Collaboration Support for Transport in the Retail Supply Chain

A User-Centered Design Study

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Abstract. The purpose of this paper is twofold. First, we describe a user-centered design process for finding functional requirements for holistic control panels supporting better collaboration and coordination between transport operations and supply chain processes affected by or affecting the transport of goods. Secondly, we present the resulting functionality as seen from the perspective of different actors in the supply chain, from producer to shop. One of the largest retailers in Norway is used as a case.

The case study and the user-centered approach are performed with several elicitation methods such as observations, interviews, innovation games and paper prototyping. The suggested solutions are expressed by means of paper prototypes which have been co-created and validated by the stakeholders in the supply chain during an iterative incremental process.

Currently, solely central experts in the organisations involved are able to solve problems by combining information from many sources and by taking the right actions. Due to the identified need for more robust and automated solutions, 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; (2) supports easy detection of deviations; and (3) supports decisions that can improve efficiency and deviation handling.

Keywords: Retail supply chain · Collaboration · Coordination · User centered design · Transport · Information technology · Paper prototype

1 Introduction

Retail supply chains involve many actors, and they 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 with different profiles. In addition the wholesalers have central and distributed warehouses and departments working together, assisted by internal information technology (IT) systems. These systems also communicate with external systems to support efficient coordination and communication for purchasing, order management, replenishment, invoicing, etc. The retail supply chain eco system is getting more

G. Fahrnberger et al. (Eds.): I4CS 2016, CCIS 648, pp. 192–208, 2016.
DOI: 10.1007/978-3-319-49466-1_13

advanced as new technology is deployed. ASR (Automatic Store Replenishment) does for example simplify the replenishment process, GPS and temperature sensors are commonly used in trucks to enable continuous tracking 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.

IT support to transport operations has to a large extent focused on single actors, e.g. transport management systems used by actors responsible for the transport. [1] addresses 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. The use of tracking technology is studied by [2]. Such technology is so far mainly motivated by the needs of the wholesalers. Suppliers have in general adopted tracking technology to strengthen the relationship towards their main customers 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.

This paper incorporates the perspectives of the different actors in the supply chain, and provides a holistic view upon the transport operations where coordination and collaboration among all parties involved is emphasized. The aim has been to identify requirements for IT support enabling more optimal coordination of tasks and processes directly and indirectly related to transport operations. An iterative approach with user-centered design is carried out in close collaboration with actors in the supply chains of one of the largest wholesalers in the retail sector in Norway. Personnel employed in different positions in the wholesaler's organisation, producers, shops, transport service providers and truck drivers have been involved.

The next sections provide an overview of the method used, the current situation, and the results which are a conceptual view upon a unified collaboration console for transport and associated paper prototypes. The results are discussed from the perspective of different stakeholders and conclusions are made.

2 Method

The coordination between the transport operations and the various operations of the stakeholders in the 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 IT systems. The aim is to improve this coordination and collaboration by providing information that is not currently easily available to support situational awareness and to assist decision making. Our hypothesis is that better IT tools for information sharing in the transport chain will lead to (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.

Our proposed solution is to merge information from various channels into holistic views specific for the different stakeholders. The suggested artifact is a design of a system that takes the different needs of the stakeholders into consideration and offers holistic and up-to-date views.

The aim of this work is to answer the research questions: RQ1: What are the information needs of the parties involved in the transport chain in order to enable better handling of and adaption to deviations? RQ2: What are the information needs of the parties involved in the transport chain in order to take more informed decisions?

2.1 Research Method

The design science research method is used according to [3], as depicted in Fig. 1. The research environment consists of all 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 transportation 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 based on the existing literature on the use of technology in retail supply chains as well our own findings.

