 30-minute in advance, which is confirmed by the driver before it is sent to the shop. In that way, the shop manager should have sufficient time to prepare the reception area.

In case of known deviations, e.g. that a road will be closed so that deliveries cannot be delivered according to plan, it must be indicated that delivered will be later than planned.

The table below provides requirements derived from the paper prototype.

ID	Ref	Requirement
S1	A1	The shop addressed must be identified
S2	B2	The current date must be provided
S3	C2	The current time must be provided
S4	A4 - An	The planned arrival dates must be provided
S5	B4 - Bn	The planned arrival slot times must be provided
S6	C4 - Cn	The goods providers must be provided
S7	D4 - Dn	The truck that will arrive must be identified
S8	D4 - Dn	There must be a link to contact information for the truck
S9	E4 - En	The estimated time of arrival must be provided 30 minutes before the expected arrival, and the expected arrival time must be confirmed by the driver before it is provided to the shop.
S10	F4 - Fn	The actual arrival time must be registered
S11	G4 - Gn	The deviations with respect to the planned arrival time slot must be registered
S12	H4 - Hn	A reference to the orders that are delivered must be provided
S13	H4 - Hn	There must be a link to more details on the orders
S14	I4-M4 – In-Mn	The number of pallet for each cargo category (dry, cold, frozen and fruit & vegetables (F&V)) as well as the total number of pallet must be provided for each order.
S15	I4 – Mn	It must be a link to more details on the content of each pallet
S16	N4-Nn	The goods must be allowed to request that the truck takes an amount of returns
S17	N4-Nn	The transport service provider must be allowed to accept an amount of return
S18	B9-11	The contact information to the shop must be provided
S19	B12	The opening hours for the shop must be provided
S20	E13	The average time it takes to unload one pallets may be provided (can be calculated based on collected data)
S21	E14	The storage capacity for the shop may be provided

S22	H9	It must be indicated which pallets that are suggested pushed by the wholesaler
S23	H10	The shop must accept pushed goods before it can be delivered
S24	H11	The shop may refuse pushed goods. The refused pallets must be removed from the view.
S25	H9 – H11	The dialogue on pushed goods must be carried out before the goods in loaded into the trucks, and the shop view must display the result (i.e. which pallet that will be pushed)
S26	H12	When deviations are indicated, there should be a link to more information
S27	-	The vehicles must be tracked
S28	-	The driver must be supported when the notification of arrival is to be sent 30 minutes ahead of arrival
S29	-	Deviations must be registered and managed
S30	-	The dialogue regarding the negotiation of extra pallets must be supported
S31	-	The dialogue regarding the return load must be supported
S32	-	The unloading of pallets must be tracked

6.7 The Producer view paper prototype

The producer's view in Figure 11 shows an example of lists of planned pick-ups of goods from the producer. The purpose of the view is to give the producers and the producer's customer (i.e. the wholesaler) an overview of the pickup times and it also provides a platform for dialogue.

One truck may pick-up pallets linked to one or more orders. For each truck the view will present the planned time slots for the pick-up and the associated number of pallets. Planned pick-ups after the normal opening hours are highlighted since they will require special preparations.

An order may also be picked up by two trucks instead of one. It is important that the producer is informed about this since it will affect how the pallets are arranged for pick-up.

30 minutes ahead of the actual arrivals, the expected arrival time must be announced to arrange for pick up preparations.

