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Co-distribution of Municipal Goods in Sweden - Procurement from a New Standpoint

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Abstract

Municipal co-distribution implies that all products from external suppliers, mainly groceries but also office supplies and other goods, will be delivered to a Freight Consolidation Centre (FCC) and co-distributed to recipients such as schools and retirement homes. A new business model is used in procurement of FCC and a transport company, named a "resource-optimized procurement process". In short will the municipality itself use route optimization to simulate complete driving routes with distance, sequencing and time window of delivery that bidders use to submit offers? A similar situation applies for payment with what is called "reverse billing" where the transport company is reimbursed for vehicle kilometers of travel and working hours. Route optimization is central where, Vehicle Routing Problem (VRP) in theoretical research and practical applications has been documented in a multitude of variations. However, when it comes to commercial use and behavioural change in transport planning, will the type of algorithms be of less importance, or will how the algorithms have been packaged into a standardized software be what matters?. Crucial in operations will be the interaction between functionality (VRP) and the data, where experience of the user and simulations with different parameter settings will change the outcome of transport planning and hence, transport efficiency.

Keywords: Freight consolidation centre (FCC); route optimization; municipal procurement; e-commerce; reverse billing

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1. Introduction

City Logistics as a concept that addresses the problem of urban areas becoming more structurally dense with decreasing space for transport, while the volume of goods transported has increased continuously. This has been resolved through various policy initiatives such as the regulatory framework for toll roads, vehicle restrictions, environmental zones, different types of parking constraints, initiatives aimed at the transport sector to collaborate on a voluntary basis, infrastructure investments in new transport technologies such as freight consolidation centrecentres (FCC) or underground transport, and intermodal transport with interaction between shipping, rail and truck transportation (Quak, 2008). On one hand is it necessary to create a functioning traffic policy through regulatory changes and public investments, on the other hand highlights research in the area of city distribution the importance of developing concepts that reflects the perspectives of different stakeholders and creates conditions necessary for coordination of freight transport in urban areas, where the main challenge is to ensure communication between transport companies and transport buyers (MacHaris & Melo, 2011). Ultimately, it comes down to a demand for change in behaviour from those involved in the current transport system.

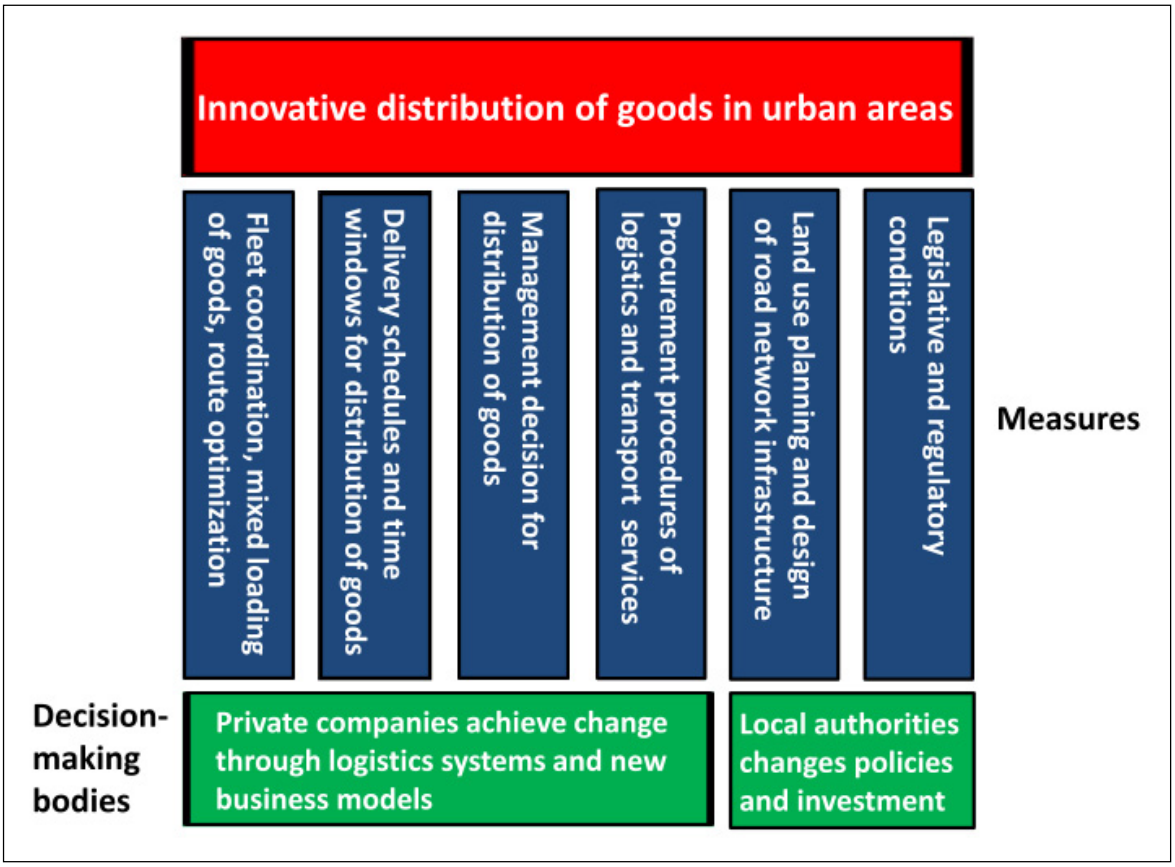

Fig. 1. "The Good City", a conceptual framework for innovative distribution of goods in urban areas, free translation from Swedish. (SNRA, 2009, p. 8)