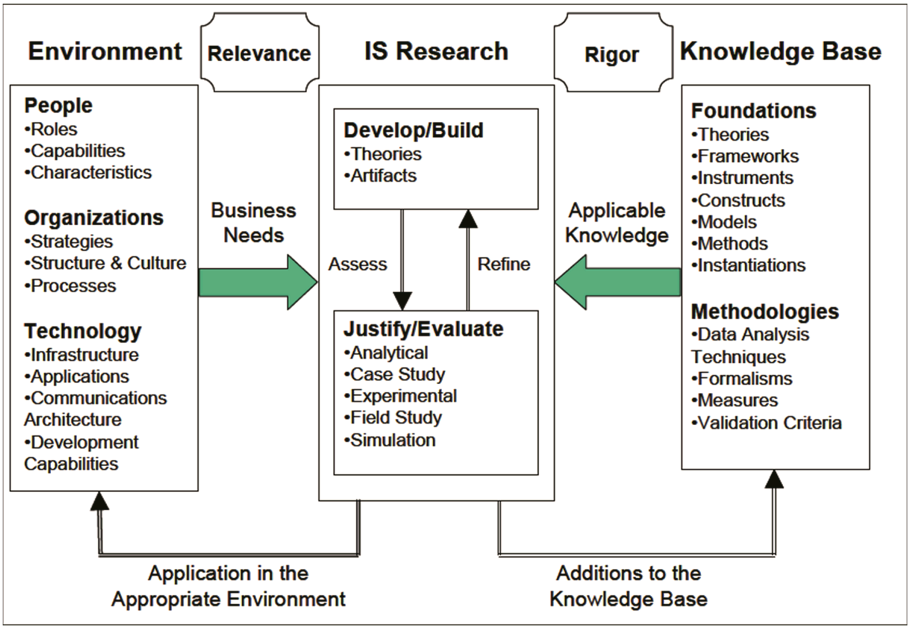

Fig. 1. Conceptual framework for IS research [3]

The information system (IS) research *refine* and *assessment* process, as depicted in Fig. 1, is carried out according to a design methodology inspired by the Lean Startup product design approach [4]. The product we build is however a paper prototype artefact, not actual software. The detailed approach is illustrated by Fig. 2 and focuses on 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.

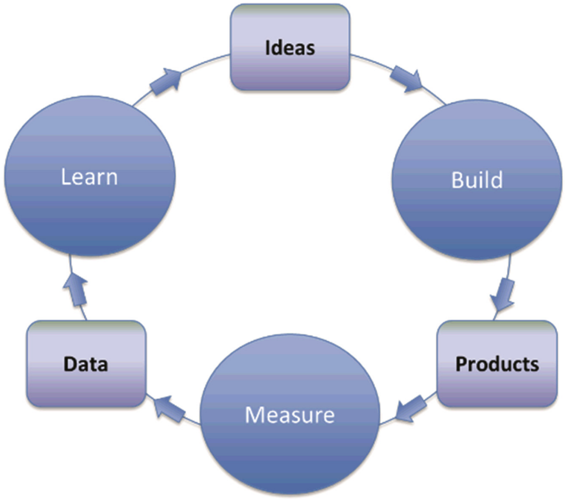

Fig. 2. The Lean Startup [4]

The first *ideas* were based on initial studies of the current situation, and the *build* activity designed a set of products, in our case paper prototypes of software solutions. These paper prototypes were evaluated (*measure*) in evaluation activities, resulting in *data* about the validity of the initial hypothesis. During the *learn* activity, data are analysed, new insights and new *ideas* gained that is input to a new build activity.

2.2 User-Centered Iterative Design

User-centered design is conducted prior to the development of complex systems to ensure deep understanding of user and stakeholder roles. The aim is to ensure that system designed support the daily work of end users and the role of stakeholders [5, 6].

User-centered design is applied in all activities in the iterative cyclic process described above. The activities are carried out in close cooperation with real stakeholders by means of various methods for data collection, as described in the sections below.

2.3 Data Collection

Table 1 summarises the steps taken to collect data on user needs and to elaborate the solution, which stakeholders have been involved, which methods have been used for data collection and what the results were.

Table 1. Steps taken to collect data

Steps taken	Stakeholders involved	Method	Results
Learn – 1st iteration: As is situation mapping	– Wholesaler (misc. roles) – Fleet operator – Shops – Producers	Case study – Observation – Semi structured interviews	– As-is situation mapping – Awareness of challenges – User needs
Build: Transport collaboration console 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 – New/refined user needs requirements
Measure: Evaluation of previous trials	– Driver – Fleet operator	– Semi structured interviews	– Evaluation of trials – Evaluation of concept/paper prototype – New/refined user needs requirement
Measure, learn, build: Evaluation, reflection and further elaboration of the transport collaboration console	– Fleet operator – Wholesaler (misc. roles) – Technology provider	Paper prototyping – 4 workshops	– Evaluation of concept/paper prototypes – Improvement suggestions – New/refined user needs/requirements – New/refined paper prototypes adapted to user needs and requirements
	– The above – Shop – Producers	– World cafe – 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 the specific needs and challenges of the different stakeholders. 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 concept of and expectations for a transport collaboration console we played **innovation games** [7] such as world café, cover story and product box to gather input from the stakeholders involved in the transport chain. The *World Café* [8], 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.

