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Evaluating new participative city logistics concepts: The case of cargo hitching

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Abstract

Five years ago the project Cargo Hitching started with the goal to use the unused capacity of public transport passenger vehicles for freight and parcel transport. Like many new city logistics initiatives it is a difficult challenge to setup a profitable private business model. A rural pilot project was developed in the East of the Netherlands, building on Dutch government funding (Dinalog), with several Dutch universities, the province of Gelderland, public transport service provider Connexxion and city logistics service provider Binnenstadservice. The paper describes how viability for the cargo hitching project was organized, providing important social and environmental benefits as well as a sustainable business model for the system.

Keywords: Integration, passenger transport, parcel delivery, business model, social value, city logistics;

1. Introduction to transport capacity sharing

In the new economy many new logistics initiatives arise, based on the principles of sharing resources by crowd participation. Resource sharing or the so-called term ‘Sharing Economy” was first mentioned in 2008 and denotes the collaborative consumption made by the activities of sharing, exchanging, and rental of resources without owning

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the goods (Lessig, 2008). In the context of economic transactions, it refers to the use of an object (a physical good or a service) whose consumption is split-up into single parts. These parts are collaboratively consumed in C2C networks coordinated through community-based online services or through intermediaries in B2C models (Hamari et al. 2015). Uber, Zipcar, Blablacar and AirBNB are the trendsetting companies who try to change the society towards a more sustainable usage of our resources. A recent survey among consumers in the USA indicated that the Sharing Economy in the sectors travel, car sharing, finance, staffing, as well as music and video streaming is supposed to increase its revenues from USD 15 billion to USD 335 billion within the next years (Bothun et al. 2015). Recently DHL (Gesing, 2017) has sketched the sharing economy trends in city logistics such as: Truly Shared Warehousing, Urban Discreet Warehousing, Community Goods On-demand, Logistics Asset Sharing, Transport Capacity Sharing, On-demand Staffing and Logistics Data Sharing. The Transport Capacity Sharing is a phenomenon tremendously growing with many startups rushing into freight brokerage platforms to help matching shippers and carriers to maximize truckload utilisation, decrease empty miles, and accelerate shipping times. Examples of these platforms are Saloodo! and QuiCargo in Europe, Freightos, Convoy, and Loadsmart in the U.S., and Huochebang in China.

In this paper, we focus on a special form of Transport Capacity Sharing, the unused capacity of public transport. Five years ago the project Cargo Hitching started with the goal to use the unused capacity of public transport capacity for parcel transport. Short-haul transport has some rare examples of a small-scale pilot in La Rochelle (France) or the failed cargo tram in Amsterdam. One of the most important success factors of this project is the enthusiasm of the people involved, the researchers, but certainly also the participating company's employees. The "theoretical harvest" from this project is impressive (Ghilas et al., 2016a/2016b/2016c; Veenstra, 2017). Different Bachelor and master projects (Sikkes, 2014; Jansen, 2014; Matena, 2015; van Berkel, 2017; Venne, 2017) have been conducted at important aspects such as the stakeholder analysis, the business models, optimizing the pickup and delivery problem with handling cost, integration of the unpredicted parcel delivery demand into bus schedules. All these studies have proved to be very positive, but more importantly, as a means of emission reduction, as the promotion of our city accessibility, and as a means of reaching secluded rural regions.

Still it is questionable whether all the theoretical advantages are likely to occur in practice. It is also questionable whether a concept like Cargo Hitching can keep its viability for society in the long run. Other city logistics initiatives such as urban consolidation centres have shown that despite the potential positive environmental and social impact, the main obstacle remains the lack of a sustainable business model. The goal of our study was to understand how to organize viability for the Cargo Hitching project as a concept providing environmental and social benefits while at the same time providing a sustainable business model (social and logistical value propositions of multi-beneficial relations between the involved stakeholders).

This paper is structured in five sections. Section 1 provides information on the research topic, followed by the problem definition and research question. Section 2 provides a literature review on integration of passenger and freight transport project followed by specification of the knowledge gap. Section 3 contains more in depth information on the available transport capacity, the logistics processes and the final parcel demand. In section 4, the design options for business models are discussed, followed by an analysis on three different demand scenarios. The conclusions are given in section 5.