Research and development in Sweden have addressed city logistics regarding the movement of goods based on physical transportation infrastructure and regulations, as well as a more behavioural approach focusing on organization, stakeholders, change processes and transportation services performance (Moen, 2013). They are both

complementary perspectives and have been treated in the Swedish literature over the past two decades, as summarized in the "The Good City", a multidisciplinary project funded by several governmental agencies (SNRA, 2006). The objective was to create a forum for research and development that leads to an attractive and sustainable society. The project treated urban development from different perspectives and disciplines, including urban environments, traffic planning, sustainable mobility, public transportation and distribution of goods. Objectives regarding the distribution of goods were to identify, categorize and analyze the actions termed as innovative distribution of goods in urban areas, with solutions that in both short and long term were aimed to streamline the transport system for municipalities, transport industry and the business community. The current paper reflects the principles of "The Good City" and an interdisciplinary approach to research related to the field of freight transport in urban areas, as the basis to introduce a new business model that has been developed, tested and implemented in three municipalities in southern Sweden.

Based on the "The Good City" project a conceptual framework been developed in Sweden, as shown in Fig. 1. The model identifies public and private decision makers as innovators regarding distribution of goods in urban areas. The right side refers to public regulations and policy instruments, while the measures on the left are attributed to changes in existing business models. Public changes and investments are determined by policy decisions at different levels in order to overcome accessibility and congestion problems in urban areas. Changes occur through local traffic regulations where the role of government is active in trying to reduce traffic volumes by influencing land use and design of the road network infrastructure. Private changes take place within companies through investment in logistics system and related internal structural changes. Implementation is more strategic where the role of government is supportive and the changes are made by businesses on a voluntary basis by aiming to improve efficiency in distribution of goods and transport planning. Vehicle Kilometers of Travel (VKT) of freight transport in urban areas are lowered through more efficient ways of ordering and receiving goods, listed in the box on the far left with fleet coordination, mixing of loads and route optimization.

Authorities' have several reasons to change the behavior of stakeholders of freight transport in urban areas, either by modifying the existing regulatory framework or through changes that come about voluntarily. Some factors stem from the global warming debate including public pressure to significantly reduce emissions and to increase efficiency of fossil fuels use. Fossil fuels will dominate as primary energy source for heavy goods vehicles, where efficiency developments for engines have fewer options compared to passenger car engines. Investment in improved engine efficiency is producing diminishing returns, and behavioral changes are more likely to produce a better return on investments. In general, there is a need to broaden the focus from vehicle and fuel issues, to include greater efficiency in the transport system and behavior of stakeholders as an increasingly important area of change.

However, measures to change the regulatory framework in an attempt to change private business practices have seen limited success. Analysis of the project "The Good City" emphasizes the importance of common understanding by all stakeholders of benefits of changing the system. Too often each side considers that the other is not doing enough, and this is characteristic not only of city logistics initiatives but have been the general perception throughout the transport sector in Sweden (Ceder et al., 2011). In general municipalities or other public bodies have subsidized new solutions, where the transport sector has been reluctant to take on the business risks. With few exceptions it can be stated, when external funding ceased also the project closed down, which is consistent with studies conducted in other European countries (Browne, Sweet, Woodburn & Allen, 2005; Quak, 2008).

2. Local Government as an Innovative Arena

In the case of Freight Consolidation centreCentres (FCC) in Sweden, the initial focus was to overcome traffic congestion and accessibility problems in the Central Business District (CBD) of the larger cities. However, in Sweden the concept has taken on an extra dimension and been used by local authorities to distribute publically own goods into what is called “co-distribution” of goods. This relates to city logistics, which has been defined as optimizing the logistics and transport activities by private companies in urban areas (Taniguchi, Thompson, Yamada & van Duin, 2001). In Sweden with a long tradition of social welfare programs, the public sector is an

important business partner as a receiver of goods with the private sector as supplier. Municipalities buy food products for an estimated one billion euros per year. Local authorities become a major player utilizing the transport system. Municipal co-distribution implies that all products from external suppliers, mainly groceries but also office supplies and other goods, are delivered to a FCC and coordinated for co-distribution to recipients such as schools and retirement homes.