After the *World Café* we used the *Cover Story* game to identify and elaborate on the long term vision of the work on a transport collaboration console. The participants wrote the headlines that they would like to see in the newspaper after a successful implementation of the console.

In the *Product Box* game the participants were asked to present and “sell” the transport collaboration console 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 also carried out evaluations of trials carried out by the wholesaler in collaboration with a transport services provider and shops such as use of RFID to support automatic registration of pallets received by the warehouse and automatic registration of pallets in trucks; and also notifications of shops 30 min 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 functionality provided by the transport collaboration console was facilitated by **paper prototyping** [9] together with the different stakeholders. Layout and visual effects were not emphasized, just the functionality and the information to be presented and shared. This was an iterative process starting with initial prototypes based on the above. We also used the *World Café* and semi-structured interviews process 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.

3 Case Study: As-Is Situation

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 Modeling Language) diagram. The diagram for outgoing transport is depicted in Fig. 3. 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 dotted lines) and status information (red dotted lines) to and from these processes are shown. The others 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 retailer, 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 Outbound Transport

Outbound 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 to initiate the transport planning, which use route plan templates optimized based on prognosis as the starting point. The

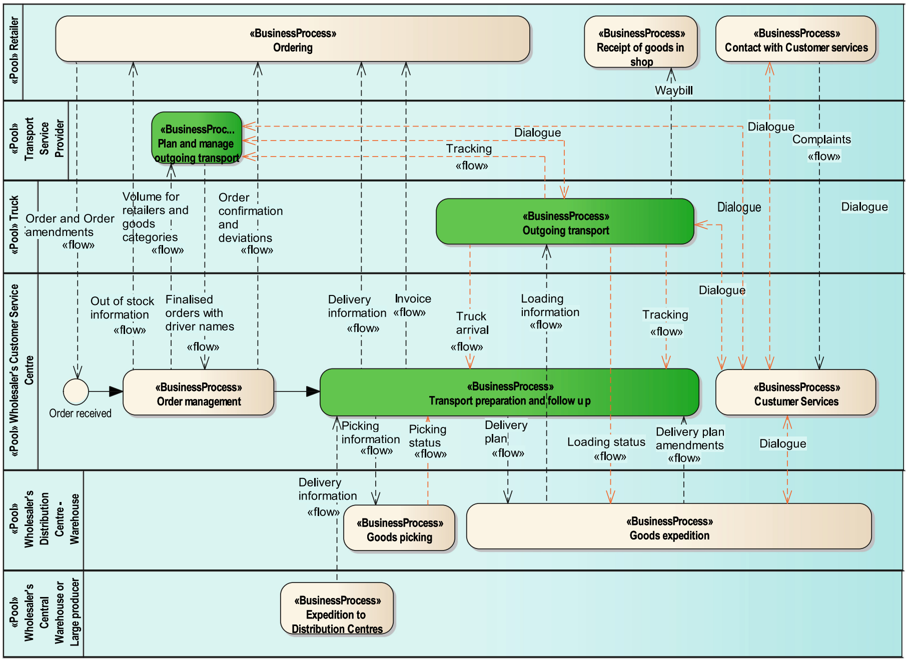

Fig. 3. As is situation - outgoing transport processes and information flows (Color figure online)

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 which confirms or disapproves (e.g. in case of out of stock) the delivery of the products listed in the orders.

The transport will be controlled by the wholesaler's transport preparation and follow up process. On arrival to the warehouse, the trucks will be 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 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.

The goods expedition process in the warehouse has for each truck 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 must approve that the delivery of some of the pallets is postponed. If there is space available in the truck, the shop will 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 h time slot, and shops do not know the exact arrival time in advance. Similarly, the local distribution centre do not get the exact arrival time of inbound 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 also takes time to detect that pallets are delivered to other shops than planned.

