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**Small or medium-scale focused research project**
**Grant agreement no: 285295**

STRAIGHTSOL
Strategies and measures for smarter urban freight solutions

## Deliverable 5.3

# Business models for innovative and sustainable urban-interurban transport

SEVENTH FRAMEWORK PROGRAMME

**Document Control Sheet**

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## List of Abbreviations

| | |
|---|---|
| APM | Adapted Parking Meter |
| BAU | Business as usual |
| BC | Business Case |
| BCA | Business case analysis |
| BRU | TNT’s depot near the Brussels’ airport |
| BMC | Business Model Canvas |
| CAPEX | Capital expenditure |
| CCZ | Congestion Charge Zone |
| D | Deliverable |
| DC | Distribution Centre |
| EUR | Euro |
| GPS | Global positioning system |
| ITS | Intelligent Transport Systems |
| KPI | Key performance indicator |
| LSP | Logistic service provider |
| MD | Mobile depot |
| NOK | Norwegian Kroners |
| OPEX | Operational cost |
| VDS | Vehicle Detection Sensors |
| VSR | Vehicle site ratio |
| WP | Work package |
| WTP | Willingness to pay |
| ZE | Zero emission |

## Executive summary

This deliverable focuses on the business model aspects of the demonstrated solutions. It aims to describe, from a business point of view, what is needed in order for the solutions to be beneficial on the long term for: the initiator, its stakeholders and society as a whole. It examines the value that the solution offers, the potential willingness to pay for this value, and the requirements that should be met to realize this exchange in practice.

Urban-interurban transport solutions are characterized by small-scale pilots and demonstrations. Even though the solutions often seem successful during the pilot phase, large-scale adaptations are scarce. The problem is that the demonstration phase does not reflect the real world in which the solution needs to survive. The demonstration phase is subsidized, has a local focus and is developed in close collaboration with a variety of enthusiastic stakeholders and experts. Both its short-term and innovative character often allow for regulative exemptions, support and participation. When the demonstration period has ended, the innovative solutions face serious challenges regarding long term and/or large-scale implementation. Subsidies finish, project teams end, and the regional, political or strategic focus of the organisation may ask for other interventions than the one that was demonstrated locally. To make sure that time and money for innovative solutions is spent effectively, it is of great importance that sufficient attention is spend on the potential future implementation of the demonstrated solution.

Within STRAIGHTSOL, we examine the business challenges for large-scale implementation using business model and business case analysis. We combine quantitative and qualitative methods to evaluate the business aspects of the demonstrations separately. Next, we generalize results into business concepts that are also useful for other urban-interurban solutions.

First, the **business model** canvas of Osterwalder and Pigneur (2010) is used to compare the business as usual with the business in the alternative (e.g. demonstrated) situation. This is a valuable exercise to identify the changes that relate to costs, revenues and the value proposition (CITYLOG, 2012). The value to society is taken into account as part of the value proposition (BESTFACT, 2010; CITYLOG, 2012). These changes are quantified in the **(social) business case analysis**. The results for the pilot situation as well as a proposed scaled scenario are presented. In case of uncertain, or very case specific input values, variations are made by means of a sensitivity analysis. Hence, the demonstrated solutions are evaluated under various conditions.

The business model canvas furthermore provides insight in the changes in activities, resources and partners that the organization need. These together address the *organizational fit* of the solution. Next, the business model canvas considers customer related aspects, such as the customer segments, relationships and channels. It considers the change in value that is offered to the customer and the willingness to pay for the experienced changes. By looking at the customer related aspects, the *market viability* of the solution is addressed. The organisational and market potential of the solution together comprise the **viability/fit** analysis. The results are visualized using the Viability - Fit tool.

Finally, we integrate the findings by defining **business model design choices**. While the previous analyses discuss the demonstrated solutions individually, the design choices have a more generic character. It proposes the critical choices that need to be made for the implementation of a broad set of urban and interurban transport solutions, namely: 1) urban consolidation centres, 2) data sharing in the supply chain, 3) automatic parking monitoring and 4) dynamic routing through monitoring.

The combination of analyses enables to draw conclusions on the financial feasibility of the solutions. The solutions are either: not financially viable (i.e. a successful business model is not likely to be developed), financially viable for the initiator (i.e. a business model can be

established without support from outside the own organisation), or desired, but complex to put successfully in the market.

In case of the latter, the demonstrated solutions are beneficial for society as a whole. But even though total benefits outweigh total costs, there are various challenges that prevent the solutions from having a successful business model. These can be: 1) costs and benefits are dispersed, 2) benefits are difficult to quantify and 3) stakeholders are reluctant to change because of non-financial (and/or non-rational) reasons.

1. **Costs and benefits are dispersed**. Stakeholders that benefit are in many cases not the ones that have the ability/willingness to invest. To solve this, identification and redistribution mechanism for benefit/cost sharing should be developed. This requires additional time, knowledge, resources and costs. Another consequence it that, when benefits are dispersed it is difficult to develop a specific product or service for one customer that is willing to pay for it.
2. **Benefits are difficult to quantify.** Benefits are often not directly financial, such as, time savings, accessibility, comfort, attractiveness of (public) space, branding, air quality, etc. Stakeholders are often not able to value these benefits and weigh them with the costs (i.e. it is difficult – or even impossible – to put a price tag on these benefits).
3. **Reluctance because of non-financial (and non-rational) reasons.** In many cases, factors such as trust, competition, dependency and uncertainty, prevent stakeholders from changing their behaviour and hence, can hinder the market uptake of the solutions. Also, current agreements, rules and regulations can be obstacles. In line with this, certain missing regulations, (either supportive like time window exemptions, or restrictive like a congestion charge) could very much support the development of certain business models when they would be imposed.

What we have learned from the business analyses is that the above factors play a key role in whether or not a successful business models can be established. These challenges should be identified and overcome first in order to make sure that future efforts are targeted effectively.

This deliverable is of value for all kind of public and private actors in the logistics sector, that are interested to initiate, support or implement innovations in the field of urban-interurban freight transport. The results can be used for large-scale roll-out (roadmaps), or for the development of new demonstrations.

The deliverable is of great value for the partners and participants within the STRAIGHTSOL project and the European Commission as it provides an in-depth, quantitative as well as qualitative analysis of the organisational and market potential of the six solutions that are demonstrated in the STRAIGHTSOL project. After the demonstrations' individual assessment (Deliverable 5.1) and the evaluation of its (potential) effects on KPIs (Deliverable 5.2), this document presents the financial value of the solutions and business requirements for market uptake. Next, the deliverable proposes business model design choices which are more generic, and applicable to a broad set of solutions. The latter can be of value in both the start-up, testing and implementation phase of urban-interurban transport innovations.

Local, national and European authorities can use the outcome to decide on future investments and to learn how they can play a role in the success of urban-interurban transport innovations.

# 1 Introduction

This introduction gives (1) a background for the project, (2) an overview of the different work packages and the place of this deliverable within the STRAIGHTSOL framework and (3) a description of the document structure.

## 1.1 Background and Overview of STRAIGHTSOL

Urban areas represent particular challenges for national and international freight transport, both in terms of logistical performance and environmental impacts. Currently around 74% of Europe's population live in urban areas. The fact that the urban share is expected to increase to 84% by 2050 highlights that city distribution is an expanding problem. It is in light of this that the project STRAIGHTSOL – Strategies and Measures for Smarter Urban Freight Solutions – is developed. Its objectives are threefold:

1. Develop a new impact assessment framework for measures applied to urban-interurban freight transport interfaces.
2. Support a set of innovative field demonstrations showcasing improved urban-interurban freight operations in Europe.
3. Apply the impact assessment framework to the live demonstrations and develop specific recommendations for future freight policies and measures.

That is, the STRAIGHTSOL project will demonstrate new solutions for smart and sustainable urban-interurban transhipment and last mile distribution. Based on the demonstrations and their assessment, policy recommendations, deployment strategies and real practice benchmarks will be core outcomes of the project. The main STRAIGHTSOL achievements will be:

- Proof-of-concept of seven real-world solutions for more smooth and efficient urban-interurban freight transport interfaces across Europe;
- Development of common information standards underpinning planning, implementation and assessment of sustainable urban freight policies at different planning levels (EC, national, regional, local/city);
- Support for future policies and deployment strategies on last mile distribution and urban-interurban freight transport interfaces, both at EC, national, regional and city level;
- Providing local, regional authorities, governments and industry players with solutions and registered effects of different measures for reducing the impacts of congestion, pollution and noise, $CO_2$ emissions and dependence on fossil fuels in urban freight transport; and
- Advice on how to better incorporate urban-interurban freight transport in local policies and plans, and how to better manage and monitor transport flows.

Figure 1's PERT diagram shows the interrelation of each work package with the others in the STRAIGHTSOL project.

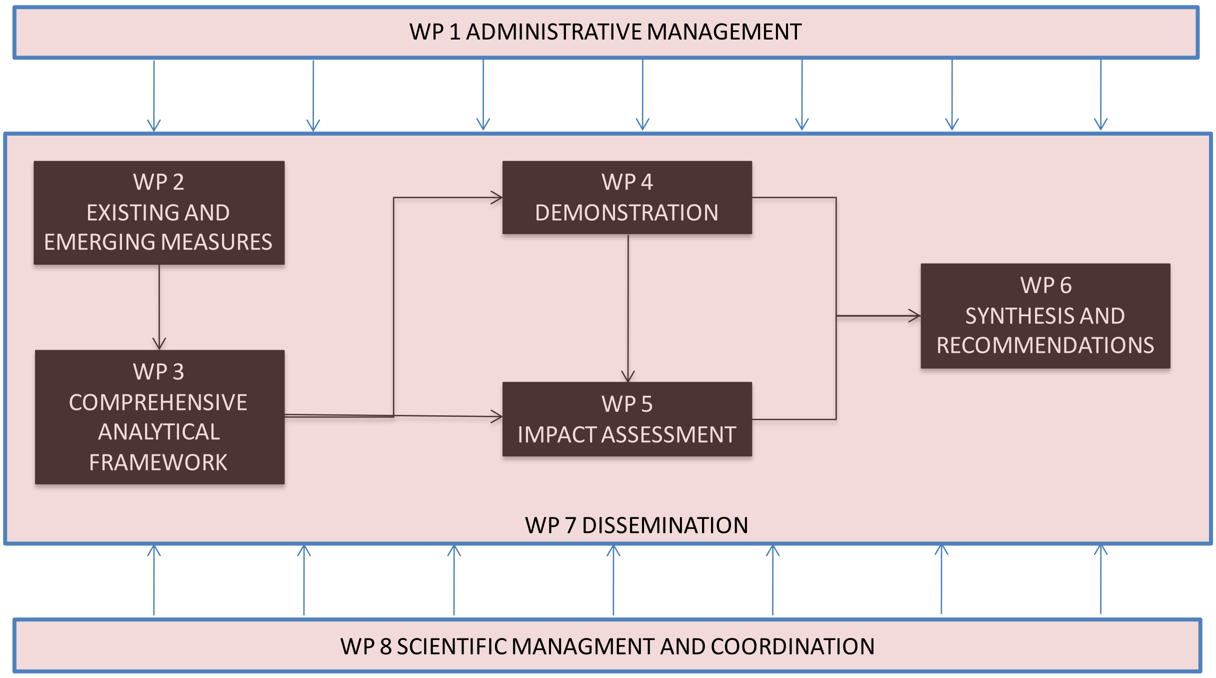



**Figure 1 The PERT diagram**

Figure 1 gives an overview of the structure of the project and its different work packages (WPs). Up until now, WP2, WP3 and WP4 have assessed the state of the art innovative measures for promoting environmentally stable and efficient urban logistics, developed a general impact assessment framework in which such measures can be holistically evaluated, and produced seven demonstrations in which innovative measures could be put into practice. This deliverable is a part of WP5, which assesses the field demonstrations. The last work package in which the STRAIGHTSOL methodology will be developed is WP6 which synthesises the results and also works out a set of general recommendations for logistics operations in urban-interurban areas.

## 1.2 Scope of the Deliverable

Deliverable 5.3 (D5.3) is the third output of WP5. Deliverable 5.1 presented a summary and description of the seven demonstration assessments. In deliverable 5.2 an evaluation assessment of the key performance indicators was provided. Deliverable 5.3 takes the findings from the two aforementioned deliverables in order to develop business models for innovative and sustainable urban-interurban transport. Deliverable 5.3 gives a detailed evaluation of the used business models in the demonstrations by means of qualitative and quantitative analysis and possible solutions will be provided for business model challenges. Consequently the generic aspects of the individual demonstrations will be subtracted for the development of requirements for successful business concepts for other urban-interurban transport solutions. More specifically the following aspects are considered in this deliverable:

- Qualitative analysis of the used/proposed business models.
- Quantitative analysis of the used/proposed business cases (incl. sensitivity analysis and social cost benefit analysis if applicable).
- Viability/fit analysis of the used/proposed business models.
- Prerequisites for successful implementation of the solution.
- Generalization of results into business concepts for other urban-interurban transport solutions.

D5.3 will constitute important input to WP6; this is the final work package which is aimed to develop a tailored set of recommendations to improve logistics operations in general in urban-interurban contexts.

## 1.3 Document Organisation

This deliverable is organised in four parts. The first part is composed of chapters 1 and 2. These are the introduction and the description of approach respectively, and are designed to give the reader all information and references necessary to be able to understand the subsequent parts of the document. The chapters 3 to 9 constitute the second part of the deliverable. The individual chapters in this part amount to one demonstration assessment each and provide 1) a general context of the demonstration, 2) qualitative analysis of the business models, 3) quantitative analysis of the business cases, 4) viability/fit analysis of the business models 5) prerequisites for successful implementation of the solution. The third part is chapter 10. This chapter assesses which aspects of the demonstrations are generic and critical for the success of the solution. Consequently business concepts for other urban-interurban transport solutions are presented. The last part, chapter 11 presents the conclusion of this deliverable.

# 2 Theory and Approach

This chapter presents the methods used in order to evaluate and further develop the business models for the cases demonstrated in Straightsol. The first part focuses on the definition of a business model. The second and third chapter provide details on the methods used to perform the qualitative and quantitative analysis of the demonstrations. The fourth part provides the basis for the overall assessment of each demonstration. Lastly, the general methods are presented that were used throughout the project.

## 2.1 Introduction

Despite the widespread interest in the concept of business models, there is still no clear definition of the term. Different definitions emphasize different aspects, such as the architecture for a product or service, a description of roles and relations of a company, the way to do business, how a company goes to market, how value is added, how to make a business viable, etc. The definition used in this report captures the main elements of the definitions mentioned above. It defines a business model as:

*A description of how a company or a set of companies intend to create and capture value with a product or service. A business model defines the architecture of the product or service, the roles and relations of the company, its customers, partners and suppliers, and the physical, virtual and financial flows between them.*

This definition implies that the success of a business model is dependent of it finding a 'fit' between different interests, on different levels (Bouwman, 2003). Not only the fit between the firm's business model and the end customer is important in this respect, but also the fit between the business models of the different actors involved in manufacturing a product or producing a service. A BM is a way for strategists, managers and business analysts to deal with innovation processes that take place in complex and networked environments characterised by many, often only loosely coupled, organisations, and by a rapid and largely unpredictable pace of technological development. It is in this context that business models acquire their strategic importance, functioning not just as cognitive models eliciting the way organisations do business under such circumstances, but as key management concepts guiding and shaping the objectives, plans and routines of organisations and even of entire ecosystems of organisations (Ballon & Arbanowski, 2005; Osterwalder, 2004). Positioning business models in this way allows for identifying results to be used in defining strategies as well as service portfolio's (see Figure 2). This section is an adaptation of the work by Ballon (2006).

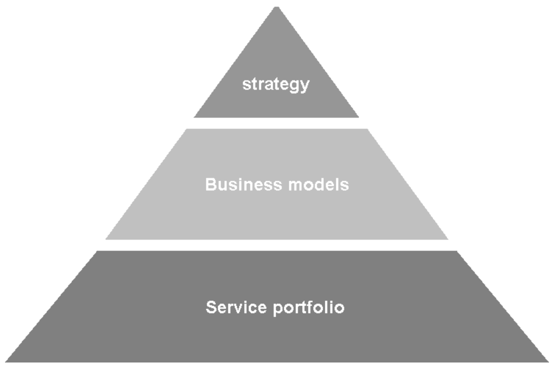



**Figure 2 Positioning business models in decision making processes**

## 2.2 Qualitative analysis: Business model canvas

To analyse which business aspects change with the integration of the STRAIGHTSOL solutions, we look into the business model of the organisation that actually runs the test with the STRAIGHTSOL solution. We compare the business model of the business as usual with the business model using the STRAIGHTSOL solution. The business models are explored through the use of the Business Model Canvas by Osterwalder and Pigneur (2010) and the work that has been carried out within TURBLOG (2011), Deliverable 2: “Business Concepts and models for urban Logistics”.

In order to describe an organisation’s business model, Osterwalder and Pigneur propose a single reference model, which is known as The Business Model Canvas (see Figure 3). The model initially consisted of nine building blocks (i.e. partners, activities, resources, value proposition, customer relationships and segments, cost and revenues streams). In the Business Model Canvas an implicit assumption is made that the goal of an organisation is to generate revenue streams. However, when it comes to urban logistics, societal and environmental impacts are of great concern as well, for example, the reduction of pollution, noise, congestion and traffic accidents. When applying the business model canvas to urban logistic concepts it becomes clear that the model does not directly capture those externalities. For this reason, a 10th building block has been added to the model (TURBLOG, 2011). By defining the 10th building block Externalities, the Urban Logistics Business Model has been created. This tenth block can be considered the value proposition to the society. The 10 building blocks together make up a complete business model. The Business Model Canvas helps to map, discuss, design and invent new business models.

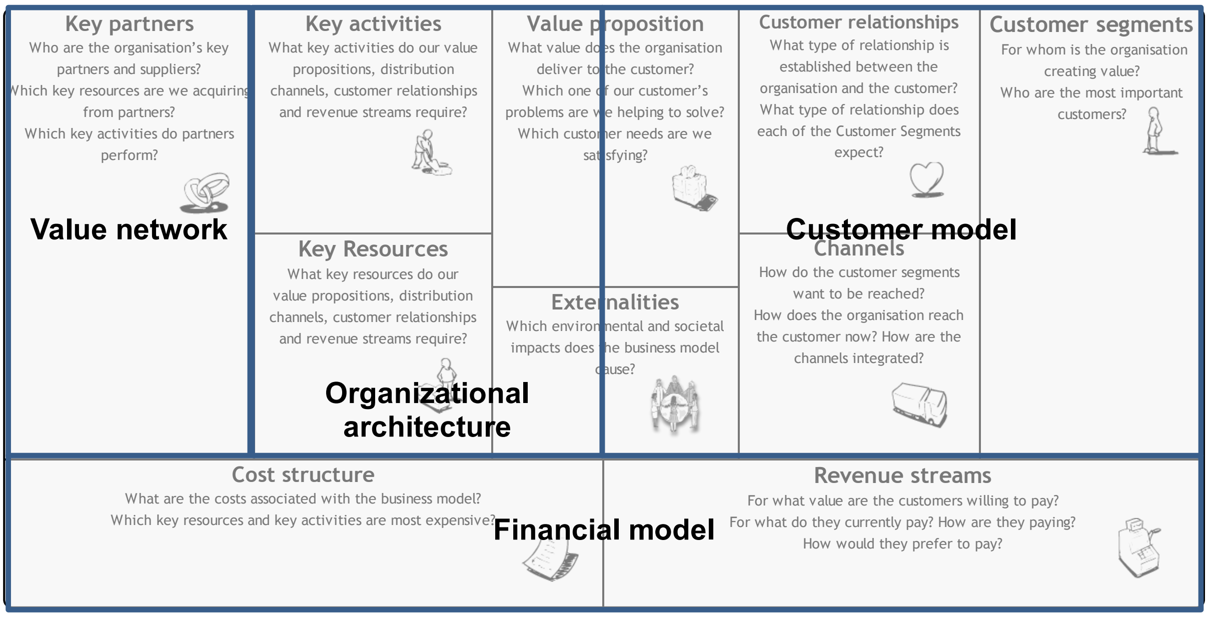



**Figure 3 Urban Logistic Business Model Canvas**

As shown in Figure 3 the Business Model Canvas is split up in four levels: customer model, organizational architecture, value network and the financial model.

*Customer model:* On the right side of the model the focus is on how value is being provided to the customer (through which channels and relationship models). The externalities-block contains the value proposition to relevant stakeholders in the urban logistics settings (for example residents), but it is often very difficult, if possible at all, to put monetary values on this proposition for the focal company. Based on what a customer is willing to pay for a service or product, a company can create revenue streams. The business model canvas shows that the three blocks at the right (i.e. customer segment, customer relationships and channels) together result in a revenue stream (which is in its turn a derivative of these three blocks).

*Organisational architecture:* On the left side, we see the elements that are necessary to make, produce or offer the value proposition by means of certain key activities and the key resources.

*Value network:* The value network is formed by the collection of business actors with reciprocal relationships. Based on certain resources and capabilities, these actors together perform value activities to create value for customers and to realise their own strategies and goals.

*Financial model:* The financial model shows the financial arrangements between the different actors in the value network. It shows how the value network intends to capture monetary value. The cost structure represents all the costs incurred by key partnerships, activities and resources. The revenue streams describe how the business model generates money for the organisation. The financial model is further described in paragraph 2.3.

The structure of the Business Model Canvas helps to analyse which part of the business will change when an innovation is implemented in an organisation and how this affects other parts and eventually what the effect of this change actually is on the value propositions. Therefore, the model is applied to each STRAIGHTSOL solution as demonstrated in the field tests. This is done by answering a set of questions for each block, as shown in Figure 3. In the analysis, we primarily focus on the changes and associated consequences.

## 2.3 Quantitative analysis: Business case

The qualitative information collected for the business model canvas is of great value for the quantitative analysis; the business case. The left hand side of the business model canvas represents the costs and the right hand side shows where revenues are generated. Where the STRAIGHTSOL solution leads to a change in the business model, the effects are quantified in terms of costs and revenues. The business case shows whether – and under which conditions – a STRAIGHTSOL solution can be brought in practice in a financially viable way. Assumptions for large-scale implementation are taken into account. The main aspects considered are the effect of the demonstrations on revenues, operational cost (OPEX) and capital expenditure (CAPEX). Furthermore, sensitivity analysis is performed to assess how the output of the business case can be apportioned to different sources of uncertainty in the input parameters. As important, it provided insights in which input parameters are critical for success for the business models of the demonstrations.

## 2.4 Viability – Fit tool: Overall assessment

The Business model canvas and the Business case analysis provide insights into the impact of an innovation on the business model of an organisation and its financial effects. Nevertheless, the Business model canvas and the Business case do not explicitly value the overall degree of feasibility of the innovation, taking both the organisational and the market potential into consideration. Furthermore, it is difficult to assess the relative difference between stakeholders in overall feasibility. The Viability – Fit tool will be used to assess the degree to which the innovations have a market perspective (viability) and an organisational match (fit).

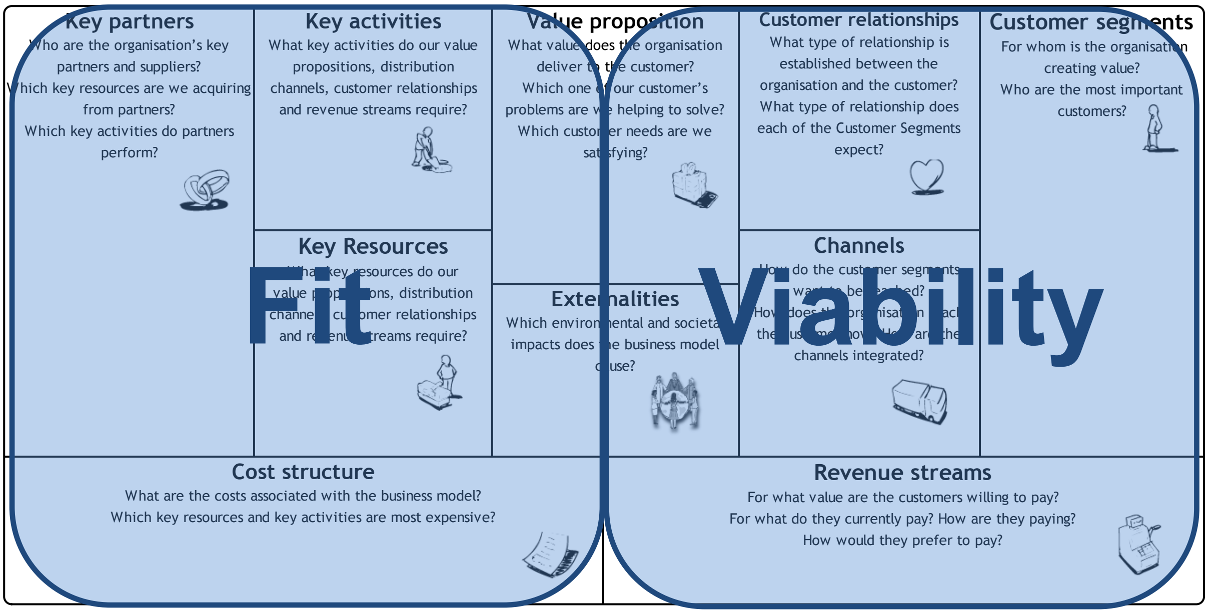



**Figure 4 Viability – Fit elements**

Viability especially focusses on quantifying the right side of the Business model canvas, such as the market size of an innovation, in how far customers are willing to pay for the innovation and the positive externalities that may come with an innovation. Fit measures the degree to which an investment dovetails with a company's existing processes, capabilities and culture. It may be clear that innovations with a high viability and fit have a high chance of success. If the innovation rates on high viability but low on fit it may be required to redesign to try to improve on organisational aspects. If the innovation rates on high fit but low on viability it may be required to redesign to try to improve on its economic perspectives. In Figure 5 an example of the fill in sheet for the viability and fit assessment is shown.

innovation for life BMICE-T

Which stakeholders would you like to assess on viability and fit of a solution? (max 5):

| | |
|---|---|
| 1: | Stakeholder 1 |
| 2: | Stakeholder 2 |
| 3: | Stakeholder 3 |
| 4: | Stakeholder 4 |
| 5: | Stakeholder 5 |

| | FACTORS VIABILITY — Value proposition: Stakeholder 1 | | | Importance |
|---|---|---|---|---|
| Value proposition | In how far is the innovation differentiating within the specific market? (also wrt ima | Market perspective | Positive | Medium |
| | In how far does the innovation address a specific customer problem? | Market perspective | Positive | Medium |
| | | Market perspective | ------------ | Low |
| Customer segment | Expected # non-paying customers | Market perspective | Positive | Medium |
| | Expected # paying customers | Market perspective | Negative | Medium |
| | | Market perspective | ------------ | Medium |
| Channels | Contribution to speed customer delivery | Market perspective | Neutral | Medium |
| | Contribution to quality customer delivery | Market perspective | Positive | Medium |
| | | Market perspective | ------------ | Medium |
| Customer relation | Contribution to customer satisfaction | Market perspective | Positive | Low |
| | Contribution to increased/improved customer contact | Market perspective | Positive | Low |
| | | Market perspective | ------------ | Medium |
| Revenues | Expected contribution to increase/decrease exisiting revenue streams | Market perspective | Neutral | Medium |
| | Expected contribution to new revenue streams | Market perspective | Neutral | Medium |
| | | Market perspective | ------------ | Medium |
| Externalities | Expected contribution to non financial cost/benefits (environment, social, etc.) | Market perspective | Positive | Medium |
| | | Market perspective | ------------ | Medium |

| | FACTORS FIT — Value proposition: Stakeholder 1 | | | Importance |
|---|---|---|---|---|
| Value proposition | In how far does the innovation fit within the exisiting value offering? | Organisational fit | Strong | Medium |
| | In how far does the innovation fit within to the organisational mission/vision | Organisational fit | Strong | Medium |
| | | Organisational fit | ------------ | High |
| Key activities | Match with current logistic/transport activities | Organisational fit | Strong | Medium |
| | Match with current organisational activities | Organisational fit | Weak | Medium |
| | | Organisational fit | ------------ | Medium |
| Key resources | Match with current logistic system (warehouse, IT) | Organisational fit | Neutral | Medium |
| | Match with current transport vehicle fleet | Organisational fit | Neutral | Medium |
| | | Organisational fit | ------------ | Medium |
| Business Partners | Match with current strategic partners | Organisational fit | Strong | Medium |
| | Match with current operational partners | Organisational fit | ------------ | Medium |
| | | Organisational fit | ------------ | Medium |
| Cost | Impact on financial resources | Organisational fit | Weak | Medium |
| | Impact on non-financial resources (employees, partners etc.) | Organisational fit | Weak | Medium |
| | | Organisational fit | ------------ | Medium |

**Figure 5 Viability Fit - Fill out form**

By visualising the degree of viability and fit of an innovation it becomes easier to assess the feasibility of the innovation. Especially in systemic innovation projects where multi-stakeholder participation is required it is interesting to plot the feasibility of an innovation for all stakeholders involved. By means of visualising it becomes possible to compare the degree of feasibility of the respective innovation for different stakeholders (for an example, see Figure 5).

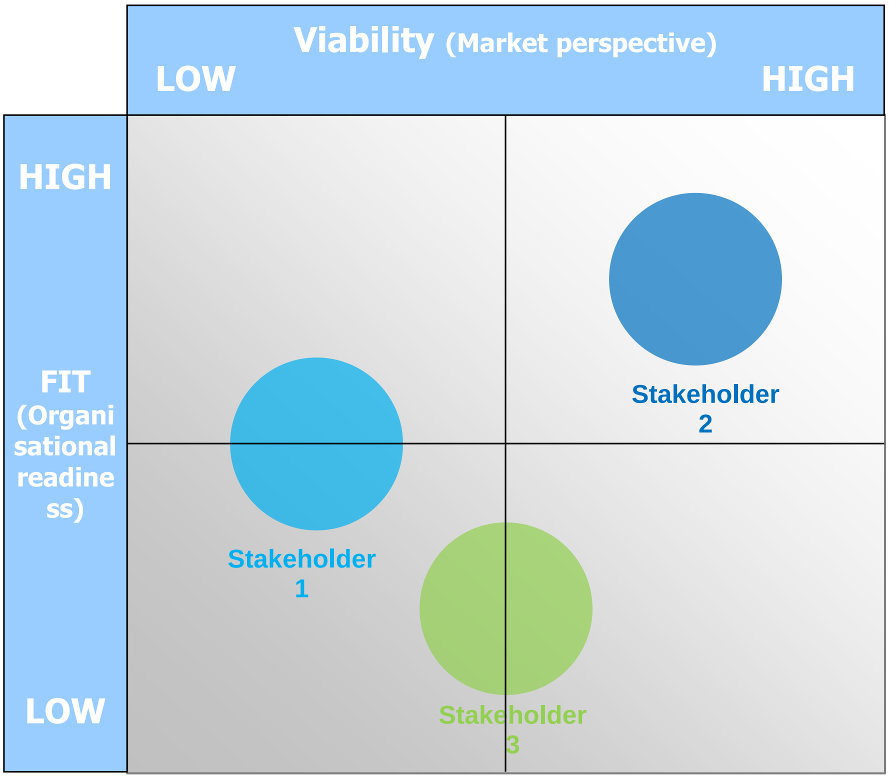



**Figure 6 Viability – Fit graph**

If there are certain stakeholders where participation is crucial, but the feasibility of the innovation is insufficient (low viability and/or low fit), the stakeholder may not be willing to participate. By visualising the feasibility for all stakeholders, it becomes possible to identify threats that may limit the start or success of a systemic innovation. In this case, collective action may be required. Collective action can be defined as joint actions by the stakeholders to pursue the implementation of a systemic innovation. It may thereby be required to redefine the innovation to make it acceptable for all stakeholders involved.

## 2.5 Business concepts

When designing a business concept, there are different tools that a business analyst might use, including organizational models, process maps, process flows, functional decomposition, requirement definitions, technology models, use case models, and revenue models. An integrated approach needs to combine these tools according to the purpose for which the business model is used (Ballon & Arbanowski, 2005). This integration is operationalized by aggregating this multi-dimensional field to design choices.

*What are critical design choices?*

In paragraph 2.2, four levels of the Business Model Canvas framework were introduced: customer model, organizational architecture, value network and the financial model. From a design science point of view (see Osterwalder, 2004), these four levels and their interrelationship can be operationalized into a number of business model design choices. We define business model design choices as a number of crucial design parameters that need to be addressed when designing a business model for new or improved urban logistics products or services. The analytical value of investigating design choices lies in the extent to which there is a strategic and operational consensus between partners in the value network on all four levels as defined above (Bouwman, 2003).

Based on the demonstration assessments, as described in chapters 3 to 8, the most relevant business model design choices were extracted. Our selection of most relevant criteria was based on the following preconditions:

a) Problematic and uncertain: The impact of the choice needs to be uncertain but potentially high. For instance, a criterion related to the organizational architecture such as efficiency, while crucial for the viability of any service or product, is not included, because the choice to make a system, service or product operate as efficiently as possible can be expected to be common to all business model designs. In contrast, design choices in the field of scalability may be highly problematic and uncertain as both the option to design dedicated systems as well as the option to design standard systems in order to be able to easily adapt to different market circumstances may be part of a valid business strategy.

b) Generic within the purpose of the research aim: the design choices needs to be generically applicable to all services leaning on urban logistic business models, and needs to be structurally related to the value creation and capturing processes for these kinds of services. For instance, a choice for a certain level of security, while very important in many concrete cases, cannot be deemed generic or structurally important enough to figure among the main business model criteria, as in many cases it may not have a direct effect on value creation, capturing or control. In contrast, a criterion such as the vertical integration (or disintegration) of supply is included, because it is generic to practically all urban logistics products or services and because it is directly related to the issue of control over the business model.

In chapter 9, the findings of the most critical criteria are described for the different urban logistic business model concepts. This is certainly not to say that the ones listed are the only design choices to be made. Others choices can also be critical, depending upon the particular market context, customer segment and other characteristics of a specific business model. Here, only the generic choices are identified. They leave room for elaboration and adjustment to specific cases, something that should be part of any business modelling process.

## 2.6 Approach

In order to assess the individual demonstrations and develop business model concepts we made use of the following sources:

- Literature: various research and publications have been written about urban and interurban logistics. Throughout the text, the consulted sources are mentioned.
- Expert sessions:
    - STRAIGHTSOL WP5 meetings: part of the WP5.3 sessions have been utilised for brainstorm sessions and reflection about the business models with the STRAIGHTSOL partners.
    - Expert session 12 December 2013 (Delft, the Netherlands): On 12 December an expert session was organised to jointly develop possible solutions for the identified challenges of the demonstrations. The following experts participated in the session:

| **Name** | **Organisation** | **Expert focus** |
|---|---|---|
| Kees-Willem Rademakers | PostNL | City logistics and sustainability |
| Martin Salet | Dutch Ministry of Infrastructure and the Environment | (City) logistics |
| Birgit Hendriks | Eco2City | Urban consolidation centres |
| Wouter Blok | RR Koeriers | Urban freight transport practitioner |
| Lori Tavasszy | Technical University Delft / TNO | Freight transport |

# 3 Urban Consolidation Centre in L'Hospitalet de Llobregat, Barcelona – DHL

## 3.1 Case description

In the pilot of DHL Supply Chain Spain, an urban consolidation centre (UCC) was applied as a logistic solution. The aim of the measure was to reduce the number of vehicles entering the city centre by combining the deliveries at the consolidation centre outside the city. Since there is a high concentration of retailers in the city centre, the deliveries of the retailers were chosen as the target deliveries. In total, 11 retailers and 5 buildings of the city council participated in the demonstration. Three additional multi-customer supply chains managed by DHL were combined as well. All the deliveries from these parties were consolidated and an overall optimisation was done as shown in Figure 7 below.

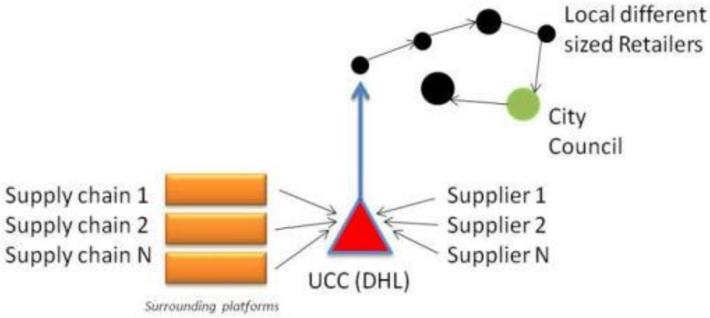



**Figure 7 Consolidation in L'Hospitalet de Llobregat**

In the literature review carried out by Allen et al., (2012), 114 UCC schemes in 17 countries were identified. According to that study, there are 3 types of urban consolidation centres:

1. *UCCs serving all or part of an urban area:* These UCC schemes are often intended to serve a specific district in an urban area and are often used to serve locations with features such as narrow streets and historic layouts
2. *UCCs serving large sites with a single landlord:* The types of large sites served by these UCCs include airports, shopping centres and hospitals. In some instances, these UCCs serve only one large while in other cases, they serve several large sites.
3. *Construction project UCCs*: These are UCCs that are used for consolidating construction materials for major building projects including housing, office blocks and hospitals.

According to this classification, the case of DHL Supply Chain falls in the first category of UCCs serving part of an urban area. Since this type of UCC benefits mainly from the traffic and environmental improvements, the initiatives are mainly taken by the local authorities. This type of UCC is seen as the most challenging type to reach financial feasibility. The novelty of this approach is the merging of demand from small retailers and multi-customer supply chain that might be able to provide a critical mass of demand.

## 3.2 Stakeholders description

In the demonstration of DHL SC Spain, there were different stakeholders involved. Initially the city council was very interested in the solution due to its potential benefits and they also took a role in the involvement of the retailers. Retailers participated by changing the delivery address for their goods. A review of the stakeholders with their roles and interests are given in Table 1.

**Table 1 Stakeholders with their roles and interests in UCC solution**

| Stakeholder | Role | Participation in solution | Interest |
|---|---|---|---|
| **Shipper** | Sender of the goods; provide goods to the retailers in the city centre. | No participation | No interest |
| **Transporter / LSP** | Delivers the goods of the shipper to the delivery address. | Not active participation. Since the participating retailers change their delivery address as DHL UCC, they deliver the goods to DHL UCC. | In small-scale no interest, if it can be applied in large-scale, they might not have to enter the city centre and save kilometers. |
| **Retailers** | Receive the goods from the LSPs and sell to their own customers. | Active participation by changing the delivery address to DHL UCC. | Bundled deliveries, saves time. Real time information on delivery. Less parking problems in front of the retailer. |
| **City Council** | Governing the city, regulations about traffic, environment etc. | Participation via advertisements for the retailers and by consolidating the deliveries of 5 municipality buildings. | Social benefits such as reducing the traffic and environment related problems. |
| **Other supply chains of DHL** | Delivering to the retailers in the city centre | Participated by consolidating at DHL UCC | Saving time and fuel costs |
| **DHL UCC** | Delivering to the retailers in the city centre | Management of consolidation: Consolidation and delivery of consolidated goods to the retailers | Being a frontrunner of a new concept. Possibly in the future acquiring new revenue streams |

## 3.3 Business model canvas

In the case of DHL SC Spain, the business model canvas represents a complete new case, since it doesn't bring a change to their usual business model but forms a new business model. In that sense, this case differs slightly from other cases.

A detailed explanation of the business model canvas is made in the Deliverable 5.1. Here we will give a short description with the most important parts of the canvas.

Looking at the right side of the canvas (see Figure 7), we can see that the customers for the demonstration are the retailers since they can control the supply chain by changing their delivery address. The main value proposition for the customers is one time delivery by bundling several supplies (from various suppliers) and thereby reducing the parking problem in front of the shops. In order to convince the retailers to participate in the solution, customer relationships are held quite intensely. Acquisitions and support are done personally. Although there are some benefits that the retailers can get from the solution, they were not willing to pay. Therefore there are no revenue streams for DHL SC Spain in this case.

On the left side of the canvas, we see as the key partners the city council and LSP's. City council offers support by dissemination and promotion activities and LSP's deliver to DHL SC since the retailers change the address to DHL UCC. The activities of DHL SC include customer acquisition and management of the UCC which involves planning, operation, consolidation and last mile delivery. Resources that DHL uses for the solution are an urban terminal (which was chosen as DHL warehouse during the demonstration), urban fleet and extra staff. Due to their extra activities and resources, there are also additional costs in the business model of DHL SC. As investment costs we see the costs made for the arrangements in the warehouse of DHL (IT and engineering), the labour cost for the development of the solution and for customer acquisition (dissemination and promotion). The operating costs are made for the extra staff at UCC, IT and engineering costs for planning and operations. There is also some decrease in the costs of DHL due to the consolidation of 3 other supply chains.