The current system of supplier's delivering ostensibly free goods in which cost of delivery is including in the cost of the goods, referred to as "free delivery", has been challenged in the last decade by a co-distribution model that has been implemented by a dozen of Sweden's 290 municipalities. Sweden is a vast country in area with a low population density, but 85 percent of the population lives in about 2000 urban agglomerations. This enables centralization of FCC's that serve several of municipalities at once. The main reason for change was due to increased environmental awareness among politicians, officials and citizens, where the transport changes reduce VKT by as much as 70-80 percent with presumably similar reductions to CO_2 emissions (Moen, 2013). Additionally, there have been strong incentives to allow for purchases of locally produced food, which has been next to impossible under the Swedish Public Procurement Act. Representatives of municipalities have turned against EU-procurement regulations, which prohibit explicit demands for locally produced agricultural products in a tender. Sweden in particular has had stricter animal welfare laws with regulations requiring shorter transport time from farm to slaughterhouse compared to the rest of the EU, which causes Swedish livestock farmers to impose higher prices for their products (Moen, 2008). The change from free delivery to co-distribution has made small and medium sized enterprises (SMEs) more competitive, since a major obstacle to overcome for SMEs to participate in bidding under free delivery has been demands for its own distribution network.

Described in general terms, the concept of municipal co-distribution of goods is easy to grasp, that all deliveries to municipal institutions will be loaded at a FCC for co-distribution. However, it has not been easy to accept as a new business model. Actual implementation is complex for all stakeholders involved, with resistance to change from both the transport industry and large food wholesalers in particular. The municipal co-distribution of goods is similar to the concept of city logistics based on FCC, with the difference that co-distribution will only include deliveries to public facilities throughout the municipal area. In its basic form, the municipality will procure vehicles, a terminal and a contractor to carry out logistics and communicate with suppliers. The initial implementation occurred in 1999 with a cluster of four municipalities around the City of Borlänge in central Sweden. The largest trucking company in the region was contracted to administer the system without input from the municipalities regarding transport decisions. By 2010 another ten municipalities had implemented the system following the same business model, called the "Borlänge model".

The business model for co-distribution of goods evolved and in 2011 became conceptually integrated with the official Swedish SFTI (Single Face to Industry) standard for e-commerce, commissioned by government agencies and coordinated by the Swedish Association of Local Authorities and Regions (SFTI, 2011). In 2010 the municipality of Växjö was first to implement both co-distribution and e-commerce as stage two in development. However, Växjö used two separate procurement processes with an overriding objective of segmenting goods on a product level to enable SMEs to participate in tendering offers. The purchasing system, which was made compulsory to all municipal institutions controls the electronic orders automatically through FCC by integratation with e-commerce, who gain direct insight into the orders placed allowing for segmented and decentralized orders of goods in a centralized distribution network (Braic, Josephson, Stavenhow & Wenström, 2012). In Växjö the adopted standards for e-commerce linked to co-distribution of goods entailed a fully automated information flow, but distribution took place in the old fashion way where planning and follow up was exclusively handled manually by a transport company that also managed the FCC.

In yet another (third) development stage three municipalities in southern Sweden, the Ystad-Österlen cluster, in addition to establishing the FCC (stage 1) and integrating e-commerce (stage 2) have also taken over logistics and inserted co-distribution as part in their own supply chain of goods (stage 3). Logistics, transport planning and vehicle monitoring were undertaken by the municipality's own staff through an entirely new form of procurement process and business model (Moen, 2013). The reason why derives from requirements of municipal institutions to centralize planning with e-commerce and co-distribution, which indirectly leads to more demands of predefined delivery times for incoming goods where the workforce will be scheduled for the tasks. Route optimization will be

performed both in the procurement stage with what has been named as “resource-optimized tender documents” and during on-going transport planning in collaboration with the contracted transport company. The entire procurement process is turned around where the tender is based on the municipal institutions needs in their supply chain of goods, where tenderer’s quotes for actual driving routes based on time, distance and sequencing.

The idea behind the three stage business model was that transport buyers who possess planning skills in-house can organize incoming deliveries with focus on its own operations and not primarily fulfill requirements of the transporter or carrier. The three stage model was developed from the work in City of Stockholm, the Swedish capital, which was conducted in 2006 and 2007. The Stockholm project is the most comprehensive attempt of municipal co-distribution that has started up in Sweden, but the project was halted early for political reasons. At the same time was the business model missing vital parts, including a working digital infrastructure with e-commerce. It was also brought forward in the broad investigation conducted by the Swedish National Road Administration, where the results were summarized in 30 recommendations of co-distribution concerning procurement, e-commerce, logistics and the supply chain of municipal institutions (SNRA, 2008). It was those recommendations that formed the embryo of the development work in Ystad-Österlen municipalities and which resulted in a business model för a resource-optimized procurement process (Moen, 2013).

Fig. 2. Map of southern Sweden with municipalities Ystad, Tomelilla and Simrishamn to the southeast, which constitutes the area of procurement.