3.2 Incoming and Intermediate Transport

The wholesaler orders deliveries from producers and the deliveries are produced and delivered according to agreed time slots. The inbound transport to the wholesaler is in this study 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 outbound transport, the producers do not know the exact time of arrival for the trucks.

The inbound transport is whenever possible organized as return load. The trucks used on outbound transport will when they return pick up deliveries from producers on their way back to the wholesaler's warehouses. The warehouses expect the deliveries within a time frame, but do not know the exact time of arrival in advance.

The warehouse of the wholesaler's local distributions centre will in addition to inbound 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.

3.3 Existing IT Solutions

The wholesaler and the shops use advanced IT systems comprising functionality such as forecasting and replenishment, warehouse management, vendor managed inventory and order management. It is possible to get access to information about almost everything if you know how to use the system. The wholesaler also has expert users who 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 are able to locate the trucks and check the temperature for the different temperature zones in real time. Previous trials have used GPS tracking to implemented SMS notifications to retailers 30 min in advance of the actual arrival of the trucks. Previous trials have also tested the use of RFID in inbound and outbound 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 Results

This section summarizes the results from the user-centered design approach which include a definition of a unified transport collaboration concept and paper prototypes.

4.1 Unified Transport Control Concept

The case study and the innovation games carried out with the stakeholders in the initial phase of the work provided input to a conceptual view upon the desired result – i.e. control console for transport related tasks providing (1) a holistic view on the transport operations; (2) support for information access related to all types of transport; (3) support for coordination between actors and processes involved in and affected by the transport; and (4) decision support in case of deviations.

Figure 4 provides an overview of the concept. The different stakeholder types will have access to the desired functions via tailor-made views. When realised, these views will be user interfaces adapted to the needs of each stakeholder type. The views present information to support the users in a way that fulfils their needs. The wholesaler already has advanced legacy 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 functionality to the stakeholders.

User needs with respect to the transport collaboration console were collected through interviews, evaluations of trials and also during the paper prototyping as listed in Table 1. Several needs addressed 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 were suggested. Other needs concerned notification about statuses and deviations as well as functionality. An important observation was that many of the different stakeholders requested the same information or functionality, which confirmed the overall concept depicted in Fig. 4. In an iterative process, requirements to the information sharing and functionality were derived from the user needs and expressed by means of paper prototypes.

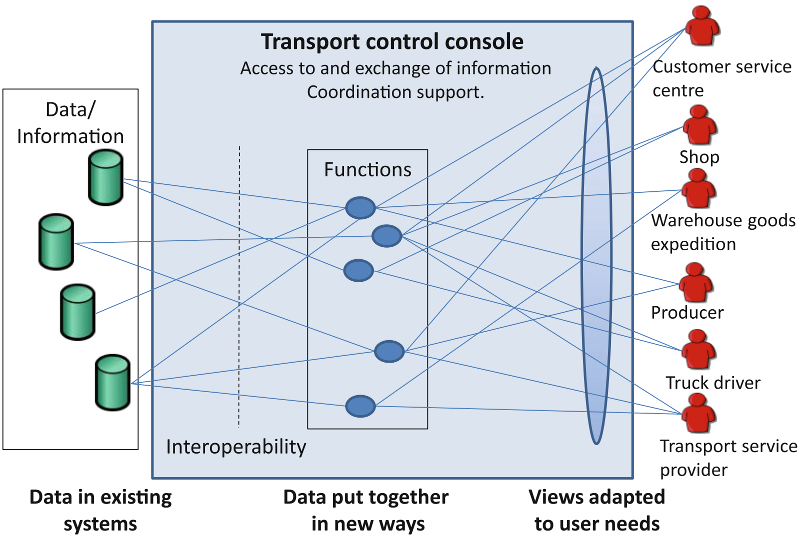

Fig. 4. The transport collaboration console concept

4.2 Paper Prototypes

The iterative approach has led to the establishment of several paper prototypes. As described above, layout and visual effects are not emphasized. The paper prototypes address information and functionality needed by different stakeholders in different situations by means of a set of views as listed in Table 2.