<table>
<tr>
<td rowspan="2">Key Partners<br>1. City Council or local administration (support by dissemination and promotion, free advertisement)<br>2. LSP's (since they deliver to DHL SC Spain)</td>
<td>Key Activities<br>1. Dissemination and promotion<br>2. Customer acquisition<br>3. Enrolment of the shipments in the UCC<br>4. Planning and operation of the terminal in daily basis<br>5. Consolidation with 3 other DHL SC Spain supply chains</td>
<td>Value Proposition<br>1. One time delivery by bundling several shipping<br>2. Less parking problem in front of the shop, easier operations<br>3. Green image<br>4. Free advertisement via city council on municipal newspaper and website</td>
<td>Customer Relationships<br>1. Personal relationships with the retailers both for the acquisition and support<br>2. Participation agreement</td>
<td rowspan="2">Customer Segments<br>1. B2B, the retailers (receivers) in the commercial mall and in the city centre<br>2. In the second phase also the municipality buildings</td>
</tr>
<tr>
<td>Key Resources<br>1. A good urban terminal. Good location, infrastructure, management system<br>2. Urban fleet adequate to the service requirements<br>3. Extra personnel; driver and administrative</td>
<td>Externalities<br>1. Reduction of traffic and emissions<br>2. Less space/parking problem<br>3. Less visual and noise nuisance</td>
<td>Channels<br>1. First phase: Personal visit to the customers<br>Second phase: First contact via Merchants Association, then CENIT contacts the retailers via phone, then personal visit of DHL SC Spain with CENIT<br>2. Change their address<br>3. Last-mile delivery provided by DHL SC Spain</td>
</tr>
<tr>
<td colspan="3">Cost Structure<br>1. Investment costs: Extra arrangements in DHL facilities for UCC (IT and engineering) Labour cost for development of the solution and for customer acquisition (dissemination and promotion),<br>2. Operating costs: Extra staff UCC, IT/engineering costs, Less transport costs due to the combination of the supply chains</td>
<td colspan="2">Revenue Streams<br>No revenue streams</td>
</tr>
</table>

**Figure 8 BMC DHL's UCC in Barcelona**

The UCC brings some changes also in the business models of other stakeholders. These are small changes compared to the business model of DHL SC Spain. However, they are still important to analyse since it helps us to understand how each stakeholder is affected by the innovation.

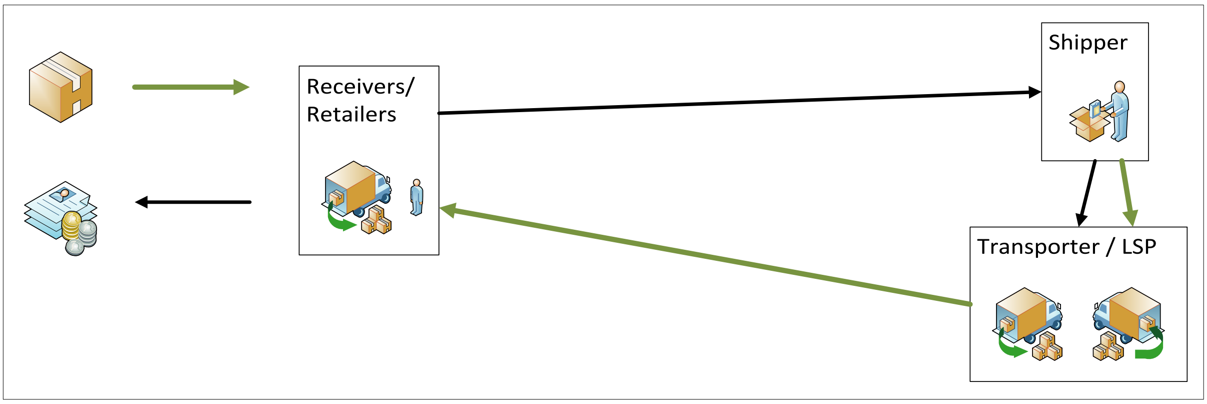
## 3.4 Business model changes for other stakeholders

Figure 8 represents the situation before the implementation of UCC called 'business as usual' and with the implementation of UCC.

In the first picture, the retailer orders some goods and pays the shipper. The shipper hires the LSP for the transport and pays the LSP and the LSP delivers to the retailer. In the second picture, there is not much change in the first part of the story. The receiver orders and pays the shipper and the shipper hires the LSP and pays the LSP. But then, the LSP delivers to UCC and the UCC does the last mile delivery. As it can be seen in these pictures, there are no changes regarding the money flow, but the transport of the goods.

In the second picture, the business model canvases are shown for each stakeholder, with green, orange and red colours, representing positive, neutral and negative changes.

*Business as usual*




*Business with the solution*

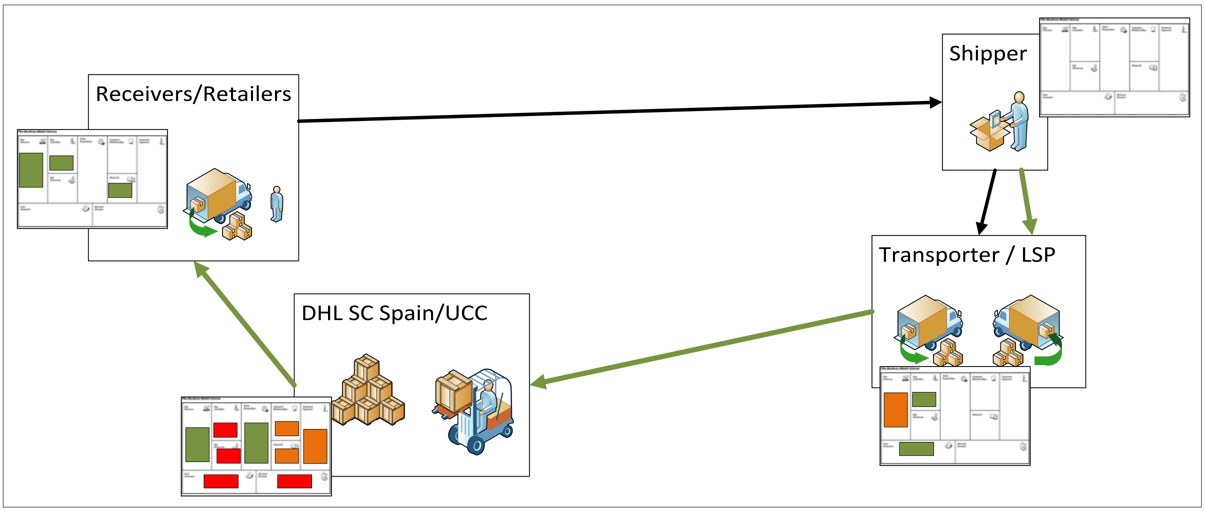



**Figure 9 Business as usual and UCC implementation**

The business model of the UCC, managed and operated by DHL SC Spain, has been already discussed. Here, we represent if these changes were experienced by the organisation as positive, negative or neutral. The market side, meaning the right side of the canvas is mainly neutral since the type of customer that DHL serves with this innovation is a type of customer that DHL is already familiar with. Regarding customer relations and channels, there are also no big changes. However, the part of revenue streams is represented in red, since there are no revenue streams for the UCC. The value proposition is coloured by green since there are new value propositions such as bundled transport and improvements such as better track and trace system. Another green area is the key partners, since DHL SC Spain expands its partners and its network to implement this solution. They partner with the city council and they come more in contact with other LSPs since other LSPs deliver to the UCC instead of the shops. There are three red areas in the canvas of the UCC; key activities, key resources and cost structure. The solution requires investment in new activities and resources. One of the challenging activities during the demonstration was the customer acquisition. Next, there have to be new facilities and equipment to do the handling of the goods at UCC and the last mile delivery. These altogether lead to new costs.

The receivers experience changes in three different areas in their business models; channels, key activities and key partners. During the demonstration the municipality offered free advertisement in the public newspaper for the participants. This can help the retailers to reach more customers. The change in the activities is that they have one time pick up of the goods instead of several times due to bundled transport. With this solution, they partner with DHL SC Spain and the city council, which means expanding their network from which they can benefit in other occasions as well.

LSPs experience changes in 3 different areas in their business model canvas, being all on the left side of their canvas. This means that they do not experience any change related to their customers and market. They experience a change with the partners since they deliver to UCC, they come into contact with DHL SC Spain. However, this is a quite minor change and therefore interpreted as a neutral change. The other changes are in their activities and cost structure. With the solution, they deliver to the UCC instead of the retailers. They can do their delivery in this way in a more bundled way, which makes the job much easier for them. This leads also to time and fuel savings which can be seen in the cost structure as a positive effect.

When we look at the picture, we see that the receivers and LSPs experience benefits of the innovation, while UCC only experiences the costs. Shippers do not get much affected from the solution unless they are responsible for their own transport (but they are then affected in their role as private carriers).

## 3.5 Business case

In order to make a sound comparison between the costs and benefits of business as usual and that of the business with the solution, cost and benefit calculations are done for two different cases (see Table 1):

1. Demonstration case (11 retailers, 5 city council buildings, 3 DHL supply chains), i.e. the demonstration situation, and

2. Solution in large-scale (a big demand attractor, city council buildings and more retailers in the centre of l'Hospitalet to create a demand of 74k pallets annually).

The calculations of the business case for the demonstration are based on the real costs made by DHL SC Spain during the demonstration, where 11 shops and 5 city council buildings participated. Additionally, DHL SC Spain combined their other 3 supply chains for cost reduction purposes. Although they could reach some cost reduction, in total the investment and operating costs of the UCC during the demonstration were much higher than the cost reduction. Since, there were no extra revenue streams for DHL SC Spain, their business case is negative.

The business case for the large-scale scenario will not be any different than the demonstration if there are no new revenue streams for DHL SC Spain. Therefore, it does not make much sense to increase the number of the retailers if the business model is not changed. Since there are stakeholders who benefit from UCC, either the benefits that they experience or the costs of UCC should be shared so that UCC has a positive business case.

The calculations for the large case scenario are made to discover the total costs and benefits of a possible scenario for different stakeholders. The calculations are based on the discussions with DHL SC Spain and on the study 'UCC Project appraisal for l'Hospitalet de Llobregat' done by CENIT (LLoret-Batlle et al., 2014).

For the large-scale, the business case for business as usual is not calculated since this innovation is a complete new business and the usual business of DHL is not relevant to this new business. Instead, the possible savings of other LSPs are calculated.

For the large-scale scenario, it is assumed that a big demand attractor, city council buildings and more retailers in the centre of l'Hospitalet participate in the UCC. The calculations are made with the assumption that these participants would create a yearly demand of 74,000 pallets[1].

**Table 2 Business case characteristics UCC cases**

| Pilot | Scaled solution |
|---|---|
| Calculation based on 3120 pallets yearly (832 pallets in 3.5 months of demonstration) | Calculation based on 74,000 pallets yearly |
| • Customer acquisition *(interviews with retailers and meetings between DHL, CENIT and the Council)*<br>• Labour cost *(staff of DHL working on the pilot for Straightsol)*<br>• Labeling of the vehicles *(Straightsol logos)*<br>• No building costs *(DHL used its own facilities)*<br>• No office costs (*DHL used its own facilities)*<br>• IT/engineering costs include the cost of the equipment (forklift) | • Less time required for customer acquisition<br>• No extra staff necessary working on the project<br>• No Straightsol logos necessary<br>• Building costs<br>• Office costs<br>• Equipment and IT costs are taken separately<br>• Transport costs are estimated by using the normal operations of DHL[2] |

Table 1 illustrates the costs made during the demonstration and the costs estimated for larger scale scenario. To calculate the yearly operational costs of the demonstration, the total operational costs made during the demonstration are used to calculate the monthly average costs. Later, these are multiplied with 12 to calculate yearly costs.

**Table 3 Business case UCC cases**

| BUSINESS CASE | | |
|---|---|---|
| **CAPEX** | | |
| | **Demonstration** | **larger scale UCC** |
| Customer acquisition | | 4,081 |
| Travel costs | 1,500 | |
| Personnel costs (sales person) | 6,662 | |
| Logistics | | |
| IT/Engineering costs (preparation) | 14,158 | 695,540 |
| Labour cost + indirect costs | 140,225 | 70,113 |
| Transport solution | | |
| Labeling of the vehicles | 150 | |
| Total Capex | 162,695 | 769,734 |
| | | |
| **OPEX (per year)** | | |

[1] This amount of demand is considered as necessary by DHL SC Spain to have a positive business case.

[2] 40% of all the transport costs from a normal operation of DHL is taken as the last mile transport costs.

| | | |
|---|---|---|
| Logistics | | |
| Building lease and user costs | | 441,075 |
| Personnel in the building (HR subcontracting) | 292,056 | 638,131 |
| IT/Engineering costs (Security (cameras)) | 138,480 | 84,700 |
| Operational lease of equipment | | 72,958 |
| Office costs | | 8,111 |
| Transport activity | | |
| Transport costs | 181,063 | 904,751 |
| Total Opex | 611,599 | 2,149,726 |

Investment costs are added to operational costs by using their depreciation values so that the total yearly costs can be observed. For depreciation values, 10 years of operation is taken as basis.

**Table 4 Business case characteristics UCC cases total costs**

| Total Capex + Opex | | |
|---|---|---|
| | **Demonstration** | **Solution in large-scale** |
| Capex Yearly Depreciation | 16,270 | 76,973 |
| Yearly Opex | 611,599 | 2,149,726 |
| Total Yearly Costs | 6,27,868 | 2,226,699 |

As it can be seen in the Table 1, the yearly costs for a large-scale implementation are 2,226,699€ and there are no revenue streams which can cover these costs. In order to cover these costs, DHL SC Spain should change its business model and find other stakeholders who are willing to share either the costs or the benefits.

The allocation of the costs and benefits resulting from a UCC scheme is seen as one of the key considerations (based on Browne et al, 2005; Transport and Travel Research Ltd., 2007 and Marcucci and Danielis, 2008). This case proves this aspect to be very important as well.

In the deliverable 5.1, the overall costs and benefits for all stakeholders are represented in a table. A summary of that table with a focus on financial costs and benefits is in Table 1.

**Table 5 Business case characteristics UCC summary**

| DHL SC Spain | Shippers | LSP | Retailers | City Council |
|---|---|---|---|---|
| UCC costs | | Less transport costs<br>Time savings | Time savings due to bundled transport | Less trucks in the city, less maintenance of the roads |

Although the solution offers benefits to 3 other stakeholders (LSPs, retailers and city council), the main financial benefits are experienced by other LSP's as decrease in their fuel cost and time spent to travel. During the demonstration, the scale was not large enough to prevent LSPs enter the city centre. If the solution can be implemented in large-scale, it has the potential to reach this ambition. However, for large-scale implementation, there are some challenges to overcome, such as financial feasibility of the solution. These challenges are discussed more in detail in the following sections.

### 3.6 External cost and benefits

The solution is expected to result in important external benefits such as decreasing the congestion in the city center and decreasing the emissions. These ambitions can only be reached if the solution is implemented in a scale which is large enough to prevent other LSPs entering the city center. Since this is not happened during the demonstration, LSPs still had to enter the city center and the decrease in their travel distances was not significant. Moreover, since they did not actively participate in the demonstration, the actual decreases in their travel distances could not be measured quantitatively. Because of these reasons social costs and benefits of this case could not be analysed.

### 3.7 Results viability and fit analysis

Four stakeholders are analysed for the viability and fit analysis of the solution. Shippers are not taken since the solution does not cause any difference in their business models.

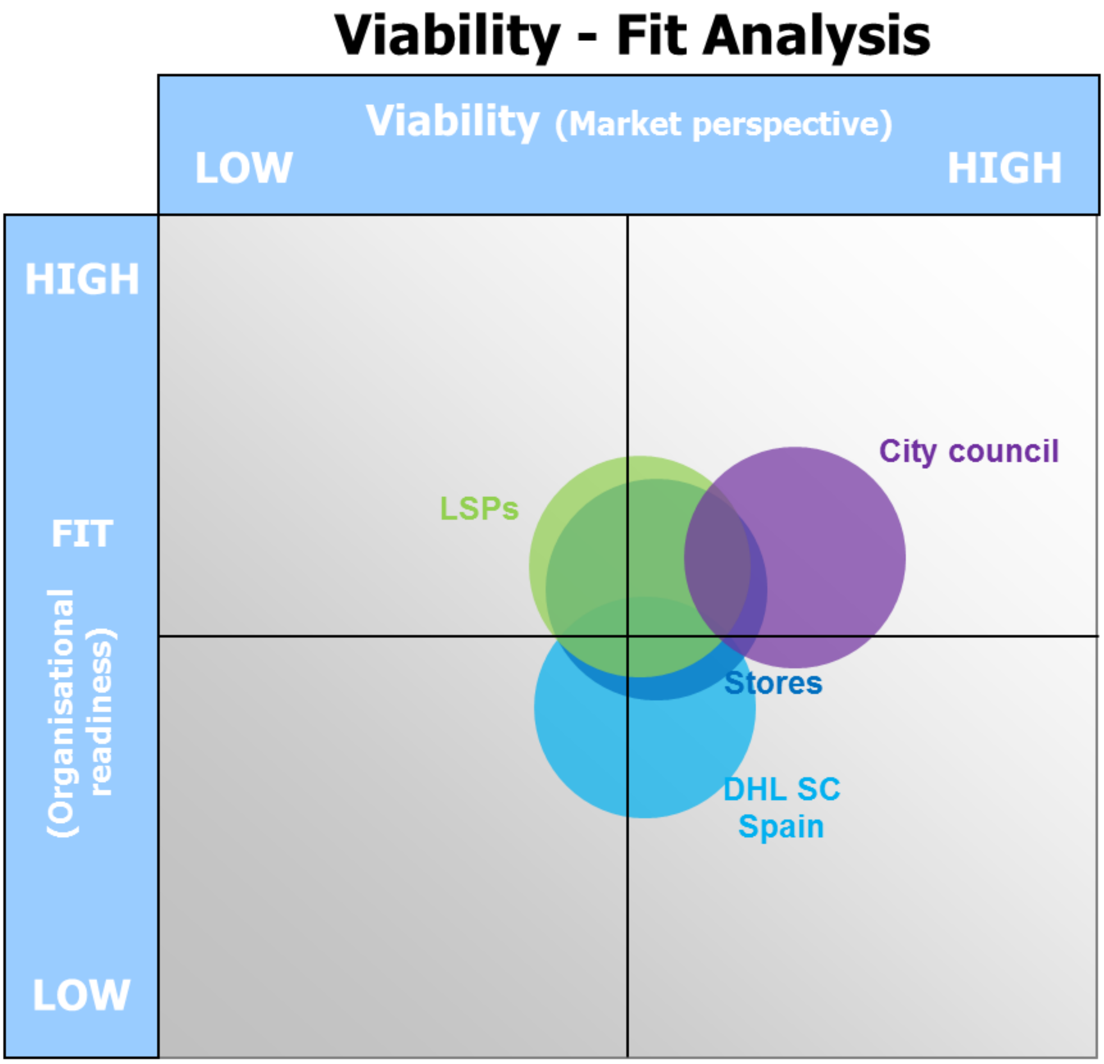



**Figure 10 Viability – Fit Analysis UCC**

1. ***DHL SC Spain:*** DHL SC Spain scores slightly positive for market perspective. Although the solution brings improvements to their service for their customers, they do not score extremely positive since there are no customers willing to pay in the current situation. This is a very important criterion since it ensures the financial viability of the case. Other than that, there are criteria which have positive impact on the viability of DHL such as addressing

a specific problem of their customers by offering bundled transport to the receivers. Another positive impact for DHL is that the solution increases their customer base and the contact with their customers. With the solution, DHL has the potential to increase the customer satisfaction and also contribute to social and environmental benefits.

For organizational readiness, the company scores negative. The solution requires new resources (new IT system, adjusting the facilities) and new activities (customer acquisition, management of UCC), in case of large-scale utilization (these investments were not necessary during the small-scale demonstration). Although most of these new resources and activities match with the current resources and activities, they require a significant amount of investment, which is the main reason for the company to score negative in organizational fit.

2. ***Stores/Receivers:*** Stores score positive in both aspects since the solution brings improvement for their organization. Considering the market perspective, there are not many changes related to their own market, but the improvements that the solution brings such as less traffic and less parking problems in front of their retailers can increase the satisfaction of the stores' customers. Additionally, by participating in the UCC, they contribute to non-financial benefits such as environmental and social benefits.

   Stores score also positive for organizational readiness because of the improvements in their transport activities due to bundled transport. The solution can create the possibility to get rid of their storage room as well. There is no direct financial impact on their organization but due to bundled transport, it can result in time savings. A non-financial benefit for the stores, during the demonstration was the free advertisement in the municipal newspaper offered by the city council.

3. ***LSP:*** LSPs also score positive in both aspects, although it does not have a direct effect on their business model aspects related to their customers. The customers of LSPs are mainly shippers. The solution does not bring any improvement for the shippers. However, since the receivers are the customers of the shippers and the shippers of the LSPs, the receivers' satisfaction from the service can increase the shippers' satisfaction as well. Therefore, the effect is more subtle than in the case with receivers.

   Regarding the organizational fit, they score quite high since they experience some important benefits such as cost reduction and time savings (whereas there are in the current model no reductions in the LSPs' revenues). Additionally, the solution matches strongly with their current logistics and organizational activities.

4. ***City Council:*** the City Council is the stakeholder that scores most positive in both aspects. Both in market perspective as well as in organizational readiness, the solution brings significant improvements for city council considering that the interest of the public is also the interest of city council.

   The impact of the solution is mainly in its externalities, such as traffic and parking problems, environmental and social aspects. Therefore, by implementing this initiative in large-scale, city council would address a specific problem of the citizens which in this case can be taken as the customers of the city council. Moreover, marketing the initiative could help to improve their image towards the citizens. The implementation of the solution would increase the satisfaction of the citizens about their cities. If the city council participates actively, it can also increase the contact that they make with the citizens.

   Taking the value offered by the council as safety on the road, less traffic and clean air, the solution strongly matches with the current value proposition of the council. It also fits very well to the mission of the council which is creating a pleasant city environment to live. Moreover, the solution does not create any financial burden for the council as it is applied during the demonstration. Therefore, it fits very well to the council.

If we look at the whole picture of viability and fit analysis, we see that the solution has positive impacts on market perspectives for each stakeholder, especially for city council since most of the benefits are social benefits. It also fits to each stakeholder's organization except DHL SC Spain, which is the executer of the initiative. Since the main reason for DHL SC Spain to score negative in fit aspect is the financial negative effects, the main challenge for the initiative is the financial aspects.

## 3.8 Prerequisites for successful implementation

There are several challenges for the solution to be successfully implemented in large-scale. As analysed and mentioned earlier, the main challenge is to reach a financial feasibility with the solution, where the costs and benefits are allocated differently. This requires a new way of organization of the market.

Other challenges identified during the demonstration were: guaranteeing the demand, which requires convincing the stakeholders for participation and finding a suitable location as the location used during the demonstration might not be available for large-scale implementation. Apart from the challenge about the location, the challenge of guaranteeing the demand and convincing the stakeholders depend strongly on the organization of the market. Therefore, we keep the focus on the organization of the market and the business models of different stakeholders.

During the demonstration, the customers are taken as the receivers and they were asked to change their shipping address as the address of the UCC. One of the main reasons to choose this approach was to ensure the required demand. Although the solution has some value propositions for the retailers, such as bundled transport, these were seen as minor changes by the retailers (i.e. the efforts for changing / transition were sometimes considered to be higher than the benefits they could gain). Thus, they were not willing to pay to UCC since there was no decrease in the amount that they pay to the shipper.

However, the receivers are not the only stakeholders that benefit from such a UCC scheme. It offers benefits to LSPs and also to city council.

**Value propositions for different stakeholders**

In this section, we make a list of value propositions for different stakeholders. Some of these are already proposed by the UCC/DHL SC Spain and some not. We include here also the ones that are not offered by DHL so that we can gain insight about potential solutions.

- Receivers
    - Bundled transport
        - One-time pick-up instead of several times
        - Time savings
        - Less trucks in front of the door
        - Less parking problem in front of the shop
        - More attractive shopping street for the consumers
    - Off-site stockholding
        - No need for extra storage room (at costly location in store in centre)
    - Pre-retailing such as unpacking, ticketing and handling of returns
        - Time savings
        - Possible personnel savings
- LSPs
    - Less stops in the city centre, potentially avoiding entering the city centre
        - Time savings
        - Fuel and money savings
    - Bundled delivery to the UCC
        - Easier planning
        - Higher load factors

- City Council and the citizens
  - Less trucks in the city centre
  - Less congestion and better traffic flow
  - Less noise
  - Less emission
  - More pleasant city environment

**Possibilities for a financially viable UCC?**

In this section we analyse possible scenarios with their drivers and barriers. One of the main challenges to analyse these scenarios is quantification of the costs and benefits, especially the benefits. The costs can be estimated to some extent, however it is very difficult to estimate and quantify the benefits. First of all, the benefits are experienced by different stakeholders. In order to be able to estimate those, it is necessary to get information from those stakeholders. Secondly, most of the benefits are social benefits, such as less parking problems or less traffic problems.

**Option 1:** *Agreement with the receivers with other value added services for which they would like to pay*

Taking the receivers as the customers of the UCC and making agreements with them ensures the demand, which is very important for the financial feasibility.

During the demonstration, it was very difficult to convince the retailers to participate in the demonstration. Therefore, there have to be other services offered by the UCC, such as off-site stockholding or pre-retailing. However, it is questionable if these extra services can provide the required revenue to compensate the costs made by the UCC. Additionally, due to recession, retailers are not willing to pay for extra services. In such situations, they usually prefer to perform these tasks self so that they can save some money.

In this scenario LSPs and the city council still enjoy the benefit of the UCC for free.

<u>*Driver:*</u> Guaranteeing the demand

<u>*Barrier:*</u> Not enough revenue streams, difficult customer acquisition (very time-consuming, and proposition has to be tailor made for each receiver). Maybe a relatively weak value proposition: especially nice to haves for retailers rather than that they are willing to pay (and recession makes it even more difficult).

**Option 2:** *Agreement with other LSPs for cost or benefit sharing*

Since LSPs are the ones who experience the main financial benefits, this solution seems to be the most logical one (reasoning based on financial flows). Either the costs made for the UCC or the benefits experienced by the LSPs should be shared.

However, LSPs usually are reluctant for this option, since this scenario is seen for them as losing a part of their business. Usually, the last mile distribution is less than 5% of the total distance they travel. However, the costs can be more than 40% and that is also where the tariff is based on. This means that sometimes more than 40% of the turnover of a LSP is from last mile deliveries. Therefore, giving this part of the business to another party does not seem to be logical, as it will result in a decrease in turnover as well as that many LSPs consider it their core business to make these deliveries in the first place. On the contrary, the study done by CENIT (LLoret-Batlle et al., 2014) shows that if the LSPs give their savings (the cost for the last mile delivery) to the UCC operator, the business case of the UCC will be positive if all the retailers in the demonstration area (331 retailers) participate in the UCC. If that is the case, this scenario can be successful since both UCC operator as well as the LSPs will enjoy the benefits. However, it is important to mention that a theoretical model is used to quantify the costs and benefits. It is necessary to use practical information as well, which requires a lot of transparency from different parties. Additionally, such a scenario might require either a strong collaboration with all the LSPs involved or restrictions from municipality or geographical restrictions such as very narrow streets where it is not possible to drive trucks such as in some Italian cities. Otherwise, it is necessary to develop a charging scheme for other LSPs which would make the solution financially interesting for them as well.

In the case of Binnenstadservice (BSS) in the Netherlands (Quak and Tavasszy, 2011), the original business model aimed the receivers as their customer segment since their involvement was crucial in the start phase to ensure the deliveries coming to UCC. However, later they changed their business model because the receivers were not willing to pay and the carriers had the main benefits. In that case, scaling the concept to other cities with a franchising model helped BSS to become a partner for carriers. However, it can not be said that this change was enough to become sustainable since the local branches had to find other revenue streams from extra services or subsidies from local governments.

Browne et al (2005), gives as possible barriers by the LSPs in such a scheme security issues, loss of control over timed deliveries/responsibility, perceived increase in damage through extra handling.

According to the recent study of Olsson and Woxenius (2014), small road hauliers serving the retail sector in Gothenburg, Sweden, see the opportunities for consolidating freight via a consolidation centre very limited. One of the restrictions that they identify is time and punctuality being the shippers' priorities rather than cost. Others are difficulties in matching deliveries among participants, shippers' unwillingness to wait for vehicles to fill up as the risk of delays increases; and small time gains for small road hauliers. There are also concerns about the increase in total transport time in case the consolidation centre is located far from the small road hauliers which would add extra vehicle kilometres.

*Driver:* Possibility for a fair allocation of costs and benefits

*Barrier:* Reluctance by the LSPs to collaborate due to the fear to lose a part of their business or to lose the control of their deliveries as well as their core business

**Option 3:** *Agreement with shippers (paying to UCC for last mile delivery instead of LSP's)*

Since it might be challenging to convince the LSPs to participate in the UCC, another option might be to make an agreement with shippers. This option seems reasonable if one thinks that shippers are the ones having the market power (they usually pay for the transport organized by LSPs). Having an agreement with shippers will ensure the required demand as well.

However, the solution does not offer much for the shippers. They do not have much interest in this initiative, apart from being more environmental friendly and most of the time only this benefit on its own is not sufficient to invest in changes in an organization. Moreover, the transport costs form a very small percentage of their costs. Therefore, even if it is possible to offer shippers some decrease in their transport costs, this might not be enough to convince them for participation.

*Driver:* Shippers have the market power, the required demand can be guaranteed

*Barrier:* Shippers do not experience a real benefit of the UCC, therefore difficult to convince

**Option 4:** *Combination with other logistic solutions such as electric vehicles or bicycles to decrease the costs*

Another opportunity is to combine the solution of UCC with another urban solution such as using electric vehicles or bicycles for urban distribution. In this way an urban consolidation centre contributes to making a vehicle technological solution work; i.e. due to the use of an UCC the limited range of for example electric freight vehicles. Quite often the UCCs result in extra costs (see FREVUE, 2013), but in some cases – where for example bicycles or electric vehicles have advantages, the overall solution might be feasible. Advantages can be extended time-windows, more parking space available, etc.

*Driver:* Make use of zero emission technology feasible (from logistics perspective)

*Barrier:* Usually not enough by itself, still new revenue streams are needed

**Option 5:** *Active involvement of the municipality to restrict the entrance of other carriers in the city centre*

As mentioned before, there are many benefits of the UCC for the citizens, both environmental and social benefits. Therefore, it makes sense that the municipality has to be involved actively in the solution. One of the ways for them to be involved is bringing some regulations to the city entrance for freight deliveries. If the municipality restricts the entrance of other LSP's to the city centre, they will have to participate in the UCC. However, this can create some problems as well such as in the case of Vicenza (Allen et al., 2012). In that case, the city transport authority limited the vehicle access severely to the city centre to encourage the use of the UCC. But, this approach runs the risk of market disruption due to the decreasing competitiveness of other carriers. In the case of Vicenza a trade organisation representing other carriers bought a legal challenge about the city authority's scheme. Although the State council authorized the city authorities in this case, it still shows that severe restrictions can result in complex legal and political issues (Allen et al., 2012; Ville et al., 2010).

# 4 City Logistics Mobile Depot in Brussels – TNT Express

## 4.1 Case description

TNT Express is an express parcel service provider, with many pick-up and delivery addresses in urban areas. An important part of TNT's operations takes place in inner cities. In the STRAIGHTSOL demonstration, TNT tested the use of a mobile depot in Brussels. They expected that it would make their last mile deliveries more environmentally friendly and less hindered by congestion. The mobile depot (a trailer with a loading dock and warehousing facilities) was moved daily between the TNT Express hub near the airport to a predefined parking area in the city. From there, last-mile deliveries and pick-ups were carried out with cargo bikes and/or small electric cars. In several cities, tricycle couriers are more and more common and some urban consolidation centres use electric cars to do the last-mile deliveries. The concept of a mobile depot that is loaded outside the city and driven into the city to be the base point for the last-mile deliveries, however, is completely new.

The demonstration ran between June and August 2013, with all TNT Express parcels destined for the postcode areas of 1030 (Schaarbeek), 1040 (Etterbeek) and 1210 (Sint-Joost-Ten-Node) being delivered through this depot. The expected benefits in terms of emission savings were indeed identified. However, the investment and operational costs appear to be too high to make the solution financially viable under the demonstrated circumstances. TNT would like to explore the most ideal conditions, for which the mobile depot could be a viable solution. These conditions, relate to:

1) the use of the mobile depot (e.g. parking location, fill rate)
2) the freight profile of the urban area (e.g. mix of packages, stop density),
3) the utilization of vehicles (e.g. capacity, operational performance)

## 4.2 Role stakeholders

Table 6 shows the stakeholders that participated actively in the demonstration.

**Table 6 Participating stakeholders in TNT solution**

| Stakeholder | Role | Participation in solution | Interest |
|---|---|---|---|
| TNT Express | Delivers express parcels | Inner city deliveries through mobile depot, with Ecopostale as subcontractor | Improve the efficiency of TNT Express' operations and service to customers, while contributing to a better environment in the city center. |
| Brussels-Capital Region | Policy makers in Brussels | Support concept by providing public space to park the mobile depot. | Improve livability of the city in terms of pollution, safety and congestion. |
| Transport company (Ecopostale) | Subcontractor for last/first mile transport services | Couriers providing transport services using electrically driven cyclocargos and small electric vans | Environmentally friendly business in the city. |

## 4.3 Business Model Canvas

The Business Model Canvas clearly shows that TNT Express does not have to change its entire business model for this demonstration. It is their aim to fit the new solution within their existing value proposition and key activities. New activities are outsourced to a (new) subcontractor.

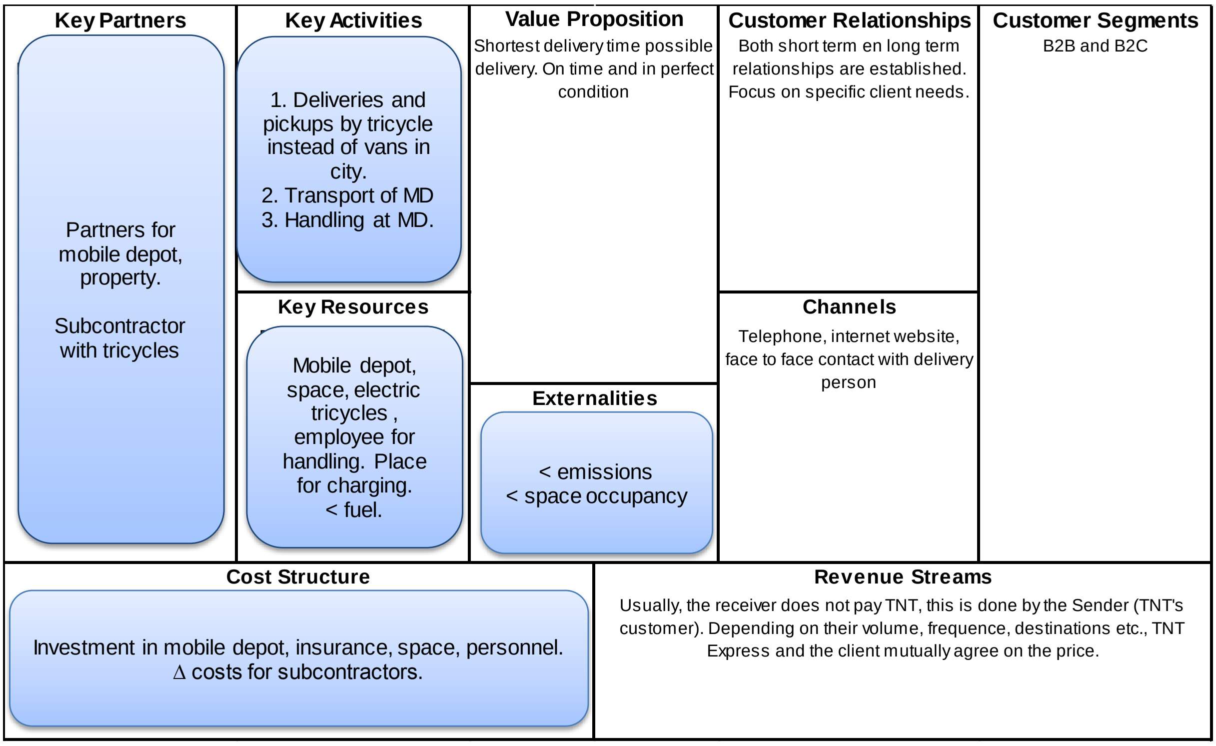



**Figure 11 Changes in Business Model Canvas TNT due to mobile depot**

***Customer, channel and relationship:*** On the right hand side of the canvas, changes are minimal. TNT Express aims its operations at the B2B and B2C market. The customer segments and the relationship that is established with the customers do not change after the implementation of the mobile depot. The channel changes partly, as some deliveries are carried out through the mobile depot and tricycle. However, the customer has no influence on the transport mode that is used.

***Value proposition and externalities:*** The value proposition of TNT is delivery in shortest possible time, on time and in perfect condition. With the use of emission free tricycles for the last mile, the service becomes environmentally friendly in the city. The negative externalities in term of emissions and traffic (congestion) decrease when vehicles are substituted by tricycles.

***Partners, activities, resources:*** Deliveries and pickups are carried out by tricycles instead of conventional vans. The goods are sorted and (un)loaded onto the tricycles at the mobile depot. The mobile depot, which is a converted trailer, is driven daily from the TNT express hub to a parking place, near the city. For these activities and resources, TNT Express needs three new important partners: the zero emissions courier service provider, the owner of the parking space and the manufacturer of the Mobile Depot. The need for conventional vehicles, van drivers and fuel in the city will decrease. TNT also needs a different allocation of personnel as employees are needed to fill and sort parcels for the mobile depot.

***Cost structure and revenue streams:*** Costs are incurred mainly for the mobile depot and the property. Costs for the subcontractors will change as the cargo bikes perform differently in terms of range and costs. There are additional costs for the movement of the mobile depot, twice a day. Revenue streams do not change on short term. On a longer term, the revenues could raise if more senders attach value to the fact that TNT Express aims to do its deliveries in an environmentally friendly way.

## 4.4 Business Case

The business case considers the financial results of the demonstration as well as for the proposed scaled scenario (where the mobile depot is used for 90% of its capacity). As many cost elements are uncertain, a sensitivity analyses is carried out. In addition to the financial results, the external costs and benefits are analysed as well.

### 4.4.1 Input variables and four scenarios

From the business model analysis, the main cost elements become clear. There are no changes on the right hand side of the canvas; revenues streams remain equal. The cost elements are categorized as follows:

- **CAPEX:** this includes the investment costs for the mobile depot of 203 kEUR[3], which are depreciated over 4 years and the GPS installation.
- **Moving and parking mobile depot**: costs for the truck that moves the mobile depot twice a day and costs for maintenance and parking.
- **Additional labour**: additional labour is needed for handling, both at the BRU (i.e. the location at the Brussels' airport is called 'BRU' by TNT - where the mobile depot is filled and leaves to the city) and at the mobile depot's location in the city.
- **Delivery by subcontractor**: the input variables that relate to the performance of the subcontractors are the number of deliveries/pickups per stop, the average kilometres per stop, the cost per stop that TNT pays and the need for ad hoc vehicles.

The calculations for the demonstration (i.e. pilot) are based on 587 delivery and 144 pickup consignments monthly. This is considered as 40% of the mobile depot's capacity. The scaled scenario is calculated at 90% use of the mobile depot, i.e. 1321 delivery and 324 pickup consignments monthly.

The expected benefits in scaled scenario, as opposed to demonstration are as follows:

- **Ecopostale MD activities**: the extra activities carried out by Ecopostale relate to the sorting process in the MD (mobile depot), moving the bikes from Ecopostale to the MD and manning the MD with a team leader. These costs are not volume driven. In the scaled scenario, these costs therefore remain the same, at an increased number of deliveries.
- **Extra labour BRU staff:** During the pilot extra labour costs were made for TNT staff at the BRU. This was mainly due to the new activities and relationship with Ecopostale. The staff spent quite some time for check-ups. In the scaled scenario, when the relationship and capabilities of the subcontractor are well developed, it is expected that these costs can reduce with 50%. The cost is not volume driven.
- **Performance subcontractor:** For optimal use of the mobile depot it will be required that the subcontractor (Ecopostale) has an electric vehicle in its vehicle fleet. During the pilot, parcels that were not suitable or able to be delivered by the cargo bikes were ad hoc delivered by vans, this accounted about an additional 20% of the total cargo bike costs. For the scaled scenario, goods that are not suitable for cargo bike delivery will mainly be delivered by electric vehicle. The subcontractor will be responsible for these deliveries.

[3] 150,000 euro for the trailer, 30,000 euro for the hydraulic extension mechanism and 20 to 25,000 euro for all the equipment.

An additional 5% of is reserved for ad hoc vehicles, that will be needed for deliveries outside the agreed time windows of the subcontractor.

- **Parking costs:** we assume that the costs for parking are 25% less than during the demonstration, because of the possibilities for long-term contracts and/or governmental support.