3. Method and Data

The empirical part of this paper deals with how the procurement process has changed the organizational structure of ordering and receiving of goods for municipal institutions in the Ystad-Österlen municipal cluster. The area includes the municipalities of Simrishamn, Tomelilla and Ystad in the most southeastern part of Sweden, with an economy based on agriculture and tourism and a population of 62,000 inhabitants (see Fig. 2). Together the municipalities buy groceries with an annual value of four million Euros, distributed to 104 municipal institutions including primary and secondary schools, day care centres, retirement homes and kitchens that distribute food through home care assistance. Preparation of a new business model began with a pilot study in spring of 2011 with a project plan that integrated co-distribution, e-commerce and logistics system preformed in-house at Ystad municipality. The year 2012 was spent developing the new business model using software for route optimization as

tool for the procurement documentation. During January through March of 2013, procurement was carried out and thereafter was the new business model implemented. LEADER, the EU fund for regional development financed the project, where the Swedish Transport Administration and the Swedish Association of Local Authorities and Regions funded the research and development part. The two Swedish agencies had somewhat different interests with the first mainly concerned with reducing emissions and the second agency concerned with a more efficient procurement process and the transition to purchasing procedures based on e-commerce.

To change the business model from free delivery to co-distribution enables the municipality to have control over planning and execution of physical distribution through route optimization. However, Swedish local authorities generally lack the procurement skills regarding logistics and transport services, particularly in terms of city logistics and co-distribution of the municipality's own supply of goods (Lindholm, 2011). This implies a steep learning curve to be able to optimize routes to ensure transport efficiency, meet environmental goals and live up to service expectations for municipalities as consignees. In practice, route optimization ensures measurability, punctuality and transparency in transport planning and the exchange of information between the municipality as buyer of transport services and the carrier as executor of the same. It also involves the supplier of goods through the municipality's e-commerce system by requiring timely and accurate delivery notification of incoming goods to the FCC. The type of route optimization software used was based on a standradized and commercially available software with Vehicle Routing Problem Time Window (VRPTW) algorithms, which staff of the municipality manages independently.

The vehicle routing problem (VRP) has more than fifty years behind it and perhaps the area that has received most attention within operations research, but with the introduction of geographical information systems (GIS) has route optimization become an integral part of transport geography, with a clear planning perspective. In the theoretical research and practical applications are VRP documented in a multitude of variations with extensions from more rudimentary solutions with regard to capacity and time windows, to more advanced VRPs with multiple depots, multiple use of vehicles, pick-ups and deliveries in the same route, dynamic planning, etc. (Golden, Raghaven & Wasil, 2010). However, when it comes to commercial use and to make a sustainable impact in an existing organization (behavioural change in transport planning), will the type of algorithms be of less importance, is how the algorithms have been packaged into a standardized software is what matters?.

Crucial in operations will be the interaction between functionality (VRP-algorithms) and data, where the experience of the user (planner/dispatcher) and simulations with different parameter settings will change the outcome of transport planning and hence, transport efficiency. Human interaction will manipulate the software to loosen/remove (spatial) constraints with parameter settings that will change the physical outcome of the "last mile problem" and will give different solutions of driving routes through numerous simulations (inductive human input), which will eventually reach optimum and increase transport efficiency in a given street network / flow of transport. This means the outcome is primarly a product of manipulation of data and software, not relying on algorithms only to solve the problem.

Studies in Sweden have shown a reduction of VKT of 20 to 25 percent when standardized VRP-software has been applied in a number of vertical industries, which was summarized in the DOTEK- project, a project funded by the Swedish National Road Administration (Moen, 2010a). The principal obstacle to overcome was not digital planning with route optimization, but soft parameters such as a new organizational structure or changing the behaviour of stakeholders. The DOTEK-project (Digital operational transport planning for increased efficiency and reduced emission : Case studies and methodological development of the concept of transport efficiency with regard to route optimization) included studies and applications in freight transport, goods distribution in urban areas, scheduling of service personnel, mail distribution, delivery of newspapers, incoming transport of animals for slaughter, the collection of household waste, school transportation planning and scheduling of home care staff. Studies were based on data collection and statistical analysis of manually planned and dispatched transport flows, compared to the same data if managed by a centralized planning function based on route optimization. A centralized planning function challengesthe existing business model and opens up the power of the supply chain if stakeholders can collaborate. The resistance to change was consistently shown to be greatest among carriers, where in the initial stage the transport company fully controlled transport planning and sequenced individual vehicles regarding who would take which consignment. With route optimization, a "neutral dispatcher" handles planning

with full transparency in the flow of information between carriers and transport buyers.

The studies generally conclude that a variety of constraints exist in all parts of the supply chain, which affects the logistics and the result of transport planning. In the DOTEK project, a method was developed where the outcome could be predicted if route optimization was implemented into an existing business model. The method includes three parameters: a geographic component for measuring time and distance, a component identifying organizational constraints and finally a component for calculating transport efficiency, where constraints prevent efficiency gains (Moen, 2010b). Thus, basic requirements to change the organizational structure must be met in order for digital planning with route optimization to work at all. For example, transport of animals to be slaughtered showed a reduction in VKT by 24 percent when the time window for planning was extended from one day to a full week, the geographical area was opened up by removing the zone system for planning and the software instead built customized driving routes for each vehicle each day (Moen, 2010a, p. 57). A centralized planning function gave route optimization the ability to concentrate routes with more stops per route and less deadhead driving.