Table 2. Views elaborated in paper prototypes

View	Description
Map	Provides overview with clickable routes, trucks, shops, warehouses
Routes	Provides statuses for all routes/ trucks (foreseen delays, available capacities, etc.)
Truck – in/out	Supports follow up of transport operations by providing truck status (foreseen arrivals, delays, faulty deliveries, temperature, etc.)
Warehouse – in	Supports cargo reception and cross-docking
Warehouse – out	Supports goods expeditions from warehouse
Shop	Supports goods reception in shops
Producer	Supports the producer's goods expedition

5 Discussion and Lessons Learned

The user-centered approach and a selection of the resulting paper prototypes are discussed below.

5.1 The User-Centered Approach

A user-centered approach is often viewed as ‘something nice to do but too expensive’, however, when keeping the end-user in the loop in an iterative approach, in the end one can be certain that the artefact indeed suits the needs of the involved stakeholders [5].

As pointed out by [2], 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. The user-centered approach ensures that the perspectives and needs of the different actors are emphasised. Through close cooperation with all involved stakeholders we also uncovered sub-optimal information sharing practises, information that was not available at all and information that it was inconvenient to get hold of.

5.2 The Route View Paper Prototype

The wholesaler and the transport service provider must have access to details on the progress on all routes in one single view with indications on statuses and foreseen delays. The route view is depicted in Fig. 5. The view provided to the transport service providers will be limited to the routes they operate. For each truck it provides the registration number, planned and actual departure from warehouse and a list of shops with planned, expected and actual arrivals and deviation. It also provides the number of pallets on board for each cargo category (dry, cold, frozen and fruit & vegetables (F&V)).

Routes from warehouse XYZ
Current time 09:10

Truck	Planned dep.	Actual dep.	Shop	Planned arrival	Expected arrival	Actual arrival	Devia-tion	# pallets Dry	Cold	Frozen	F&V	Sum	Return	Free space (pallets)
VH12345	05:30	06:15						**50**	**4**	**3**	**2**	**59**	**30**	**7**
			Shop A	06:00-08:00	07:05	07:06		20	2	1	1	24	30	1
			Shop B	10:15-12:15	11:20			10	2	2	0	14		15
			Shop C	16:30-18:30	17:45			20	0	0	1	21		36
VH23456	06:00	07:00						**13**	**4**	**7**	**7**	**31**		**35**
			Shop A	08:00-10:00	10:00			1	1	1	1	4		39
			Shop D	10:15-12:15				2	2	4	0,5	8,5		47,5
			Shop E	16:30-18:30				10	1	2	5,5	18,5		66
VH34567	06:00	08:00						**6**	**15**	**24**	**15**	**60**		**6**
			Shop X	07:00-09:00	09:30			1	4	7	6	18		24
			Shop Y	10:15-12:15				2	5	8	5	20		44
			Shop Z	16:30-18:30				3	6	9	4	22		66

Delayed/deviation
May be delayed
As planned/delivered

Fig. 5. Overview of routes

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 supports information exchange and decisions on space utilisation. The amount of return load from each shop can be entered, and the total availability of empty space after the visit to each shop is presented to support the planning of return load.

5.3 The Truck In/Out View Paper Prototypes

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 are more or less the same, so we are just showing one of the views in Fig. 6.

Current time 14:10		**Type of product**			**Dry**	**Chilled**	**Frozen**	**F&V**		
		Measured temperature			N/A	4C	-23C	4C		
Faulty deliveries (yes/no): No										
					# pallets per product type				Click for m3	
Route	**Plan**	**Arrival**	**Departure**	**Deviation**	**Dry**	**Chilled**	**Frozen**	**F&V**	**Sum**	**Rest**
Local warehouseTrondheim	11:00		11:20	0:20	**4**	**5**	**4**	**2**	**15**	**9,5**
- Shop B	11:30-13:30	13:15	14:00		2	2	1	0,5	5,5	0
- Shop C	12:00-14:00	14:30		0:30	0	2	2	0	4	4
Checkpoint K	12:30-14:30	15:00								
- Shop A	13:00-15:00	15:30			1	0	0	0	1	1
- Shop F	16:00-18:00				1	1	1	1	4	4
- Shop Y	17:00-19:00				0	0	0	0,5	0,5	0,5
Driver	Tine Maarudsson		**Status (driving/stoped): Driving**							
Phone	9912323									
Registration number:	VH 12345									
No of pallets - 1st hight	33							According to plan		
No of pallets - 2nd hight	66							Delayed		

Fig. 6. Overview of outgoing trucks

The locations to be visited on the route are listed. This may be warehouses, shops, producers and waypoints. For each location the planned, expected and actual arrival and the actual departure are provided. If relevant, deviations are also included. The number of pallets in cargo categories (dry, cold, frozen, F&V) is also provided as well as statuses with respect to faulty deliveries and remaining pallets for each l.