2. Literature review on integrating passenger and freight transport

In the field of air transportation , already for many years, it has been common practice to combine freight and passenger transport. In the literature, several studies are reported on the possibilities of letting cargo travel with public transportation companies, see Trentini & Mahléné (2010), Ghilas et al. (2013), Lu (2014), Jansen (2014) and Pternea et al. (2018). They have shown that synergy may exist when logistic service providers are cooperating with scheduled passenger service providers, such as public transport companies. Nowadays, especially in low urbanised areas, these companies have the challenge to increase the utilization of public transport because many citizens perceive a higher benefit from traveling with their own transportation modes. For this reason they are searching for new business opportunities and therefore they do not only focus on increasing the incentive for citizens to use scheduled services, but instead try to increase the incentive for cargo transportation companies to make use of scheduled services when there are situations of unused capacity. The general idea here is combining passengers and

cargo in order to achieve an increase of the used capacity in public transportation. In the literature the following projects of integrated passenger freight transport were found.

Bussgods service (Sweden)

Bussgods is a nationwide transport system which transports for both businesses and individuals. For the most part, this is done in the existing bus services, the buses that run after the timetable. This makes Bussgods one of the most environmentally friendly and punctual transport options, because they run both passengers and packages at the same time (Bussgods, 2017). Bussgods has some agents/service points in the main cities of Sweden. Customers can find the nearby agents and track their parcels via their website.

Dabbawala system (India)

The Dabbawala system is a lunchbox delivery and return system that delivers lunches from homes or restaurants to people at work and study. The Dabbawala system achieves very high service performance (highly accurate and on-time) with a low-cost and very simple operating system (Baindur & Macário, 2013) based on numbers and colours. Every morning, a Dabbawalla-carrier will either walk or travel by bicycle to collect lunch boxes in his/her area. After collection, they will go to the local train station where they are gathering with other Dabbawalas. Next step is the sorting of the lunch boxes. They are put on the trains according to their next destination. When the boxes arrive, they are handed over to the appropriate Dabbawalas. After the train trip, the Dabbawalas deliver the lunch boxes to the owners by bicycle. The processes are the same for the return of empty lunch boxes. This particular delivery system provides job opportunities for (semi-) literated people. Dabbawalas are self-employed. They join the organisation with some capital. Their customers are business men, students, and meal suppliers. The Dabbawalla service-industry is still growing at a steady rate of 5% to 10% per year (Rai, 2007).

CarGoTram (Germany)

CarGoTram is a freight tram in Dresden, started in 2001, carrying car parts across the city center to the Volkswagen factory (Livingrail, 2001; Lightrail, 2017). CarGoTram transports goods with a separate freight tram and shares a tram track network with passenger trams. Many other cities share passenger transport infrastructure with freight transport as well. Vienna (Austria) and Zürich (Switzerland) use trams as mobile recycling depots. Kislovodsk (Russia) had a freight-only tram system that was used exclusively to deliver bottled mineral water to the railway station. In Manhattan, Amazon couriers use the underground train network to deliver goods because the traffic in that city is gridlocked and traveling by underground train is quicker (Crow, 2015).

Amsterdam Cargo Tram (the Netherlands)

Amsterdam Cargo tram pilot project started by CityCargo Amsterdam in 2007 (Chiffi, 2015). Initially the idea was based on the Dresden CarGoTram project. Similar to CarGoTram passengers and goods shared the same track network, and they were transported by a separate freight tram. Two cargo trams ran through the city centre of Amsterdam between 7 am and 11 pm during the testing and pilot phases. There was no influence on passenger tram schedules. When cargo trams arrived, the goods were unloaded onto small electrically powered vehicles (E-cars) which were utilised for the final delivery. The initial benefits looked promising. It was estimated that Amsterdam Cargo Tram could reduce the total number of commercial vehicles by 50 percent, the noise could be reduced and air pollution could be reduced as well. Also economic benefits were calculated. Still the Cargo Tram project went bankrupt in 2009 due to a shortage of public subsidies.