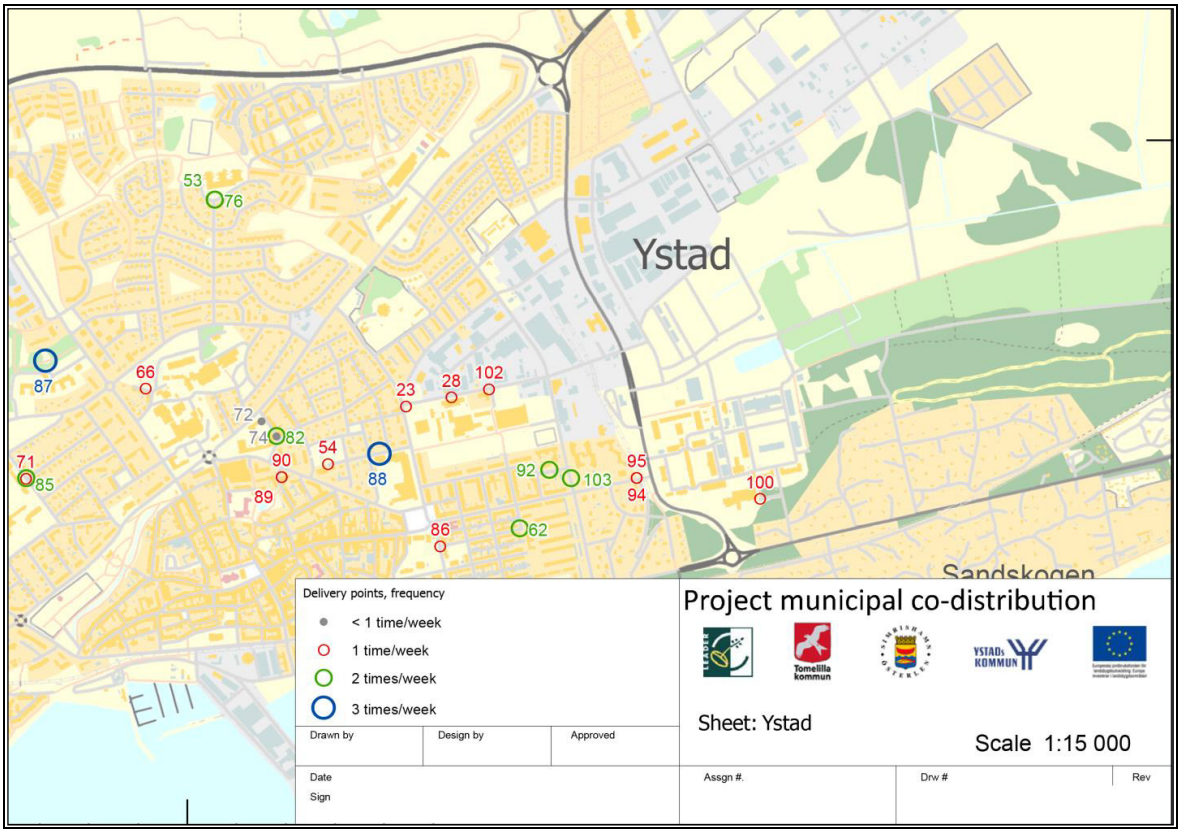

Fig. 3. Map of City of Ystad with municipal institutions that receive deliveries one, two or three times per week based on route optimization. (Ystad Municipality, 2012)

Furthermore, contract specifications based on route optimization requires relevant input where the municipalities thoroughly had thought through their own prioritizes. In order to obtain the total time for each driving route, the municipal institutions were required to supply information for each delivery point. Ahead of the Ystad-Österlen procurement, a detailed survey was conducted of the number of stops and stop times for each shipping address to determine if kitchens required deliveries once, twice or three times a week, compared to eight to twelve times a week with a business model based on free delivery. The survey gathered information where each

institution was asked to specify such information for all goods delivered in a week. The results provide a basis for the volumes, types of products and the days of deliveries, which were then aggregated and converted to a combined stop time and used in simulation with route optimization. The information needed as the basis for co-distribution of goods can be defined as the number of driving routes, number of kilometers per driving route, time per driving route, number of vehicles, type and size of vehicle and number of pallets or role cages per vehicle. The geographical part of the procurement document is displayed in the map in Fig. 3, and shows municipal institutions that receive deliveries once, twice or three times a week in the City of Ystad.