5.4 The Warehouse In/Out View Paper Prototypes

The wholesaler needs an overview on incoming truck to each warehouse to be able to plan and prioritize the reception of the cargo. Figure 7 provides a list of all incoming trucks, the planned arrivals to the warehouse, the departure time and location (from), the expected and actual arrival time and also the amount of cargo of different categories, including cargo for cross-docking. By means of data from the central systems of the wholesaler it is possible to identify trucks with goods that is to be transhipped within a short timeframe and prioritize based on this information.

Local warehous XYZ								Click for m3					
Current time: 04:00								# pallets					
Planed arrival	Depar-ture	Devia-tion	Expected arrival	Actual arrival	Truck	From	From location	Cross-dock	Dry	Cold	Frozen	F&V	Total
00:00-06:00	23:00		05:00		DL12345	Central warehouse	Oslo	66					66
00:00-06:00	23:24		05:20		DL23456	Central warehouse	Oslo	15	10			30	55
00:00-06:00			N/A		N/A	Pizza producer	Stranda		16	50			66
00:00-06:00			N/A		N/A	F&V wholesaler				10		50	60
00:00-06:00			N/A		N/A	Dairy ABC	Verdal			63			63
06:00-12:00			N/A		N/A	Dairy ABC	Heimdal			20			20
06:00-12:00			N/A		N/A	xxx							0
12:00-18:00			N/A		N/A	Producer BCD							0
						...							
							Will be transshiped in less than 2 hours						

Fig. 7. Overview of incoming trucks to warehouse

The wholesaler's warehouse goods expedition needs an overview of the status with respect to the picking and loading of pallets for outgoing trucks. Figure 8 provides such an overview of trucks and planned and actual departures and deviations. 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 is 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.

Local warehouse xyz						Click for m3					
Current time: 05:30						# pallets					
Planned dep.	Actual dep.	Deviation	Truck	Shop	Field	Cross-dock	Dry	Cold	Frozen	F&V	Total
06:00			VH12345			0	22	11	12	6	51
				- Shop B	2		2	2	1	0,5	5,5
				- Shop C	2		3	8	6	0	17
				- Shop A	3		7	0	0	0	7
				- Shop F	3		10	1	5	5	21
				- Shop Y	3		0	0	0	0,5	0,5
06:30			VH2345			8	20	10	10	7	55
				- Shop Z		8	20	10	10	7	55
										Picked	
										Loaded	

Fig. 8. Overview of outgoing trucks from warehouse

5.5 The Shop View Paper Prototype

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 know the driving and traffic conditions nor the status with respect to the obliged resting hours of the driver. Also a GPS location close to the shop might 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, we agreed on a notification with the expected arrival time 30-minute in advance, which is confirmed by the driver before it is sent to the shop. This maintains the drivers' privacy and the shop manager has sufficient time to prepare the reception area.

The shop's view in Fig. 9 supports the coordination of deliveries between the transport service provider and the shop, and also the deliveries of extra goods pushed by the wholesaler to the shop based on foreseen campaigns. In case of the latter, the shop may accept or refuse the extra goods. The number of pallets to be provided within each goods category will be presented to support the planning of the cargo reception, space allocation, etc.

Shop XYZ												
Current time:	Monday 1/2	10:30		Arrival				# pallets				
Date	Plan	From	Truck	Expec-ted	Act-ual	Devi-ation	Order	Dry	Cold	Frozen	F&V	Sum
Monday 1/2	10:30-12:30	Warehouse A	VH12345	11:00			12345	1	1	1	1	5
							12346	1				
							22222	1	1	1		3
Wednesday 3/2	14:00-16:00	Dairy ABC	VH23456				56789	0	1	0	0	1
Friday 5/2	07:00-09-00	Warehouse A					23456	2	2	1	2	7
Address	xxx						Extra goods offered by wholesaler					
Phone	xxx						Extra goods approved by shop					
Contact	xxx						Extra goods refused by shop					
Opening hours	08-23(8-21)											

Fig. 9. Overview of incoming trucks to shop

5.6 The Producer View Paper Prototype

The producer's view in Fig. 10 supports the coordination between the producer and the transport service provider. One truck may pick up pallets linked to one or more orders. For each truck the view will present the planned time slots for pick-ups and the associated number of pallets. Planned pick-ups after the normal opening hours are highlighted since they will require special preparations. 30 min ahead of the actual arrivals, the expected arrival time will be announced.