**Table 7 Input for the four scenarios**

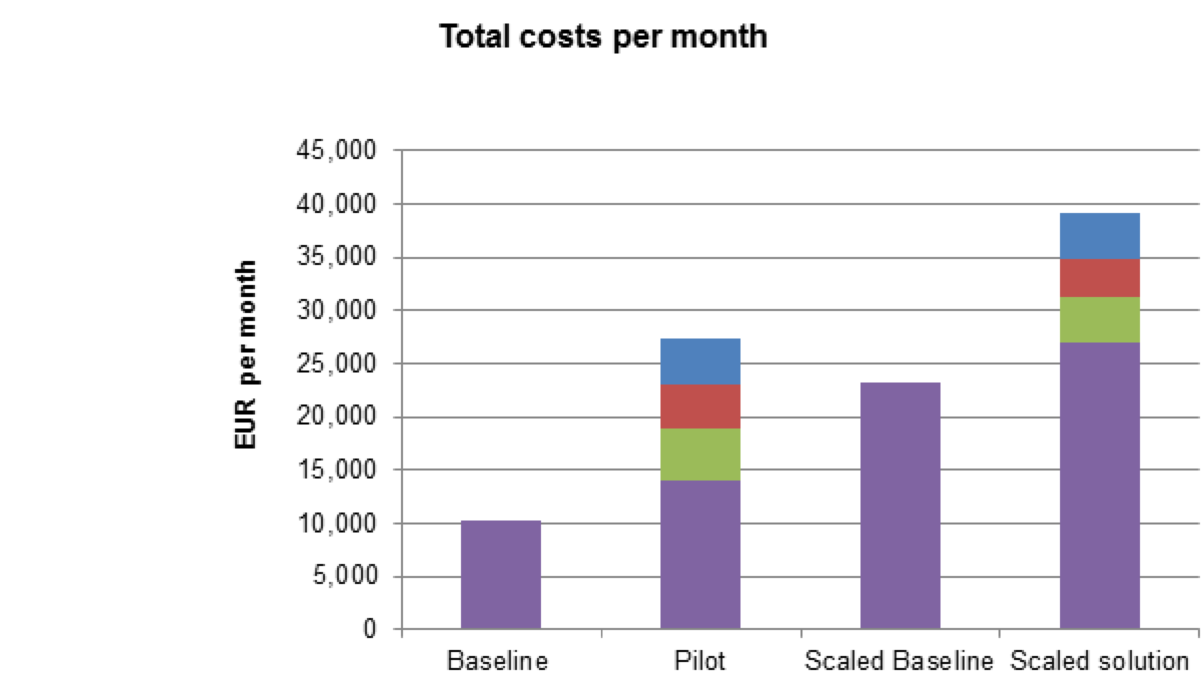
| | Scenario | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|---|
| CAPEX | | 0 | 203 kEUR | 0 | 203 kEUR |
| Moving and parking | Transport of MD from/to depot | n/a | 14 km | n/a | 14 km |
| | Maintenance and service MD | | - | | €75 p/q |
| | Parking rental Jubelpark | | €1,125 p/m | | 75% of pilot costs |
| | Prohibition to park signs | | €767 p/m | | |
| Additional labour | Extra labour BRU staff | n/a | €313 p/w | n/a | 50% of pilot costs |
| | Ecopostale MD activities | | 24 hour p/w | | 24 hour p/w |
| | Cleaning | | €130 p/w | | €130 p/w |
| Delivery by subcontractors | Average deliveries per stop | 1.3 | 1.3 | 1.3 | 1.3 |
| | Average pickups per stop | 2.00 | 1.60 | 2.00 | 1.80 |
| | Nr of stops (monthly) | 2,269 | 2,347 | 5,105 | 5,183 |
| | Average km per stop | 1.35 | 0.93 | 1.35 | 0.93 |
| | Cost per stop | €4.53 p/s | €4.95 p/s | €4.53 p/s | €4.95 p/s |
| | Ad hoc vehicles | n/a | 20% of bike costs | n/a | 5% of bike costs |

### 4.4.2 Results cost benefit analysis

The analysis of the four scenarios, with the input as described above is presented in Table 8 and Figure 12. It shows that when the mobile depot is used at 90% capacity, the total monthly costs are about 69% higher than in the scaled baseline scenario. The demonstrated concept is more expensive than the business as usual, which follows from the fact that the cost per stop of the zero emission (ZE) subcontractor is 9% higher than in the initial situation. On top of that are the costs to purchase, move and operate the mobile depot. In order to be competitive with the van delivery, the difference in cost per stop should be in favour of ZE delivery. In addition, the mobile depot related costs for TNT should be reduced where possible. Various measures that could improve the financial viability of the mobile depot solutions are analysed in the sensitivity analysis.

**Table 8 Results cost benefit analysis (per month)**

| | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|
| **CAPEX (depreciaton for one month)** | | | | |
| **Mobile depot capex** | | | | |
| Mobile depot | - | 4,227 | | 4,227 |
| GPS installation mobile depot | - | 48 | | 48 |
| Total Capex | - | 4,275 | - | 4,275 |
| **OPEX (per month)** | | | | |
| **Moving and parking MD** | | | | |
| Transport of MD from/to depot | | 2,225 | | 2,225 |
| Maintenance and service mobile depot | | 25 | | 25 |
| Parking rental Jubelpark | | 1,125 | | 844 |
| Prohibition to park signs | | 767 | | 575 |
| ***Additional labour*** | | | | |
| Extra labour BRU staff | | 1,356 | | 678 |
| Ecopostale MD activities | | 3,120 | | 3,120 |
| Cleaning | | 446 | | 446 |
| ***Delivery by subcontractors*** | | | | |
| Delivery per van | 10,277 | | 23,123 | |
| Delivery per bike (or EV) | | 11,616 | | 25,653 |
| Delivery per EV | | | | |
| Ad hoc vehicles | | 2,323 | | 1,283 |
| Total Opex | 10,277 | 23,004 | 23,123 | 34,849 |
| TOTAL | 10,277 | 27,279 | 23,123 | 39,124 |
| Δ | | | | 69% |




| | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|
| CAPEX | - | 4,275 | - | 4,275 |
| Moving and parking MD | - | 4,141 | - | 3,669 |
| Additional labour | - | 4,923 | - | 4,245 |
| Delivery by subcontractors | 10,277 | 13,939 | 23,123 | 26,936 |
| **Total** | **10,277** | **27,278** | **23,123** | **39,125** |

**Figure 12 Results per month**

## 4.5 Sensitivity analyses

Various input values are highly uncertain in the scaled scenario. That is why we vary with some of these values, to see how much this affects the breakeven point of the demonstrated concept. The breakeven point is considered as the maximum cost per stop of the ZE subcontractor, to be competitive with the current subcontractors (i.e. EUR 4.53 per stop). During the pilot, a temporarily agreement was made with Ecopostale. TNT paid EUR 4.95 per stop. This price is even higher than the baseline situation, meaning that the additional costs of the mobile depot cannot be compensated. Under the scaled scenario circumstances (as presented in Table 7), TNT can pay Ecopostale maximum EUR 1.85 per stop in order not to lose money on the concept. This means, in order to keep total costs *with* the mobile depot equal to the total costs *without* the mobile depot.

The break-even point can be explained by the stop per delivery $(x)$ where:

$$[Total\ cost\ with\ MD\ and\ a\ cost\ per\ stop\ of\ EUR\ x] = [Total\ cost\ without\ MD\ and\ a\ cost\ per\ stop\ of\ EUR\ 4.53]$$

The main question in the sensitivity analysis is: how much should the cost per stop be, to be competitive with the current situation under different circumstances? We vary with 1) costs for parking, 2) capital investment costs (CAPEX), 3) congestion charge and 4) deliveries per stop. The measures are discussed in more detail below. We look at every parameter by leaving all other parameters equal. The results for the variations are shown in Figure 13. In the initial scaled scenario (as shown Table 7 and Table 8) the break-even point was 1.85. This is included as benchmark value. The figure shows the effectiveness of several measures on the competitiveness of the mobile depot solution. A reduction in parking or capital costs slightly increases the breakeven point. The breakeven point is more sensitive for the congestion charge variations, though in order to approach the current cost per stop of EUR 4.95, the congestion charge per kilometre for van deliveries should be extremely high.

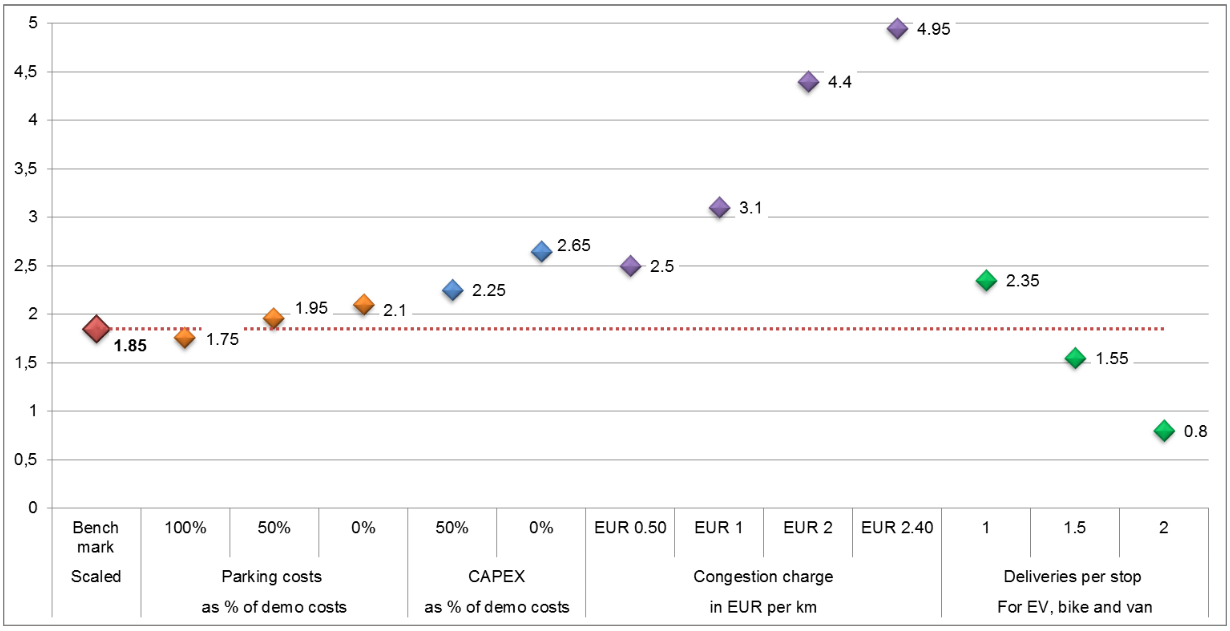



**Figure 13 Breakeven points sensitivity analysis for different variations**

**Parking**: The availability of an appropriate, dedicated parking spot is essential for the success of the mobile depot project. One incorrect parked car can already make it impossible for the mobile depot to manoeuvre and park. The costs for parking and park signs depend greatly on the willingness/capabilities of the local authority to support the project. As space in the inner city is rather scarce and expensive, it is very city specific whether this space can be given for free. In the previous calculations, we have assumed that the costs for parking are 75% of the demonstration costs (i.e. 25% less). In the sensitivity analyses, this input variable varies between 100, 50, and 0% of demo costs (i.e. no reduction, half reduction and fully supported by the city council)

**The capital investment costs:** the CAPEX are about 11% of the total costs. These costs may reduce in the future, when the mobile depot is shared, partly subsided or when many mobile depots are developed (i.e. economies of scale). As these costs are higher than the parking costs, the variations are more effective.

**Congestion charge**: when city authorities oppose a congestion charge on the use of conventional vehicles, this will support the use of low/zero emission alternatives. Such a congestion charge is already in place in London, where most motor vehicles pay £10 (EUR 12) per weekday[4]. In the sensitivity analyses, we have included a cost per kilometre of EUR 0.50, 1, 2 and 2.40 (see Figure 14). The congestion charge applies to the van deliveries and the ad hoc deliveries[5]. The results show that a congestion charge can make the demonstrated

[4] The London congestion charge is a fee of £10 (EUR 12) per day charged on most motor vehicles operating within the Congestion Charge Zone (CCZ) in central London between 07:00 and 18:00 Monday to Friday. Zero and ultra low emission vehicles qualify for a 100 per cent discount on the congestion charge.

[5] The impact of a congestion charge for the MD solution is very minimal, and therefore left out of Figure.

concept with ZE delivery (at a price of EUR 4.95 per stop) competitive with the van delivery when it is EUR 2.40 per kilometre.

When compared with the situation in London: for a vehicle that drives 100 kilometre per day within the congestion charge zone, this means that the charge should be EUR 240 per day instead of the current EUR 12, being 20 times higher. We can conclude that, even though a congestion charge could support the use of bike couriers in the future, it is unlikely that it will be as high as needed for the mobile depot to become a financially viable solution.

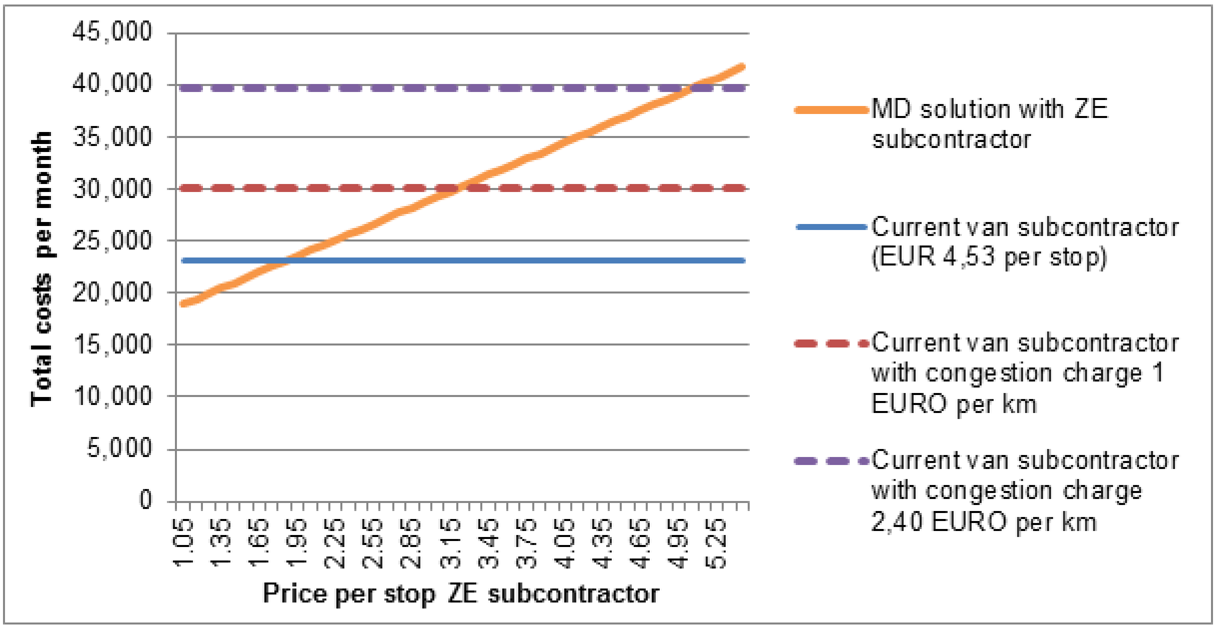



**Figure 14 Sensitivity analysis – congestion charge**

**Deliveries per stop**: the number of deliveries per stop depends on the characteristics of the urban area. For example, in a highly clustered business district more deliveries are combined at one stop. When the number of deliveries per stop increases, given that other aspects remain the same, the ZE subcontractor needs an even lower cost per stop to be competitive.

## 4.6 External costs and benefits

The TNT demonstration focused to great extent on environmental objectives. The use of cargo bikes in the city reduces the negative environmental impact of transport in terms of (noise) emissions and safety. In addition to the financial costs, we have therefore analysed the external costs of $NO_x$, $CO_2$, and $PM_{10}$, emissions, safety and noise. The equivalents that are used can be found in Table 4. The calculations are based on the number of kilometres driven by van (incl. the ad hoc vehicles) and trailer. For the cargo bikes and electric vehicles, external costs are assumed to be zero. The results (see Table 9 and Figure 15) clearly show a great reduction of external costs in the scaled scenario with mobile depot, namely about 77%. Especially noise and safety in urban areas have a high external cost factor. The use of the trailer for the movement of the mobile depot still causes emissions, (especially $NO_x$), and so do the ad hoc vehicles, but these are highly compensated by the zero emission deliveries by the cargo bikes in the city.

Although the results support governmental objectives with regard to the liveability of cities, they are minor in relation to the financial results of TNT. The external costs represent about 5% of the total social costs and benefits in the baseline scenario and 1% in the mobile depot scenarios. Hence, given the current external cost factors, the external benefits do not compensate for the financial loss (Figure 16).

**Table 9 Equivalent emission and cost factors per vehicle type**

| | $NO_x$ | $PM_{10}$ | $CO_2$ |
|---|---|---|---|
| *Gram per km (STREAM: CE, 2008)* | | | |
| Small vehicle (2-12 ton) | 1.2 | 0.029 | 325 |
| Trailer | 8.6 | 0.094 | 1023 |
| *Costs per kg (in €) (CE, 2008)* | 9.8 | 885 | 0.04 |

| Safety | Noise |
|---|---|
| *Cost per km (in €) (Ecorys, 2009) for 2011* | |
| 0.04 | 0.10 |
| 0.05 | 0.16 |

**Table 10 Results external costs**

| EXTERNAL COSTS | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|
| CO2 | 40 | 30 | 90 | 28 |
| NOx | 36 | 56 | 81 | 54 |
| PM10 | 79 | 62 | 177 | 57 |
| Safety | 123 | 50 | 276 | 42 |
| Noise | 294 | 139 | 660 | 121 |
| **SUM External costs** | 571 | 338 | 1.284 | 301 |
| Δ | | | | -77% |

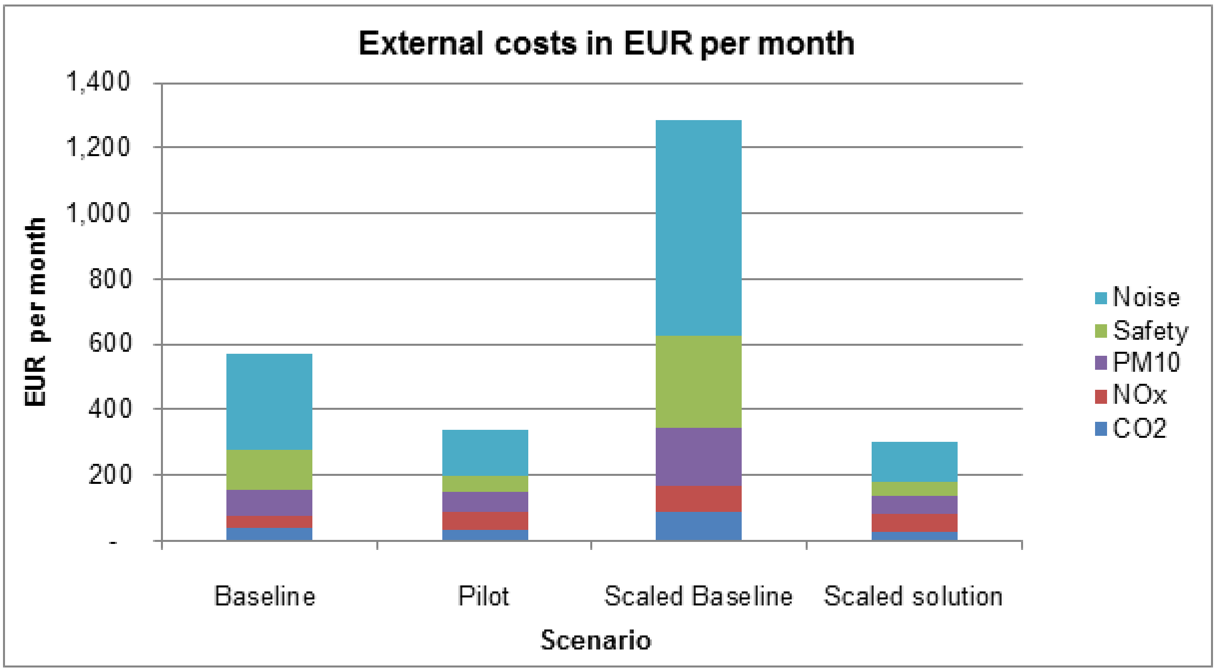



**Figure 15 Results external costs**

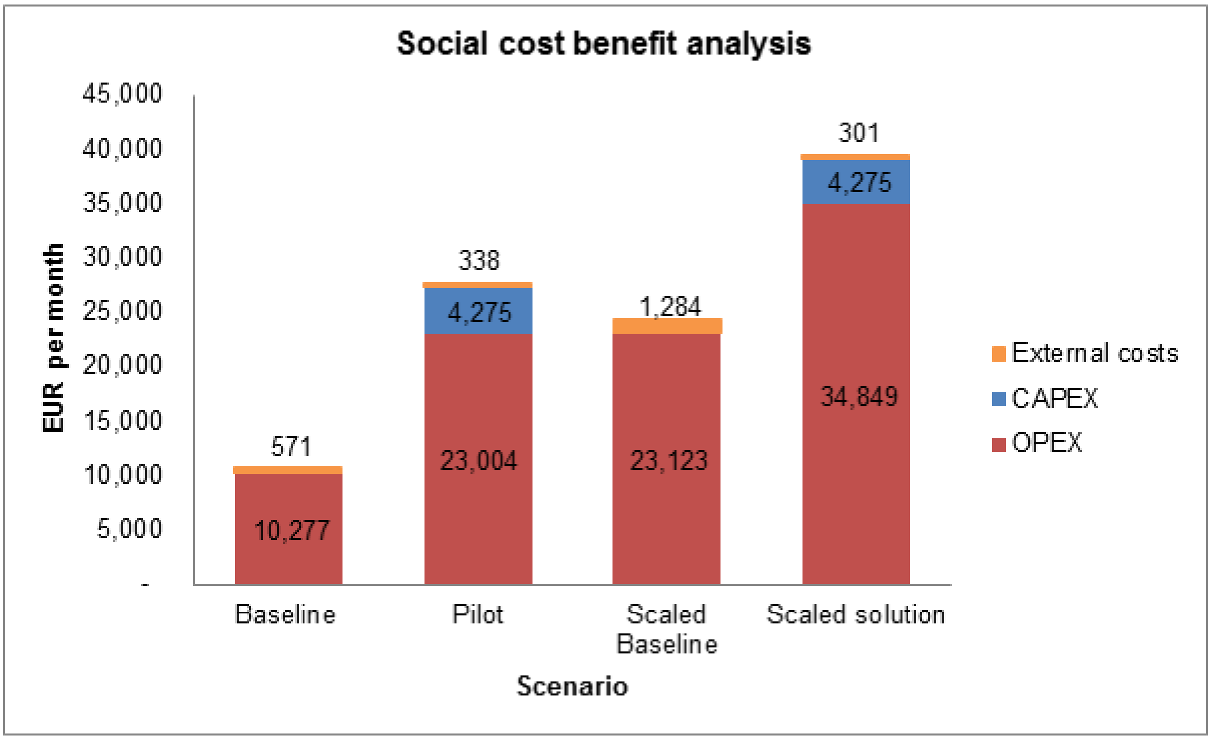



**Figure 16 Social cost benefit analysis**

## 4.7 Viability fit analysis

Figure 17 shows the outcome of the viability/fit analysis for the TNT solution. The market perspective is slightly positive due to the positive externality effects and differentiating character of the concept. Other than that, as concluded from the business model canvas, the customer side does not change. The organisational readiness of the concept is low. This is mainly due to the financial results and the required activities and resources and need for new subcontractors. The organisational readiness from a city council's perspective is high, as in fact, the city council only need to provide the space and the mobile depot and it can then allow transport operators (i.e. the market in that perspective) to make use of it.

In a city with a congestion charge in place, for example London, the viability would be significantly higher, especially if a delivery area with an optimum mix of shipments can be found. Transport operators will in that case be evne more willing to pay for the usage of a mobile depot.

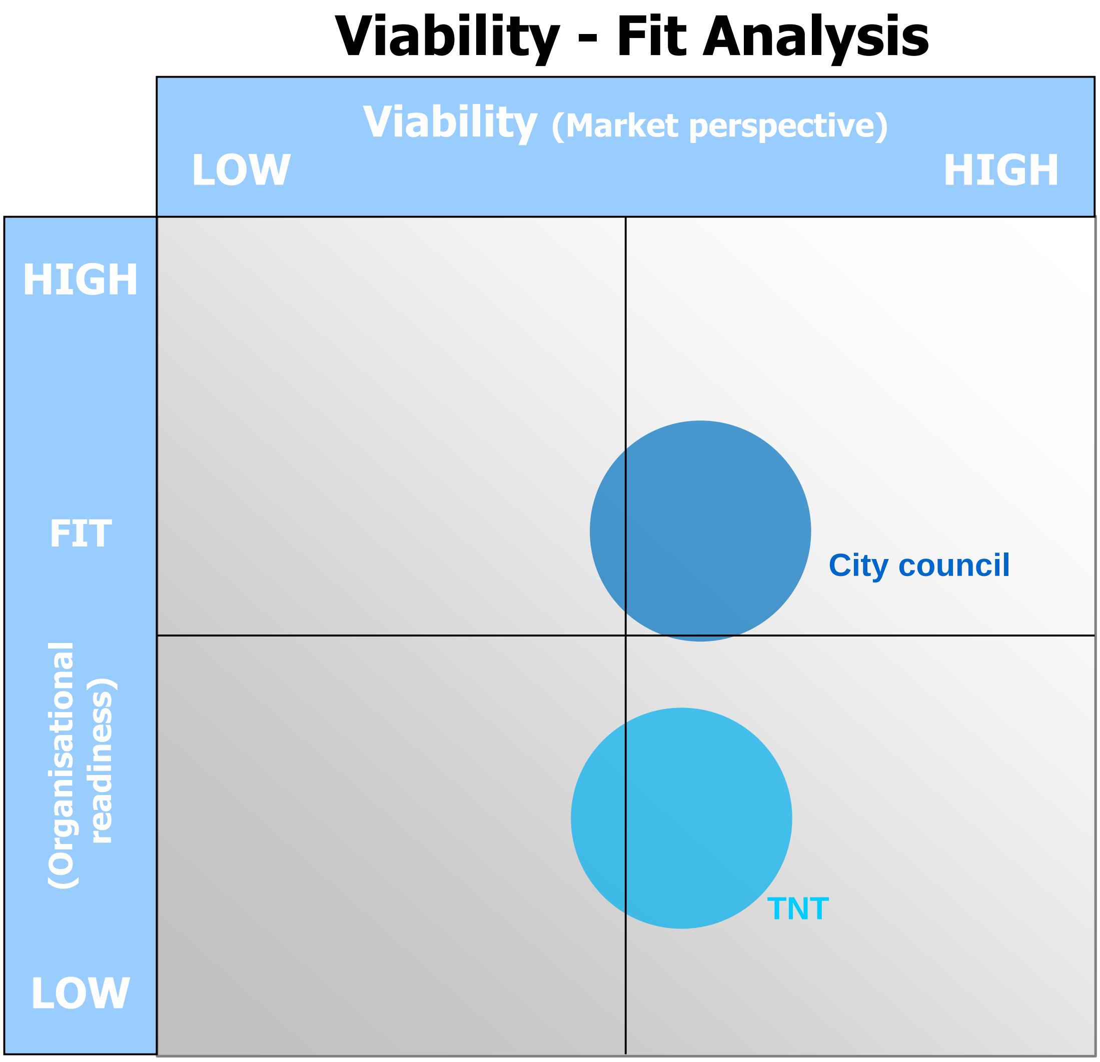



**Figure 17 Viability fit analysis TNT solution**

## 4.8 Prerequisites for successful implementation

From the analysis above, we have learned various lessons that are relevant for the implementation of the concept in the future. First, the concept is not financially viable. This has to do both with the organizational fit (the expenses increase considerably) and market readiness: there are no increased revenues. Hence, the mobile depot has no financial value at this moment (at this location). Other non-financial benefits are: 1) improved image, because of innovative and environmental friendly character and 2) social benefits in terms of emissions, noise and safety.

A limitation of the analysis is that we have not taken different freight profiles of the urban area into account. The mix of parcels in the urban area (e.g. amount, size, proximity) influences the suitability of the concept. For example, when distances between stops are long, it is more efficient to go by van, whereas when the stop density is high and parcels are small, then cargo bikes become more efficient. The permanent availability of an electric van will help limit the sensitivity of success to a freight profile containing small shipments only.

Increasing the stop density could be achieved by working together with other courier companies, e.g. by redistributing freight orders. However, even though the efficiency of zero-emission vehicles can improve under certain circumstance, it will not be financially attractive as long at the cost per stop for the ZE subcontractor is higher than the current subcontractor. In fact, the cost per stop should be considerably lower to compensate for the capital and operational expenses of the mobile depot.

In the sensitivity analysis, we have looked at how low the cost per stop can be for various circumstances. We have looked at these variations by only changing one parameter at a time. Though, to make the mobile depot a viable concept, the parameters should be changed simultaneously. So TNT will need to find a better shipment mix, a better subcontractor, a full mobile depot, an affordable parking space and all kinds of efficiency improvements, to make the concept viable.

A highly uncertain element in the analysis is the parking costs for the mobile depot (approximately 7% of the costs during the pilot). We have assumed that these costs can decrease with 25% on the long term (being <4% of all costs). However, this is very uncertain as parking possibilities and costs are very case (and city) specific. The success of the mobile depot concept depends to great extent on the availability and affordability of a suitable parking place. Exploring the (financial) possibilities, requirements and conditions for parking should therefore be the starting point for implementation in the future.

Follow-up questions are:

1. Can the authority support by providing a location or shared mobile depot? On the one hand, providing free parking space can be a relatively easy way for the authority to support the concept. Though on the other hand, space in inner cities is scarce and expensive, authorities are often not willing to devote it to logistic activities (e.g. as commercial activities generate much more revenue), let alone to provide it for free.
2. How to pay or get paid for environmental costs/benefits? It might be that the deliveries by van becomes more expensive in the future. For example, when a congestion charge is introduced for van deliveries. Another option is that the environmental benefit of the demonstrated concept is valued by either the authority and/or TNT customers. Though the willingness to pay for these external benefits is not likely to be as much as needed to compensate for the increased costs.
3. How to subcontract the activities? For the scaled scenario, new negotiations will need to take place. The tariffs will depend on the freight profile of the urban area (e.g. the stop density and mix of parcels), since it determines the number of deliveries and stops that the subcontractor can complete in a day. For optimal use of the mobile depot it is required that the subcontractor has an electric vehicle in its vehicle fleet. If the cost per stop of the new subcontractor does not reduce, it is not likely to compete with the van delivery of EUR 4.53 per stop.

Another option for making the MD solution more financially viable might be to add value for customers by using the mobile depot as a local office. The MD is designed to have staff available at the MD. The staff, however, is currently not adding value. Since the MD solution is not cost effective, this leaves room for two options: 1) to reduce costs for the MD (for example a simpler box (without the facilities of the current MD) that is only used to transport and store parcels, or 2) to use the facilities in the MD in order to create value for customers (as a small local office, where customers can pick up deliveries and bring parcels themselves). These options were not further explored in this study, but from a cost benefit perspective, these options might be wise to examine for the further development of the MD concept for other areas.

# 5 Remote 'Bring-Site' Monitoring near London – Oxfam

## 5.1 Case description

Currently, Oxfam schedules roundtrips based on historical data concerning banks filled with clothes. The planning is essentially fixed from one week to the next, aside from the inclusion of ad hoc jobs. This can result in the undesirable situation where lengthy journeys are made to banks which contain very little stock. On the other hand, banks can overflow when goods donations suddenly exceed the historical pattern. This can lead to superfluous miles driven to banks which contain very little stock, or a loss of goods because of overflowing banks. Remote monitoring of banks can be the solution.

Remote monitoring facilitates dynamic routing. Remotely monitoring banks using fill-level sensors, assists Oxfam, providing insight into the real-time amount of goods placed in the banks. This avoids trips to banks with little stock, and prioritises banks which are overflowing.

Dynamic monitoring of waste banks is already used in some waste industries e.g. waste oil, yellow grease, secure document shredding, clinical waste and glass recycling. Companies which use this monitoring solution in practice, may experience reduced operating costs and less nuisance and theft from overflowing banks and/or bins. Remote monitoring can be beneficial for collecting goods which are provided by the public in an unpredictable way. Therefore the collection of clothes seems to be suitable for this solution.

The demonstration showed the impact of remote monitoring on the transport costs. Only the urgent banks were visited, which resulted in more volume per driven mile. The demonstration focussed on to banks which generate the most stock and need servicing more frequently. The demonstration did not directly evaluate the impact of improved visibility of banks afforded by remote monitoring. Oxfam's main goal is to improve transport efficiency.

**Table 11 Role and stakes of different actors**

| Stakeholder | Role | Participation in solution | Interest |
|---|---|---|---|
| **Oxfam** | Manages and operates collections from Oxfam banks and shops using own vehicles and drivers. | Remotely monitoring banks using fill-level sensors and creating routes. | Real time information on bank stocks, less miles driven by drivers. |
| **Members of the public** | Donates to banks and shops | No participation | Due to the new solution, members of the public may encounter an untidy site less often, and therefore have fewer problems donating. |
| **Authorities and private site owners** | Offers public/private space to Oxfam banks | No participation | Fewer crimes; tidiness of sites; fewer trucks on the road will lead to reduced congestion and emissions. |

Three stakeholders can be defined within the solution (see Table 11). Oxfam is the main stakeholder due to their implementation and executing activities. Oxfam changes the daily activities to implement the solution. Members of the public and site owners (e.g. local authorities, supermarkets) have a passive role. These stakeholders do not have to change their behaviour/daily activities to make the solution successful. They have interest in the effect of the solution (e.g. reduced congestion and emissions).

Within the solution, we do not distinguish Oxfam shop managers as stakeholders. Currently all shops in the demonstration area are serviced on fixed days of the week, with some being visited three times a week. This severely constrains the vehicle rounds and limits the potential benefits from dynamic scheduling, as has been proven through off-line evaluation (McLeod *et al*, 2013). Therefore shop visits influence the effect of remote monitoring, but remote monitoring is not in the interest of shop-owners, and they do not participate to make the solution to a success.

## 5.2 Business Model

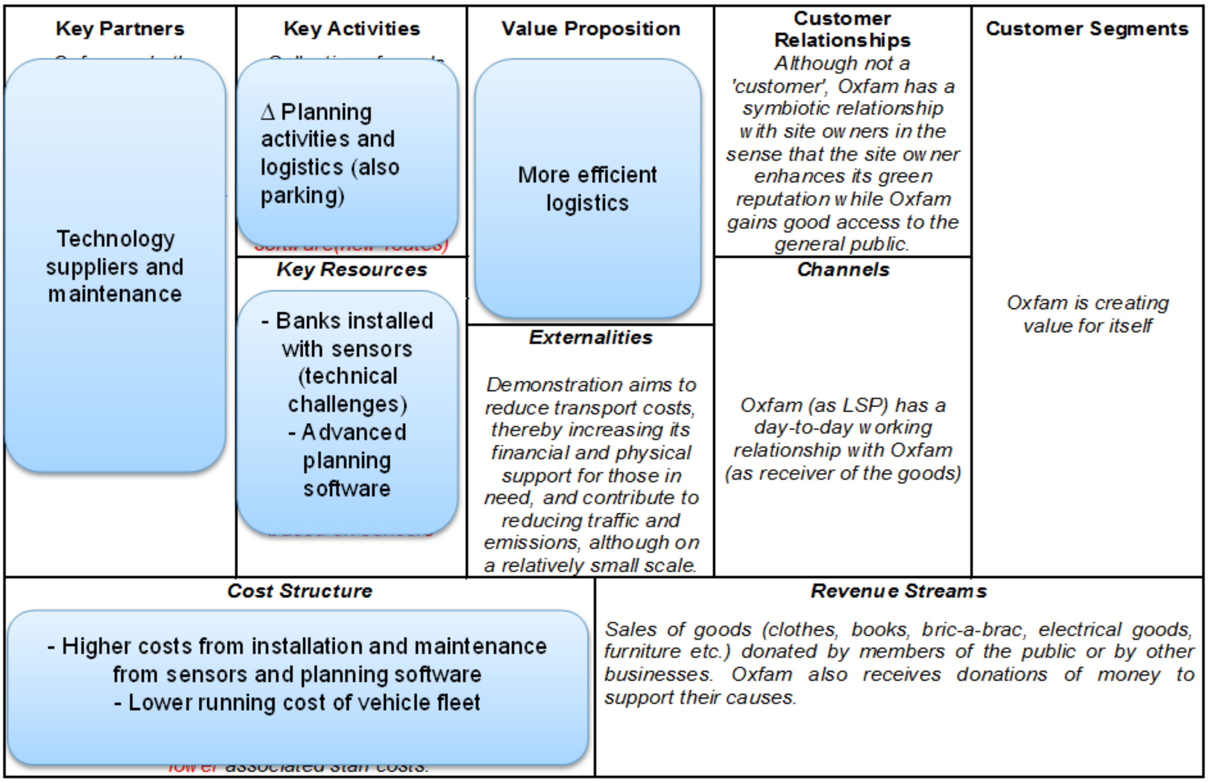



**Figure 18 Changes in BMC Oxfam due remote monitoring**

The solution influences the daily activities of Oxfam. Operational changes have to be made to execute the new logistics solution. As described in the stakeholders and actors description, members of the public and/or authorities do not have to change their business model. For this reason, only the business case of Oxfam is discussed.

Notable in the business model (see Figure 18) is the fact that changes only appear on the left-side of the business model canvas. This implies that changes only occur on the cost side. No additional activities are implemented that change the revenue streams. Transport efficiency is the main goal for Oxfam. This can be derived from the value proposition which states more efficient logistics. To achieve this value proposition, Oxfam purchases and installs remote sensors in the banks and additional software on top of their transport management system, which communicates with the sensors. The new planning software requires additional activities from the transport planners.

Implementation of the key resources depends on key partners. Within this case the sensor supplier Smartbin, plays a key role in implementation and maintenance of the sensors and supports in the process of remote monitoring and dynamic planning.

## 5.3 Business Case

To estimate the impact of remote sensors on the cost-side, the business case has to be set for the pilot situation, and in addition to the scaled situation. Next, external costs and benefits are considered.

### 5.3.1 Pilot Scenario

According to Oxfam, the pilot area is highly representative for the whole of the UK. The area includes a wide range of rural, urban and industrial sites. The vast majority of collections took place in urban areas, including the cities of Cambridge, Oxford, Peterborough and Northampton. The collection rounds visited a total of 58 bank sites. In the demonstration, 40 banks were equipped with sensors at 21 different sites (many sites contained two or more banks). In this area, 75 shops were visited, which have a fixed pick-up schedule.

Oxfam's depot (Milton Point) is used as a transfer station for the collections. In this area Oxfam used 1 van and 5 lorries. New planning software was implemented and additional management and planning hours were needed. The pilot's duration was 9 weeks. For the business case this term is compared with 9 weeks of the year before (the baseline), see also Table 12.

### 5.3.2 Scaled scenario

The scaled area is taken to be five times bigger. The pilot area is multiplied by 5 and includes 375 shops and 290 bank sites. 5 vans and 20 lorries are operating in this area. 200 banks are provided with sensors, at 105 sites. The scaled scenario which includes the sensors is compared with the scaled baseline scenario.

One can derive from the business model that no revenue streams are included. The new solution is primarily introduced to reduce transport costs. It does not lead to increased volumes and therefore revenues are unaffected. The CAPEX consists of £145 purchase costs per sensor and £45 installation costs per sensor. This includes installation and usage of the routing software. Additional labour costs for set-up and planning are estimated on £ 28,000 during the pilot scenario. This includes handling costs made by the planner and management, to execute new routes dynamically. These costs are only expected at the implementation of the solution. We expect the scaled scenario will lower additional labour costs (-50%) for set-up and planning, due to economies of scale. Therefore we estimate the additional labour costs in the scaled scenario to be £ 70,000.

Several operational costs do change due to the implementation of the sensors. These OPEX include additional running costs of the sensors, transport costs and communication costs (GSM) for each sensor which amounts to £11 per sensor per month.

Transport costs are derived from the miles driven. The costs per mile are £1.70 for a lorry and £1.00 for a van[6]. This includes all direct and indirect vehicle operating costs (fuel, depreciation, insurance, labour). Due to more efficient routing, transport costs decreased by 6% in the pilot scenario. The number of vehicle roundtrips (23 roundtrips) and average duration of a roundtrip (9:34) did not change during the pilot. For this reason these costs are excluded from the business case.

In the pilot, maintenance costs for the sensors were not measured but were estimated to be 10% of the purchase costs of the sensors per year. Finally, labour costs for management should be added to the operational costs. This labour consist of; gathering and processing the sensor data, running the algorithm, post-processing of the suggested routes considering the

[6] Derived from Oxfam's operation department.

routes which are generated by the system, manually adjust changes, liaise with vehicle loaders and drivers and sort out keys for them. It is expected that management input will still be essential, which is estimated by OXFAM to be two hours.

**Table 12 Oxfam's business case**

| OXFAM BUSINESS CASE | | | | |
|---|---|---|---|---|
| **CAPEX** | | | | |
| | Business as usual (small scale) | Demonstration | Business as usual (large scale) | Solution in large scale |
| **Transport solution** | | | | |
| Cost for purchase sensors | £ - | £ 5.800 | £ - | £ 29.000 |
| Cost for installation sensors | £ - | £ 1.800 | £ - | £ 9.000 |
| Labour cost for set-up and planning | £ - | £ 28.000 | £ - | £ 70.000 |
| Total Capex | £ - | £ 35.600 | £ - | £ 108.000 |
| **OPEX (per month)** | | | | |
| Running cost (sensors) | £ - | £ 440 | £ - | £ 2.200 |
| Transport cost | £ 20.345 | £ 19.027 | £ 101.724 | £ 95.137 |
| Maintenance sensors | £ - | £ 48 | £ - | £ 242 |
| Labour (manager) | £ - | £ 889 | £ - | £ 4.444 |
| Total Opex | £ 20.345 | £ 20.405 | £ 101.724 | £ 102.023 |
| **OPEX (per year)** | | | | |
| Running cost | £ - | £ 5.280 | £ - | £ 26.400 |
| Transport cost | £ 244.138 | £ 228.328 | £ 1.220.691 | £ 1.141.640 |
| Maintenance cost | £ - | £ 580 | £ - | £ 2.900 |
| Labour (manager) | £ - | £ 10.667 | £ - | £ 53.333 |
| Total Opex | £ 244.138 | £ 244.855 | £ 1.220.691 | £ 1.224.273 |
| **Operating benefits (per year)** | | **-£716** | | **-£3.582** |

To implement the solution on a large scale, both CAPEX and OPEX will increase. Total investment costs are £108,000 for the scaled scenario. The sensors have an average product lifecycle of three years, and have to be replaced after this period. OPEX per month increase, especially due to labour costs. Transport manager's time is outweighing the benefits. This results in operating benefits of £-3,582 per year. Considering the investment costs to be £108,000, return on investment will not be achieved.