Ystad-Österlen municipalities agreed to base its priorities for transport planning on the needs of the institutions that receive food products, which was the main reason to move logistics (route optimization) in house. But there is a decision to be made. Two somewhat opposed planning settings control the software algorithms, according to either the prioritization of transport efficiency by simulation within a geographical setting of distance or a setting to accommodate institutional need of shipment and delivery dates, which occur within priority of time windows. From an efficiency perspective, the best results would be obtained the fewer constraints that planning has to take into account, which is when algorithms distribute supplies free of time restrictions or geographical limitations. However, this represents the opposite priorities of kitchens when predefined time windows and deliveries are simulated, and in practice were Ystad-Österlen municipalities accommodating the requests from kitchens when it was possible. The main difference from a business model based on free delivery from each supplier is that the delivery of goods from the FCC will take place in a completely separate transport flow without loading by other shippers goods.

4. Findings

The tendering process that is wholly controlled by the Swedish Public Procurement Act will fundamentally change how transport companies quote their price based on VKT and working hours, and similarly payment will be made using what is called “reverse billing”, where the transport company gets paid for time and distance registered in real time of each performed route. The transport sector is characterized by low IT maturity compared to other vertical markets like banking, with all transactions in a digital format or retail barcodes, that follow an item throughout the supply chain. Lack of information technology will make change hard, especially when change implies increase in transport efficiency which gives fewer assignments in the industry at large. Change in behaviour does not come by itself, change will hurt in parts of the supply chain especially in parts dominated by established know-how and resistance to change. However, one must take into account that change is not only efficiencies and exclusion of transporters, a new type of digital trading platform has the capability to add value added services with e-commerce, vehicle routing and scheduling, GPS-tracking, etc. with a substantial impact on delays, vehicle operating costs, reliability, customer confidence, etc. (Hassall, Welsh & Qi, 2011).

The key question in a resource-optimized procurement process is where to locate the Freight Consolidation Centre (FCC). In the procurement document of Ystad-Österlen there was a choice between the three main urban areas of Ystad, Tomelilla and Simrishamn in Fig. 2. The operator obtained index figures based on VKT and working hours per week, simulated by using a standardized route optimization software with VRPTW-algorithms. All driving routes were multiplied by the tender index, meaning that local environmental objectives would supersede the Public Procurement Act regarding principles of equal treatment and non-discrimination. When municipal environmental policy takes over, the FCC location closest to centre of gravity of municipal institutions will get the lowest index figure and other locations will be penalized by a higher conversion ratio because of their sites comparatively negative environmental impact. It shall be pointed out that the staff at Ystad municipality received a two-week training course from the vendor, and then spent two months with hundreds of simulations using survey data to produce three planned solutions with weekly routes for each presumptive location of the distribution terminal.

A question arises as to what is the appropriate method. Should municipal environmental regulations or the Public Procurement Act which includes EU principles of equality and non-discrimination, be predominant? In an early challenge from 1988 decided European Court of Justice to give Denmark right in the “Bottle case”, where the Danish requirement being part of a national recycling glass system was considered justified although it could

indirectly discriminate foreign suppliers (EU, 1988). In another case the "Finnish buses" from 2002, the Court granted rights to the City of Helsinki to procure local bus routes to give extra points in the evaluation process to tenders with low levels of emissions and noise (EU, 2002). This is the type of law invoked when the business model changes from free delivery to the co-distribution based on a resource-optimized procurement process, where it will be up to the transport industry to consider a tender based on environmental considerations and then make a bid. Ultimately, the relationship between suppliers of goods, carriers and the municipality as transport buyer will change fundamentally, where the control (power) of the supply chain will shift from the transport company to the transport buyer, in this case the municipality.