The producer may request deviations from the suggested plan. They can indicate when the goods can be ready for pickup and suggest changes in the number of pallets if the requested quantum cannot be produces or if more goods can be provided. In case of the latter, information on the free capacity in the trucks is used when the number of extra pallets is suggested. The suggested changes must however be accepted by the transport service provider.

Monday 1/2				Current time: 10:30							
				Arrival			Act-ual		# pallets		
Date	Receiver	Truck	Order no.	Planned	Expec-ted	Divi-ation	dep	Ready	Order	Chan-ge	Free space
Monday 1/2	Warehouse A	VH12345	12340 12345	10:30-12:30	11:00			1/2 11:00	4 8	0 -4	6
Monday 1/2	Warehouse A	VH2346	12345 12347	12:30-14:30				1/2 12:30	4 4	+4 +3	8
Thursday 4/2	Warehouse B	VH12345	23447 23456	17:00-19:00				4/2 15:00	5 10	-3 +5	5
Friday 5/2	Warehouse C	VH12345	23456	07:00-09-00				4/2 16:30	10	-5	10
Producer xxxxx								Accepted			
Address xxxxx								Resused			
Phone				45 519 272				Not accepted/refused			
Contact person				NN				Column for input			
Opening hours				08:00 -16:30				Time earlier/later			

Fig. 10. Overview of pick-ups at producer's location

6 Conclusion

The asymmetric needs of the actors in the retail supply chain are a challenge when new technology is to be introduced. The actor perspective and user-centered approach used in the work described by this paper is one of the measures that have ensured that the views of all actors involved have been considered. These views are defined in paper prototypes. Due to the identified need for better collaboration and coordination support, the paper prototypes show unified solutions that (1) provide easy and automated access to the right information at the right time for all actors in the supply chain; (2) supports easy detection of deviations; and (3) supports 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 are answered by the paper prototypes. They define the information needs of the parties involved in the transport chain in order to enable better handling of and adaption to deviations and with that information they are enabled to take better informed decisions.

6.1 IT Solutions

The case study showed that the IT solutions required to enable the desired functionality are partly 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 delays and to announce arrivals to shops and producers. Temperature sensors support detection of deviations in cargo condition during transport and transshipments. Cargo units labelled with RFID tags and RFID readers in warehouses, shops and transport means arrange for automated and reliable tracking of cargo units and thus also detection of deviations.

The internal IT system of the wholesaler is the nave in the coordination of cargo handling processes, but currently the dedicated portals provided to transport service providers, shops and produces do not include sufficient information on statuses and deviations. The systems must be extended to support the views defined by the paper prototypes. Events and deviations can be detected or predicted based data collection from the sensors and RFID readers described above.

The views defined by the paper prototypes can be realised as extensions of the IT systems of the wholesaler, but may also be 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 IT systems of the wholesaler should also be implemented via these interfaces.

6.2 Decision Support

The current IT systems provide useful information and functionality, but there is a need for expert users who know how to find and combine the relevant information elements in order to establish an overview that supports decisions. Other users are to a large extent informed by the expert users via manual communication (mainly phone). More easy access to information and better decision support can make the expert user even more efficient and also lower the pressure on these users by supporting other users.

The functionality defined by the paper prototypes supports situational awareness and detection of deviations. The outgoing truck view will for example indicate foreseen deviations to inform shops and to support decisions on how to handle the situation. The view also arranges 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 deviation 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 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 be prioritized. The goods expedition can allocate gates to trucks according to picking updated statuses.

6.3 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 [2] 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 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 addressed by this paper 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. The paper prototypes define the requirements for such an implementation.

Acknowledgments. The authors gratefully acknowledge the Norwegian Research Council and the BIA program for financial support of the project as well as the participating case companies, which together enabled this study.

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