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Producer**	**abc**										
2	**Monday 1/2**				**Current time: 10:30**							
3					**Arrival**			**Act-**		**# pallets**		
4	**Date**	**Receiver**	**Truck**	**Order no.**	**Planned**	**Expec -ted**	**Divi- ation**	**ual dep**	**Ready**	**Order**	**Chan -ge**	**Free space**
5	**Monday 1/2**	Warehouse A	VH12345	12340	10:30-12:30	11:00			11:0	4	0	6
6				12345					0	8	-4	
7	**Monday 1/2**	Warehouse A	VH2346	12345	12:30-14:30				12:3	4	+4	8
8				12347					0	4	+3	
9	**Thursday 4/2**	Warehouse B	VH12345	23447	17:00-19:00				15:0	5	-3	5
10				23456					0	10	+5	
11	**Friday 5/2**	Warehouse C	VH12345	23456	07:00-09-00				4/2 16:30	10	-5	10
12	**Address xxxxx**							Accepted				
13	**Phone**		45 519 272					Resused				
14	**Contact person**		NN					Suggested				
15	**Opening hours**		08:00 -16:30					Column for input				
16								Time earlier		Time later		

Figure 11 Overview of pick-ups at producer's location

The view also arranges for dialogue/feedbacks. The producer can suggest a change in the number of pallets to be delivered if the requested quantum cannot be produces or if more goods can be provided. A status indication for each change suggestion (*suggested, accepted, denied*) is provided. The producer must also indicate when the goods can be ready for pickup (e.g. before the planned pick up time slot). Such information arranges for more flexible pick-ups, and free capacity in the trucks may be used when the producer can provide extra pallets.

The table below provides requirements derived from the paper prototype.

ID	Ref	Requirement
P1	A1	The producer addressed must be identified
P2	B2	The current date must be provided
P3	E2	The current time must be provided
P4	A4 - An	The planned arrival dates must be provided
P5	B4 - Bn	The goods receivers must be provided
P6	C4 - Cn	The truck that will arrive must be identified
P7	C4 - Cn	There must be a link to contact information for the truck
P8	D4 - Dn	A reference to the orders must be provided
P9	D4 - Dn	There must be a link to more details on the orders
P10	E4 - En	The planned arrival slot times must be provided
P11	E9	Pick-ups that will take place outside the opening hours must be highlighted since they will require special arrangements
P12	F4 - Fn	The estimated time of arrival must be provided 30 minutes before the expected arrival, and

		the expected arrival time must be confirmed by the driver before it is provided to the producer.
P13	G4 - Gn	The deviations with respect to the planned arrival time slot must be registered
P14	H4 - Hn	The actual departure time must be registered
P15	I4 - In	The producer must enter the time for when the goods will be ready for pick up
P16	I4 – In, I16	It must be indicated it the ready for pick-up time is different from the start of the planned time slot (to arrange for changes in pick up plans, e.g. earlier pick-ups or later pick-ups)
P17	J4 - Jn	The number of pallets in the order must be provided
P18	K4 - Kn	Changes in the number of pallets that can be produced can be provided (e.g. to arrange for flexible pick-ups)
P19	K4 - Kn	Transport service provider/Wholesaler must accept or reject the changes in the number of pallets
P20	L4 - Ln	Available capacity in the trucks should be provided so that the producer can suggest extra pallets if they are able to produce these pallets in time for the pickup. The available capacity must be updated according to accepted changes in the number of pallets.
P21	A12-A14	The contact information to the producer must be provided
P22	A15	The opening hours for the producer must be provided
P23	I-L12-16	It must be easy to see where data can be entered, the suggestions that are entered, which data that must be confirmed and the status of confirmations.
P24	-	The vehicles must be tracked
P25	-	The driver must be supported when the notification of arrival is to be sent 30 minutes ahead of arrival
P26	-	Deviations must be registered and managed
P27	-	The dialogue regarding changes in the number of pallets must be supported
P28	-	The dialogue regarding changes in the time schedule must be supported
P29	-	The loading of pallets must be tracked

7 Conclusion

The asymmetric needs of the actors in the retail supply chain are a challenge when new ICT solutions are to be introduced. The actor perspective and user-centered method used address the needs of all actors involved. The viewpoints defined by the paper prototypes reflect these needs with a focus on better collaboration and coordination support. The paper prototypes explore functionality and information needs in a unified solution that 1) provide easy and automated access to the right information at the right time for all actors in the supply chain; 2) support easy detection of deviations; and 3) support decisions that can improve efficiency and deviation handling.