### 5.3.3 External costs and benefits

Less driven miles can cause external benefits. But can these benefits outweigh the increasing investment/operational costs? Derived from vehicle mileages and assumed average emissions factors of 400g/km for a lorry and 215g/km for a van (den Boer, et al., 2011), dynamic routing results in an emissions reduction of 9%. This is a saving of 61,200 kg $CO_2$ per year for the scaled scenario. Since there is no distinction between urban and non-urban miles driven within the pilot, locational emissions cannot be distinguished. To estimate the external costs of the $CO_2$ emissions, the emission factor (Ecorys, 2009) is used to determine the social cost/benefit. Other external costs (noise, accidents, NOx) were not taken into account, because the solution is not primarily focused on urban transport. A savings of 61,200 kg $CO_2$ results in a social cost benefit of £1,255 per year (£20.50 per ton kg).

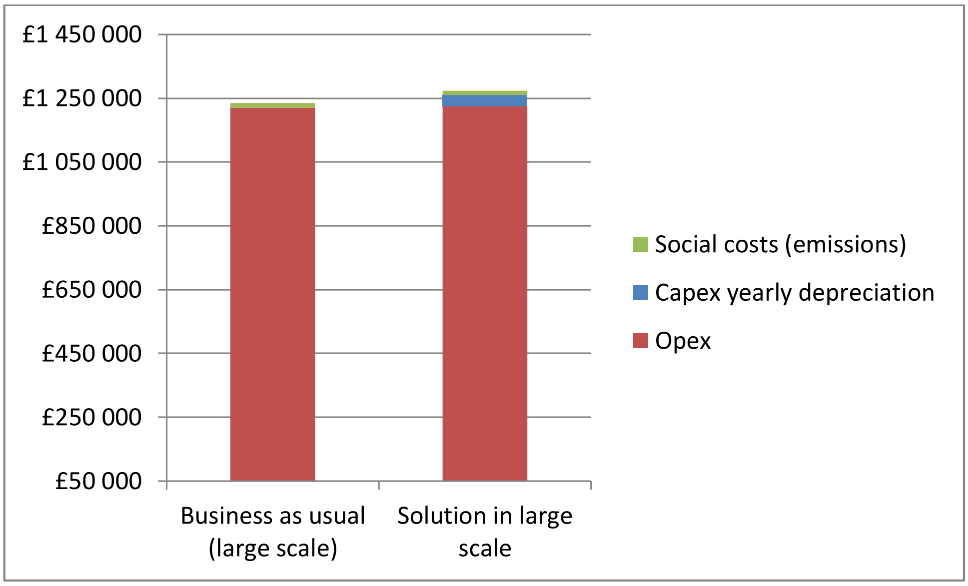



**Figure 19 Results yearly costs large-scale scenario**

Once we put these costs in perspective to the yearly costs mentioned in the business case, social costs comprise approximately 1% of the total yearly costs (for the solution a bit less than 1%) for both scaled scenarios. We can conclude that though decrease in external cost is marginal compared to the total costs, there are savings to be realised. The reduction is however negligible considering the amount of fuel used during transport, and the value attached to the reduction.

### 5.4 Viability Fit analysis

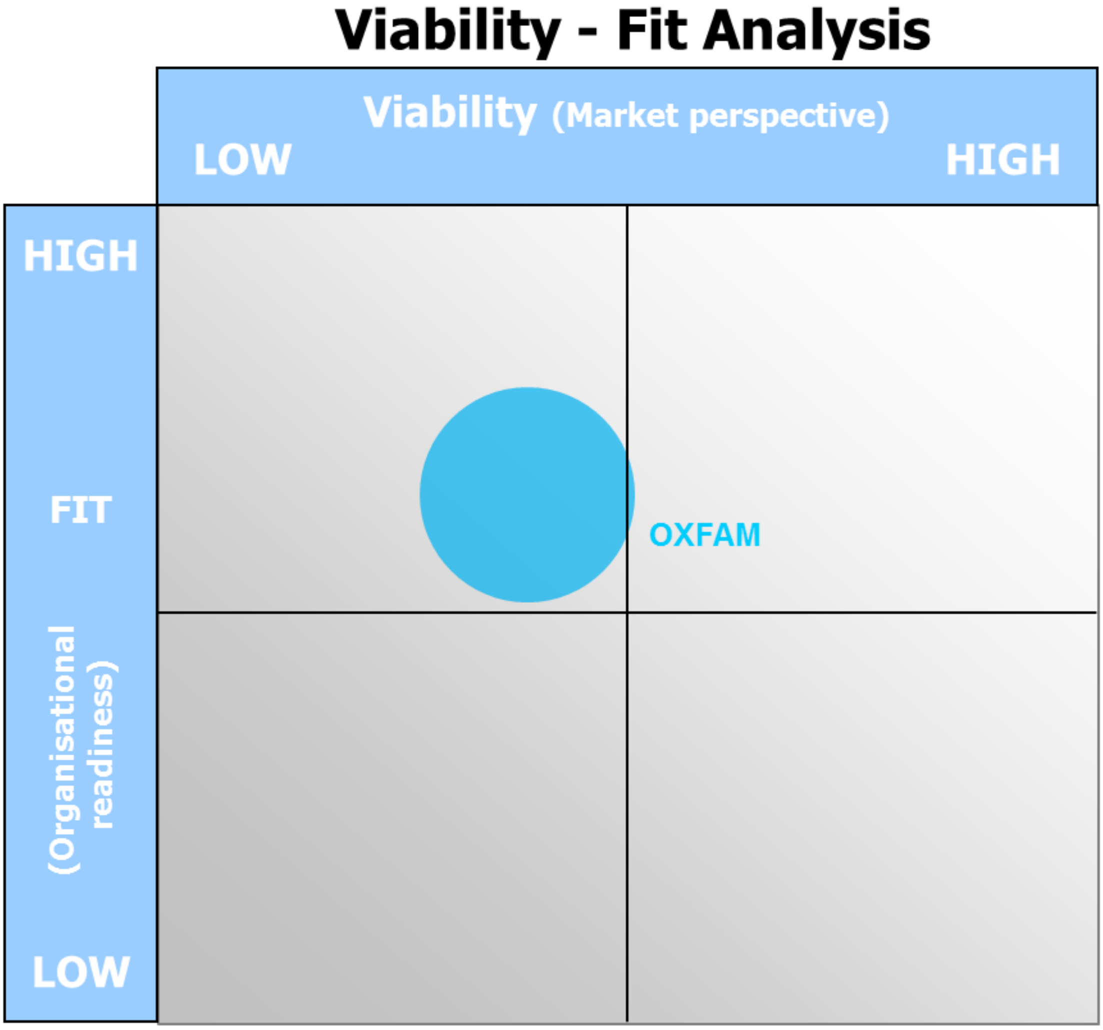



**Figure 20 Viability fit analysis Oxfam**

The solution is positive for the organisational readiness (fit), but negative for the market perspective (viability). In case of the viability, it is complex to measure viability for a solution which does not directly attracts new business, but is primarily focussed on more efficient logistics and reduction of operational costs. In this case, the customers (general public) will not notice anything of the installed sensors. This is confirmed by the BMC, which does not show any changes on the right side of the model. More important, nothing changes on the revenue side. The solution is successful when customers do not have to compensate in any way for the solution. However, the solution does not have a strong viability due to higher overall costs. Externalities (less congestion/emissions) will not change this outcome.

Concerning the organizational readiness, the solution strengthens the vision/mission of Oxfam, namely increasing revenue stream towards charity funds, due to lower transport costs on a long term. The solution will affect key resources and key activities. There is a strong match with the current logistic/transport activities. The solution highly supports and therefore matches with current transport activities. The solution requires organizational change (planning/management). Oxfam already pointed out the complexity of the solution with the organizational fit.

Strongly linked to the key activities, are the key resources. New planning and routing software have to be installed on top of existing software. Also the sensors have to be installed in the banks. A weak link with current IT resources is inescapable.

## 5.5 Prerequisites for successful implementation

Assuming that the technology works optimally, the following areas of interest will determine the success of the pilot.

Dynamic routing entails **additional labour** for the transport manager. These additional costs consist of two to three additional planning hours each day. Oxfam experienced this time as a high burden on their daily planning operation. The underlying cause of this problem is the fact that static routing cannot easily be replaced by dynamic routing. Static route planning is imbedded in the whole organization, and therefore the whole operation. Management, planners and drivers all work according to specific standards and specific routines. Operational changes require a lot of time to be implemented in a logistics organization, and will even take more time to run optimally. For Oxfam this process was even impaired because of the technical implementation problems. Process standardizing within all divisions of the organization therefore did not occur.

Sufficient and reliable sensors are a precondition to operate. Obtaining **reliable remote monitoring data** was a major issue, with unsatisfactory performance at 23 out of 40 banks. Connection problems were the main reason of failure, especially in the rural areas. The developer of the sensors is working on the connectivity of the sensors and is expecting that in the near future better communication can be established, even in areas with poor signals; future communications technologies (e.g. 4G) are expected to bring improvements.

Next to the technical issues, the **security of the banks** also has to be assured, when implementing the sensors. In the pilot scenario banks were trashed, sensors were demolished and clothes were stolen. Beforehand, Oxfam expected the sensors to indicate theft, but because of the unreliable signals from some sensors, theft could not be readily identified. More secure and robust banks can be a solution. A more secure location can also prevent theft from banks. A bank placed in a busy street may be less vulnerable to theft, compared to one placed in a quiet rural area.

The **amount of shops** to be serviced alongside the banks is critical for the success, or not, of the solution. Shops have a fixed pick-up time, which restricts the planner from optimizing the routes. Providing shops with a sensor or comparable measurement tool could be an option, but Oxfam suggest that it would be too complex to introduce this as their shops use hundreds of volunteer staff with widely varying skill sets.

Closely linked to the amount of shops, is the **share of banks equipped** with a sensor with respect to the total amount of banks in the area. In the pilot scenario, only 36% (21 out of 58) of the bank sites were equipped, due to limited availability of replacement sensors. Like the shops, this will restrict dynamic routing.

# 6 Rail Tracking and Warehouse Management in Thessaloniki – Kuehne+Nagel

## 6.1 Case description

In the pilot of Kuehne Nagel the solution applied to the logistic system falls in the class of Intelligent Transport Systems (ITS).

The transportation by K+N comprises of two legs:

- 1st leg: Interurban-urban rail transport of goods from Central Europe to K+N premises in Sindos, Thessaloniki, Greece.
- 2nd leg: Urban distribution of goods (last mile delivery) by truck in Thessaloniki.

In the demonstration, the solution is applied to the 1st leg by installing GPS devices on the wagons during the rail transportation leg. Tracking the wagons provided Kuehne Nagel, the LSPs and the other stakeholders with the opportunity to have real time reporting. This information is important for the second leg of the transportation. In the second leg, trucks are rented mainly by K+N but also by their customers to perform last mile deliveries. Since the international railway trip lasts almost a week, it results in unnecessary renting of trucks in case the wagons are delayed. When the trucks are rented, they have to drive from their base to K+N facilities which results in excessive costs. The main benefit of the demonstration is in preventing the extra renting of the trucks, thereby reducing fuel use and consequently $CO_2$ emissions. Additionally, since by better tracking of the wagons, K+N can inform its customers about the delays, it improves the relation of K+N with its customers.

Although the solution offers improvements in the transportation, due to some technical challenges with GPS devices and roaming problems, the solution could not be applied to its full extent.

## 6.2 Role stakeholders

In this demonstration the main stakeholder is K+N. Although there are other stakeholders involved, they did not actively participate in the demonstration. An overview of the role of the stakeholders, their participation and interest in the solution is presented in Table 13.

**Table 13 Role stakeholders K+N solution**

| Stakeholder | Role | Participation in solution | Interest |
|---|---|---|---|
| **Shipper** | Shipping companies, they receive the goods from K+N, so they are the customers of K+N | Not active participation, but since they are dependent on the 1st leg of the transportation, they are directly affected by the delays and also by the positive effects of the solution | Cost and time savings resulting from real time tracking. |
| **International railway organisations** | Providing rail infrastructure and equipment (responsible for the provision of rail wagons to K+N according to the demand) | | |
| **Final receivers/retailers** | They receive the goods from the shippers | Not active participation, but since they receive the goods from the shippers, they are directly affected by the delays and also by | Getting informed about the delays with the help of real time tracking |

| | | | |
|---|---|---|---|
| | | the positive effects of the solution | |
| **K+N** | Logistic service provider of the 1st leg (international) and partly 2nd leg (last mile) | The owner of the solution. Uses GPS devices to receive real time information from the wagons and provide its customers with this information | Time and cost savings due to less extra truck renting, better customer relationships resulting from better informing. |
| **Public** | Might be the end user of consumers of the goods, or only affected by the negative effects of urban distribution | No participation | Receiving the goods on time and getting the social benefits of the solution, such as less traffic, less air pollution, etc. |

## 6.3 Business Model Canvas

The business model canvas in Figure 21 demonstrates the changes in the business model of K+N brought by the demonstration. The items written in the black font represent the business model of K+N in the situation of 'Business as Usual'. The items written in the red font represent the changes taking place in the business model with the demonstration.

As it can be seen in the canvas, the main changes are on the left side of the canvas, which means that the solution brings more changes in how the K+N is organized, but not much to its market side. The only change on the right side of the canvas takes place in the channels. In the present situation K+N informs the customers via telephone calls about the location of their goods. In the new situation track and trace service is given via an electronic platform where the customers will receive automated emails or messages. In the revenue streams there are no changes, since there are no main changes on the right side of the canvas.

The solution does not change the value proposition of K+N which is timely delivery and tracking, but it improves the proposition. The delays will be eliminated with the solution and the tracking will be done automatically and more accurate. The external values brought by the solution are fewer emissions, less traffic, less noise and air pollution resulting from fewer wrong shipments and less delays.

The changes brought to the left side of the canvas are related to the key partners, key activities and key resources. By the key partners we see two additional key partners for K+N. These are the providers of the new tracking system equipment and the telecommunication network providers. This is the most important change in the key partners section. Moreover, the solution requires more intense partnering with the railway operators in the other locations throughout the Europe. The changes in the activities are mainly related to the implementation and use of the GPS devices. They have to be calibrated and charged each time before the trip. The personnel have to make sure that these activities are done correctly. Moreover the solution requires a good communication between the K+N and railway stations throughout the Europe. After the devices reach to K+N premises, they have to be sent back to Sopron, Hungary. This shipment is done by airlines. The additional key resources are the new tracking equipment (GPS devices) and extra operations equipment which is developed by the K+N's technical department in order to meet the requirements of the demonstration.

Since there are many changes on the left side of the canvas, we observe quite some changes in the cost structure as well. The changes occur both in the investment costs and operating costs. Purchase of the GPS devices creates extra investment costs. In the present situation, a cut-off wagon results in an unnecessary rent of the trucks, since K+N is not aware of the delay on time. The demonstrated solution is expected to result in a decrease in these unnecessary rents, which will translate into less ‘extra’ trips by the trucks from their bases to the K+N facilities. Therefore, the cost reduction can be observed in the rent of the trucks, in the cost of the fuel and personnel. However, there will be some extra operating costs with the solution which are the GPS operation costs and extra roaming costs. During the pilot test period there were also some extra roaming costs due to the fact that the real time data transmission frequency was higher than expected, resulting in significant communication cost. Since the equipment upgrading and development of new communication servers and software is done based on existing technology by K+N’s technical department, there are no extra costs incurred. There are also some extra costs related to the shipment of the devices back to Sopron, Hungary.

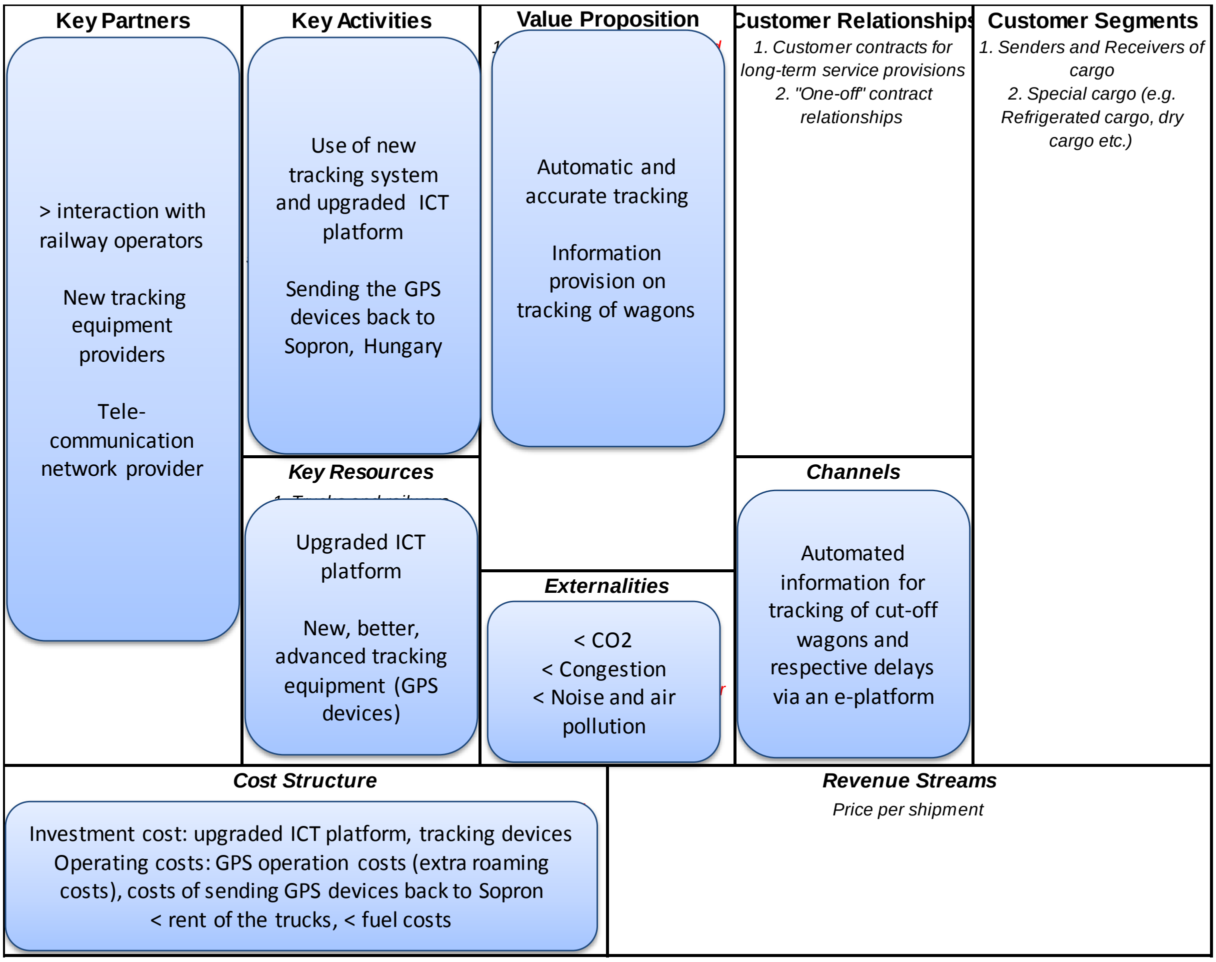



**Figure 21 Changes in Business Model Canvas K+N in Straightsol**

## 6.4 Business case

In order to make a sound comparison between the costs and benefits of business as usual and that of the business with the solution, cost and benefit calculations are done for four different cases;

1. Business as usual (small-scale)
2. Demonstration case (6 GPS devices, used in 24 wagons per month)
3. Business as usual (large-scale)
4. Solution in large-scale (202 GPS devices, used in 806 wagons per month, namely all wagons)

The overall business case is first analysed, meaning that it involves the cost reductions for all stakeholders (including other shippers of second leg transportation). These cost reductions are the result of less unnecessary truck renting for the second leg. As 95% of the second leg transport is done by K+N; 95% of the cost reduction is assigned to the specific business case for K+N.

### *Overall Business Case*

Table 14 illustrates the cost and benefit analysis involving also the trucks rented by the customers of K+N.

**Table 14 Cost and benefit analysis**

| OVERALL BUSINESS CASE | | | | |
|---|---|---|---|---|
| **CAPEX** | | | | |
| | **Business as usual (small-scale)** | **Demonstration** | **Business as usual (large-scale)** | **Solution in large-scale** |
| **Transport solution** | | | | |
| Cost of GSM | - | 26 | - | 879 |
| Cost of GPS | - | 1,620 | - | 54,540 |
| Total Capex | - | 1,646 | - | 55,419 |

| **OPEX (per year)** | | | | |
|---|---|---|---|---|
| **Costs generated by the solution** | | | | |
| Cost of data communication | - | 1,080 | - | 36,360 |
| Return of GPS back to Sopron | - | 8,640 | - | 290,160 |
| **Costs reduced by the solution** | | | | |
| Number of extra trucks rented | 108 | 69 | 3,201 | 2,049 |
| Trucks (rent) | 14,040 | 12,874 | 453,150 | 418,579 |
| Fuel costs | 27,945 | 26,633 | 911,553 | 872,661 |
| Personnel costs for loading/unloading | 1916 | 1,916 | 1,814 | 62,496 |
| Personnel costs related to cut-off costs | 415 | 415 | 341 | 13,950 |
| Accident cost | 828 | 789 | 27,009 | 25,857 |
| Total Opex | 45,144 | 52,170 | 1,468,158 | 1,714,224 |

The first part of the table shows the investment costs required for the solution. Investment costs are related to the purchase of GPS devices. 1 GPS device costs 270€ and 1 GSM card costs 4.35€, which makes the investment cost for the demonstration case 1646€ and for the large-scale case 55419€.

The operational cost items that are taken into consideration for the business case are the ones that are affected by the solution. Therefore, the costs such as the rent of the trains are not included here, since the solution does not have an impact on that. The operational costs can be divided into two according to the impact of the solution, the ones that are generated due to the solution and the costs that are reduced by the implementation of the solution. The costs generated by the solution are costs of data communication (roaming costs) and costs related to the return of GPS devices from K+N facilities back to Sopron. Roaming costs are 15€ per device, per month. The costs to return the devices back to Sopron by airplane is 30€ per device per trip. The 6 devices used in the demonstration are used 4 times per month, therefore had to be returned 4 times per month back to Sopron, which cost 720€ in total per month.

The cost reduction is caused by the lower amount of trucks rented for the second leg of the transportation. During the demonstration, there were some technical problems mainly related to network coverage in the former Yugoslavian countries. Therefore, only 36% of the trips was successful. For the calculations of the business case, this percentage is taken as basis. For the 24 wagons monitored during the demonstration, at business as usual 39 trucks are rented, 9 out of which were rented unnecessarily. With the success of 36%, 3 of these extra rented trucks are avoided in the pilot case per month, and 96 in the large-scale scenario. Additional to the renting cost of the trucks, there are also fuel costs saved due to the km's travelled from the base of the trucks to the K+N premises. There are two types of personnel costs affected by the solution. First one is the man-hours for loading and unloading of the trains. With the help of monitoring, the work can be better planned and there will not be any personnel waiting for the delayed wagons unnecessarily. Second type is the personnel costs related to cut-off wagons. These are the costs made for the tracking of the cut-off wagons and re-planning their trip to Sindos. Since the tracking is already done by the GPS devices, this step can be avoided. Therefore a 50% of cost reduction is assumed for the personnel costs related to cut-off wagons. Another operating cost that the solution has an impact on is accident costs calculated based on truck kilometres driven. Total operating costs of the solution are higher than the business as usual although the solution results in reduction for some operating costs. The main reason for that are the high return costs of GPS devices back to Sopron.

### *Business Case for K+N*

As mentioned before the business case of K+N is calculated based on the general business case. 95% of the truck renting cost and fuel costs are taken for the business case of K+N. The rest of the operating costs are taken the same since they are not directly related to the second leg transport.

**Table 15 Business case K+N**

| K+N BUSINESS CASE | | | | |
|---|---|---|---|---|
| **CAPEX** | | | | |
| | **Business as usual (small-scale)** | **Demonstration** | **Business as usual (large-scale)** | **Solution in large-scale** |
| **Transport solution** | | | | |
| Cost of GSM | - | 26 | - | 879 |
| Cost of GPS | - | 1,620 | - | 54,540 |
| Total Capex | - | 1,646 | - | 55,419 |
| Depreciation (3 years lifetime) | - | 549 | - | 18,473 |
| **OPEX (per year)** | | | | |
| **Costs generated by the solution** | | | | |
| Cost of data communication | - | 1,080 | - | 36,360 |
| Return of GPS back to Sopron | - | 8,640 | - | 290,160 |
| **Costs reduced by the solution** | | | | |
| Trucks (rent) | 13,338 | 12,230 | 430,492 | 397,650 |
| Fuel costs | 26,548 | 25,301 | 865,976 | 829,028 |
| Personnel costs for loading/unloading | 1916 | 1,916 | 1,814 | 62,496 |
| Personnel costs related to cut-off costs | 415 | 415 | 341 | 13,950 |
| Accident cost | 828 | 789 | 27,009 | 25,857 |
| Total Opex | 43,045 | 50,195 | 1,399,923 | 1,649,662 |
| Operating benefits (per year) | - | -7,150 | - | -249,740 |
| Total Yearly Costs | 43,045 | 50,743 | 1,399,923 | 1,668,135 |

Although there is a cost reduction of 5.4% with the application of the solution, the operating costs with the solution are still higher than the operating costs for business as usual. The reason is that the reduction resulted by the solution (2570€ and 76780€ for the demonstration and the large-scale, respectively) is much lower than the costs generated by the solution (9720€ and 326520€ for the demonstration and the large-scale, respectively). Additional to the operational costs generated by the solution, there are extra investment costs as well which are added to the operational cost by taking their depreciation values. To calculate the depreciation values the lifetime of GPS devices are taken as 3 years. The table below illustrates the yearly costs for business as usual and solution in large-scale. Since the business case is negative there is no breakeven point (see Figure 23).

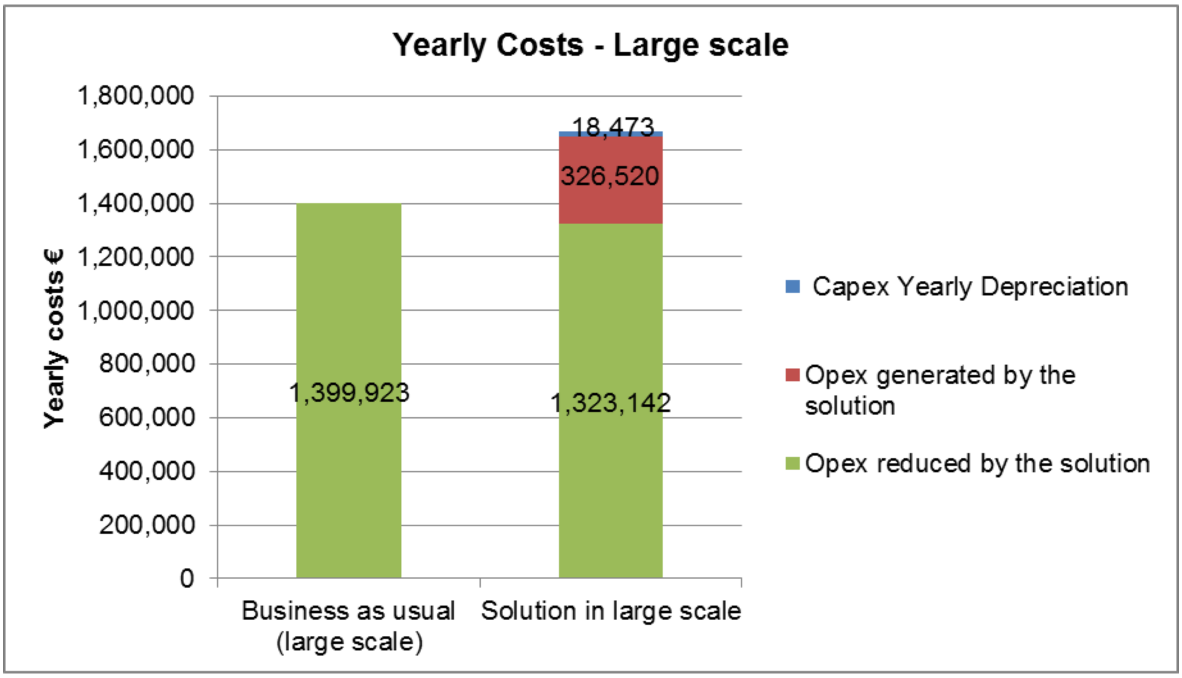



**Figure 22 Results yearly costs large-scale scenario**

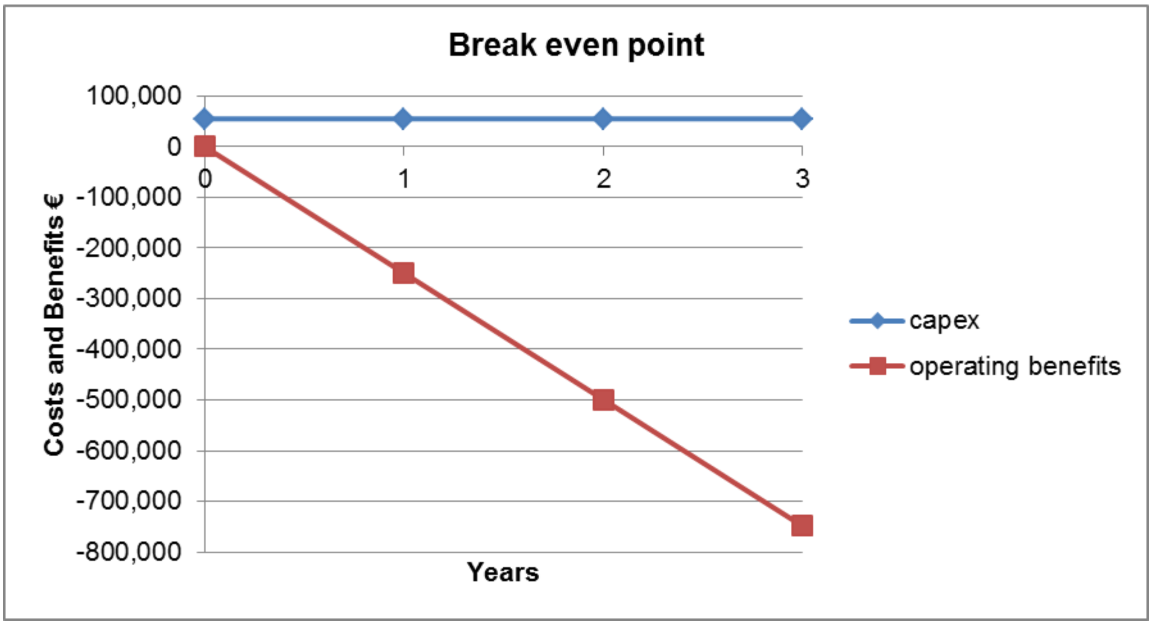
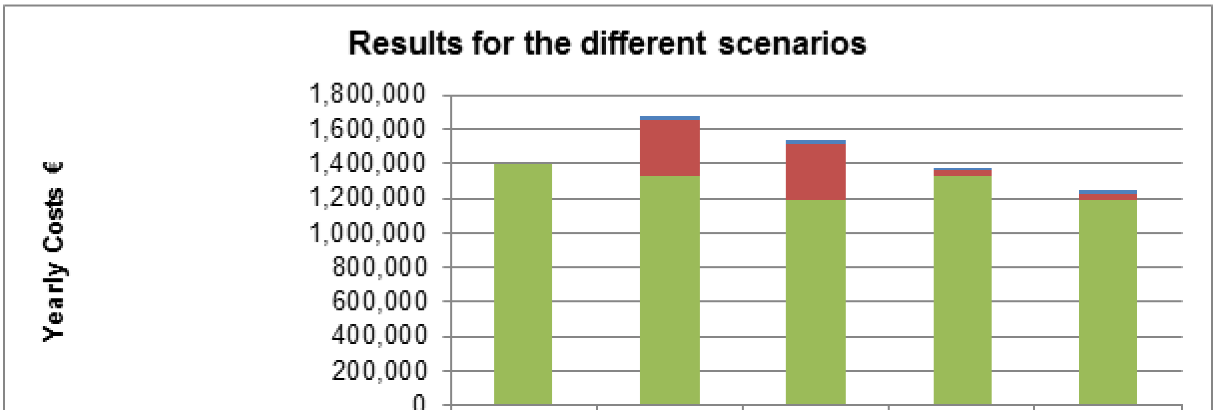



**Figure 23 Breakeven analysis**

## 6.5 Sensitivity analysis

In order to investigate the requirements for a positive business case, three different scenarios are defined after which the effects on the business case are examined. The scenarios consider the case of 1) 100% successful trips, 2) zero return costs and 3) a combination of both. Figure 24 shows the results for the three scenarios, next to results from the business as usual and the results from paragraph 6.4 (i.e. "real case").




| | Business as usual | Real case | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|---|
| Capex Yearly Depreciation | 0 | 18473 | 18473 | 18473 | 18473 |
| Opex generated by the solution | 0 | 326520 | 326520 | 36360 | 36360 |
| Opex reduced by the solution | 1399923 | 1323142 | 1186644 | 1323142 | 1186644 |

**Figure 24 Yearly costs for different scenarios as compared to BAU**

***Scenario 1: 100% successful trips***

As mentioned before, due to some technical problems during the demonstration, only 36% of the trips were successful, which resulted in 5.4% cost reduction in operating costs. In this scenario, we calculated the business case as if there are no technical problems and all the trips are successful. Although this might be quite difficult to realize in reality, the results give an understanding for success prerequisites.

100% successful trips mean there will be no extra trucks rented. This means for large-scale implementation, that the rent of 3,041 extra trucks can be avoided. This results in 15.2% reduction in operational costs. However, there is no change in the generated operating costs and in the investments made. The results show that this scenario does not result in a positive business case. Calculations for this scenario make clear that merely solving the technical problems and increasing the success percentage of the trips is not sufficient. In order to make the business case positive, the operating costs generated by the solution must decrease.

***Scenario 2: No return costs with 36% successful trips***

There are two operational cost items generated by the solution; cost of data communication and return cost of GPS devices back to Sopron. The latter is responsible for 89% of generated costs. Therefore in this scenario we assume that GPS devices do not have to be returned back by airplane but by the same trains. A possibility might be that devices are installed on the trains permanently. For this scenario the success percentage of the trips are kept the same as in the real case, namely at 36%. The results were shown in Figure 22 and Figure 24. In this scenario, the solution with GPS devices results in a 21,948€ and 1.5% reduction in total yearly costs, which makes the business case positive. In this case, breakeven point can be reached in less than 1.5 half year (see Figure 25).

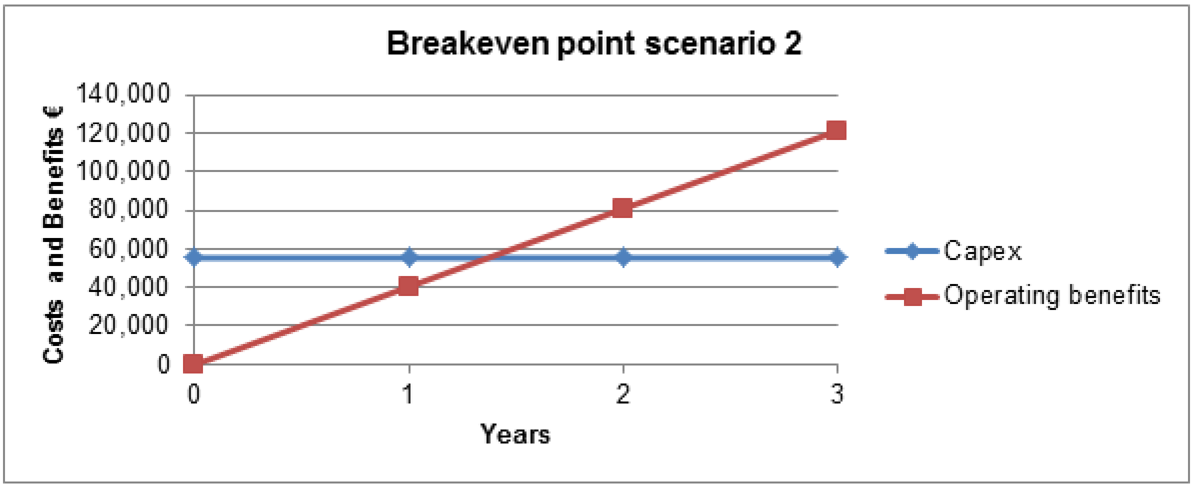



**Figure 25 Breakeven analysis scenario 2**

***Scenario 3: No return costs and 100% successful trips***

This scenario, where we look at the business case without any technical problems, thus 100% successful trips and without return costs, has the best results. In this scenario, the solution results in a 158446€ (11.3%) reduction in total yearly costs, which makes the business case positive and very attractive since the breakeven point can be reached only in a few months, namely less than 4 months.

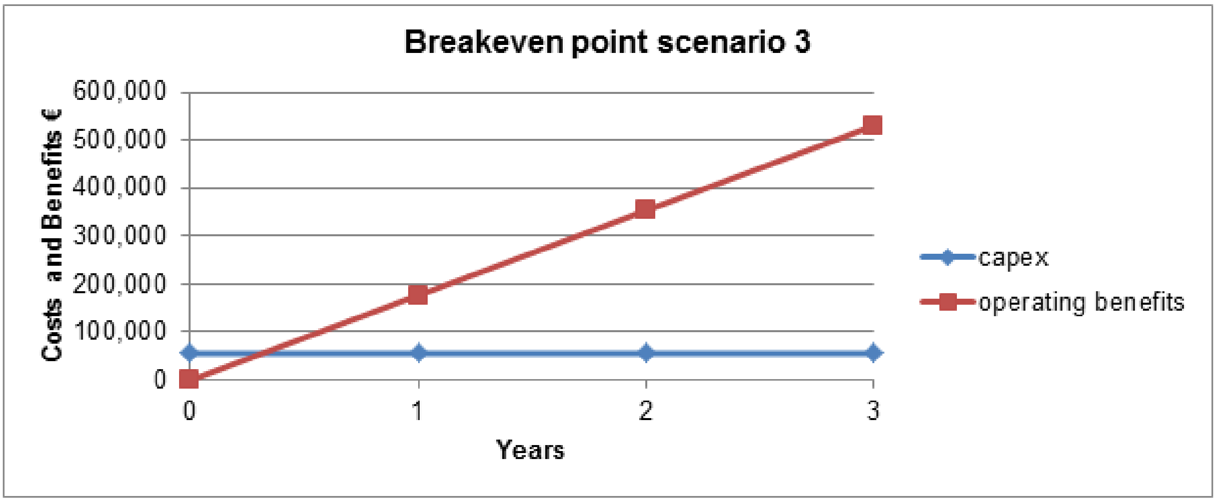



**Figure 26 Breakeven analysis scenario 3**

In the case that there is a solution for the return cost of GPS devices back to Sopron, the innovation becomes very attractive to implement. In that case, it is even not necessary to reach a high rate of success for trips, which means that even if there are some technical problems, the use of GPS devices will result in a positive business case. Figure 27 shows how the total yearly costs change with respect to the success percentage in case there are no return costs for GPS devices. In this case, total yearly costs (including CAPEX depreciation) are equal to the costs of the business as usual at a success rate percentage of 26%. This means that when there are no return costs, the business case will be positive at a success rate of more than 26%.