To sum up, there are several project studies about infrastructure sharing between passengers and freight, as well as practical projects. The scientific literature however shows only few papers on the integration of freight and passenger transport. Sharing infrastructure increases the utilization of vehicles or tracks, and at the same time, reduces transportation costs, reduces CO2-emission and congestion. Most of these studies are carried out in urban areas instead of rural areas. Sharing transportation usually involves multiple groups of actors, so it suffers from the challenges of cooperation between business, cost allocation, etc. Arvidsson et al. (2016) conclude that integrating passenger and freight transport in urban areas is a promising approach. However, to advance operational integration of passenger and freight transport services, integration at the institutional and business levels of freight and passenger transport provision is required. Therefore, the development of a sustainable business model is essential the success of integrated passenger and freight transportation. Capacity sharing projects have been attempted in different places. According to their findings, stable economic sources can ensure the viability of the project. Also the inclusion of some social values, such as the jobs for the (semi)-laterated people in the Dabbawala system, seems to be an important factor for the long term viability. According to Austin et al. (2006) the economics of a social

entrepreneurial venture often makes it difficult to compensate staff as competitively as in commercial markets. In fact, many employees in social entrepreneurial organizations place considerable value on nonpecuniary compensation from their work. The positive balance is than found at a higher level than narrow private business models, building on corporate social responsibility or social cost-benefit analysis.

3. The pilot project: Cargo Hitching

3.1. Project Introduction

This project was initiated with funding of the national government (Dinalog), by a consortium of Dutch universities, government agencies and private companies. Cargo Hitching includes cargo that hitches a ride on a vehicle transporting persons, or persons hitching a ride on a vehicle transporting cargo. Millingen aan de Rijn has been selected to demonstrate the Cargo Hitching project. It is a small village nearby the city of Nijmegen (driving distance is approximately 17 km). It is located in the east of the Netherlands, and it borders Germany.

In March 2017, Binnenstadservice (BSS), Breng and Pluryn launched the pilot project as main initiators.

- BSS Nijmegen operates a logistics city hub close to the centre of Nijmegen. The main function of logistics hubs is collecting, storing, sorting, packaging parcels (Zäpfel & Wasner, 2002) and consolidating parcels from multiple customers.
- Breng is the public passenger transport service. The passenger transportation system in the Netherlands is arranged by tendering agreements (Mouwen & Rietveld, 2013).
- Pluryn is the social care organisation that provides treatment and support for disabled, child welfare and mental health care in Millingen aan de Rijn (Pluryn, 2017). This project provides job opportunity for people with difficulties in doing normal jobs. People from Pluryn will take care of the parcels in the public bus. The main interests of Pluryn are creating job opportunities and societal benefits.

BSS is responsible for transporting parcels from the logistics hub to Nijmegen centrum and the bus station. Besides, BSS operates the local service desk in Millingen aan de Rijn where the parcels can be pickup by/delivered to the inhabitants. The main interests of BSS are financial profit, good service quality and societal benefits (Hendriks, 2017). The local depot, as a service point, can also lead to additional revenues for nearby retail (Weltevreden, 2008). Furthermore, according to Hendriks (2017), BSS aims for lean and green logistics performance. The (potential) costumers are the inhabitants who order the packages, logistics service providers (who don't want to deliver all the way to Millingen a/d Rijn) and shippers.

The state of the services and their utilization at the beginning of the project was as follows. In the pilot project, Breng, a part of Connexxion, operates two bus lines (Line 80 and Line 82) traveling from Nijmegen Centrum to the village of Millingen (Breng, 2017). Public transportation service providers are interested in financial benefits, on-time performance (Mouwen & Rietveld, 2013; Boitani et al., 2013). The lines 80 and 82 are relatively well utilised lines. Most of the passengers are school children and students. The bus transporting from Nijmegen to Millingen aan de Rijn has peak hours from 14:00 to 18:00 on weekdays. November and February are the busiest months while summer vacation months are the least busy ones. As cancellations are limited to 0.2% of the buses, transport service availability is reliable. Each bus has a capacity of 31 seats, 51 standing places and 2 wheelchair locations. Assume the parcels are transported by public bus line 80 and 82 during 9:00 to 16:00. Between 14:00 to 16:00 the line buses are very busy with passengers. During peak hours the number of rolling containers is at maximum one for a trip. The capacity of transporting parcels by public bus is calculated as follows (Table 1).