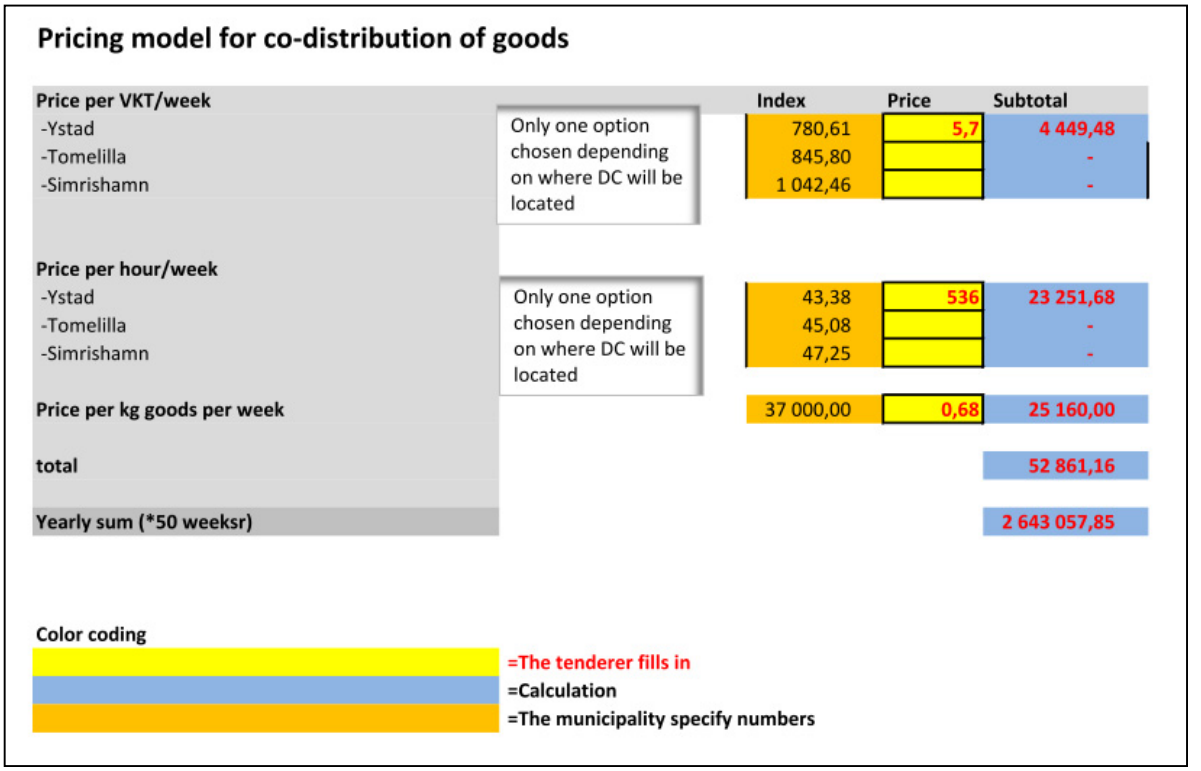

Fig. 4. The digital interface of the resource-optimized procurement procedures of co-distribution for the Ystad-Österlen municipalities (Ystad Municipality, 2012)

The pricing model used to submit tenders in the Ystad-Österlen municipalities procurement is shown in Fig. 4, which summarizes the development work that was carried out during 2011-2012. The inventory of a coordinated stop time as discussed above provided input for simulations where the results shown as index values represent key information for the transport company to consider for tender submission. The simulations in the pricing model show that the location of the FCC in Ystad resulted in the lowest mileage (VKT) and driving times, compared to the locales of FCC in Tomelilla and Simrishamn. The example of Fig. 4 of FCC located in Ystad is based on the kilometer price of 5.70 Swedish Crowns (SEK), an hourly rate of 536 SEK and a price per kg of goods flowing through the terminal with 0.68 SEK per kg, which would give a quoted price of approximately 2.6 million SEK per year. In comparison, the environmental discount for Ystad implies that a carrier in Tomelilla would have to put in an offer on 4:10 SEK per kilometer. Alternatively, a kilometer price of 2:50 SEK would be required of a FCC in Simrishamn to beat out the Ystad bid, when cost of time and price per kilo is kept constant. In this way, environmental policy emerges in the objectives and measurable requirements in a resource-optimized procurement.

Until the Ystad-Österlen municipalities procurement the standard contractual model of co-distribution of goods

was stage one or the Borlänge model (see above). In stage one of the business model payments were based on a unit price per stop regardless of VKT, but with a rate that differentiated for additional minutes that exceeded a certain stop time and for bulky or heavy goods. Certain parts of the stage one business model are difficult to grasp and above all to monitor and check the municipal environmental policy. In the proposed business model with reverse billing, the municipality as transport buyer has complete transparency in planning with route optimization. The transport company receives payment based on VKT and hours worked, by the price offered in the municipal contract, the very core of the concept of "reverse billing". The outcome of the procurement in the Ystad-Österlen cluster showed that prerequisites and the business model were accepted by the transport industry and the tenders submitted were in a close price range, indicating that the municipalities as contracting authority showed high competence and purchasing skills, as shown in Table 1.

Table 1. Result of procurement Ystad-Österlen municipalities, completed in March 2013, prices in Swedish Crowns = SEK (Ystad Municipality, 2013)

	Bidder 1	Bidder 2	Bidder 3	Bidder 4
Price per kilometer				
Ystad	5:70			
Tomeililla		38:25		
Simrishamn			18.00	27:18
Price per working hours				
Ystad	536:00			
Tomeililla		330:00		
Simrishamn			525:00	437:00
Price per kilogram	0:68	0:46	0:57	0:44
Offered bid in SEK	2,643,058	3,216,642	3,233,027	3,263,116

Table 1 indicates that the environmental factor was strong, since Bidder 1 produced the lowest offer, taking into account that the bid was based on Ystad with the lowest index value. But the other three bidders were close in submitted price despite being (environmental) penalized by using Tomelilla as starting point in bid 2 and Simrishamn for bid 3 and 4. Overall, the bids in Table 1 are close in price, (much) more so than what usually been the case in stage one for procurement of co-distribution, where the main difference lies in the procurement documents themselves. Procurement based on price per stop, transport companies start with a list of municipal institutions and the number of stops and volumes transported during a year. Then it's up to the tenderer to assess resource needs in terms of number of vehicles, transport planning with driving routes, distance to drive and based on that will transport companies submit tenders. The difference is illustrated in Table 2, which shows the outcome of Halmstad municipality procurement in 2012 that emanated from stage one of co-distribution where the tender documentation was based on price per stop as well as price per kilo transported.