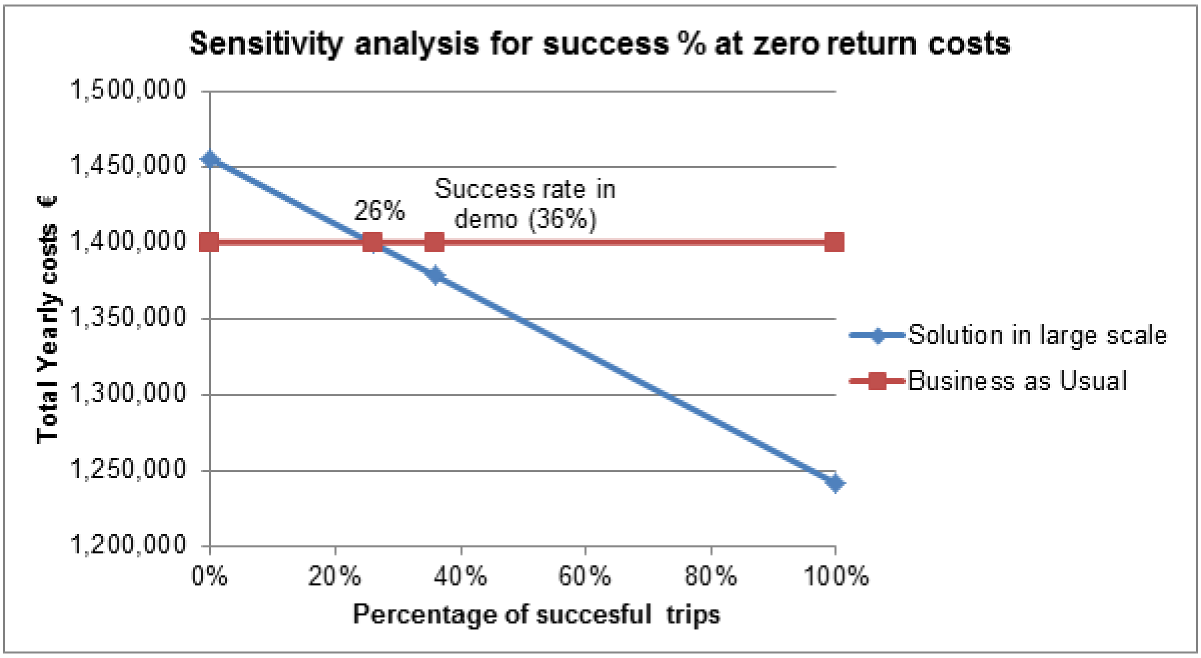



**Figure 27 Sensitivity analysis success rate (scenario 2)**

## 6.6 External cost and benefits

The main external benefits of this case result from the decrease of the travelled distance by the trucks since the solution decreases the rent of extra trucks. If the solution is implemented in large scale where all the wagons will be tracked by the GPS devices, the rent of 96 extra trucks can be prevented. The distance from the basis of the trucks to the K+N premises is approximately 25km. Therefore the solution can avoid 50kms travelling for each extra truck, which makes 4,800kms per month and 57,600 kms per year. Using the average emission factor for a truck trailer as 1,500g/km (den Boer, et al., 2011), the $CO_2$ emission savings per year resulting from this solution is calculated as approximately 89,000kg. The conversion of these savings to monetary terms is done by taking the factor of €25 per ton $CO_2$ (Ecofys, 2009). The external benefits resulting from large scale implementation are €2,225 per year. The reduction is however negligible considering the amount of fuel used during transport, and the value attached to the reduction. The solution may lead to much greater external cost savings on the long term though, when the solution would be implemented on European scale with more LSPs involved.

## 6.7 Viability fit analysis

Business case results show the financial feasibility of the innovation for K+N. In this part we look at different stakeholders involved in the innovation either by actively participating or experiencing the impacts of the innovation. We analyse if the innovation is viable for their market and if it fits to their organisation. For this analysis we use the real case demonstration, where the percentage of successful trips is 36 and GPS devices are returned back to Sopron by airplane.

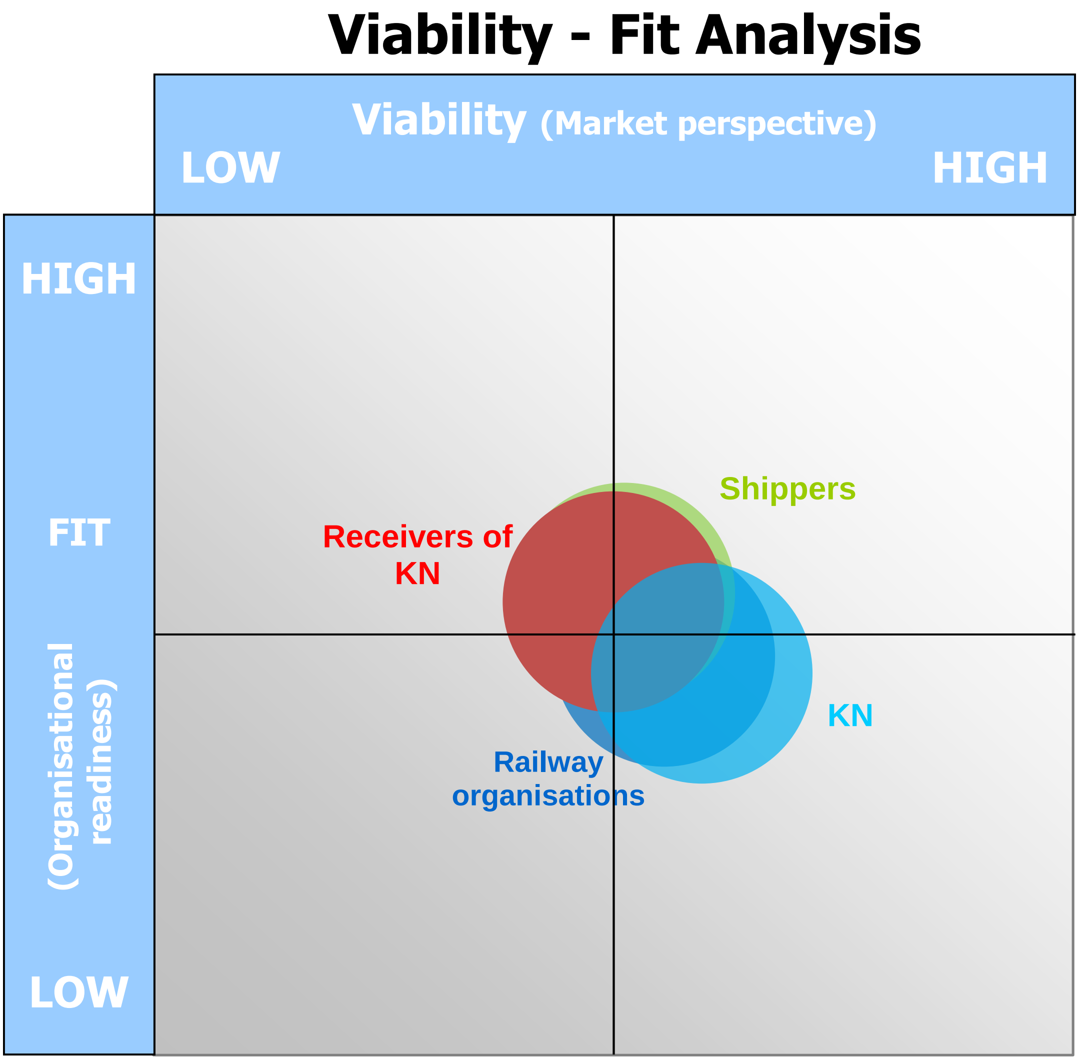



**Figure 28 Viability fit analysis**

In the execution of the innovation, there are four important stakeholders:

1. **Kuehne+Nagel*:*** K+N scores positive for the market perspective, but negative for organisational readiness. It scores positive for the market perspective, since the innovation brings an improvement to the value propositions of K+N like more automatic and accurate tracking of their goods. With the help of the new system K+N improves their customer contact as well which results in more customer satisfaction. Additionally, there are some nonfinancial benefits such as less $CO_2$ emissions resulting from the innovation as well. K+N scores negative for organisational readiness, mainly due to the negative business case. Although the innovation brings improvements in the logistic activities of K+N, the negative impact on financial resources makes the innovation a poor fit for the organisation.
2. **Railway organisation*:*** Railway organisations score positive for the market perspective because of exact same reasons as Kuehne Nagel. This innovation addresses a specific problem of their customers, namely renting trucks unnecessarily and not being able to inform the receivers timely. Therefore, the innovation increases the customer satisfaction. However, railway organisations as well score negative for organisational fit, although not as negative as K+N. In order to implement the innovation, railway organisations have to train their personnel about the use of GPS devices and they need to collaborate with K+N more intensely which might cost more time for the railway organisations than as usual.
3. **Shippers (for the 2nd leg):** Shippers score both for the market perspective and organisational fit positive, since with the innovation they avoid extra truck renting and they can keep their own customers informed about the delays. They experience only positive financial effects of the innovation.
4. **Receivers of K+N (at the end of 2nd leg):** Receivers score positive for organisational aspects since with the innovation they can be timely informed about any delay of their goods and plan their activities accordingly. Considering market perspective, receivers score neutral since the innovation does not have an impact on the customer segment and customer relations of the receivers.

To conclude, all the stakeholders score positive for market perspectives, which means that the innovation is an improvement for the whole market. However, considering the organisational fit, the executers of the innovation; K+N and railway organisations experience a negative impact of the innovation. In case that these negative impacts can be compensated, the innovation has a potential of being a success for the whole market.

## 6.8 Prerequisites for successful implementation

The main challenge for successful implementation of the innovation is the negative impacts on financial resources of Kuehne Nagel. Although the innovation brings some cost reductions, they are not enough to compensate for the costs generated by the innovation.

There are two aspects of negative financial results:

- Not 100% successful trips: This results in lower cost reduction than expected
- Return of GPS devices back to Sopron: This item was too costly during the demonstration since the devices are sent by airplane.

**Success of the trips:** The success of the trips refers to the timely information collection from the wagons. During the demonstration there some technical problems occurred due to which the tracking of the wagons was not always possible.

One of these challenges was network coverage in the former Yugoslavian countries. Due to insufficient network coverage, it was almost not possible to track the wagons in this region. Therefore, the percentage of successful trips was only 36, which did not give the expected cost reduction.

**Return of GPS devices back to Sopron:** Looking at the analysis done by the business case calculations, the main prerequisite for a successful implementation of the solution is finding another way to return the GPS devices back to Sopron. Returning them by airplane as it was done during the demonstration is too costly which is impossible to compensate by the cost reductions achieved, even if there are no technical problems at all.

One possible solution for returning the devices is the instalment of the devices on the wagons permanently. In this way, the devices can be used also on the way back to Sopron. However, this requires different agreements with railway operators, since they are the owners of the wagons. Another challenge that might arise with the permanent installation of the devices is their charging. Since there is no electricity available in the wagons, a new infrastructure might be necessary for charging of the devices. Another idea to solve this problem is to purchase modular devices, the batteries of which can be uninstalled and installed. In that case, extra batteries can be purchased to replace the batteries which are depleted. Risk of theft needs to be considered when implementing such a solution.

**Different business models:** According to the results of viability and fit analysis, the innovation has the potential to be beneficial for all the stakeholders. However, since the costs and execution of the solution remains by Kuehne Nagel which makes the innovation a poor fit for their organisation. Therefore, another possible solution can be sharing of the costs or benefits with other stakeholders. This can be done in different ways:

- K+N can charge their customers for the improved service
- Railway operators can implement the solution and charge their customers (K+N, but also others) for the service that they deliver.

**Economic recession:** One of the main reasons to implement this innovation is to make the logistic activities more efficient by avoiding the rent of excessive trucks in case of wagon delays. Before, K+N had to rent the trucks one day earlier than the supposed arrival date of the wagons. However, due to the current economic situation, most of the trucks are available even for renting on the same day. Therefore, at the moment K+N does not need to rent the trucks one day before. By renting on the same day as the arrival of the wagons they already avoid renting excessive trucks. Thus, the benefits of the innovation become even smaller.

# 7 Retail Supply Management and Last Mile Distribution in Oslo – GS1

## 7.1 Case description

The aim of the GS1 Norway demonstration was to 1) demonstrate smarter solutions for information collection and sharing between stakeholders in the supply chain by use of GS1 standards, and 2) demonstrate the usefulness of a joint buffer storage facility in shopping centres. The concepts are introduced below. A detailed description of the demonstration is available in Deliverable 5.1. The further evaluation in this chapter considers the combined use of the concepts. The demonstration showed that there is a great interest in the solution, An obstacle for future implementation is the current unequal distribution of costs and benefits. How to overcome this challenge is the main focus of this chapter.

***Information Collection and Sharing***

The demonstration showed how automatic data capturing solutions in the value chain contribute to more efficient and predictable deliveries. Events in terms of WHAT (individual object instances), WHERE (read point, business location), WHEN (time stamp) and WHY (business step, type of event) and disposition (object condition i.e. "damaged") were shared. Push messages about important event information such as delayed deliveries or arrival of items were sent by SMS. In the Oslo GS1 demonstration there was data capturing at three points: 1) the warehouse/terminal of the retail chain or logistics service provider, 2) at the shopping centre's freight receipt and 3) in the individual retailer's shop. Data is collected by RFID tags and sent to the EPICS (Electronic Product Code Information Services) server. When dispatching the goods the captured data was used for controlling if the consignment was matching the advised goods. They captured data furthermore gives increased accuracy for transport planning and delivery purposes.

***Joint buffer storage function***

The demonstration showed how a joint buffer storage could reduce delivery times. Instead of direct delivery at the shops, the truck driver delivered his goods to a security guard of the shopping centre. The security guard verified that the deliveries were according the order, signed the papers and placed the goods in a locked buffer storage area. The security guard took care of the internal delivery to the shops, at the time requested by the shop managers.

This way of organizing reduces delivery times for the truck drivers. Information from the EPCIS server is also shared with the security guard (by SMS or e-mail) such that he could be prepared at the unloading area when the freight arrives.

## 7.2 Role stakeholders

The demonstration involved many stakeholders, who, except from the final customer, actively participated. The different actors and the freight-, financial- and information streams are shown in Figure 29. Their role, participation and interest in the solutions are described in Table 16.

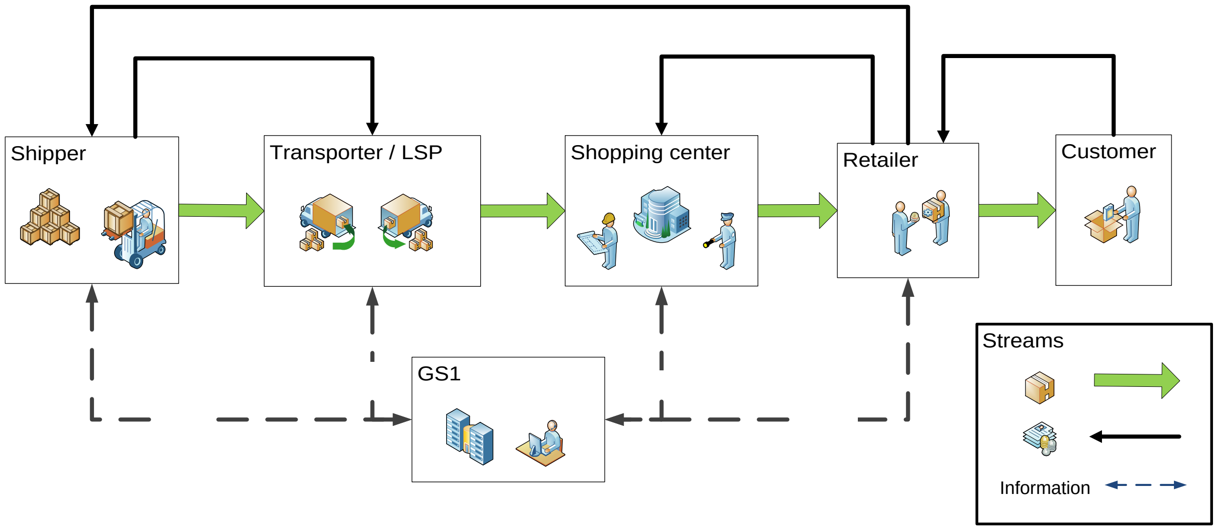



**Figure 29 Relation stakeholders**

**Table 16 Participating stakeholders in GS1 solution**

| Stakeholder | Role | Participation in solution | Interest |
|---|---|---|---|
| **Shipper** | Sender of the goods; provide goods to the retailers in the mall[7]. | Label pallets with RFID tags. | Real time information on delivery to customer. |
| **Transporter / LSP** | Delivers the goods of the shipper to the mall, e.g. DB Schenker. In the business as usual, the LSPs deliver directly to the shopowners. | Scan the RFID tags when pallets leave the warehouse. Deliver to the buffer storage of the shopping centre instead of to the retailer. | Shorter delivery time at the mall. More efficient planning. |
| **Shopping centre** | The owner of the shopping mall Stovner Senter, is Steen & Strom Norge (Major owner is Klépierre, France). | Responsible for collection and temporarily storage of goods that are delivered at the mall. Scanning of RFID tags and communication with shop owners. Taking care of internal transport to the shops. | More attractive business/shopping climate for retailers and their customers. |
| **Retailers** | Shopowners in the mall, e.g. Nille. Sell to visitors of the mall. | Communicate with shopping centre about when to receive the goods. Scan the goods at arrival. | More flexible, secure and bundled delivery. Saves time. Real time information on delivery. |

[7] In almost all cases the shipper is the retail chain's central warehouse. The retail shop is owned by the chain, or has a franchise agreement with the chain. The retail chain (i.e. shipper) has normally the main contract with the shopping centre owner with regard to the shop premises and centre services.

| | | | |
|---|---|---|---|
| **Customers** | Visitors of the shopping mall. | No active participation. | Less disturbance of freight delivery while shopping. |
| **GS1 Norway** | Develops and maintains standards for data collection and sharing in supply chains. | Act as a mediator between supply chain actors and technology providers. | Proof the applicability of technology (in new segments). |

## 7.3 Business Model Canvas

The business models of the shipper, LSP, shipping mall and retailer will change when the solutions are implemented. The effects for the stakeholders on the canvas buildings blocks are summarized in Table 17 and categorized by 1) storage facility, 2) data capturing and 3) information sharing. The business models of the different actors are described separately in the following paragraphs. The business model of the non-profit organisation GS1 Norway does not change, (other than that more customers might be attracted), and is therefore not further discussed.

**Table 17 Summary Business Model changes**

<table>
<tr><th></th><th></th><th>Shipper</th><th>LSP</th><th>Shopping mall</th><th>Retailer</th></tr>
<tr><td>Storage facility</td><td>Delivery at buffer storage, temporally storage and bundled internal delivery</td><td></td><td>< activity in the mall<br>< delivery costs</td><td>> costs for space and employee<br>> value proposition<br>< negative externalities</td><td>> time for relationship<br>< negative externalities<br>< inventory cost</td></tr>
<tr><td rowspan="2">Data capturing</td><td>Place RFID tags</td><td>New activity<br>New cost</td><td></td><td></td><td></td></tr>
<tr><td>Scanning RFID tags</td><td colspan="4">New activity<br>New resources<br>New cost: training personnel<br><u>Cost</u>: who invest in the scanning equipment?</td></tr>
<tr><td rowspan="4">Information sharing</td><td>Rent of EPCIS server</td><td>New cost</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Sharing track and trace information within supply chain</td><td colspan="3">New channel<br>New resources</td><td></td></tr>
<tr><td colspan="4">New partners</td></tr>
<tr><td>More accurate information, i.e. predictability</td><td></td><td>> value proposition<br>< costs; better planning</td><td>> value proposition</td><td>< cost for planning staff and inventory</td></tr>
</table>

### 7.3.1 Business model Canvas shopping mall

Steen & Strom is the owner of the shopping mall in the Oslo demonstration. Figure 30 shows the changes in the blue boxes that occur in Steen & Strom's business model.

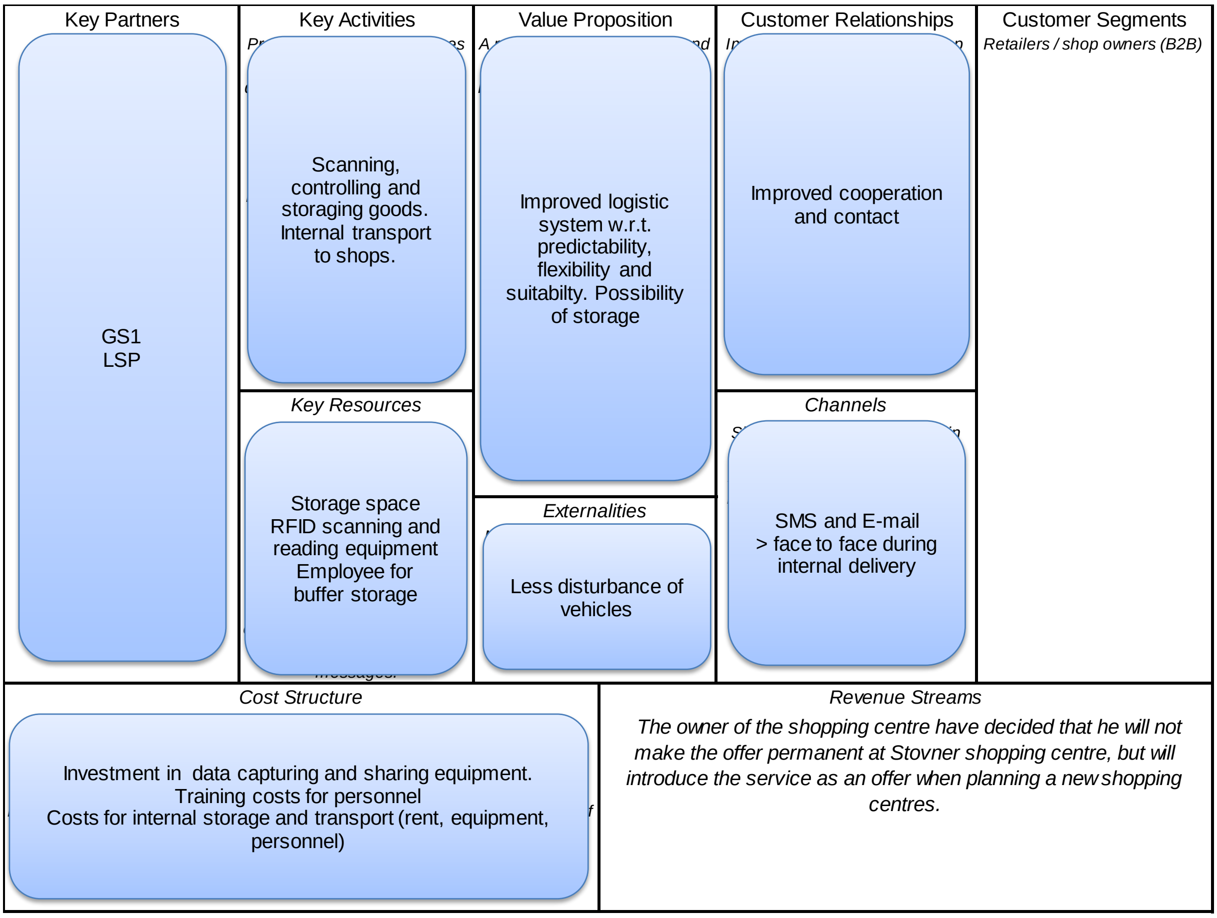



**Figure 30 Business model Canvas shopping mall**

***Customer, channel and relationship:*** The customers of Steen & Strom are retail shop owners in the shopping mall. With the solution of GS1, track and trace information is shared with customers and partners by SMS and/or e-mail. There is additional face to face contact when the internal logistic service provider delivers goods to stores. The relationship intensifies as there is more cooperation and communication.

***Value proposition and externalities:*** Steen & Strom offers an attractive shopping environment and business environment for shop keepers. An improved logistics system, resulting in a reduction in delivery times and delivery costs and improved predictablity and flexibility will contribute to this proposition. Steen and Strom offers additional value with short term storage possibilities and to deliver the goods to retailers when they need it (at suitable times). Externalities that result from loading and unloading activities in front of the shopping mall, may reduce as deliveries take less time.

***Partners, activities, resources:*** The resources needed registration equipment at supply chain reading points. Buffer storage and equipment for internal transport of goods in the shopping mall. The internal transport and logistics is carried out by an internal LSP, named Securitas. A new activity in the business model is data sharing with the use of new technology, with GS1 as key partner. GS1 act as a mediator for the RFID tags, the Electronic Product Code Information Services (EPICS) and support. Another partner are the logistic service providers, such as DB Schenker Norway, Tollpost Globe and Flotten Transport.

***Cost structure and revenue streams:*** The solution requires an investment in scanning equipment for RFID tags. Appropriate cell phones or e-mail access is needed to read messages from the software. Personnel should be trained. Furthermore, the internal storage and transport of goods requires equipment, personnel and space. In order to have a successful business model, the investment costs should be compensated. Whether this is possible for the shopping mall, is discussed in paragraph 7.5 and 7.6.

### 7.3.2 Business Model Canvas Logistics Service Provider

Figure 31 shows that changes for LSPs in their business model due to this Staightsol solution.

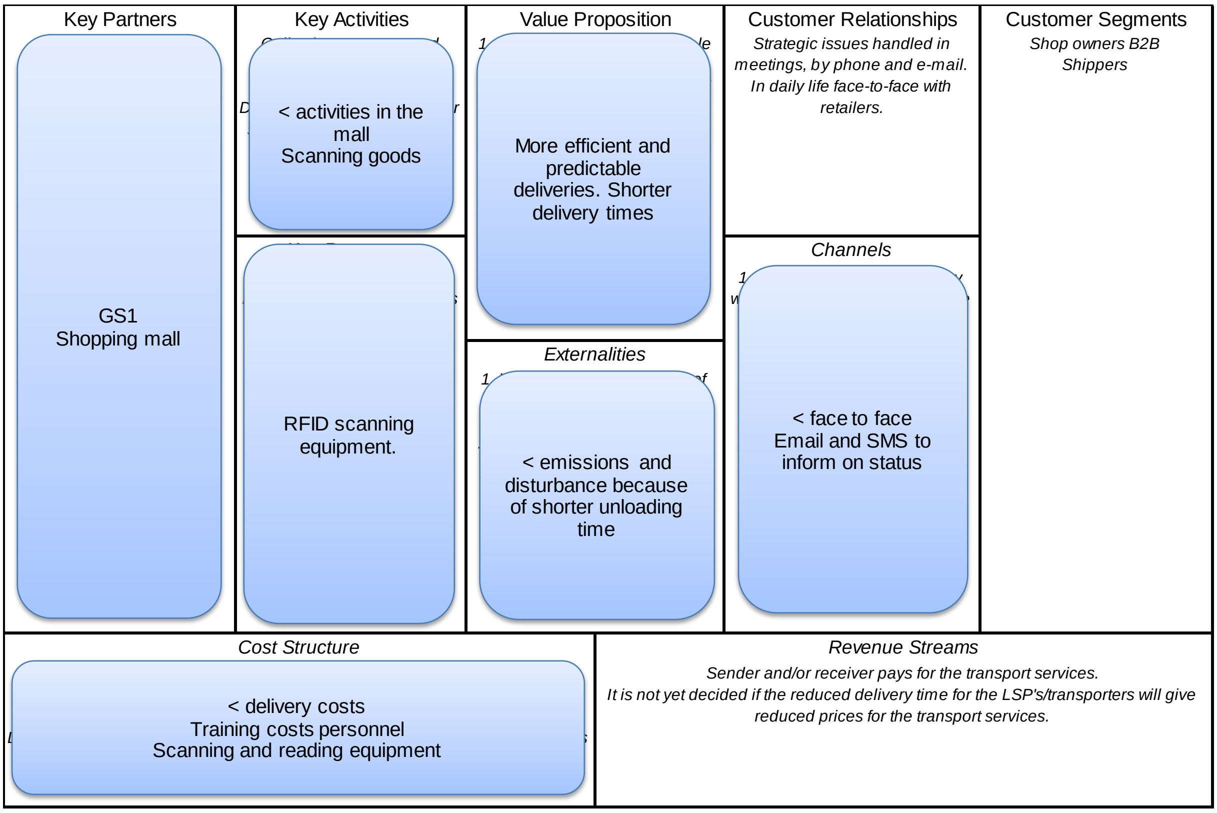



**Figure 31 Business Model Canvas LSP**

***Customer, channel and relationship:*** The customer of the LSP is the shipper and/or the receiver of the goods. They may work in close relationship. The relationship intensifies due to the track and trace possibilities. More information is shared by email and SMS. Face to face contact with retailers will become less when the internal LSP of the shopping mall takes over the responsibility for the last few metres.

***Value proposition and externalities:*** As the LSP need less time at the shopping mall for unloading activities, externalities in terms of emissions and disturbance will be reduced.

***Partners, activities, resources:*** The resources needed are RFID scanning equipment at supply chain reading points. A provider should be found for this. Another partner of the LSP is the shopping mall. In the new concept, the LSP delivers the goods at the buffer storage of the mall, instead of directly at the retailer. This can save time and lead to more efficiency. A new activity is the registration of track and trace information and data sharing. More predictability in the supply chain also leads to more efficiency.

***Cost structure and revenue streams:*** Investments should be made for the equipment for RFID scanning and information sharing. Also, costs are made for training of personnel. Costs per delivery will reduce, as less time is needed per delivery. As a consequence, more deliveries can be combined in a truck or in a day.

### 7.3.3 Business Model Canvas shop owner (retailers)

Figure 32 shows the changes in the business model canvas for the shop owners.

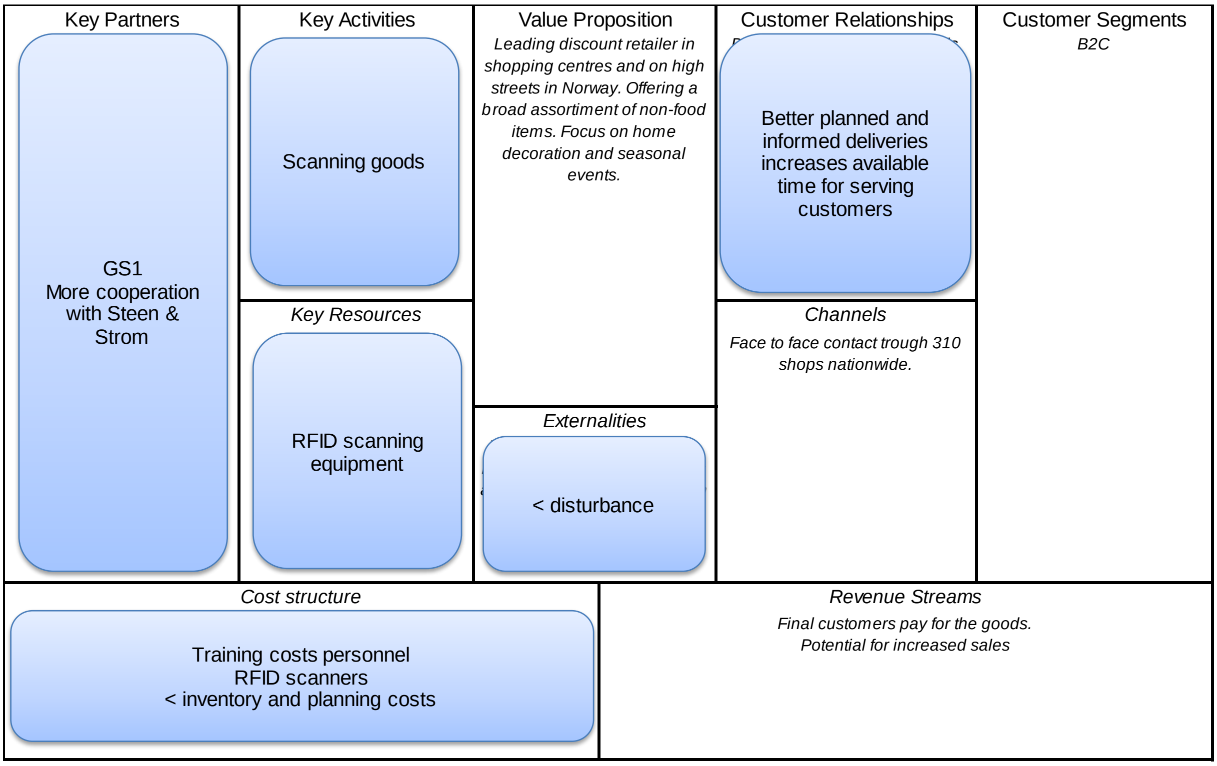



**Figure 32 Business Model Canvas shop owner**

***Customer, channel and relationship:*** The customers of the shop owners are in the B2C market. The customer will in general not directly notice the use of new technology in the supply chain. The better planning of deliveries does allow for more personal customer assistance though.

***Value proposition and externalities:*** One of the shops is a leading discount retailer of non-food items in shopping centres and on high streets in Norway. Better informed and planned deliveries may positively contribute to their image. The disturbance in the mall that result from unloading activities will be reduced.

***Partners, activities, resources:*** The shop owner will use the new technology to track and trace the status of the ordered goods. Goods are scanned in the warehouse and upon arrival in the store. For this, they need the appropriate equipment. Second, the new concept gives the shop owner more influence on the time of delivery, as Steen & Strom offers short term storage. The cooperation with the shopping mall intensifies.

***Cost structure and revenue streams:*** costs are made for the equipment to scan and read out RFID tags. The shop owner will furthermore have costs for the training of personnel. More predictability within the supply chain may reduce the inventory costs. It is not certain whether and how the shop owner (and other retailers) will benefit from the potential cost savings of the LSP. It is also not sure whether they will face a rent increase of Steen & Strom to compensate for the improved services inside the mall. Regarding the revenue streams, no direct changes occur. There is indirectly a potential for increased sales.

### 7.3.4 Business Model Canvas Shipper

The business model of the shippers does not change much, as Figure 33 shows.

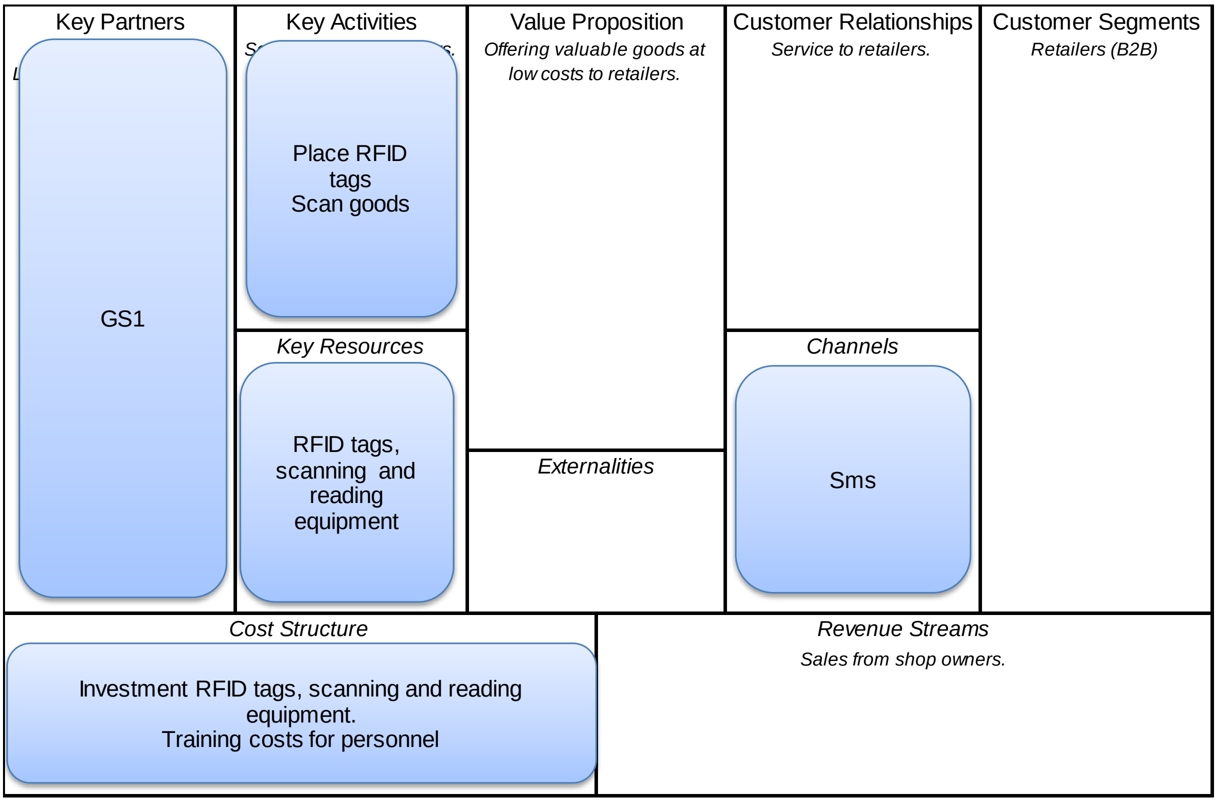



**Figure 33 Business Model Canvas Shipper**

***Customer, channel and relationship:*** The customer of the shipper are the retailers in the shopping mall. With the new solution, the shippers will also use SMS to communicate on the status of the goods.

***Value proposition and externalities:*** The value proposition and externalities do not change.

***Partners, activities, resources:*** The shipper does not participate actively in the buffer storage concept. He is at the start of the data sharing concept though. The shipper places the RFID tags and need to make sure that these are scanned when the lorries leave the warehouse. GS1 can act as a mediator in this concept.

***Cost structure and revenue streams:*** Costs need to be made to purchase, place and scan the RFID tags. Personnel needs to get instructions on how the work with it.

## 7.4 Business Case

The business model analyses help to identify the cost and benefits elements. The main cost elements are:

- Storage space at shopping mall
- Employee(s) and equipment for internal transport
- RFID tags and readers/scanners including data capturing software.
- Software for event tracking and monitoring and for integrating EPCIS-server and operational IT-systems.

The main benefit elements are:

- Time/delivery cost savings for transport operator
- Less inventory and planning costs for shop owners
- Planning efficiency for transport operator (long term)

- Potential for increased revenue for transport operator, shopping mall and shop owners (long term)

The capital expenses (CAPEX) relate to the scanning equipment and training. The operational expenses (OPEX) relate to the monthly costs of the event tracking and monitoring, the costs for delivery and collection of goods, and RFID tags. The values used in the business case, are primarily based on the demonstration results. Additional assumptions were made in collaboration with TOI and GS1 Norway.

### 7.4.1 Input variables and the four scenarios

**Number of participants and storage space:** The pilot situation, included 4 shops, 4 shippers and 75 $m^2$ of storage space. In the scaled situation, it is assumed that 50 shops and 50 shippers will participate. The yearly rent cost per $m^2$ in the shopping centre is EUR 93.75 (750 NOK). In the scaled scenario about 150 $m^2$ is needed as buffer storage. There is 1 full time job created for the collection of the goods at the storage buffer and the internal transport. The costs for the tracking and monitoring system per shop can reduce significantly since a large amount of shops participate[8].

**Time savings:** The delivery time for the transport operator decreased from 17 minutes (i.e. baseline situation) per pallet to 3 minutes per pallet. The time for queuing at the freight receipt reduced with 5 minutes from 5 (i.e. baseline situation) to 0. The time savings in the pilot situation are monetized by multiplying the time savings by the hourly wage/cost rate. This is EUR 31.25 (250 NOK) for the employees in the shopping centre (both security guard and shop employees) and EUR 56.25 (450 NOK) for the transport operator and the use of the truck. Average fuel consumption during idling time (which is 9 minutes in baseline and 3 minutes with solution) is assumed to be 2.3 litre per hour at a cost of 1.79 per litre (14.28 NOK). In the scaled situation, the time needed to deliver or receive a pallet are kept equal to the baseline and pilot situation. The queuing time, which was reduced to 0 minutes during the demonstration, is expected to increase again, to 3 minutes, as many LSPs will deliver their goods at the storage buffer.

**Number of pallets and deliveries:** During the demonstration, the participating shops are all relatively large. On average, 31 pallets per month per shop were delivered. This is not representative for the other shops in the mall, as many have fewer deliveries. Therefore in the scaled scenario an average of 20 pallets per shop per month is assumed. In the sensitivity analysis (see 7.5), the number of pallets in the scope is variable. The ratios of pallets per delivery (approximate 2.9) is kept equal.

**Table 18 Summary of the four scenarios**

| Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|
| Calculation based on 126 pallets monthly (174 pallets in 6 weeks of demonstration), 4 shops, 4 shippers in scope. | | Calculation based on 1000 pallets monthly, 50 shops and 50 shippers in scope. | |
| • No storage buffer or information sharing | • Storage buffer of 75$m^2$, and 5 hours p/w employed. | • No storage buffer or information sharing | • Economies of scale w.r.t. storage facility: |

[8] According to GS1: in case of 50 shops; NOK 7,000 (€875) per year per shop should cover all costs related database access and user interface software, scanner app, WIFI-costs and a support agreement. Additionally, there is one time start-up fee (per database) of fixed NOK 10,000 (€1,250).

| | | | |
|---|---|---|---|
| • CAPEX zero<br>• Time for LSP: 17 minutes delivery per pallet and 5 minutes queuing at freight receipt<br>• Time for shop owner: 30 minutes per pallet | • Time for LSP: 3 minutes delivery per pallet and no queuing at freight receipt<br>• Time for shop owner: 10 minutes per pallet.<br>• Event tracking and monitoring services EUR 312 p/m per shop. | • CAPEX zero<br>• Time for LSP: 17 minutes delivery per pallet and 5 minutes queuing at freight receipt<br>• Time for shop owner: 30 minutes per pallet | 150 m$^2$ and 40 hours p/w. employed.<br>• Time for LSP: 17 minutes delivery per pallet and 3 minutes queuing at freight receipt<br>• Time for shop owner: 20 minutes per pallet<br>• Event tracking and monitoring services EUR 75 p/m per shop. |

**Table 19 Summary of the four scenarios**

| | Total benefit per month | Total benefit per year | Benefit per pallet | Δ |
|---|---|---|---|---|
| Potential results | € 10,798 | € 129,576 | € 11 | -33% |

### 7.4.2 Results total costs and benefits

The analysis of total costs and benefits (see Table 20 and Figure 34) shows that the solution of the buffer storage and information sharing has a positive business case. The benefits in terms of time savings outweigh the costs for the storage buffer, RFID tags and scanning equipment with almost EUR 130,000 per year. The cost reduction is approximately 33% (Table 19). The analysis is based on 1,000 pallets per month.