Table 1. Parcel transport capacity (9.00 – 16.00)

	Off-peak period (8:54 – 13:24), Line 80	Peak period (13:54 – 16:09), Line 80	Peak period (13:54 – 16:09), Line 82	Number of parcels
# trips	10	5	4 (at weekdays)	
60 parcels per roller container	Roller container	Roller container	Roller container	1140
	Roller container	Roller container	No	900
	Roller container	No	No	600
15 parcels per trolley	Trolley	Trolley	Trolley	285
	Trolley	Trolley	No	225
	Trolley	No	No	150
Use both	Roller container	Trolley	Trolley	735
	Roller container	Trolley	No	675

3.2. The Cargo Hitching Logistics processes

Figure 1 shows the processes of Cargo Hitching. It starts with the customers who are the parcel receivers living in Millingen aan de Rijn. Participating people change their address to the address of the logistics hub (BSS) in Nijmegen, and obtain a unique code given by BSS, when they shop online.

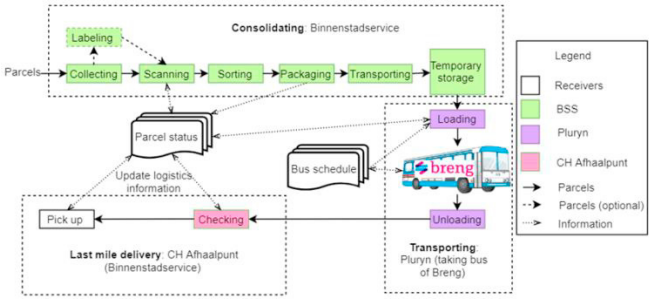

Figure 1 : The Delivery process of Cargo Hitching

At their logistics hub, BSS consolidates parcels from different carriers and Parcel Delivery Service Providers (PDSP). BBS sorts and packages the freight in a roller bag or a parcel trolley, and then transports them to Nijmegen Central Station. There is a small room for temporary storage of the parcels. Pluryn is responsible for transporting parcels from Nijmegen Central Station to the local service point. The Pluryn employees transport parcels according to the transport planning. They take parcels out of the storing room and travel with the parcels as private luggage by the public bus (Lines 80 and 82, operated by Breng). One of the two places for wheelchairs on the bus could be used, which are safe locations in the bus. When the bus arrives at Millingen aan de Rijn, the Pluryn employee takes the parcels out of the bus and hands them over to the local Cargo Hitching service desk. No extra time is needed for taking out the parcels. The local service desk is close to the bus stop. When the parcels arrive, the employee working at the local Cargo Hitching Servicedesk will check the parcels. During the pilot project, receivers can take their parcels at the depot from 16:00 to 20:00 on weekdays, and Saturdays from 12:00 to 16:00.

3.3. Estimation of parcel demand

Based on resident questionnaires and interviews with PDSP's, parcel delivery demand for Millingen aan de Rijn can be determined. 112 residents filled in a questionnaire out of 5860 inhabitants. According to the survey, the average demand is 1.31 parcel per person per month. It was found that 75% (based on the questionnaire results) of the parcels should be delivered to the receivers' front door, and the service is to be provided 26 days per month (from Monday to Saturday). In Millingen aan de Rijn, the total daily average demand is 295.3 parcels (5860 residents) and the demand for home delivery is 221.5 parcels per day.