The involvement of the relevant actors in the user-centered design has provided answers to our research questions RQ1 and RQ2 (see section 2). The paper prototypes and the associated requirements define the information needs of the parties involved in the transport chain to enable better handling of and adaption to deviations. With easy access to the information needed, better and more informed decisions are supported.

7.1 IT Solutions

ICT solutions must support:

- User interfaces fulfilling the user needs addressed by the paper prototypes
- Access to the information to be presented to the users
- Tracking of vehicles
- Tracking of the temperatures in the different temperature zones of the vehicle
- Estimation of arrival times based on the actual position of vehicles
- Prediction of delays or possible delays based on the actual position of vehicles and estimated travel times
- Registration and management of actual and foreseen deviations
- Tracking of pallets loaded into vehicles and the management of the status with respect to loading
- Tracking of pallets unloaded from vehicles
- Management of the actual content of the vehicle (#pallets, and which pallets) at any time
- Management of data on which vehicles that transports cargo for immediate transhipment
- Tracking of the picking process and management of the status with respect to picking
- Assistance to the driver when notification of arrival is to be sent 30 minutes ahead of arrival
- Dialogues regarding the negotiation of extra pallets to shops
- Dialogues regarding the return load from shops
- Dialogues regarding changes in the number of pallets to be picked up from providers
- Dialogues regarding changes in the time schedule for pick-ups

The case study showed that the ICT solutions required to enable the desired functions are in use or partly in the stage of being adopted. The data collection from GPS sensors in transport means is crucial for situational awareness and detection. By comparing positions with distribution plans and time schedules, it is possible to detect or foresee delays and to announce arrivals to shops and producers. Temperature sensors support detection of deviations in cargo condition during transport and transhipments. Cargo units labelled with RFID tags and RFID readers in warehouses, shops and transport means cater for automated and reliable tracking of cargo units and therewith detection of statuses and deviations.

The internal ICT systems of the wholesaler are the nave in the coordination of cargo handling processes, however currently the dedicated portals provided to transport service providers, shops and produces do not

include sufficient information on statuses and deviations. The views defined by the paper prototypes can be realised as extensions of the IT systems of the wholesaler, though may also be implemented as independent applications, for example apps running on mobile phones. Such applications must have open interfaces for information exchange with suppliers and customers. The integration with the ICT systems of the wholesaler must also be implemented via such interfaces.

7.2 Decision Support

The current IT systems provide useful information and functionality, but currently there is a need for expert users who know how to find and combine the relevant information elements to establish an overview that supports decisions. Other users are in general informed by the expert users via manual communication (mainly phone). Direct access to information for all actors in the supply chain and better decision support can lower the pressure on the expert users, and they can use their expertise where it is most needed.

The functionality defined by the paper prototypes supports situational awareness and detection of deviations. The outgoing truck view will for example indicate foreseen deviations. Thus, the insight achieved can be used to inform shops and support decisions on how to handle the situation. As illustrated by the paper prototypes, some of the views also arrange for coordination. The producer may for example indicate when products are ready for pick-up and the quantity that will be ready.

Better situational awareness and information on deviations arrange for better self-coordination. Shop managers and producers who are notified about the time for arrival of the truck can schedule preparations and do resource allocations that are better adapted to other activities. The wholesaler warehouse can use information on foreseen arrival of trucks when the use of resources is planned, and trucks with goods for cross docking can for example be prioritized. The goods expedition can allocate gates to trucks according to updated picking statuses.