**Table 20 Total costs and benefits**

| | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|
| **CAPEX (Depreciated values per month)** | | | | |
| **Data capturing** | | | | |
| Scanning equipment | | 260 | | 2,813 |
| Training of scanning personnel | | 13 | | 141 |
| Total Capex | - | 273 | - | 2,953 |
| **OPEX (per month)** | | | | |
| **Storage facility and internal transport** | | | | |
| Rent for storage space | - | 583 | - | 1,172 |
| Employee / security guard | - | 677 | - | 5,417 |
| **Information sharing** | | | | |
| Event tracking and monitoring software | | 1,250 | | 3,750 |
| **Data capturing** | | | | |
| RFID tags | | 24 | | 188 |
| **Delivery by LSP / transport operator** | | | | |
| Delivery cost per pallet | 2,003 | 353 | 15,938 | 2,813 |
| Costs for queuing at freight receipt | 203 | - | 898 | 539 |
| Fuel costs during idling time | 73 | 26 | 582 | 205 |
| **Unpacking activities in the shop** | | | | |
| Total cost for collecting and unpacking | 1,964 | 655 | 15,625 | 5,208 |
| Total Opex | 4,243 | 3,567 | 33,042 | 19,291 |
| TOTAL | 4,243 | 3,841 | 33,042 | 22,244 |
| Δ | | | | -0 |

**Table 21 Monthly costs (grouped) in four scenarios**

| Results | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|
| Unpacking activities in the shop | 1,964 | 655 | 15,625 | 5,208 |
| Delivery by LSP | 2,279 | 379 | 17,417 | 3,557 |
| Storage facility | - | 1,260 | - | 6,589 |
| RFID scanners, tags and training | - | 297 | - | 3,141 |
| Tracking and monitoring software | - | 1,250 | - | 3,750 |
| **TOTAL** | 4,243 | 3,841 | 33,042 | 22,244 |

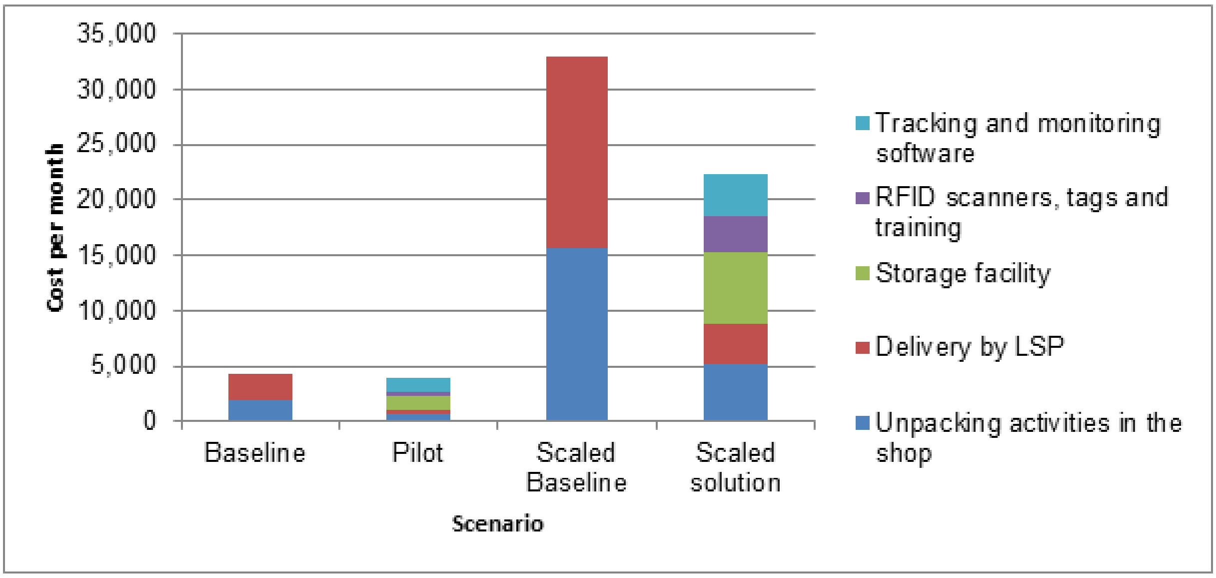



**Figure 34 Division of monthly costs in four scenarios**

## 7.5 Sensitivity analyses

Whether or not there is a positive business case for large-scale implementation depends on various circumstances, for example the time savings of the shop owners and the number of pallets that are delivered at the storage buffer. To take this into account, we have varied with different input variables and analysed the effects on the breakeven point. The breakeven point is considered as the required number of pallets such that the benefits, in terms of time and fuel savings, are at least equal to the costs for the buffer storage and information sharing technology. We have varied with:

- The number of pallets that are delivered at the storage buffer.
- The number of shops that participate: either 25 or 50.
- The time savings of the LSP: reduced with up to 50%.
- The time savings of the shop owners: reduced with up to 100%.

The results are shown in Table 22. Scenarios A to F represent different combinations of time savings, as percentage of the demonstrations results. It appears that the number of participating shops barely influence the total costs. We have therefore kept it equal at 50 shops for the cost calculation[9]. Though, the required number of pallets per shop is significantly higher when only 25 shops participate. The feasibility considers whether the average number of pallets per shop needed is realistic to occur in the shopping mall. The limit is set at 28, with 20-27 being uncertain. This depends on the type of shops that participate. Scenario B is graphically shown in Figure 35 as an example.

[9] When more shops participate, the costs for the event tracking system per shop will be lower. When there are more pallets, the need for space, scanners and employee hours will be higher. However, the total additional costs for 25 shops, is only about 1% more than with 50 shops.

**Table 22 Sensitivity Analysis**

| Scenario ↓ | Time savings LSP (as % of demo results) | Time savings shop owners (as % of demo results) | Breakeven point in # pallets (benefits ≥ costs) | Average nr of pallets per shop needed | | | |
|---|---|---|---|---|---|---|---|
| | | | | If 25 shops participate | Feasible?[10] | If 50 shops participate | Feasible? |
| A | 100% | 100% | 475 | 19 | ✓ | 10 | ✓ |
| B | 100% | 50% | 600 | 24 | ? | 12 | ✓ |
| C | 100% | 0% | 950 | 38 | ☒ | 19 | ✓ |
| D | 50% | 100% | 650 | 26 | ? | 13 | ✓ |
| E | 50% | 50% | 1075 | 43 | ☒ | 22 | ? |
| F | 50% | 0% | 1825 | 73 | ☒ | 37 | ☒ |

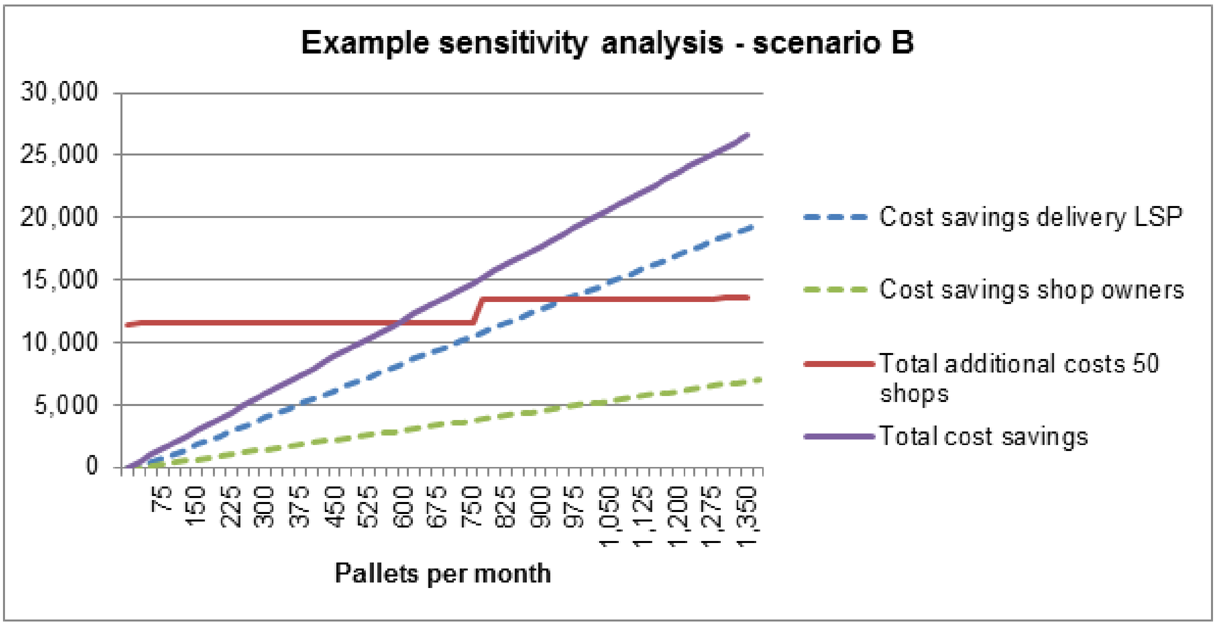



**Figure 35 Sensitivity analysis – scenario B**

## 7.6 External costs and benefits

The external cost savings in the GS1 demonstration relate to the use of fuel. Burning fuel harms the environment and has a negative effect on people's health in terms of air quality. Fuel savings result from the reduction in idling time (from 9 to 3 minutes per pallet). The drivers, who often let the engine running during unloading, need less time to deliver the goods. The estimated fuel used during idling in the scaled scenario is 115 liters per month as opposed to

[10] Considers whether the average number of pallets per shop needed is realistic to occur in the shopping mall. The limit is set at 28, with 20-27 being uncertain, depending on the type of shops that participate.

326 liters in the scaled baseline. This is a reduction of 211 liter, which equals 661 kilogram $CO_2$[11]. The reduction is however negligible considering the amount of fuel used during transport, and the value attached to the reduction. The external cost of 661 kilogram $CO_2$ is about EUR 26[12]. There will be some additional external cost savings in terms of $NO_x$ and $PM_{10}$ but this is limited, also due to the location where the emissions are emitted. The solution may lead to much greater external cost savings on the long term though, when LSPs are able to adjust their transport planning, because of the reduction in delivery time at the shopping mall. When they could save kilometers driven (in the inner city), savings on external costs will increase considerably.

## 7.7 Viability-fit analysis

Figure 36 shows the results of the viability-fit analysis, which is based on the assumption that the shopping centre is the main investor– and operator – of the storage buffer.

***Viability - Market perspective:*** the market perspective of the solution is low for the shop owners mainly as their customers (i.e. the shopping public) do not notice much from the solution and are not able to pay for the solution. This very much relates to the B2B character of the solution. The market perspective of the LSP, Shipper and Shopping Centre is positive as it adds to their communication channels, improves customers satisfaction and has potential to attract more customers. This applies even more for the shopping centre, considering that it offers a new supportive, and valued, service.

***Fit - organisational readiness:*** The organisational fit of the demonstrated solution is positive for the shop owners and LSP. The solution supports their current activities, without the need for many adjustments. Also, for the shipper there are not many adjustments necessarily other than scanning the RFID tags. This is different for the Shopping Centre though. The organisational fit for the shopping centre is low as the solution is very different from their current activities and mission (i.e. renting shopping space).

The analysis shows that, even though the solution is a differentiating and value adding service that the Shopping Centre could offer, the organisational (*un)*readiness, raises the question whether the Shopping Centre is the appropriate actor to carry out the required activities.

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[11] Well-to-wheel emission factor of 3135 gram per liter diesel is used.

[12] Source: IMPACT - Handbook on estimation of external costs in the transport sector

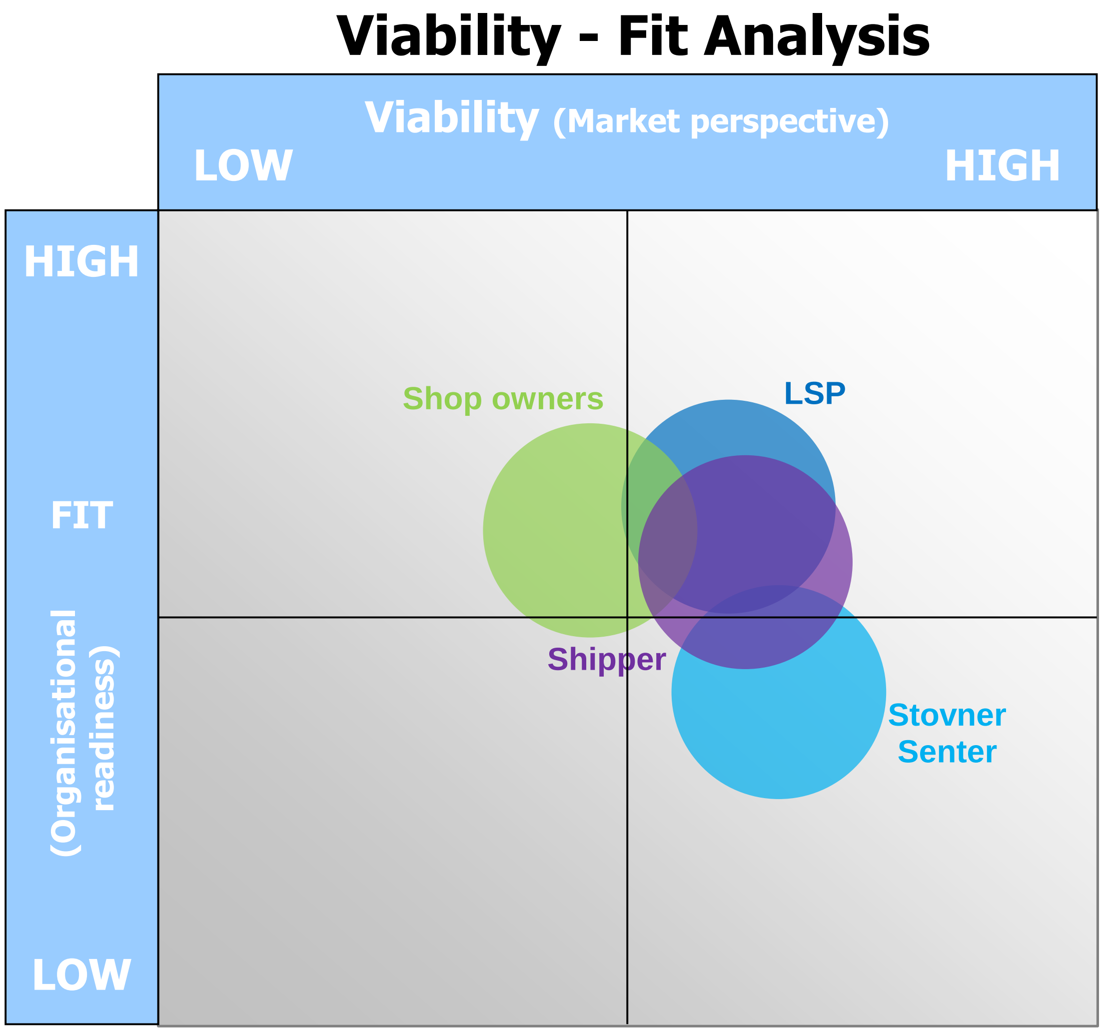



**Figure 36 Viability Fit analysis**

## 7.8 Prerequisites for successful implementation

The analysis of total costs and benefits shows that the solution of the buffer storage and information sharing has a positive business case for different scenarios. Even when the time savings of the shop owners and LSPs are less than experienced in the demonstration. However, the difficulty is that costs and benefits are not equally distributed among the stakeholders. At this moment, none of the stakeholders has taking the initiative to continue with the solutions yet. This is because of the unequal distribution of costs and benefits. In order for the solution to become successful the costs and benefits need to become more transparent and redistributed. So that the actor that invests, will also gain, either in terms of cost savings or increased revenue streams. In this paragraph we propose several steps for redistribution to accomplish an (more) equal distribution of costs and benefits. The proposed redistribution and the requirements are presented at the end of this paragraph in Figure 37 and Figure 38.

Discussions[13] with TOI, GS1 Norway, Stovner Senter, logistics service providers and other experts (within and outside STRAIGHTSOL) have led to the understanding that:

- There has to be one organisation that sets up an agreement with the vendor of the tracking and monitoring system and then charge the different users separately.

[13] Sources: 1) STRAIGHTSOL stakeholder workshop, 25 September 2013, Amsterdam, The Netherlands, 2) STRAIGHTSOL expert session 12 December 2013, TNO, Delft, The Netherlands

- The shopping mall should focus on its core activities instead of offering storage and bundling facilities.
- LSPs (who experience great benefits) are not likely to pay the shopping centre for the last “mile” delivery.

Therefore the possibilities of an external facilitator are explored. Based on the figures from the scaled solution (Table 21), the investment for the external facilitator is about EUR 161,750 EUR per year or 13,479 per month (see Table 23), regardless of the number of pallets

**Table 23 Costs for external facilitator**

| Costs for external facilitator | Per month | Per year |
|---|---|---|
| Storage facility | 6,589 | 79,063 |
| RFID scanners, tags and training | 3,141 | 37,688 |
| Event tracking and monitoring software | 3,750 | 45,000 |
| **Total** | **13,479** | **161,750** |

The facilitator’s cost per pallet for different number of pallets is shown in Figure 37[14]. The graph also shows the monetized time benefits per pallet of the LSP and shop owners for scenario A, B and C[15]. More explanation on the graph is given in the textbox below. The most important conclusion that we can draw, is that the benefits of the LSP are required to compensate for the investment of the external facilitator. Without an (indirect) redistribution from the LSP to the facilitator, the solutions will not be financially feasible. How much the service price per pallet for the LSP and retailers should – and can be – depends on the number of pallets that are handled by the facilitator and (very much) on the willingness to pay for the service, how and to who.

14 The graph includes a threshold of 750 pallets, with >750 pallets a larger storage room has to be rented (150m2) and an additional scanner needs to be purchased.

15 Scenario A = time savings are 100% of demonstration results for both LSP and show owner. Scenario B = time savings are 100% for LSP and 50% for shop owner. Scenario C = time savings are 50% of demonstration results for both LSP and show owner.

***Examples:*** When the storage buffer handles 750 pallets, the total cost for the facilitator divided by the number of pallets is EUR 16.The average benefit per pallet in scenario A for the LSP is EUR 14 and for the retailer EUR 10. In order for the facilitator to break-even at 750 pallets, he will need to receive at least EUR 16. When the LSP contributes EUR 11 per pallet and the retailer EUR 7, this would mean that the LSP will remain EUR (14-11 =) 3 benefit, the shop owner EUR (10-7=) 3 and the facilitator EUR (-16 + 11 + 7=) 2 per pallet (see

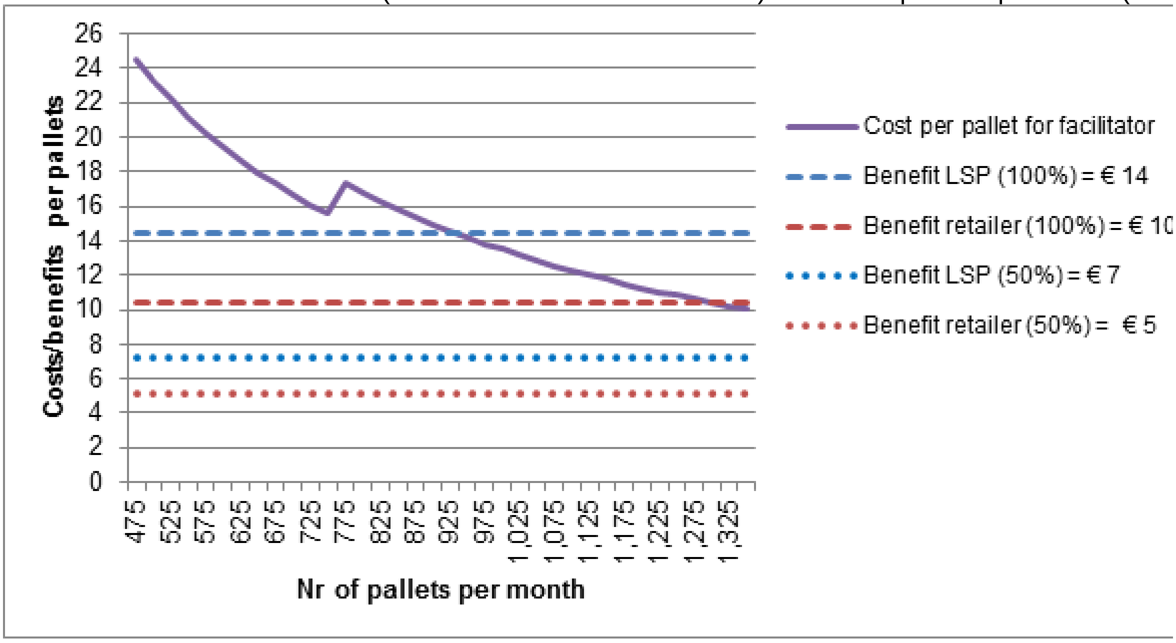



Figure 37).

In scenario B however, the benefit of the retailer is on average EUR 5 per pallet, which implies that the LSP should contribute at least EUR 11 per pallet in order to implement the solution (for 750 pallets) without losses for any of the stakeholders. Given that the retailers contribute all their benefit.

When 1,200 pallets are handled at the storage buffer, the facilitator will need to receive EUR 11 per pallet to compensate for the costs of storage and information sharing.

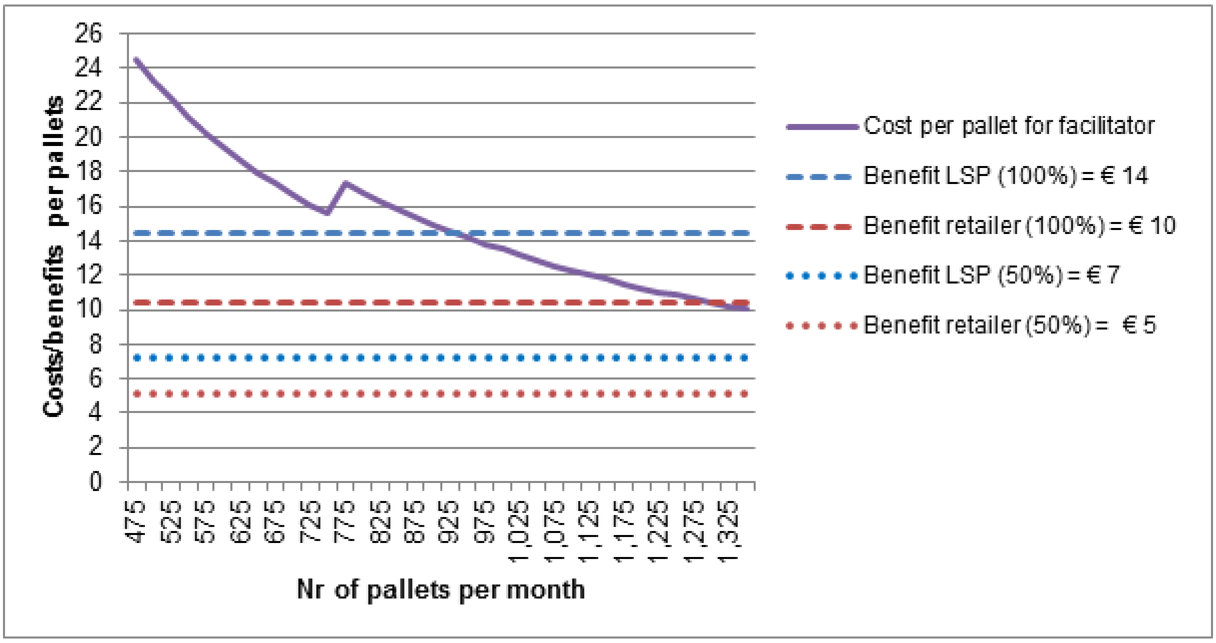



**Figure 37 Costs and benefits per pallet per stakeholder**

The following questions need to be answered to determine the feasibility of this scenario:

- o How much are the LSP and shop owners willing to pay for the time savings they experience?
- o How should the benefits be redistributed to compensate for the investment of the facilitator?
- o Is the shopping centre willing to outsource the activities without direct (but with indirect) gain?
- o Which external (independent) company would be suitable to take the role as facilitator?

We will further elaborate on these questions in the next paragraph from the perspectives of the different stakeholders.

**Shop owner:** are the shop owners willing to pay for more efficient deliveries and time savings? If yes: should this be included in the monthly rent or as an additional service cost, e.g. per pallet? It has not been analyzed how shop owners will react to a new service cost. There is a risk that not many shop owners will make use of the service if they need to pay for it. Increasing the monthly rent will not be feasible in the current rental contracts. This means that the most likely solution will be that a rent increase occurs in new established contracts, when new retailers establish in the shopping centre, or when a new shopping centre is established. The shop owner could also pay the shipper, (who is in most cases the retail chain group head office) who then redistribute the benefits to the facilitator.

**LSP:** is the LSP willing to pay for shorter delivery times in the shopping mall, or to reduce the freight costs in the agreement with the retail chain? In case the LSP would pay to the facilitator, this means a new financial stream and additional administrative costs. This is not likely to happen. The preferred solution will be that billed freight costs are reduced, and that the savings are shared between the shipper (i.e. retail chain) and the external facilitator.

**Shipper:** although the shipper seems the least financially involved, it is an important actor as it can redistribute the benefits from the LSP and shop owners. The shipper can pay for the new services, when it would receive benefits in return. This can be by 1) a reduction in the delivery costs paid to the LSP, and 2) an increase in revenue streams from the shop owners. If the shipper does not receive sufficient financial benefits, they will not be likely to take the role as redistributor though (see Figure 39).

**Shopping centre:** Is the shopping centre able to take the responsibility as investor? In that case, the shopping centre will need to receive higher revenue streams in return. The shopping centre has however not the possibility to increase the monthly rent of the shop owners shortly. It is preferred that the shopping centre outsources the activities to an external facilitator. While the shopping centre is then excluded from direct costs and benefits, it still (indirectly) benefits on the long term as:

- o More space will become available for renting, as less space is needed for parking and individual inventory.
- o There will be less damage in the mall as deliveries are better taken care off.
- o More attractive and sustainable shopping area, may lead to more shopping public, businesses and willingness to pay for the rent.

The above factors may be a reason for the shopping centre to support the external facilitator with the set up costs and optionally to increase the rent paid by the shop owners.

**External facilitator:** The facilitator should be willing to make the investment; i.e. set up the storage facility, procedures and equipment and set up an agreement with providers of the event tracking and monitoring systems. The facilitator should then involve (and charge) the other stakeholders. To convince the required number of retail chains to participate in the concept however is very time consuming and not likely to be achieved on a short term. It is therefore strongly preferred that the use of the storage facility and data technology will become compulsory and that it is paid for by a limited number of actors. The bill can for example be given to the shipper (i.e. the start of the retail chain). The shipper can then be compensated through the current financial streams that it has with the LSPs (↓) and shop owners (↑). The shipper furthermore benefits as deliveries will become more efficient and reliable, improving he value that it offers to its customer. An example of a company that can act as facilitator in Norway is ColliCare Logistics[16]. Colli Care is a LSP who also offers logistic services to a shopping centre and retail chains.

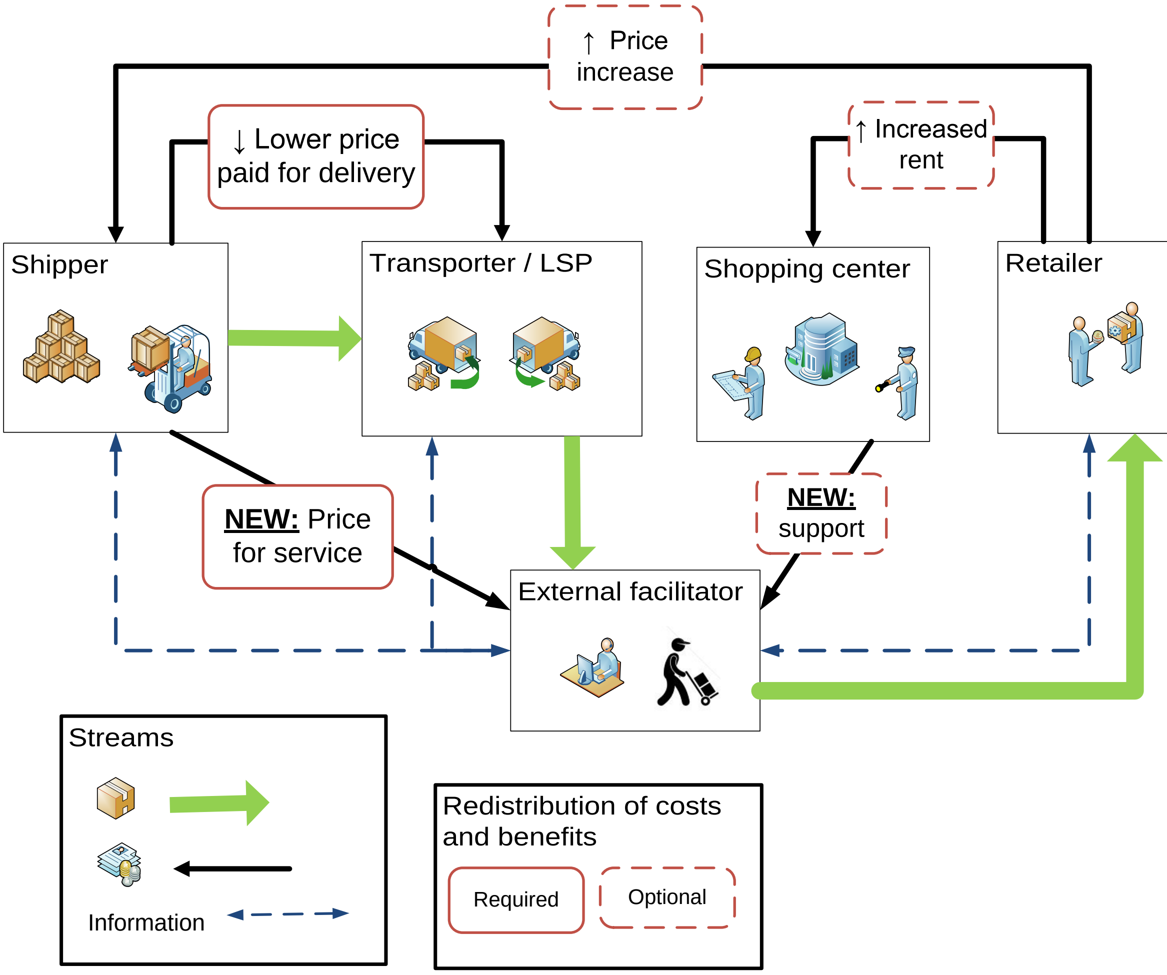



**Figure 38 Streams between stakeholders in proposed solution**

[16] See www.collicare.no

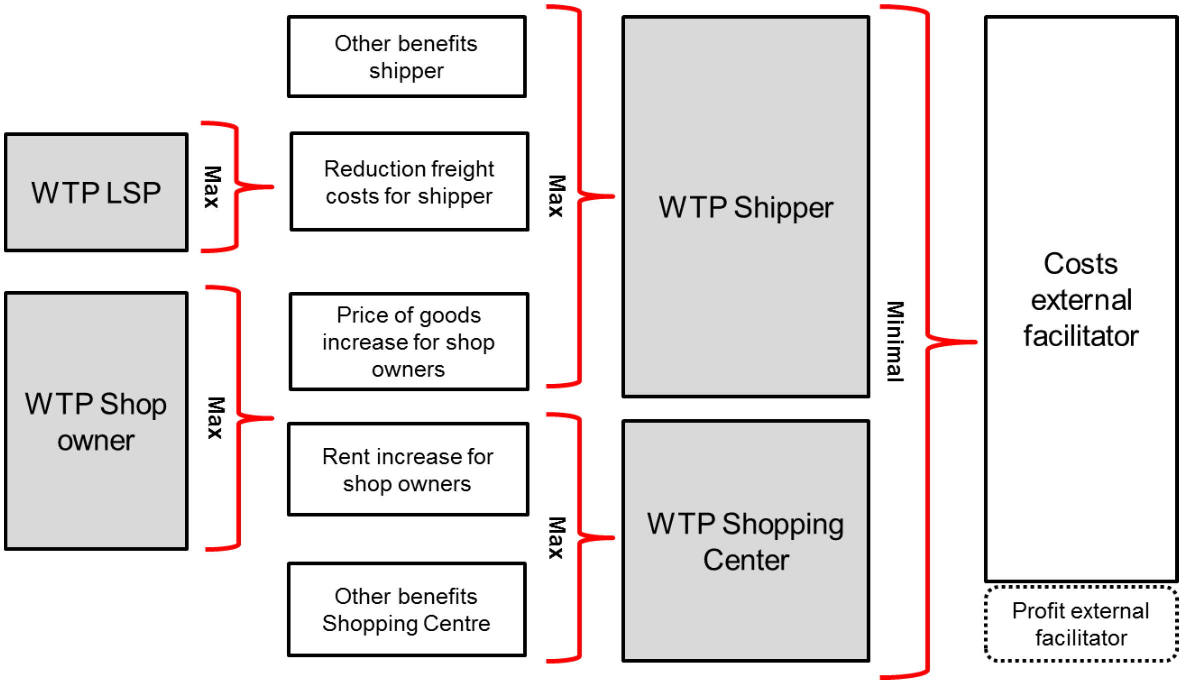



**Figure 39 Requirements proposed redistribution** (WTP = Willingness to pay)

# 8 Real time parking monitoring in Lisbon - EMEL

## 8.1 Case description

The inner city of Lisbon has to deal with growing problems concerning the loading and unloading of trucks and vans in the city. Due to the loading/unloading activities, road congestion and blockage is common in the narrow streets of Lisbon. Next to congestion, illegal parking on sidewalks, double-parked cars and cars which occupy private parking spaces cause irritation among the general public, especially among pedestrians and shop owners.

EMEL manages Lisbon's parking in accordance with the mobility and accessibility policies drawn up by the Lisbon City Council. Within the STRAIGHTSOL project EMEL has implemented two solutions, based on two different technological schemes to control loading/unloading activities. The first solution is the contactless card, purchased by an Adapted Parking Meter (APM), which permits loading and unloading activities for thirty minutes. The contactless card communicates with the system of EMEL, therefore EMEL is notified when the time limit is exceeded. The second solution is the instalment of Vehicle Detection Sensors (VDS) on the ground. The sensor registers when a car is parked in the loading/unloading area and automatically sends a message to EMEL's control centre. The driver has thirty minutes to finish his loading and unloading activities. Ground agents are notified when cars remain parked beyond their legal time. Both technologies were put in practice in one street in the city of Lisbon, and are an example of real time parking monitoring.

VDS are a growing information source to provide information on the status of parking spaces. Cities all over the world (Melbourne, San Francisco and Westminster) already use these sensors for the remote monitoring of parking spaces. The cities value the technology as highly supportive in addition to regular parking management.

Regarding the APM, contactless cards are commonly used for parking management.

## 8.2 Role stakeholders

Different types of stakeholders can be distinguished within the EMEL solution. The stakeholders' role, level of participation in the solution and their interest in the solution differ. EMEL is responsible for the implementation of the technologies, and executing all additional activities. Transport operators, shop owners and other road users all play a role in traffic or loading/unloading activities, and therefore all have an interest in less congestion and better parking regulations. Although they will benefit from the solution and are indirectly involved in the execution of the solution, they will not play a leading role in the set-up of the solution. This is the main reason these stakeholders are not seen as key stakeholders.

**Table 24 Role and stakes of different actors**

| Stakeholder | Role | Active participation in solution | Interest |
|---|---|---|---|
| **EMEL/Municipality** | Responsible for parking management and regulations in the city of Lisbon | Responsible for executing the pilot (installing, operate and regulate) | Effective parking management is their core business |
| **Transport operators** | Cause the main problem in the streets (congestion/illegal parking) | No participation required<br>(Their activities will change due to regulation, but no active participation is required) | More effective parking management will cause less time for the driver to find a regular loading/unloading place |

| | | | |
|---|---|---|---|
| **Shop Owners** | Receive/send goods from/with transport operators. | No participation required | They benefit from more reliable deliveries; |
| **Other road users** (road traffic/pedestrians) | Participate in traffic | No participation required | They benefit from less congestion and a safer environment due to less illegal parking. |

## 8.3 Business Model Canvas

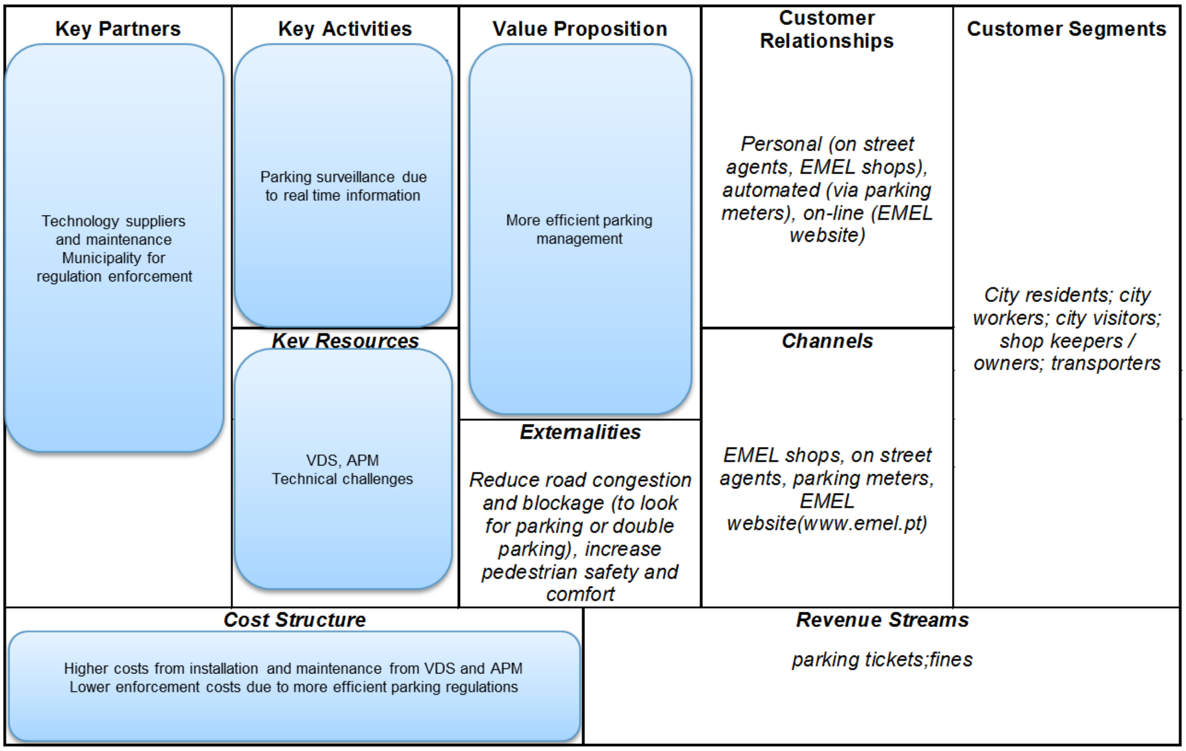



**Figure 40 Changes in Business Model Canvas EMEL**

Efficient parking management is the *value proposition* of EMEL (see Figure 40). This is achieved with support of adapted parking meters or road sensors. Installation of software which supports the technical hardware, is also part of the *key resources*. Activation of hardware and software is established through new *key activities*, which contain real time monitoring and control of the loading/unloading activities. The activities are executed by the planning staff and ground agents. *Key partners* have to be involved to install and maintenance both technologies. EMEL depends on technical partners which are needed to execute these activities. New regulations have to be introduced by the municipality concerning parking control on the basis of road sensors. These regulations were not introduced in the pilot situation.

## 8.4 Business Case

The business case shows an understanding of the costs and revenue streams for EMEL. Since EMEL supports and is part of the municipality, a closed business model is not a requirement. By investing in parking management, EMEL supports general public (less congestion), and is willing to pay for this public service. Return on investment is not a requirement. Although high costs can be a problem for implementation.

Since there was no distinction made during the pilot in revenue streams for the VDS and the APM, the business case for the pilot situation is a sum of both technologies. The pilot scenario was rolled out in one street with a duration of 4 months. In the scaled scenario we distinguish a VDS and an APM scenario. The duration of the scaled scenario depends on the lifecycle of the technical solutions. The VDS has an estimated lifetime of 5 years, the APM has a lifetime of 7 years.

**Table 25 Costs and benefits for EMEL**

| EMEL BUSINESS CASE | | | | | |
|---|---|---|---|---|---|
| **CAPEX** | | | | | |
| | Business as usual (small scale) | Demonstration | Business as usual (large scale) | VDS sensors in large scale | APM in large scale |
| Purchase and installation Sensor | € - | € 4,500 | € - | € 1,000,000 | € - |
| Purchase and installation Meter | € - | € 5,000 | € - | € - | € 832,500 |
| Communication costs | € - | € 3,000 | € - | € 10,000 | € 10,000 |
| Total Capex | € - | € 9,500 | € - | € 1,010,000 | € 842,500 |
| **OPEX (per month)** | | | | | |
| Enforcement costst | € 510 | € 425 | € 60,000 | € 50,000 | € 50,000 |
| Maintenance costs | € - | € 79 | | € 8,333 | € 6,938 |
| Total Opex | € 510 | € 504 | € 60,000 | € 58,333 | € 56,938 |
| **OPEX (per year)** | | | | | |
| Enforcement costst | € 6,120 | € 5,100 | € 720,000 | € 600,000 | € 600,000 |
| Maintenance costs | € - | € 950 | | € 100,000 | € 83,250 |
| Total Opex | € 6,120 | € 6,050 | € 720,000 | € 700,000 | € 683,250 |
| **Operating benefits (per year)** | | **€ 70** | | **€ 20,000** | **€ 36,750** |

### 8.4.1 Pilot Scenario

The demonstration took place in Avenue Guerra Junqueiro, chosen because of the great diversity of shops (ranging from small shops to large ones) and the types of loading/unloading procedures used (by hand, in pallets, in trolleys, etc.). The two technological schemes were applied simultaneously, each on one side of the street. Nine sensors and two adapted parking meters were installed, which serviced seventeen loading/unloading spots. Before the pilot, operational costs consisted of enforcement costs (OPEX, mostly labour costs), these are estimated at €30 per month per loading/unloading bay. No investment costs (CAPEX) were made. During the pilot, costs were made to purchase and install the sensors and meters. Investment costs were €2,500 for each APM and €500 per each sensor. On top of these costs, EMEL covered the cost of €3,000 to promote the new parking situation (flyers and a promotional video). In total the CAPEX increased to €9,500. However, the OPEX decreased marginally, due to more efficient parking control. During the pilot, enforcement costs are estimated to be €25 per parking place. Maintenance of the APM and VDS were (similar to OXFAM), estimated to be 10% of the purchase costs per year. In total this resulted in €70 operating benefits per year.