4. The Cargo Hitching Business Model Design

4.1. The Cargo Hitching business model

The business model of the pilot project is described with the Osterwalder Business Model Canvas technique (Osterwalder & Pigneur, 2010), see Figure 2. The nine building blocks of the Canvas are classified into the following four categories: value proposition (shaded core part of the business model), customer interface (blocks right to the core), resources (blocks left to the core) and financial flows (bottom blocks).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Proposition</th><th>Customer relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">1. Receivers
2. Breng
3. Pluryn
4. PDSPs and carriers
5. Shippers
6. BSS</td><td>1. Collecting and sorting parcels
2. Transporting parcels to the village by public buses
3. Logistics information tracking
4. Operating the local service point
5. Expected societal and environmental benefits</td><td rowspan="2">1. Parcel delivery service
2. Making use of unused capacity of public bus and combining passengers and parcels and reducing transporting cost.
3. Providing job opportunities for people with poor job prospects
4. Environmental benefits (reducing CO_2 emission)
5. Higher efficiency and utilization of rural public buses
6. Traffic safety (fewer vehicles in the village)</td><td>Customers (receivers) use the address of BSS with an identification code when do shopping online</td><td rowspan="2">Receivers of parcels (residents of Millingen aan de Rijn)</td></tr>
<tr><td>Key Resources
1. Warehouse space
2. Public bus (Line 80 & 82)
3. IT platform
4. Organizational capacity
5. Personnel</td><td>Channels
1. Unique codes for customers (Online orders)
2. Tracking information to customers
3. Local service point</td></tr>
<tr><td colspan="3">Cost Structure
1. Rent
2. Personnel
3. Management & maintenance of vehicles equipment and infrastructure
4. IT platform (SaaS)</td><td colspan="2">Revenue Streams
Governmental funding</td></tr>
</table>

Figure 2 : The business model of Cargo Hitching

Product/service (Value propositions)

Cargo Hitching provides a parcel delivery service for customers. The environmental and societal benefits of this project are important by making use of unused capacity of passenger buses and consolidation of parcels leading to a reduction of CO2 emission. An important value of this project is that it creates job opportunities for people with difficulties in doing normal jobs.

Customer interface (Customer segment, Customer relationship & Channel)

In the project, the customers are consumers/receivers, residents living in the village. They use the delivery address of BSS logistics added with their unique customer code when they are ordering goods online. The logistics information of the parcels can be traced via a smartphone application and a notification is sent when the parcel can be picked up. When their parcels arrive at the village, the customers can pick up their parcels at the local service point.

Infrastructure management (Key partners & Key resources)

The Cargo Hitching project was launched by BSS, cooperating with Breng and Pluryn. Besides, these key partners receivers, shippers and parcel delivery service providers are included as partners. These actors work together to deliver goods to the final consumers. The key resources are warehouse space, public buses, IT platform and personnel.

Financial aspects (Costs & Revenue streams)

The financial aspects consist of the cost structure and revenue streams. The cost of operating the project are rental cost for the pickup point, personnel cost, management and maintenance cost of vehicle equipment and infrastructure, and the cost for the IT-platform (Saas) plus coordination cost/management. During the testing period, customers could enjoy this service for free, receiving and sending parcels without paying extra money. Based on the results of the costing analysis, operating the pilot project costs about €2705.30 per month, which is too expensive compared to the current demand. The Province Gelderland funds this project during the pilot period. In order to keep this innovative parcel delivery service running after the pilot period, it is important to find out a sustainable business model for the long run.

4.2. Business model design options

In order to design and analyse the business model and relationships between business models of different stakeholders, it is important to identify the roles and responsibilities of stakeholders. In this respect, the Cargo Hitching Servicedesk is considered as an independent business entity.

- ***Who are the customers?*** The potential customers of Cargo Hitching are consumers (local residents and businesses), shippers (B2B and B2C businesses) and carriers/PDSPs (e.g. DHL). Receivers are interested in environmental and social impacts, while shippers and PDSPs care more about the cost reductions and the related financial profits.
- ***Who can do the interfacing to the customers?*** The customer-facing company directly talks to customers. It can be anyone of the Cargo Hitching group, such as BSS, Breng, Pluryn and CH Servicedesk.
- ***Who can do the consolidation of the parcels?***
- Currently the parcels are consolidated at Nijmegen and then transported to the village by public bus. Some spaces are needed to consolidate parcels. The BSS logistics center is ready-made for this purpose. The parcels can also be consolidated at Nijmegen central station (Breng office), or at Pluryn office building or even other places.
- ***Who is responsible for transporting and supervising the parcels?***
  After consolidating, the parcels are transported to Millingen aan de Rijn. The possible subcontractor is Breng, Pluryn, taxi companies and even individual passengers. If transportation is outsourced to Breng, Breng can hire Pluryn employees for guiding parcels on the bus. If the subcontractors are Pluryn or passengers, they will transport parcels by using public buses or private cars.
- ***Who is responsible for the service point***?
- The collection point can be part of business in a local shop or act as an independent Cargo Hitching Servicedesk. A digital parcel locker could be an option as well.
- ***Who is responsible for the final home delivery?***
  The parcels are delivered by bike. The possible responsible parties are the customer-facing company, e.g. BSS, or delivery subcontractor, or the Cargo Hitching Servicedesk.