7.3 Further Work

It remains to implement and test the functionality defined by the paper prototypes and to evaluate the effects for the different actors in the retail supply chain. According to (Hinkka, et al., 2013) it is important that the wholesaler lowers the implementation barriers of other actors in the supply chain since the wholesaler is the actor with the most power and also the actor who probably will benefit most from better IT solutions. Hinkka also states that this can be done by alignment of roadmaps; by understanding the challenges of the other actors; by taking the main responsibility for the implementation; by using the wholesaler's negotiation power in discussions with system providers; and by purchasing equipment for the other actors to get discounts. In the case here, the wholesaler controls most of the information as well at the systems that can control the information flows in the supply chain. Thus, the wholesaler should take the leading role and implement IT support for the functionality required by the other stakeholders.

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References

Brown, J. (2010). The World Café: Shaping our futures through conversations that matter: ReadHowYouWant. com.

Gray, D., Brown, S., & Macanufo, J. (2010). Gamestorming: A playbook for innovators, rulebreakers, and changemakers: " O'Reilly Media, Inc.".

Hevner, A. R., March, S. T., & Park, J. (2004). Design Science in Information System Research. *MIS Quarterly Vol. 28*(No. 1,), 75-105.

Hinkka, V., Främling, K., & Tätilä, J. (2013). Supply chain tracking: aligning buyer and supplier incentives. *Industrial Management & Data Systems, 113*(8), 1133-1148.

Natvig, M. K., & Wienhofen, L. W. (2016). *Collaboration Support for Transport in the Retail Supply Chain: A User-Centered Design Study.* Paper presented at the Innovations for Community Services: 16th International Conference, I4CS 2016, Vienna, Austria, June 27-29, 2016, Revised Selected Papers 16.

Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses: Crown Business.

Wong, C. W., Lai, K.-h., Cheng, T., & Lun, Y. V. (2015). The role of IT-enabled collaborative decision making in inter-organizational information integration to improve customer service performance. *International Journal of Production Economics, 159*, 56-65.

Annex A Initial user needs

An initial workshop involved personnel working with transport issues in the wholesaler's customer support centre, personnel responsible for the wholesaler's warehouse (goods reception and goods expedition processes) and a fleet manager. The latter also represented the drivers.

The table below show the initial user needs collected via this workshop as well as the initial interviews of different stakeholders. It is obvious that several stakeholders are interested in the same information. We have used colours to group the user needs.

#	Initial requirements	Customer support.	Ware-house	Fleet manager
1	Better tools for statistics	X		
2	Better tools for collection of figures from shops	X		
3	Better tools for definition of routes	X		
4	More use of route planning optimisation tool (training is needed)	X		
5	Map showing the trucks	X	X	X
6	Data on truck: Details on the cargo on board	X	X	X
7	Data on truck: Temperature data for the cargo	X		
8	Data on truck: Departure time			X
9	Data on truck: Estimated time of arrival		X	
10	Data on truck: Cargo types on board		X	
11	Data on truck: Temperature zones on board		X	
12	Data on truck: Goods not in original plans (remaining goods, etc.)		X	
13	Data on truck: Status on the truck (stopped/driving)			X
14	In map: Traffic information			X
15	Simpler/better adapted solution	X		
16	Bar codes on flowers	X		
17	Better rout planning in relation to holidays	X		
18	Automated notifications in case of deviations	X		
19	Information on cargo amounts, cargo types, and arrivals available the day before (cargo related to campaigns included)		X	
20	Systems providing the information you need in a simple way – providing good overview. Access to information in few clicks.		X	
21	Support facilitating picking before the transport order is ready		X	
22	Automated cargo reception for all cargo, and pallets with RFID		X	
23	Mobility of personnel between different parts of the warehouse		X	
24	Support for prioritising of pallets/shops – efficient decisions in case of capacity problems			X
25	All relevant information in one view	X	X	X
26	RFID readers in vehicles for registration of cargo			X
27	Automated notifications in case of faulty deliveries	X		

28	Automated notifications in case of delays	X		
29	Automated notifications in case of long stops thet is not due to resting hours	X		
30	Automated notifications in case of wrong temparature	X		

Information need

Decision support

In general

Other systems/tools (outside the scope)

Automated notifications

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