### 8.4.2 Scaled Scenario

In the fictive scaled scenario's, both techniques will be rolled out separately through the inner city of Lisbon. This area contains 2,000 loading and unloading spaces. Within the VDS scenario, 2,000 sensors will be purchased and installed. For the APM scenario, 333 adapted meters are installed. The cost for communication of the new parking situation is estimated at €10,000. In case of the scaled VDS scenario, the CAPEX is €1,010,000 while operational benefits (OPEX) are €20,000 per year. In case of the APM, CAPEX is €842,500, OPEX benefit is €36,750 per year. With a lifetime of 5 years for the VDS and 7 years for an APM, return on investment will not be reached.

**Table 26 Results scaled scenario**

| | CAPEX (€) | OPEX benefit (€) | Return on investment (%) | Loss (€) |
|---|---|---|---|---|
| VDS (in 5 year) | 1,010,000 | 100,000 | 10% | 910,000 |
| APM (in 7 years) | 842,500 | 256,669 | 30% | 585,831 |

As the business model for the new scenario shows, there is a slight change on the revenue side. This change is not included in the business case analysis. EMEL generates income from tickets derived from private cars and company cars. Income from fines decreased during the pilot. The reason for this decline cannot be assigned to the new situation. On top of that, no distinction was made between personal cars and company cars regarding these fines. Therefore it is not possible to see a correlation between the amount of fines and the new parking situation. The revenue stream concerning the parking tickets did not change during the pilot.

## 8.5 External cost and benefits

External costs or benefits attached to emissions, congestion and other external factors are not taken into account. Therefore the business case adopts only factual costs made by EMEL.A number of factors that could have an effect on externalities was measured, such as loading and unloading time, type of vehicles using the loading and unloading bays and operations per parking space. But none of these factors showed significant changes and therefore the external costs or benefits are not included.

## 8.6 Viability and fit analysis

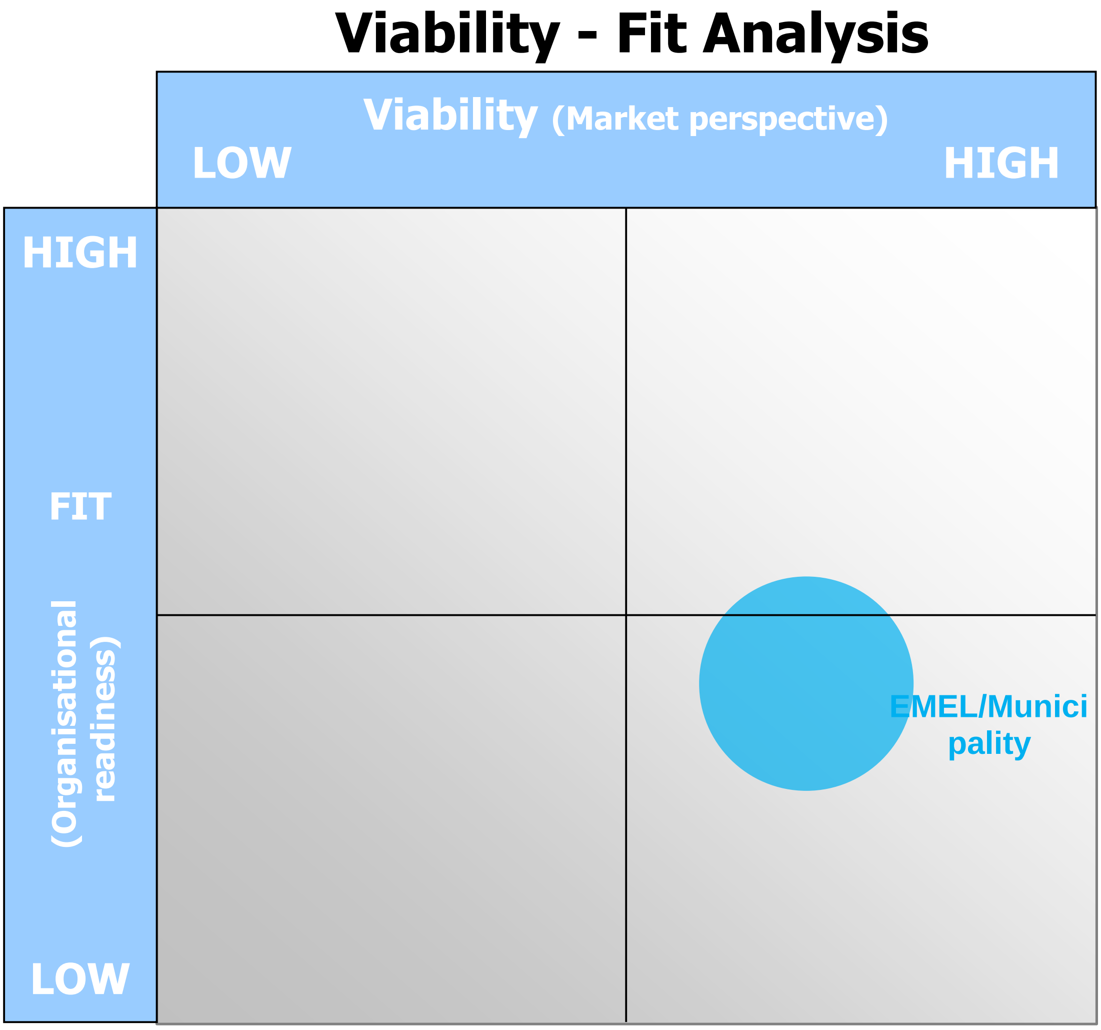



**Figure 41 Viability/Fit analysis EMEL**

Concerning the organizational readiness, the solution is a reinforcement of EMEL's current activities and core-business, namely parking management. The value proposition remains and gets even stronger. EMEL's key activities remain, and there is no change in the relationship towards business partners. The weakness of the solution for the organization is the cost of it. The purchase and installation of the meters and sensors have a significant impact on the financial resources. In the current case these costs will be paid by EMEL, since no stakeholder is paying for the solution and no new or bigger revenue stream arises. Next to costs, new partners (suppliers of the new techniques) have to be found, because the old supplier of the parking meters is not capable of introducing the new techniques by themselves. Overall, the organizational readiness is fairly weak.

The viability (market perspective) of the solution is high. The solutions are very innovative within the market of parking management. Also addresses the solution a specific problem, namely congestion in the narrow streets of Lisbon. Therefore customer satisfaction from shop owners and general public will rise. The solution also affects environmental and social benefits. Less emission and congestion from vans and therefore less irritation from the public are positive externalities which come with the solution.

## 8.7 Prerequisites for successful implementation

As shown in the viability and fit analysis, the organisational readiness is not strong enough to implement the technique on a large-scale. Some changes regarding *technical solutions*, *cost sharing mechanism* and *stakeholder participation* must be made, before the solution can become a success. EMEL already stated this conclusion and tries to improve the solutions. The constraints of the APM and VDS are set up and prerequisites for successful implementation are described below.

***Technical aspects:*** Regarding the APM, its battery lifetime needs to be extended as the current one might not be long enough to communicate all the transactions with EMEL's system in real-time. Next to system failure, some sensors were demolished. The robustness of the sensors is not optimal, so they can easily be damaged.

It can be concluded that the technique of the APM was not optimal during the pilot, and efficient parking control on the basis of the new technique could not be executed. Another restriction is the regulation concerning sensors. The current Portuguese law forbids the usage of sensor data to fine cars that are parked beyond legal time.

Possible solutions are:

- Sensors should not be a stand-alone solution, but should be **in favor and support of other technical tools**. The sensor data should be matched with data from the contactless card. In practice the sensor informs the agent of a car which is parked beyond legal time, the agent verifies this with the contactless card.
- **Sensor data can also match with on board units** (fixed unit or mobile unit). The sensor notices a parked car and requests the driver to log in. The driver connects the unit to the sensor and this match is send to the system of EMEL. In this case, an APM will be superfluous.

***Cost structure:*** A negative business case for a public party is reasonable and often unavoidable. This also reflects to EMEL. A loss will be taken for granted, but in principle EMEL is searching for a solution which is cost efficient or even profitable. With the current cost structure, there will be a loss of €600,000 regardless any external profits. Cost allocation is necessary to make the business case for EMEL less negative.

Possible solutions are:

- The authority can introduce a so called '**business investment zone**'. In this structure, all stakeholders who have any interest in the solution will be charged on the basis of their degree of interest. A clear view of the gains is necessary to introduce such a structure. EMEL is not willing to charge shop owners. They believe charging shop owners can lead to discouraging shops which have a very positive influence on the social and economic dimension of the inner city.
- **Allocate cost** to the party who is responsible for the problem in the first place. EMEL already experiments with this cost allocation. An LSP who is using the loading and unloading places pays a fee of €30 per car per month. This is €15 per car when the LSP is operating more than 3 cars. With an amount of approximately 2000 to 3000 cars, the cost for EMEL can be significantly reduced.

***Stakeholder participation:*** In case of the APM, the shop owner hands over the contactless cards to the LSP. These shop owners felt involved in the parking solution during the pilot. They felt responsible for their LSP's. This resulted in shop owners who activated the card for their LSP. In case of the sensors, shop owners were not involved, which made the LSP the only responsible party.

Possible solutions are:

- **Changing the amount of responsible stakeholders from one to several**, will have a positive effect on the outcome of the solution. In case of the APM, the shop owners felt involved in the parking solution, which results in pro-active handling.
- When the **shop owner is authorized to validate parking tickets in the shop**, involvement from several stakeholders is created. This validation can be done by time-stamps or contactless cards which the shop owner has to validate.

***Proposed scenario for successful implementation:*** According to the constrains and possible solutions, a new best practice scenario can be made. This new scenario refers to changes on a technical and organizational level. EMEL is already experimenting with some of these changes.

In this scenario, VDS sensors are placed for 2000 loading and unloading places throughout the whole city of Lisbon. 2500 vans are registered to execute loading and unloading activities for a limited time of 30 minutes. The driver communicates with the sensors by mobile phone. The driver subscribes the van, and the van is connected to the parking spot. EMELs parking system has a real time awareness of which car is parked where for how long. The LSP pays a fee of €20 per month per car. EMEL's experiment shows that the LSP is willing to pay this fee, as long as there is secure supervision. On the other hand, LSPs have an incentive to control each other. LSPs that are not registered have to pay regular parking fees for loading and unloading activities.

Some shop owners execute logistic activities with their own car. For these shop owners, it is possible to pay a regular parking place for €25 per month. This brings them in a position in which they can park and load and unload.

Additional to these fees, a free parking time zone can be introduced. Some shops have deliveries which are not time bounded. This means that these deliveries can take place any-time. Free parking after peak hours and on Saturdays can stimulate LSPs to avoid business and therefore to reduce congestion.

Overall this will change the business case. Taking into account the Capex and Operational benefits from the current VDS situation, return on investment will now appear just after 10 months. This is due to the new revenues stream from fees (€90,000 per month).

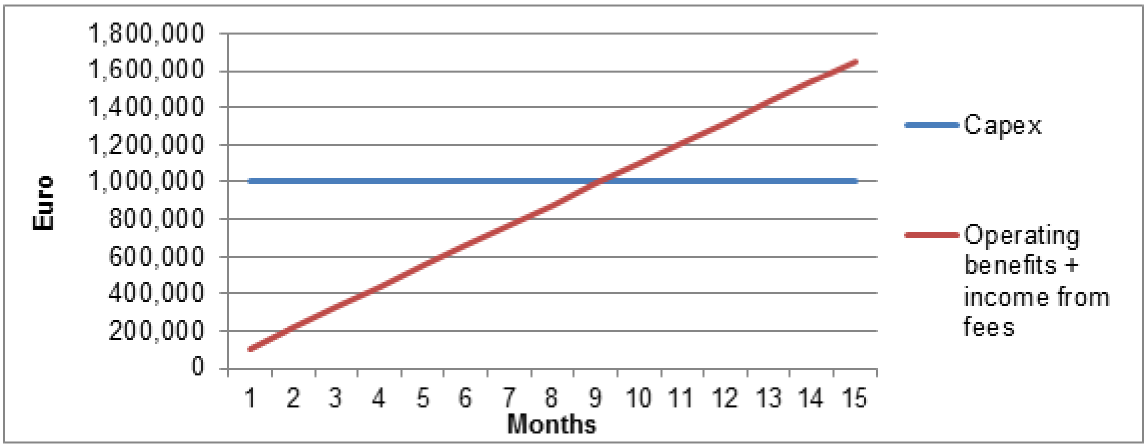



**Figure 42 Return on investment for VDS situation**

# 9 Night deliveries in Brussels - Colruyt and Delhaize

## 9.1 Case description

Many traffic service providers rank Brussels as the most congested European city. Drivers in Brussels face average delays of over 33% during peak traffic hours. These delays do not only affect the everyday commuter, but also the inner-city freight deliverer. The potential time gains have increased the interest among carriers and the bigger retail chains to shift some of the deliveries to the off-peak hours. That is also the case for Colruyt and Delhaize, the two biggest Belgian food retailers. Together, they operate 39 big supermarkets in the Brussels-Capital Region. Most Colruyt and Delhaize shops in Brussels currently have an environmental permit allowing them to load and unload between 7am and either 7pm, 8pm, 9pm or 10pm.

Within STRAIGHTSOL, Colruyt and Delhaize demonstrated night time deliveries to the shops in Brussels. The main benefits of night delivery are time, fuel and emission savings by avoiding peak traffic during the day. The solution has positive and negative societal effects. One the one hand, there is a positive effect on traffic congestion and safety but there is also noise nuisance at night. Because of that, investments had to be made in silent equipment, on trucks and trailers and for (un)loading. The demonstration took place at five sites; two of Colruyt, and three of Delhaize. However, with the new equipment and organization of DC operations, the solution could easily be scaled to more sites. This would also lead to a more efficient use of the resources overnight.

Although Colruyt and Delhaize are two separate retailers, the analysis is based on data from Colruyt. This is because much less data were available in time from Delhaize. Assumptions have been verified with expert opinions. The outcome on the (social) business case is expected to be about similar for Delhaize.

## 9.2 Role stakeholders

Table 27 Shows the stakeholders that participated in the demonstration.

**Table 27 Participating stakeholders in Colruyt and Delhaize solution**

| Stakeholder | Role | Participation in solution | Interest |
|---|---|---|---|
| Colruyt | Food retailer | Night time delivery to two sites | Improve the efficiency of operations (i.e. reducing operational costs), while reducing negative externalities for drivers and society. |
| Delhaize | Food retailer | Night time delivery to three sites | |
| Brussels-Capital Region | Policy makers in Brussels | Grant permit for overnight deliveries and decide on feasibility of the concept for the future. | Improve urban livability in terms of pollution, safety, congestion and noise nuisance. |

## 9.3 Business Model Canvas

Figure 43 shows the business model canvas for Colruyt. The blue boxes represent the changes that are required for or result from the solution. The business model canvas clearly shows that most of the changes occur on the left hand side of the canvas. Customers will not directly notice a change, but the solution does have an effect on various externalities.

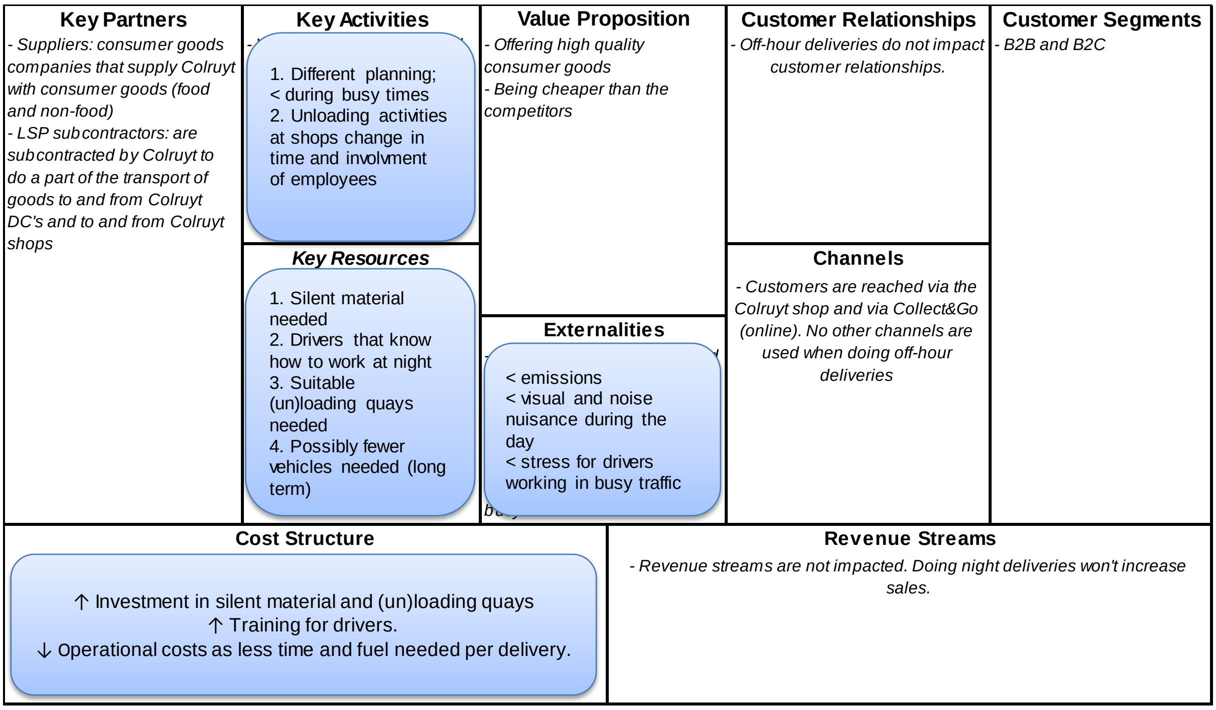



**Figure 43 Business Model Canvas**

***Customer, channel and relationship:*** there are no required or inevitable changes on the right hand side of the canvas.

***Value proposition and externalities:*** the value delivered to society relates to the reduction of traffic during the day (during congested hours). This has a positive effect on visual nuisance, safety and polluting emissions. In addition, drivers feel less stressed when they can avoid congested hours in traffic.

***Partners, activities, resources:*** Each supermarket site requires its own environmental permit stating that night deliveries are allowed. If that is currently not the case, the local authorities will not change the environmental permit unless the night rest for the local residents is guaranteed which requires considerable investments from Colruyt. The actual transport activities in itself do not change much, other than that part of the activities shift to the night which means that shop employees are not always there to help with the unloading activities.

***Cost structure and revenue streams:*** The cost structure is affected by the solution. Colruyt have invested in silent trucks, silent rolling stock and the education of truck drivers to work quietly. The revenues streams are not directly affected, at least they were not noticeably affected during the demonstration. It can be assumed that when shops are delivered at night, the chance of empty shelves for customers in the morning reduces, which can have a positive effect on sales revenue over time.

## 9.4 Business Case

The business case considers the financial results of the demonstration as well as for the proposed scaled scenario. The demonstration included two weeks of deliveries to 2 sites, of which 19% were carried out at night. The scaled scenario includes all 14 sites in Brussels. The proposed solution in the scaled scenario is an equal spread of deliveries over 24 hours. As different input elements are uncertain, a sensitivity analyses is carried out. In addition to the financial feasibility, the external costs and benefits of $NO_x$ and CO emissions are analysed.

### 9.4.1 Input variables and scenarios

The business case looks at a total of four scenarios.

The capital expenses (CAPEX) relate to the costs that had to be made to obtain permission for night time delivery and to the utilization of vehicles:

- **Investment in material:** this includes the truck, trailer, hand pallets (see Table 28) and the (un)loading quays at the sites. It depends on the site whether or not a large site investment (€225,000) has to be made. For some sites a small investment (€10,000) is sufficient.
- **Human resources:** time is spent to prepare the permit application (€1,260 per site). In addition, sites need to be instructed (€250 per site), and drivers need training (€700 per driver).

The operational expenses (OPEX) are costs that are made daily, and continuously:

- **Transport**: calculated per minute (€1), includes fuel usage and labour costs of drivers.
- **Labour costs for loading/unloading**: In the business case analysis, no changes are taken into account for labour costs for loading and unloading at the stores and at the DC. This is because the demonstrations have been too small to identify a (plausible) change. In the scaled scenario, there might be a positive effect on efficiency at the DC as the distribution is more equally spread over the day. However, there might be a negative effect on efficiency at the stores as driver and store employee cannot unload together.

**Table 28 Costs (silent) material and depreciation time**

| Costs in € | Day delivery | Night delivery |
|---|---|---|
| Truck | 90,000 | 90,000 |
| Trailer | 37,500 | 45,500 |
| Hand pallet | 6,000 | 7,700 |

| Depreciation time | Years |
|---|---|
| Site infrastructure | 18 |
| Trailers | 15 |
| Truck, hand pallets, HR | 5 |

**Calculation of average driving time:** The average driving time in the *baseline* and *pilot* (50 minutes) is derived from the logbooks that were kept during the STRAIGHTSOL demonstration. The driving times are based on the two demonstration sites Woluwe and Veeweyde. The reduction in average driving time is 8%. For the scaled scenario all 14 site in the Brussels's region are considered. The distance and therefore the driving time to each of the 14 sites from the DCs of Colruyt is different, varying from 10 to 75 kilometre. As Woluwe and Veeweyde represent two fairly different sites in Brussels in terms of routes and distances to the DCs, the average driving time to the two sites (50 minutes) is also used for the *scaled baseline.*

The average driving time in the *scaled solution* is based on the difference in weighted average speed between the *baseline* and *scaled solution* (see Figure 45b). The average speed per time period - morning/day/evening/night - (see Figure 45a) is derived from the logbooks and was weighted for each scenario according to the spread of deliveries over 24 hours (see Figure 44). In the *scaled solution*, 50% of the deliveries are carried out during 12 hours daytime and 33% are carried out during the 8 hours at night. The change in average driving time in the scaled solution, initially set at -11.7%, is a variable factor in the sensitivity analysis.

For the scaled scenario all 14 sites in the Brussels Capital Region are considered as possible night delivery locations. The expected changes in the scaled scenario, as opposed to demonstration are as follows:

- **OPEX:** The deliveries are equally spread over 24 hours (see Figure 44). This results in an increase in average speed (see Figure 45b), and in a further reduction of the average driving time.
- **CAPEX:** The equal spread allows for a more efficient utilization of the vehicles. On average 1.2 vehicles are needed to deliver a site, as opposed to 1.5 in the baseline. Relatively more drivers need training, as drivers do not have fixed routes and schedules and there are strict driving time regulations.

**Table 29 Input for the scenarios**

| | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|
| Number of sites | 2 | 2 | 14 | 14 |
| Weekly deliveries per site | 23 | 23 | 23 | 23 |
| Average driving time per delivery | 50 | 46 | 50 | 44* |
| Driver site ratio (for training) | 0 | 3 | 0 | 4 |
| Small and large site investment | 0% / 0% | 50 / 50% | 0% / 0% | 67% / 33% |
| Vehicle site ratio | 1.5 | 1.5 | 1.5 | 1.2* |

**Varied in sensitivity analysis.*

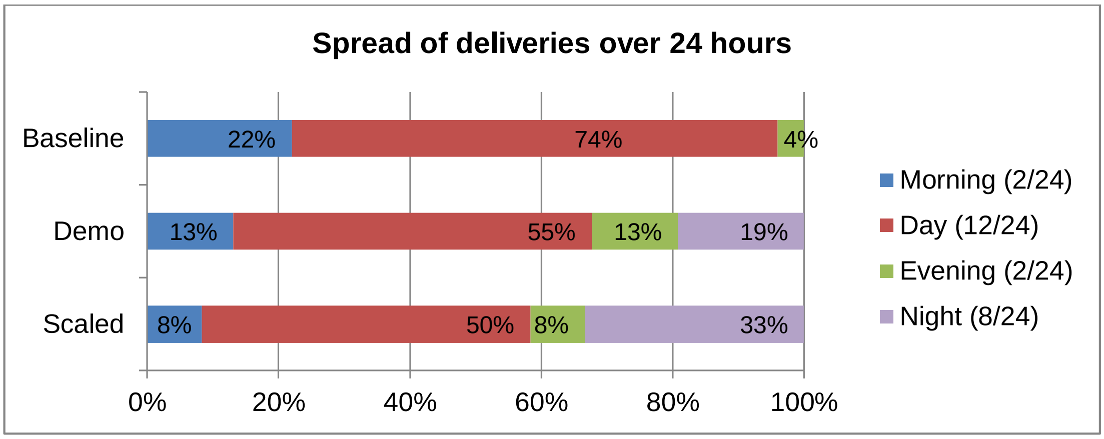



**Figure 44 Spread of deliveries in the different scenarios**

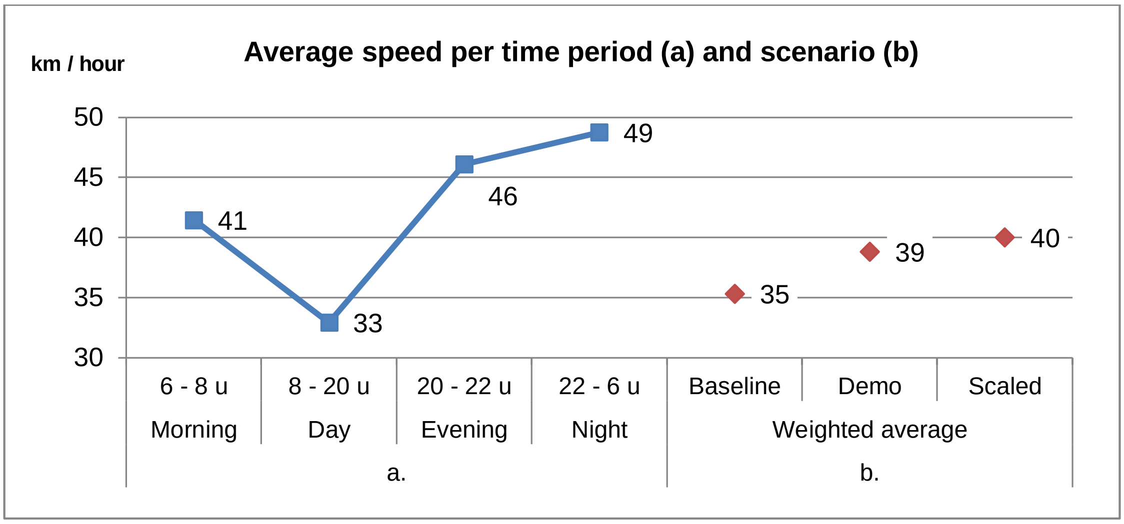



**Figure 45 Average speed per time period (a) and per scenario (b)**

### 9.4.2 Results cost benefit analysis

The analysis of the four scenarios, with the input as described above is presented in Table 30 and Figure 46. The results are calculated and depreciated for a period of one month.

In the pilot scenario, the capital expenses increase with 24%, while the operational expenses decrease with 8%. The total effect is an increase of 3%. In the scaled scenario, the capital expenses also decrease because of the more efficient utilization of vehicles. Hence, the positive effect on vehicle procurement seems to compensate for the required adjustments in silent equipment and sites. In addition, the operational expenses reduce with 11% resulting in a total cost reduction of 8%. This shows that the solution is financially viable when night distribution becomes possible for more sites in Brussels and when it leads to a more efficient utilization of vehicles.

The fact that we have excluded the potential benefits at the DCs further supports the business case. It is assumed that when deliveries are equally spread over the day, loading activities can be organized more efficiently leading to a reduction in both the capital (e.g. loading equipment) and operational costs (e.g. labour hours).

**Table 30 Results business case**

| BUSINESS CASE | Baseline | Pilot | Scaled Baseline | Scaled solution |
|---|---|---|---|---|
| **CAPEX (per month)** | | | | |
| **Material** | | | | |
| On site - infrastructure | - | 1,088 | - | 5,293 |
| Truck | 4,500 | 4,500 | 31,500 | 25,200 |
| Trailer | 625 | 651 | 4,375 | 3,746 |
| Handpallet | 200 | 257 | 1,400 | 1,797 |
| **Human resources** | | | | |
| External - application permit | - | 42 | - | 294 |
| Internal - implementing changes | - | 8 | - | 58 |
| Training drivers | - | 70 | - | 653 |
| Total Capex | 5,325 | 6,616 | 37,275 | 37,042 |
| **OPEX (per month)** | | | | |
| **Transport** | | | | |
| Combined fuel and labour | 10,046 | 9,229 | 69,767 | 61,604 |
| Total Opex | 10,046 | 9,229 | 69,767 | 61,604 |
| TOTAL FINANCIAL | 15,371 | 15,845 | 107,042 | 98,646 |
| Δ with baseline | | 3% | | -8% |

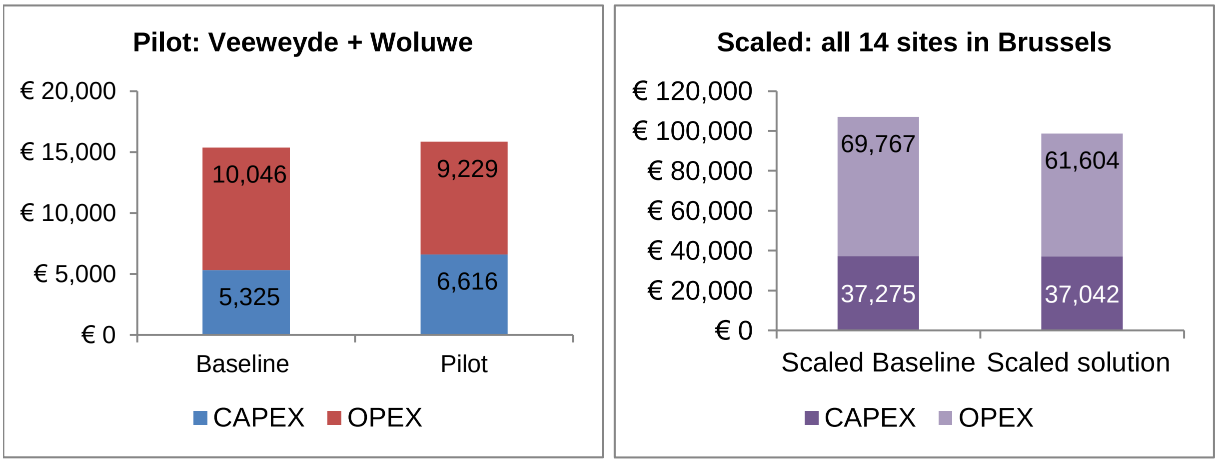



**Figure 46 Results pilot and scaled scenario (per month)**

## 9.5 Sensitivity analyses

Various input values are uncertain in the scaled scenario. The average driving time is based on the two demonstration sites Veeweyde and Woluwe. It is not certain that the observed reduction is an average proxy for the 14 sites in total. Also the change in vehicles needed (the vehicle site ratio) is an educated guess and can be higher or lower in reality. In the sensitivity analysis we vary with:

- **CAPEX**: we vary the utilization of vehicles by changing the vehicle site ratio (VSR) from 1.2 to 1.5 and 1, shown by the different coloured lines.
- **OPEX**: the reduction in average driving time becomes a variable input factor, shown on the horizontal axis.
- **Baseline**: the average driving time (ADT) in the business as usual (BAU) could not been determined with complete certainty. We therefore vary with this input variable to identify different breakeven points for different circumstances.

Figure 47 shows the results for a baseline average driving time of 50. Each of the coloured lines represent a vehicle utility level (VSR) and expresses the total monthly costs of the scaled solution (vertical axis) as a function of the driving time (horizontal axis). The figure shows that when the vehicle utilization remains unchanged (VSR = 1.5), the solution becomes financially viable at an average driving time of 45 minutes. This is the intersection of the red line and the black dotted line.

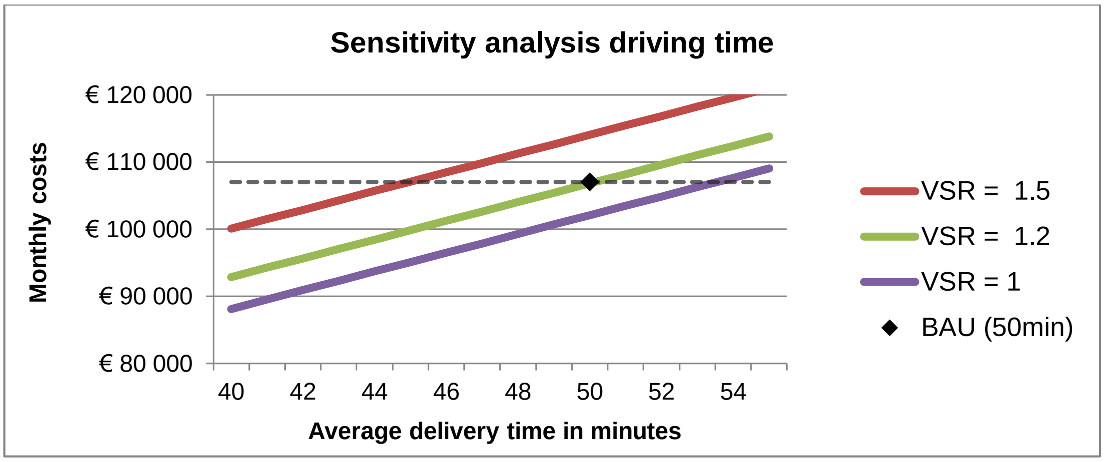



**Figure 47 Monthly costs as a function of ADT**

Next, we have compared the costs with the *Scaled Baseline* to identify breakeven points. The total monthly costs in the Scaled Baseline depend on the average driving time (ADT) in the business as usual. Therefore, the break-even point is where:

$$CostsBaseline_{(\mathrm{ADT})} \;=\; ScaledSolution\ CAPEX_{(\mathrm{VSR})} \;+\; ScaledSolution\ OPEX_{(\Delta\ \mathrm{ADT})}$$

Figure 48 shows the change in costs (vertical axis) as a function of the reduction in average driving time (horizontal axis). Again, this is done for the three vehicle utilization levels, initially assuming a BAU of 50 minutes. The points where the coloured lines intersect the horizontal 0% line is the breakeven point. The figure furthermore shows for example that a 15% cost reduction can be achieved, when only 1 vehicle per site is needed and the average driving time reduces with 16% (this is the point where the purple line intersects with the -15% horizontal line).

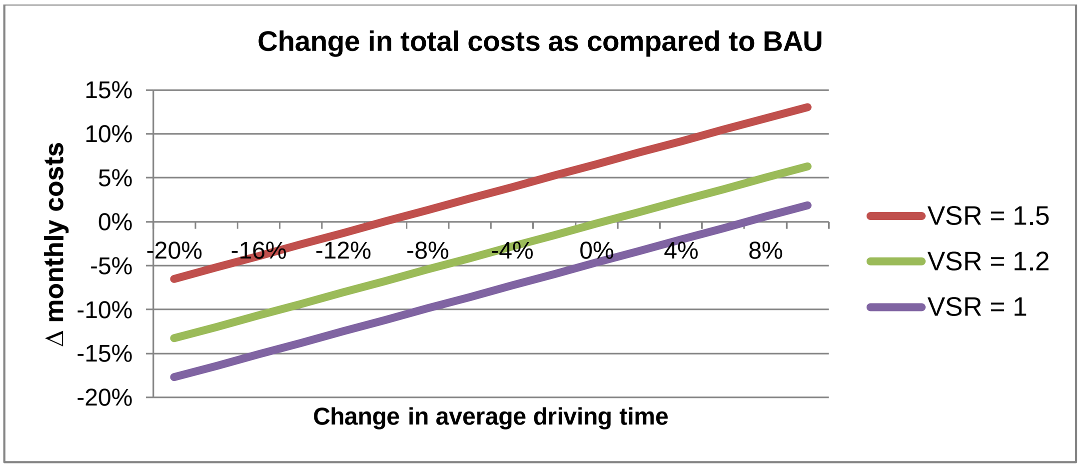



**Figure 48 Change in cost as a function of change in time**

The sensitivity analysis as shown in Figure 47 and Figure 48 has been repeated for different baseline values of the average driving time. The average driving time was initially, based on the demonstration, set at 50 minutes. Although assumed, it is not completely certain that this is also the scaled average. We therefore vary with this input variable to identify different breakeven points for different circumstances. The results are presented in Table 31. It shows that:

- When the vehicle utilization remains unchanged (1.5 vehicle per site), the average driving time should decrease with 5 minutes for the solution to breakeven, regardless of the baseline average driving time. When the current average driving time is 60 minutes, this means a reduction of 8%. When the BAU is 50 minutes, a reduction of 10% in average driving time is needed to breakeven. This is achieved when about 25% is delivered at night instead of during the day[17].
- When the utilization of vehicles reduces to 1.2 per site suffice, the decrease in vehicle depreciation compensates for the silent investment. No reduction in driving time is required to breakeven.
- When night delivery allows for a vehicle utilization of 1 per site, then the average driving time can even increase (with approximately 4 minutes). It seems not likely that these two effects will occur simultaneously. However, it does show that the positive effects of the solution may lead to other network considerations in the future. For example, Colruyt could open a store further away, or could distribute stores from a DC further away without increasing its total costs.

**Table 31 Breakeven points for different scenarios and input values**

**a. Breakeven point absolute (minutes)**
What is the required *new* average driving time?

| | New vehicle site ratio ↓ | | |
|---|---|---|---|
| **Current average driving time ↓** | **1.5** | **1.2** | **1** |
| **45** | 40 | 45 | 49 |
| **50** | 45 | 50 | 54 |
| **55** | 50 | 55 | 58 |
| **60** | 55 | 60 | 64 |

**b. Breakeven point relative (%Δ)**
What is the required change in average driving time?

| | New vehicle site ratio ↓ | | |
|---|---|---|---|
| **Current average driving time ↓** | **1.5** | **1.2** | **1** |
| **45** | -12% | 0% | 9% |
| **50** | -10% | 0% | 8% |
| **55** | -9% | 0% | 6% |
| **60** | -8% | 0% | 6% |

Note: when the potential benefits at the DCs would have been included in the analysis, the absolute breakeven points (i.e. the required average driving time in minutes) would have been higher.

## 9.6 External costs and benefits

Emissions are a function of speed, distance, vehicle weight, engine and fuel type, driving style, traffic flow conditions and, to an increasing extent, optional features such as air conditioning. The actual emissions of a trip are therefore very difficult to predict.

[17] This is calculated using weighted average speeds. With an average driving time of 50, then an reduction in hour/km of 10% is achieved when the spread of deliveries over the morning, day, evening and night is 22%, 49%, 4%, and 25% respectively. This means that as compared to the current situation 25% should be delivered at night instead of during the day.

The main direct effect in the Colruyt demonstration is a change in average speed. We have used the TNO Emission Mini-model[18] to estimate emissions per kilometre for the different vehicle speeds that were observed in the demonstration. See Table 32. A. The calculations are based on a truck trailer of 16 tons and a payload of 12 ton. Table 32 shows that the reduction in $CO_2$ and $NO_x$ per km for a trip during the night as compared with the day is about 30%. Next, we have weighted these emissions according to the spread of deliveries over 24 hours (see Figure 44) to get that weighted modelled emissions per scenario. The results are shown in Table 32 B showing a reduction of about 9% per kilometre in the scaled scenario.

*Assumption in Emission Mini-Model:* The model assumes that the average speed is appropriate for a trip with dynamics appropriate for that average speed. This seems suitable as we do not know the actual dynamics of each trip for Colruyt. However this assumption might underestimate the influence of congestion during the day time. The potential savings during the night may therefore be higher than shown in Table 6. From Figure 49 we see that when the average speed falls below 10 km / hour it increases the emissions per kilometre enormously, and therefore it matters how the average speed on a trip is obtained (i.e. the trip's dynamics).

**Table 32 Modelled emissions per time period (A) and scenario (B)**

| | **Input model** | **Modelled emission** | | **Δ with value "Day"** | |
|---|---|---|---|---|---|
| A. Time | Speed (km/hour) | $CO_2$ per km (kg) | $NO_x$ per km (gr) | $CO_2$ | $NO_x$ |
| **Morning** | 41.47 | 1.21 | 7.65 | -18.7% | -20.1% |
| **Day** | 32.94 | 1.49 | 9.58 | - | - |
| **Evening** | 46.08 | 1.10 | 6.92 | -26.3% | -27.7% |
| **Night** | 48.75 | 1.06 | 6.67 | -29.0% | -30.3% |

| B. Scenario's | **Weighted average modelled emission** | | **Δ with value "Baseline"** | |
|---|---|---|---|---|
| | $CO_2$ per km (kg) | $NO_x$ per km (gr) | $CO_2$ | $NO_x$ |
| **Baseline** | 1.41 | 9.05 | - | - |
| **Demo** | 1.32 | 8.42 | -6.6% | -7.0% |
| **Scaled** | 1.29 | 8.23 | -8.7% | -9.1% |

The weighted emission per kilometre for the baseline and scaled scenario is used as input for the external cost calculations. The calculations are furthermore based on a total of 41,850 kilometres a month[19]. The total monthly emissions are shown in Figure 50. Next, the emissions are multiplied with a monetary value per kg, which is €0.04 per kg $CO_2$[20] and €9.80 per kg

[18] Ligterink, N. E., Tavassy, L. A., De Lange., R., 2012. A velocity and payload dependent emissions model for heavy-duty road freight transportation, Transportation Research Part D 17 (2012) 487–491.