The design variables and corresponding possible options are summarised in Table 2.

Table 2. Cargo Hitching Design options

Design variables	**Options**				
Customer	Receivers	Shippers			PDSPs
Customer-facing company	BSS	CH Servicedesk	Breng		Pluryn
Consolidator	BSS	Breng	Pluryn		
Transport subcontractor	Breng (driver)	Breng (Pluryn)	Pluryn (taking bus)	Passengers (taking buses/private cars)	Taxi (driver)
Local service point	No	Parcel locker (operated by the customer-facing company)	A local shop	CH Servicedesk	
Final home delivery	No	Customer-facing company (e.g. BSS)	CH Servicedesk		

4.3. Demand scenarios

The viability of the business model of the project will depend on the demand for services. Therefore, the scenarios are built upon variation in the number of parcels transported by Cargo Hitching. Based on the analysis of daily demand, the maximum parcel delivery demand in Millingen aan de Rijn is around 300 parcels a day. The three following scenarios are designed:

- *Scenario 1: low demand; average 30* parcels *per day*

The low demand scenario is set to 30 parcels per day. This gives a monthly demand of 780 parcels (parcels are not delivered on Sundays). Assuming the percentage of home delivery is about 70%, then every day, 21 parcels are

delivered to customers' home while seven parcels are delivered to the service desk.

- *Scenario 2: average demand; average 100 parcels per day*

Scenario 2 is assumed to deliver 100 parcels per day. In this case 70 parcels are home delivered, and 30 parcels are picked up by customers.

- *Scenario 3: high demand; average 300 parcels per day*

The third scenario is the high demand scenario with a daily demand of 300 parcels. In this case almost all the parcels towards Millingen aan de Rijn are transported by Cargo Hitching. We assume that 210 parcels will be delivered to customers' homes and 90 parcels will be delivered to the service desk.

Combining the design options with the scenarios leads to the following configurations of the Cargo Hitching project (see Table 3).

Table 3. Scenario –design options Cargo Hitching

# Scenario	Daily demand	Customers	Customer-interfacing company	Transport subcontractor	Service point
1	30 parcels	Consumers (residents)	Binnenstadservice	Pluryn	A local shop
2	100 parcels	Consumers, shippers	Binnenstadservice	Breng	CH Servicedesk
3	300 parcels	Consumers, PDSPs	Cargo Hitching Servicedesk	Breng, Taxi companies	CH Servicedesk

4.4. Evaluating for the three demand scenarios

If the activities are clustered into three groups namely, transport, service point and home delivery, the average cost per parcel of each group can be calculated (see Table 4). The average cost of "transport" and "home delivery" are relatively stable in different scenarios. However, the average cost of parcels being delivered to the service desk differs significantly. The more parcels being delivered to the service desk, the cheaper the average transport cost become. The crucial cost are related to the rental cost of the Cargo Hitching Servicedesk.

Table 4. Cost of transport, service point and home delivery

# Scenario	Transport cost		Service desk		Home delivery	
	Total	**Average**	**Total**	**Average**	**Total**	**Average**
1	€ 533.07	€ 0.68	€ 39.25	€ 0.17	€ 596.00	€ 1.09
2	€ 1,100.00	€ 0.42	€ 2,420.00	€ 3.10	€ 1,870.00	€ 1.03
3	€ 3,060.00	€ 0.39	€ 2,420.00	€ 1.03	€ 5,560.00	€ 1.02

For the last mile delivery the CO2 emission of riding a bicycle is zero. Therefore, home delivery with bike couriers would reduce CO2 emission compared with delivery by vans. Because Millingen aan de Rijn is a small village, the drop density is considered dense with 21 or more drops. The average CO2 emission of one drop with a relatively high density is around 110g (Edwards, McKinnon, & Cullinane, 2010). Assuming one home delivery parcel per drop, Table 5 shows the reduction of CO2 emission of three scenarios.