Table 2. Result of procurement Halmstad municipality, completed in February 2012, prices in Swedish Crowns = SEK (Halmstad Municipality, 2012)

	Bidder 1	Bidder 2	Bidder 3	Bidder 4
Price per stop	177:00	95:00	65:00	99:00
Price per kilogram	0:10	0:85	1:25	1:97
Offered bid in SEK	3,814,500	5,221,350	5,950,850	9,238,000

A major difference between the two procurement models is that municipal procurement skills needs to be at a higher level when a resource-optimized procurement process is used, based on route optimization with predefined driving routes with time, distance and sequence. Higher procurement skills are displayed by the tenderers having

clearer registry data to respond to, which is attested by the spread from low to high of 23 percent in Table 1 as compared to the spread of 143 percent in Table 2. In the latter case one can say that neither the transport buyer (the municipality), nor the transport companies had a clue what the price would be in the end and what constituted a fair price. In the three stage business model (Table 1), municipalities can better predict the cost of the assignment as well achieve higher service and control of the supply chain with high demands on punctuality of incoming goods derived from when the municipality holds logistics in-house.

During the project development phase, an analysis was conducted of the three presumptive FCC sites, compared with more remote localization to cities Sjöbo and Malmö, see map in Fig. 2. The results of simulations are shown in Table 3, in which Ystad has the lowest index value, where an higher index can be seen as additional feeder distance in the distribution network of the served catchment area. What is remarkable is that Malmö that formed starting point for many of the suppliers that delivered to the Ystad-Österlen municipalities by a business model based on free delivery, have a feeder distance to first shipping address each week longer than the VKT to serve overall distribution to 104 institutions in three municipalities. There is an urgent need for research and development devoted to the issue of feeder distance and location of the FCC, as more and more FCC tend to be located outside cities further away from the catchment areas and the affect on VKT, load capacity and fill rate, punctuality and service to the consignee is not known.

Table 3. Percentage of feeder distance for total VKT when the starting point is either Ystad, Tomelilla, Simrishamn Sjöbo or Malmö east, sea map Fig. 2 (Ystad Municipality, 2012)

Location FCC	VKT per week (km)	Feeder distance (km)	Proportion in percentage
Ystad	781 km	-	-
Tomeililla	846 km	65 km	8,3 %
Simrishamn	1042 km	261 km	33,4 %
Sjöbo	1216 km	435 km	55,7 %
Malmö east	2125 km	1344 km	172,1 %

As an international comparison, a strong trend has been noted in metropolitan areas, where terminals are moved further and further away from the catchment areas that they intend to serve, which can be defined in geographical terms as logistics sprawl. In a study using a technique called “centrography” as an indicator of sprawl, has the centre of gravity in the metropolitan areas of Paris, Atlanta and Los Angeles been calculated for warehouses as well as for economic activities in general. The average distance from centre of gravity for warehouses has increased substantially more because of locations to the outskirts of cities, where in Los Angeles has the distance increased by 9 kilometers (from 42 to 51 km) in the years 1998-2008 (Dablanc, 2011, p. 76). When feeder distance increases as much as 20 percent will it have implications for all stakeholders in a supply chain, as well as an increase in traffic congestion and negative environmental impact. It can be noted that more research is needed to determine when the feeder distance becomes counter-productive, for example in terms of environmental effects, time windows of recievers of goods and fill-rate and load capacity of vehicles.

5. Conclusion

There are many stakeholders involved in municipal co-distribution of goods that ultimately leads to structural changes in an existing business model. This has economic implications to parts of the supply chain, mainly to transport companies through fewer consignments. Structural change include that some parts in an existing supply chain are removed, replaced by new parts or reverses the order of existing parts. In the business model of co-distribution of goods are numerous vehicles and carriers involved replaced with one FCC and one transport company, which is a major change in the industry and a major change of behavior among stakeholders. On the other hand, this must be balanced against the benefits of the transport buyer and a move towards a more efficient organization within municipal institutions where goods arrive at predetermined and fewer times, and where staff

can be scheduled for incoming deliveries for receiving and unpacking the food products.

Furthermore, the positive municipal embrace of the co-distribution concept is derived in part from the large size of the public sector in Sweden. But that was not the only reason to change, especially increased environmental awareness in the population at large has been a major catalyst. A business model with co-distribution of goods gives a reduction of VKT by 70 to 80 percent compared to distribution based on free delivery. In addition, the development of e-commerce and more efficient payment procedures has contributed and especially public procurement issues and decisions to buy Swedish food products has played a crucial role. Also a municipality acting as transport buyer can make more comprehensive transport decisions, unlike the many individual companies acting in their own interests with support from carriers. In particular, increases the municipality's procurement skills, where the three stage process model of co-distribution is a concept to be explored for similar transport flows in the private sector as well as attempts with freight consolidation centres in CBD.

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