Table 5. Daily reduction of CO2 emission (Kg)

# Scenario	Transporting to Millingen aan de Rijn			Home delivery	CO_2 emission reduction	Total CO_2 emission reduction
	Min.	Max.	Max. CO_2			
1	0	136 km (4 trips * 34 km)	22.89 kg	21 drops	2.31 kg	25.20 kg
2	0	170 km (5 trips * 34 km)	28.61 kg	70 drops	7.70 kg	36.31 kg
3	-	204 km (6 trips * 34 km)	34.33 kg	210 drops	23.10 kg	57.43 kg

The social care organisation, Pluryn, is involved as one of the key stakeholders who perform the integrated passenger and freight transportation. To supervice the parcels in the public bus is an easy job, which is suitable for

Pluryn employees who have difficulties with normal jobs. This project provides job opportunities for these people. One return trip takes about 90 minutes. The working hours of three scenarios are shown in Table 6.

Table 6. Working hours for Pluryn employees

	Scenario 1	Scenario 2	Scenario 3
Working hours (per month)	78 hours	78 hours	234 hours

From a cost perspective it is interesting to see that scenario 1 are 3 financial viable scenarios. The environmental gains can be obtained in all three scenarios. From a social perspective scenario 3 is most preferable compared to the other scenarios. Even the social part of the evaluation needs more attention both in literature as in practice, as the ranking of possible benefits of this project made clear that more than half of the respondents find it most important to offer job opportunities to people with poor job prospects. Reducing CO2 emission was ranked as the second important benefit (see Table 7).

Table 7. Ranking of the Benefits Cargo Hitching

Benefits of Cargo Hitching project	1 (least)	2	3	4 (most)
Lower emission	15.2%	29.5%	27.7%	27.7%
Offer people with poor job prospects work	6.3%	9.8%	28.6%	55.4%
Better traffic safety	29.5%	40.2%	23.2%	7.1%
Better occupation for the bus	49.1%	20.5%	20.5%	9.8%

5. Conclusions

As Arvidsson et al. (2016) we conclude that integrating passenger and freight transport is a promising approach. To advance operational integration of passenger and freight transport services, integration at the institutional and business levels of freight and passenger transport provision is required. Therefore the development of a sustainable business model is essential for the success of integrated passenger and freight transportation. In our research three different demand scenarios were developed to testify the most viable business model design. The following findings can be derived from this research:

- The potential customers are consumers, shippers and parcel delivery service providers.
- The social benefit is a significant factor to attract customers. Therefore, the public bus (bus of Breng) is a preferred transport mode and it creates job opportunities for people with poor job prospects (Pluryn employees).
- There are two last mile delivery options, picking up at the collection point, and home delivery. Both services are provided to ensure the customers' service quality.

As for the Cargo Hitching Servicedesk, it can be set in a local shop or be operated independently. However, operating Cargo Hitching Servicedesk on its own does not lead to a viable service in a low and middle demand scenario. The additional cost analysis also shows that the cost of Breng and Pluryn to join in are very low and that setting the service in a local shop is much cheaper than operating an independent Servicedesk. In a high demand scenario, integrated passenger-freight transportation can be feasible and economically viable.

An important factor are the target customers; if they show more interest in society and environment and their opinions will affect the decisions of shippers and parcel delivery service providers. Approximately 57.43 kg CO2 emission is reduced per day if all the parcels towards Millingen aan de Rijn are delivered by Cargo Hitching. In the high demand scenario, 234 working hours per month are provided for Pluryn employees.

Also an important conclusion from the business modelling is that the long term viability of Cargo Hitching strongly relies on the social inclusiveness of the concept. This implies that besides necessary ‘hard’ financial viability, the project should add value in non-monetary dimensions such as social labour, environmental reductions and safety improvement, appealing to ‘soft’ social values of the customers. The value of these non-financial factors can be quantified in cost-benefit analysis, although this may not sufficiently count the real value of social inclusiveness for individuals with a distance to the labour market. Many employees in social entrepreneurial

organizations place considerable value on nonpecuniary compensation from their work (Austin et al., 2016). A smile of such a person says more than 1000 words. To conclude, therefore, we argue that social inclusiveness should be considered as a key element for evaluating new participative concepts in logistics.

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