[19] We assume an average distance of 30 kilometre per delivery including roundtrips (based on the demonstration results), and 1,395 deliveries per month.

[20] IMPACT - Handbook on estimation of external costs in the transport sector, 2020 values used.

$NO_x$[21] to obtain the external costs. See Table 33 for the outcome. The *scaled solution* shows a reduction of 9% in external costs as compared to the *scaled baseline*.

In this comparison, the average number of kilometres per delivery is kept equal. Further reductions on emissions, and hence, external cots are possible when night deliveries also lead to more efficient routes/roundtrips (i.e. reducing the kilometre per delivery).

The external costs are added to the financial costs from Table 30, resulting in the social costs benefit analysis, as presented in Figure 51. The reduction in external costs supports the viability of the solution further. However, the external costs are minor as compared to the financial costs, representing 5% of total social costs.

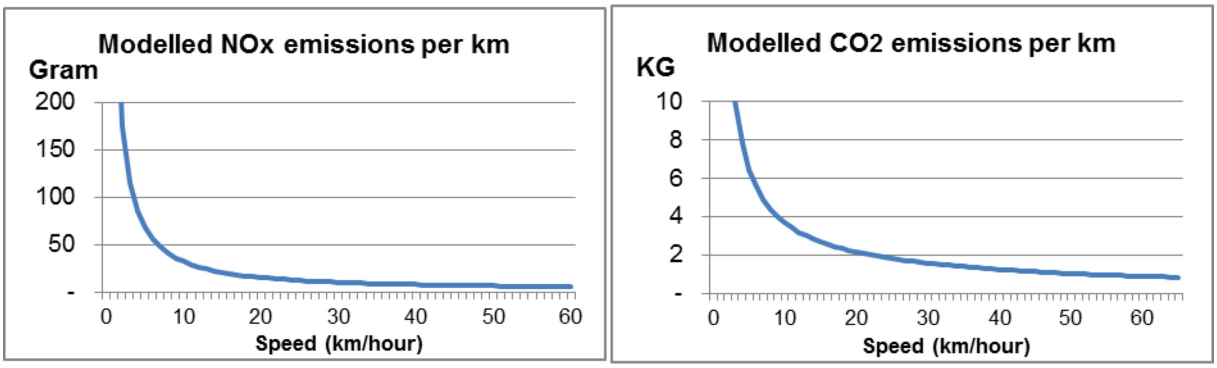



**Figure 49 Modelled emissions per km**

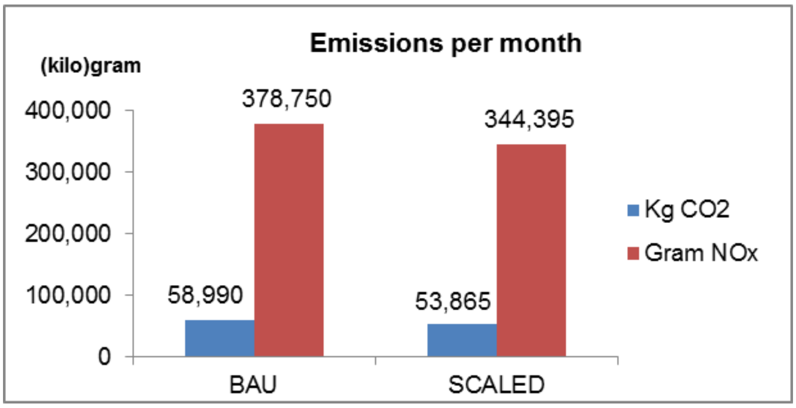
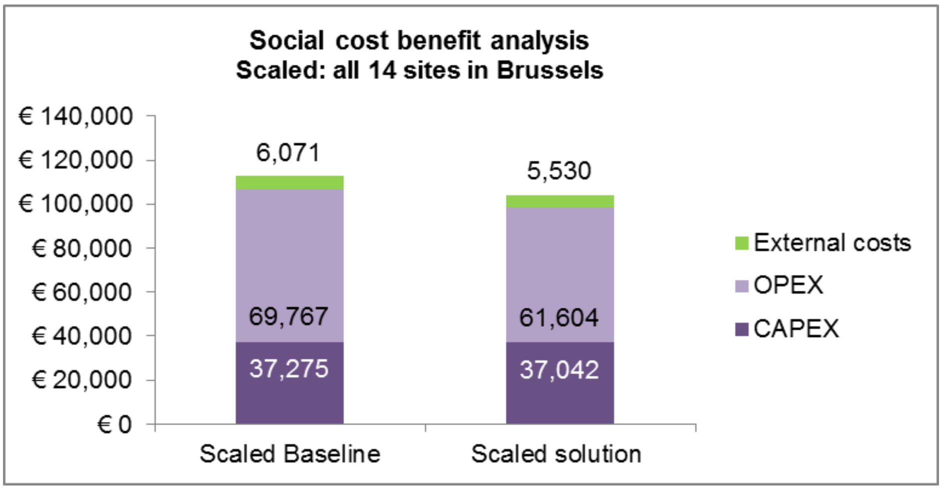



**Figure 50 Emissions per month**

**Table 33 External costs per month**

| EXTERNAL COSTS | | |
|---|---|---|
| | **Scaled Baseline** | **Scaled solution** |
| CO2 | 2,360 | 2,155 |
| Nox | 3,712 | 3,375 |
| TOTAL EXTERNAL | 6,071 | 5,530 |
| Δ with baseline | | -9% |

[21] CE (2008), Berekening van externe kosten van emissies voor verschillende voertuigen




| | | Scaled Baseline | Scaled solution |
|---|---|---|---|
| Total Capex | | 37,275 | 37,042 |
| Total Opex | | 69,767 | 61,604 |
| Total External | | 6,071 | 5,530 |
| **TOTAL FINANCIAL AND EXTERAL COSTS** | | **113,113** | **104,176** |
| Δ with baseline | | | -8% |

**Figure 51 Social cost benefit analysis (scaled scenario)**

## 9.7 Viability fit analysis

Figure 52 shows the outcome of the viability/fit analysis for the night distribution solution.

- **Viability:** the ***market perspective*** is slightly positive due to the positive externality effects and differentiating character of the solution. Other than that, as concluded from the business model canvas, the customer side does not change. It should be noted that this is highly due to the fact that Colruyt controls both the deliveries and the receivers. A different situation could make the market perspective more complicated. Hence, the viability could be lower when the receiver and LSP do not belong to the same organisation. In that case, the receiver might not easily accept unattended deliveries at night.
- **Fit**: the ***organisational readiness*** of the concept is very high. This is mainly because the solution does not require different activities, other than that they are partly shifted to the night. Although the fit between the current resources and the requirements for night distribution is fairly weak, on the long term, the solution has a positive effect on the utilization of resources (strong fit). In addition, the financial results show a viable business case: the effect on the cost structure is positive.

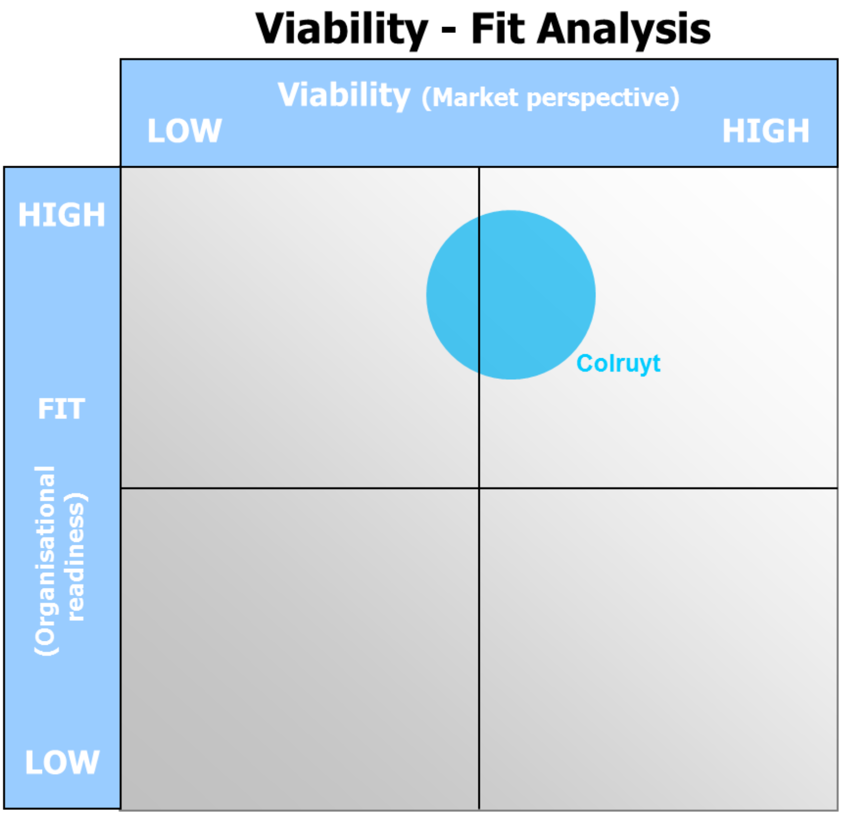



**Figure 52 Viability fit analysis Colruyt**

## 9.8 Prerequisites for successful implementation

The analysis in this chapter shows that the demonstrated *night delivery* solution has great potential in terms of financial and (non-)financial benefits. Avoiding congested traffic hours during the day saves energy and time. A more equal distribution of deliveries over 24 hours therefore directly reduces the operational expenses. In addition, it reduces polluting emissions in the city and stress among drivers. Capital and HR investments have to be made to get approval to deliver at night. But over time, these investments are (more than) compensated considering that the solution allows for a more efficient use of vehicles and DC operations.

From a financial and external cost perspective, the demonstrated solution seems to become a success when it is scaled. Though there are several political, social and behavioural aspects that can prevent a successful implementation of the solution. The key prerequisites for success are:

- **Permit/approval from the Brussels municipality**. On 25 May 2014 elections take place in Brussels. It highly depends on the outcome, whether the new government supports or jeopardizes night deliveries in the future. Without approval from the local authorities, Colruyt cannot shift deliveries to the 8 night hours (10pm – 6am).
- **Acceptance from the neighbourhood.** Complaints from the neighbourhood on noise will lead to less support from the municipality and therefore decreases the likelihood of night delivery approval.
- **Satisfaction among receiver (e.g. employees at the shops)**. To prevent resistance to change, drivers and site employees should make better agreements with regard to unloading activities. The shop employees can try to make the storage space as empty as possible in the evening, so that there is more space available for the drivers at night. Secondly, drivers should be instructed how to place the goods after unloading. **Note:** This prerequisite should be considered with more care, when the LSP and receiver do

not belong to the same organisation. In that case, receivers should be approached differently as they are not likely to accept unattended night deliveries easily. Other than security and trust issues, discussions about gain sharing might arise. When the receiver is aware that night deliveries are beneficial for the LSP, they will probably try to benefit from it as well, by means of transport price reductions. This can make the business model more complicated.

# 10 Business concepts for urban-interurban transport solutions

## 10.1 Introduction

In paragraph 2.2, the four levels of the Business Model Canvas framework were introduced: customer model, organizational architecture, value network and the financial model. As explained in paragraph 2.5, these four levels and their interrelationship can be operationalized into a number of business model design choices. By analyzing the demonstrations, four business model concepts could be extracted. In chapter 2, the four business concepts are mentioned and which demonstration cases and elements from the cases were used to develop the concepts. Based on the demonstration assessments, as described in chapters 3 to 0, the most relevant business model design choices were extracted in order to develop business concepts. This is certainly not to say that the ones listed are the only design choices to be made. Others choices can also be critical, depending upon the particular market context, customer segment and other characteristics of a specific business model. Here, only the generic choices are identified. They leave room for elabouration and adjustment to specific cases, something that should be part of any business modelling process. In the remainder of this chapter, the business concepts and their most critical design criteria are described.

**Table 34 Business concepts**

| Concept name | Demonstration case | Elements of demo used for business concept |
|---|---|---|
| Urban Consolidation Centre | DHL, TNT Express, GS1 | All elements DHL, TNT, storage area aspect GS1 |
| Data sharing in the supply chain | GS1, Kuehne-Nagel | All elements Kuehne-Nagel, data sharing aspect GS1 |
| Automatic parking monitoring | Emel | All elements Emel |
| Dynamic routing through monitoring | Oxfam | All elements Oxfam |

## 10.2 Urban Consolidation Centre

We identify the following design choices as critical in designing a feasible business model for an urban consolidation centre (UCC) (see Figure 53). As part of this concept we consider DHL's UCC, TNT's mobile depot and the buffer storage of Stovner Centre in Oslo. Although the demonstrations look different, the core is the same, namely: (re)bundling goods at a central location, before delivery to the receiver, which allows the use of different transport modes for the last mile delivery (e.g. by bike, foot, electric vehicle). Where the cases differ, and this might also result in different design choices, is in the complexity of the consolidation. TNT's MD is used by TNT as a consolidation location that enables bike deliveries, whereas in the other cases flows of different shippers are combined. TNT already combined different flows earlier in their network (at their Brussels' depot). The MD solution could be open for more LSPs, but this is outside the scope of this analysis.

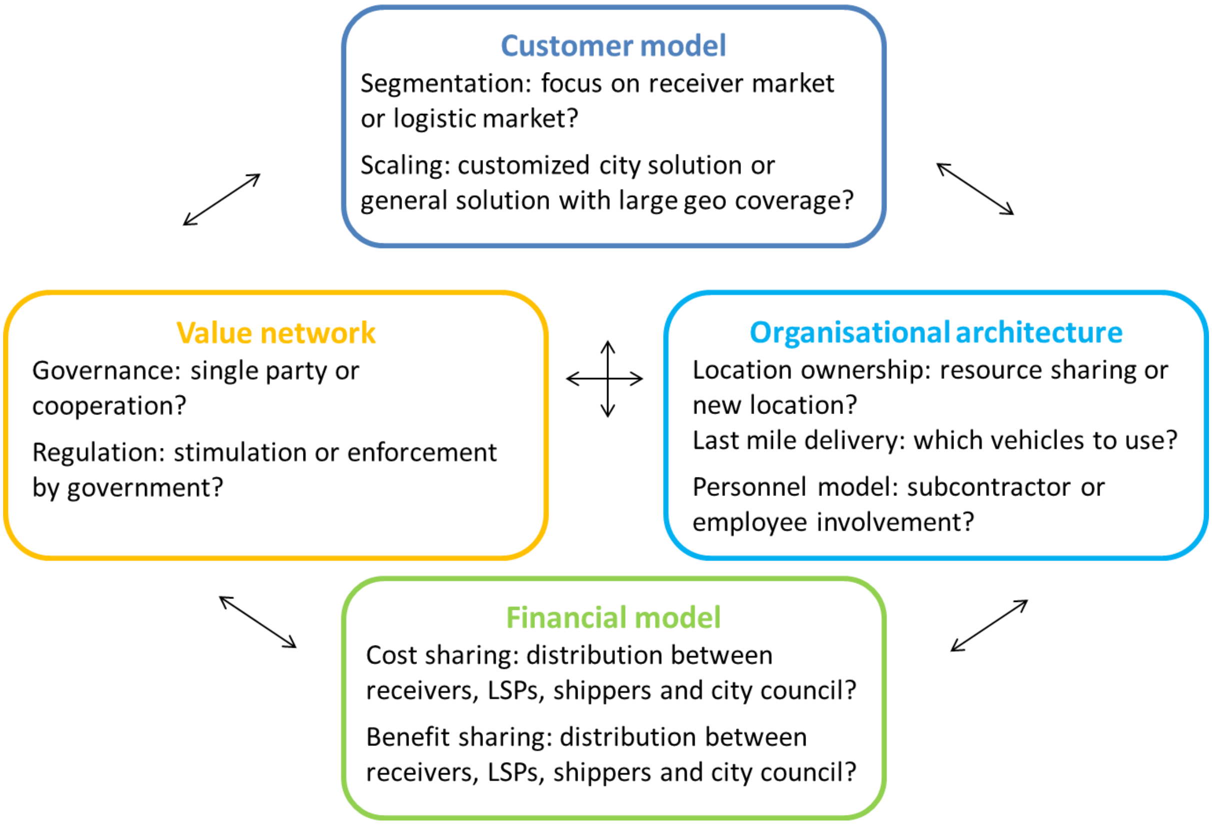



**Figure 53 UCC critical design choices**

### 10.2.1 Customer model

***Segmentation:*** The benefits of an UCC can be explained to different roles in the supply chain; to the shipper (who pays for the delivery), LSP (who takes care of the delivery and is paid to make the delivery) and to the receiver (who receives the delivery). Who, in which role, should be approached as customer?

In the DHL demonstration, the focus was on local retailers in a mix of residential and commercial areas. The receivers were approached and asked to change their shipping address. The GS1 demonstration was focused on a commercial area, namely a shopping centre. Many of the participating shippers owned (or franchised) a shop in the shopping centre. Hence, the shipper and receiver belonged to the same retail chain. The demonstration of TNT covered both B2B and B2C parcel deliveries but only changed the activities of the LSP internally.

From the demonstration assessments it became clear that significant savings are possible in terms of transport time, (external) costs and emissions. However, on the other hand, there are different types of additional costs: operational costs for handling at the consolidation area (e.g. staff, parking, rent) and IT/engineering costs. To decide who the customer is that will pay for these costs, it is the question who is:

1. able to generate (external) cost savings;
2. able and willing to make the benefits transparent; and
3. willing to invest/compensate/redistribute for the extra cost that come along with the UCC

It became clear that right customer segmentation is crucial for success. There are different stakeholders involved along the supply chain who may have a different interest in or benefit from the solution. Depending on the location of consolidation the market and the organisation of supply chains, it may be beneficial to offer a UCC concept either to the receiver, the shipper or to the logistic service provider market[22].

*Receiver as customer*: The end of the supply chain may have an interest in the solution if benefits from bundling are clear. These benefits may be financial (paying a lower price if bundled) and/or non-financial (receiving one bundled shipment with all ordered parcels instead of individual shipments per parcel and possibly paying a higher price for this). Examples of the non (or indirect)-financial benefits of bundling at a UCC are:

- it can increase the attractiveness of the receiver's premises (less disturbance of freight),
- it allows shop owners to have more time for their customers in the shop
- the consolidation centre may offer a more suitable time to collect/receive the goods
- it can offer other value adding services, e.g. collection of waste, storage room, facilities for e-commerce deliveries, etc.

Furthermore, it may be considered that the receiver market does not only consist of receivers but also senders (returns), which creates another opportunity for bundling. Although, receivers can clearly benefit in various ways, the individual benefit of the receiver are in most cases not as significant as the potential transport cost savings.

*LSP as customer*: For LSPs the UCC may offer a benefit if it saves them from carrying out the last-"mile", often time-consuming, delivery in congested and/or restricted areas (e.g. low emission zone, shopping mall, restrictions). If only part of their delivery area is contracted via the UCC it is not attractive for them as they will still need to get into the city for the remaining shipments. This means theoretically that the cost reduction of delivering to the UCC (time, gasoline) has to be higher than the missed (indirect)benefit of delivering to the area. This benefit can also (to great extent) consist of indirect aspects, such as customer contact, trust, product security, or brand visibility. It is often difficult for LSPs to distract, assess and weigh these various pros and cons.

*Shipper as customer*: By merging shipments and delivering more frequent truckload volumes, shippers can increase turns, reduce inventory and transport cost. If the shipper is responsible for his own logistics and has a potential for pooling shipments this may be a direct benefit. This makes the shipper a potential customer. Another reason why the shipper is a potential customer, is that it can act as a redistributor of costs and benefits among the other stakeholders as it has both a financial relationship with the receiver and the LSP.

Table 35 jointly analyses whether each of the three roles could act as customer of the UCC by answering the question that was raised at the beginning of this paragraph.

***Scaling:*** By focusing on scaling the solution towards a specific area such as the L'Hospitalet de Llobregat in Barcelona or the shopping centre in Oslo it becomes possible to maximize efficiency in bundling regional shipments. On the other hand, the market is smaller when a specific region is chosen with a smaller pool of customers. Furthermore, the solution may not be interested for all customers as they may not be interested in changing their supply chain for only one region if their target region is larger than that specific region.

Depending on the region and customer concentration it may therefore be interesting to develop a scaling strategy towards a larger regional or national solution with different (smaller) consolidation locations. This strategy may offer less consolidation potential than in the specific

[22] The distinction of "receiver", "LSP" and "shipper" represents the different roles in freight delivery. One organisation can fulfil multiple roles though. For example, when a wholesaler takes care of its own transport, it may experience both the benefits as shipper and as LSP.

area strategy, but may be a more interesting proposition to customers. A regional/national solution also offers economies of scale for subcontractors, required IT and equipment. For example, for the manufacturing of mobile depots, the bike courier company that carries out the last mile delivery or for the logistic facilitator that can exploit storage buffers at shopping centres.

**Table 35 Determining the customer of an UCC**

| *It is the question who → is ↓ :* | Receiver | LSP | Shipper |
|---|---|---|---|
| 1) able to generate (external) cost savings? | The receiver has the power to change its delivery address. Its individual cost savings are however not always as clear. | If the UCC can take over a part of the last-mile delivery costs this saves costs for the LSP as well as external costs for other stakeholders/society. | The shipper has the power to instruct on delivery conditions. But this will not directly generate own cost savings if it is carried out by a LSP. |
| 2) able and willing to make the benefits transparent? | No, they often do not know the value of the non-financial benefits and in addition, have no insight in the transport savings. | LSPs are often not willing (or able) to make their cost and benefits transparent and able to weigh these with non-financial aspects. | The shipper is probably willing, but not able to make the transport costs transparent. |
| 3) willing to invest/compensate/redistribute for the extra cost that come along with the UCC? | Receivers are not likely to be willing to invest in or pay for the additional costs of the UCC. | LSPs are not likely to compensate for extra costs that take over their activities and client contact. | The shipper could act as redistributor of costs and benefits along the current financial streams with the receiver and LSP. |

### 10.2.2 Organizational architecture

Setting up a UCC facility requires specific resources, such as a UCC location with (IT) facilities, infrastructure (e.g. space for parking, loading and unloading) and a management system. Due to the capital intensiveness of the location it is an important design criterion for success. In this respect a trade-off could be made between using an existing location, so called resource sharing, or setting up a new location.

- *Resource sharing:* in the DHL Supply Chain Spain demonstration, excess capacity of the consolidation centre of DHL was utilized. Though adaptations to the facilities had to be made and the IT system had to be adapted, the UCC terminal itself was an existing location. This also applies to the demonstration in Oslo, where the Shopping Centre used existing space in the mall as buffer storage. The advantage of using an existing location is especially related to the lower amount of investment cost of the concept. In addition, there is little time required to set up a UCC facility in comparison to building a new facility. Naturally, there are barriers attached to resource sharing. Related to competition, as there is possible insight into each other’s’ logistical planning. Furthermore, there may be limitations to the scalability of the UCC, outsource potential, and the suitability of the location itself. An appropriate governance format (see 10.2.3) and financial architecture (see 10.2.4) can play a role in solving the first two challenges.
- *New facility:* as opposed to the demonstrations of DHL and GS1 it can be a design choice to set up a complete new UCC facility with the corresponding resources, like TNT Express did by building the mobile depot. The advantage of setting up such a new

location could especially be related to the neutrality and potential innovativeness of the facility, and to the possibility to design the UCC facility towards the needs and demand of the involved stakeholders. Disadvantages are the potential higher investment cost related to the new location (including search and agreement costs) and the financial risk involved if the concept will turn out to be unsuccessful.

Another decision that should be made relates to the vehicles that are used for the last mile delivery and whether or not to outsource the handling and transport activities. During the DHL demonstration, the organisational activities were carried out by DHL. TNT and Stovner Senter found a subcontractor for the operational activities (Ecopostale and Securitas respectively), but were greatly involved themselves as well, to make sure that the new activities were carried out properly. Though, they both agreed that they should rather focus on their core activities and emphasized the need for a qualified subcontractor with the required vehicle fleet for successful implementation in the future.

### 10.2.3 Value network

***Governance:*** The organizational activities that come along with a UCC broadly consist of the planning and management of the activities at the terminal, (un)loading goods from the vehicles. and transportation to the receivers. In deciding upon the governance model of a UCC it is important to consider whether the UCC is to be controlled by a ‘colored’ party or a neutral party. Below both forms are shortly described. Depending on the context, one or the other governance format may be more suitable.

- ‘*Colored’ governance format:* The advantage of having an existing commercial LSP controlling the UCC is that it can be easy to set up. In the case of DHL for example, the UCC activities were easily integrated with their standard logistic activities. Furthermore, a commercial party may offer the UCC as a service. This may be a suitable format where customers and the UCC governance party are in a non-competitive position. On the other hand, a single and/or commercial organization governance format may not offer the required neutrality for customers.
- ‘*Neutral’ governance format*: In case neutrality is important, for example, when competitive LSPs are interested in the service, a more neutral third party controlling the UCC may be more suitable. Knowledge and information sharing from companies is key in the UCC concept, which tends to be extremely difficult in a competitive situation. In case of a ‘neutral’ governance role, a for-profit or a not-for-profit format could be chosen. In the last case a more cooperative format may exist between different stakeholders. The disadvantage of a neutral cooperative format is that it usually takes a rather long time to get all parties aligned. Furthermore, it may be more difficult to scale up to other regions when regional parties are involved that may have less interest in other areas.

***Regulation:*** In the assessment of initiatives, it turned out that stakeholder participation is a challenge. When implementing a UCC concept the government may play an important role. In this respect, the municipality can either adopt a stringent regulatory role, but also a coordinative, simulative or, as the loosest option, a facilitative role.

*Enforcing role*: Though it will be challenging for the government or local authorities to directly enforce parties to participate in a UCC concept, they may develop regulative measures that indirectly influence parties to make use of the UCC concept. These regulative measures may consist of expanding the environmental zone in the city centre. The expansion can either be done geographically, but also by adding more vehicle types to the zone, such as delivery vans or setting regulations with respect to vehicle types, such as emissions performance requirements. In respect to enforcing measures it remains important to keep a balance between accessibility of the city centre and effect on economic development.

*Stimulative/Coordinative role*: in contrary to an enforcing role, the government may also use a stimulative or coordinative role in the UCC concept. A stimulative role may consist of a financial participation in the investment of a UCC facility or in a financial incentive in the operations (see 10.2.4). A more coordinative role could be using process management. By means of a process management role, parties can start the conversation about what their wishes and demands are and what is expected from the municipality. In this way, the municipality can find out what is required from their side to increase the attractiveness. A positive side-affect can be that stakeholders find each other and start collabourating.

*Facilitative role*: the government can facilitate with regard to the location. This is especially relevant for consolidation at a mobile depot, in which the city authority can support by proving an affordable and suitable parking space, and also by giving exemptions on certain parking fees or obligations.

### 10.2.4 Financial model

***Cost and benefit sharing:*** Multiple stakeholders may have an interest in a UCC concept. The costs for setting up a UCC concept do however, in most cases not outweigh the benefit of an individual stakeholder. As a result, there are only a limited amount of successful UCC cases in the market. An important design element is therefore how costs and benefits are to be shared among stakeholders. The main stakeholders involved in the UCC concept are the receivers, LSPs, shippers, the city council and the UCC facility holder. Below, the possible cost benefit constructions are described per stakeholder:

- *Receiver*: the main direct benefits for the receiver may be relating to bundled transport (one time pick-up, time savings, less hinder from truck parking). See also *customer model*. The degree of benefit very much depends on the receiver mix profile and corresponding delivery requirements. From literature and the STRAIGHTSOL demonstrations it becomes clear that receivers could theoretically benefit from the UCC, but are not likely to either invest in the UCC or pay a higher price for delivery. Nevertheless, additional services can be offered at the UCC, such as off-site stockholding (no need for extra storage room), pre-tailing services and handling of returns (time and personnel savings). Receivers may be willing to pay a service fee for this, however, this fee is unlikely to cover investment and operating cost of the UCC. Usually the financial benefits are limited, and the receivers are not willing to change their current business (to which they are used, and of which they know these are working in practice). In other words, the efforts to make changes in combination with the risks and uncertainties that follow, are often considered more important than the relative limited financial (or sustainability) gains.
- *LSPs*: depending on the LSP profile, the main benefit could relate to a decrease in driven kilometers in the city centre, leading to a decrease in costs for fuel and time (personnel cost, opportunity cost). It may very well be the case that the cost savings are exceeding the loss in revenues for outsourcing the last mile to a UCC; however, many LSPs have difficulties in calculating the exact costs and revenues for a part of their transport operations (i.e. the part in the urban areas). The LSP profile that may experience the aforementioned benefits has the following characteristics: Less Than Truckload (LTL) shipping in or from the city centre or specific area, significant distance to customer, potential bundling synergy with other LSPs due to similar or complementary shipments, or generic customer contact that is easily replaced by the UCC operating party. When the LSP has the profile as just described it may be a potential party to invest or share operating cost of the UCC. Reluctance by the LSPs to collabourate due to the fear to lose a part of their business or to lose the control of their deliveries could be solved by choosing the right governance model (see 10.2.3).The use of an UCC can create opportunities for the use of zero emissions transport modes (such as bikes or EVs) for the last mile delivery. This may lead to new businesses and/or reduced costs for LSPs as well.
- *Shipper*: Shippers have the market power, as they set the required conditions for the delivery. As the shippers are at the start of the chain, they can guarantee the required

demand. Shippers do not experience a real direct benefit of the UCC though, which makes it more difficult to convince them to act as an initiator. However, as they have a financial relationship with both the LSP and the receivers, they can play a very important role as redistributor of costs and benefits. Here again, it is sometimes difficult to motivate a stakeholder that has hardly direct financial gains to change its behavior. Changing requires efforts, and in case there are no benefits to compensate for these efforts, many shippers tend to stick to their business as usual.

- *City council:*. As mentioned before, there are many benefits of the UCC for citizens, both environmental and social benefits. Therefore, it makes sense that the municipality is actively involved in the solution (see also value network: regulation). Active involvement of the municipality to restrict the entrance of other carriers in the city centre can play an important role in the adaptation of an UCC Funding could be made available to initiate a bundling service (especially as long as initial and depreciation costs are not economically viable).
- *UCC facility holder*: The UCC facility holder could act – independently – as a redistributor of costs and benefits as well. Though, considering the uncertainties in the willingness to pay for the service, it is difficult to determine the chance that this actor will be able to make a profit out of it. Therefore, a non-profit organization might be more suitable than a commercial party to fulfill this role, which could be (partly) funded by the local government.

## 10.3 Data sharing in the supply chain

We identify the following design choices as critical when designing a business model for data sharing in the supply chain (see Figure 54).

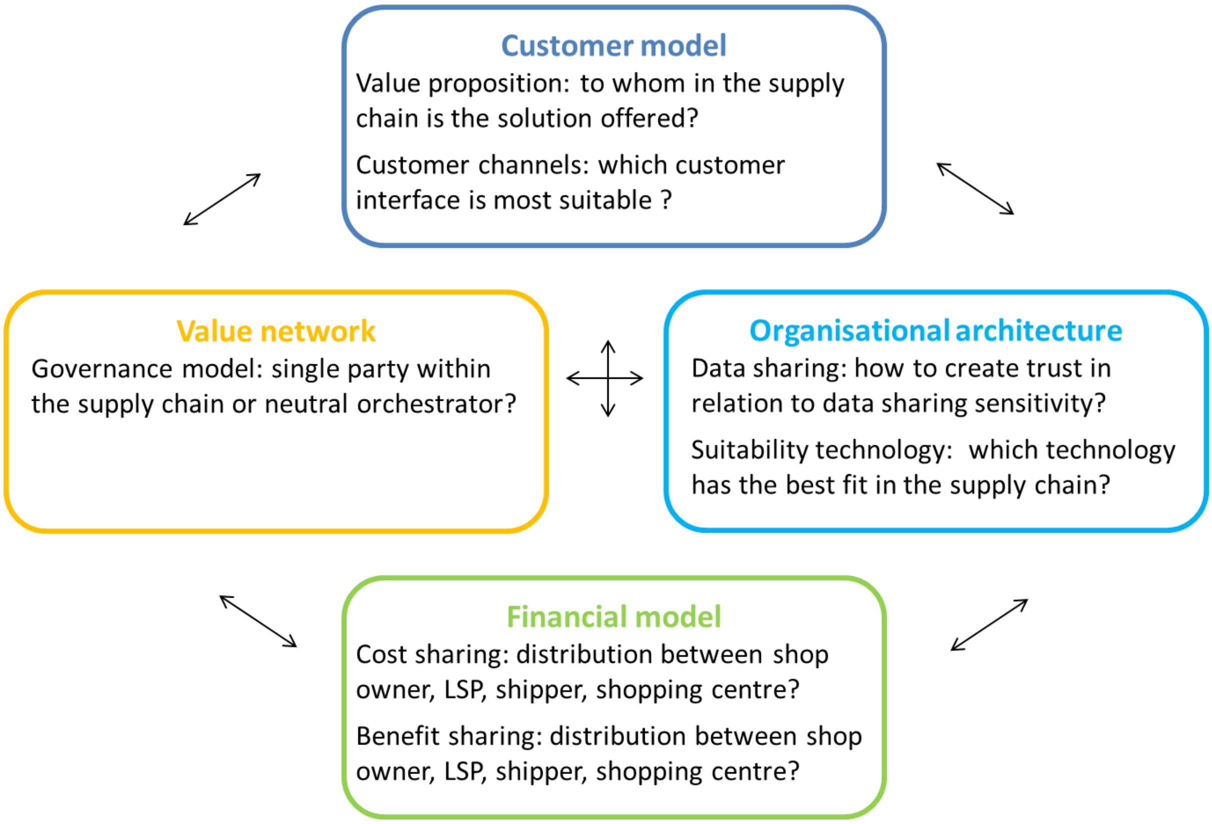



**Figure 54 Critical design choices data sharing in the supply chain**

### 10.3.1 Customer model

***Value proposition: to whom is the value offered?*** Sharing data in the supply chain has value for different actors. When the benefits are dispersed among various stakeholders (e.g. shipper, receiver, LSP), it becomes difficult to assign one customer. The customer should be chosen such that it can act as a redistributor of costs and benefits. It does not necessarily need to be the stakeholder who benefits most. It is more important that it has the power to convince or force others to participate, also financially (see also financial model). Depending on the size, and number of LSPs involved, the main customer to whom the solution is offered could be the LSP (like in the K+N demonstration) or the shipper (preferred for the GS1 demonstration). The choice is also influenced by the relationship between the shipper and the receiver, who may be part of the same retail group. In that case there is often more involvement and willingness (or obligation) to cooperate if the shipper initiates to share data. Although transport operators might benefit considerably from data sharing, it is often not the preferred group to act as main customer (see also value network).

***Customer channels:*** The customer channel should (preferably) be able to reach all the data sharing participants in the supply chain in a quite similar way, and not only the main customer. This is to create the feeling of joint effort, openness and “fair play”, which will make it easier to get more supply chain actors willing to participate.

### 10.3.2 Organisational architecture

***Data sharing and suitable technology:*** A transparent, accessible and easy-to-use architecture of the solution, which at the same time secures the privacy of its users is crucial for the success of data sharing. For optimal use and acceptance, receiving or sharing data should 1) not be much effort and 2) be trusted. Integration or alignment with current technologies, for example with mobile phones and RFID tags, is highly preferred. This can reduce the need for additional (expensive) equipment like scanners.

### 10.3.3 Value network

***Governance model:*** Data sharing always comes with sensitivity and privacy issues. A critical design choice therefore relates to the governance model of the solution. It is often preferred to have a neutral orchestrator who owns the database and regulates the accessibility. This independent orchestrator can, in collabouration with the main customer, set up the regulations and restrictions for the various users. Resistance to share data often exists among LSPs, who aim to remain a certain level of playing field during negotiations. This stakeholder group might therefore be less willing to participate when the retail chain (shipper and/or receiver) manage the data sharing solution. Whereas, when the LSP initiates the solution, like in the K+N demonstration, the need for a neutral orchestrator could be less present.

### 10.3.4 Financial model

***Cost/benefit sharing:*** Although benefits are often dispersed among various stakeholders in the supply chain, it is required/highly preferred that there is one actor who is responsible for the costs. Hence, the supplier of the data sharing solution should set up an agreement with the key customer (see customer model). The key customer should then be compensated by the other companies that benefit from the service. It is preferred that the redistribution of costs and benefits occurs along the current financial streams, e.g. by reducing/increasing current prices between shippers and LSPs or shippers and receivers. This is expected to be easier when the shipper and receiver are part of the same retail chain and when there is a well-established relationship with the LSP (e.g. dedicated transport). This is because a certain level of transparency and openness with regard to costs en benefits is needed.

## 10.4 Automatic parking monitoring

We identify the following design choices as critical when designing a business model for automatic parking monitoring (see figures Figure 55).

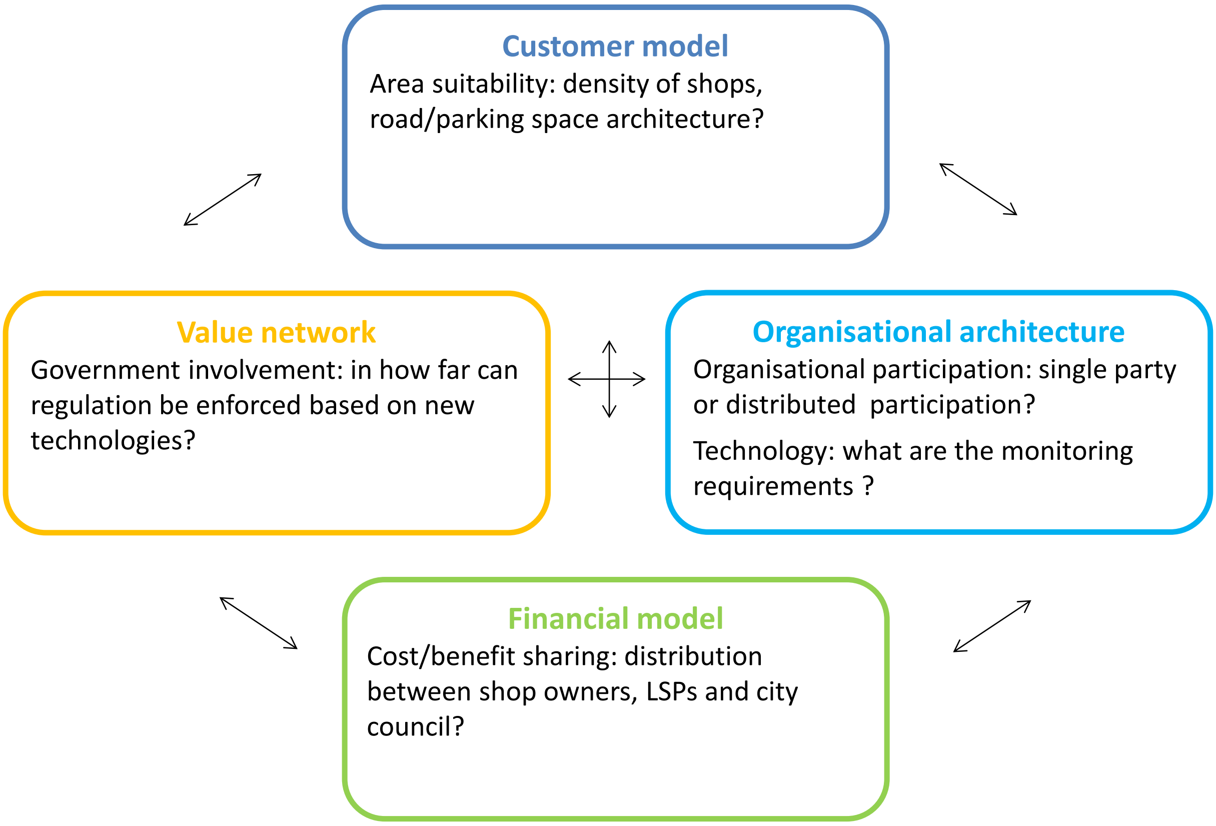



**Figure 55 Critical design choices automatic parking monitoring**

### 10.4.1 Customer model

***Area suitability:*** The suitability of a decision for automatic parking monitoring solutions very much depends on the area involved. For example, in case of the Adapted Parking Meter (APM) solution used in the EMEL demonstration the shop owner hands over the contactless cards to the LSP. This makes it an important prerequisite that the walking distance between the parking spot and the shop being delivered is reasonable. For the Vehicle Detection Sensors (VDS) on the ground this prerequisite is of less importance.

### 10.4.2 Organisational architecture

***Organizational participation:*** The degree of stakeholder participation may have an effect on the outcome of the solution. In case of the APM of the EMEL demonstration, the shop owner hands over the contactless cards to the LSP. These shop owners felt involved in the parking solution during the pilot. They felt responsible for their LSPs. This resulted in shop owners who activated the card for their LSP. (This might already contribute to a solution, that local shop owners feel the responsibility for the parking issues in their street). In case of the sensors, shop owners were not involved, which made the LSP the only responsible party. The involvement of shop owners can however, also be a disadvantage when instructions are not followed up or if certain employees are unaware of the contactless card. Furthermore, it may be costly and time consuming to engage the shop owners and shopkeepers in the solution.

***Technology:*** Another design choice is choosing the right technology. In the demonstration, EMEL has taken no decision towards the choice of one of the technologies, as both technologies needed small adjustments /improvements related to communication, reporting and equipment durability in order to be used in a larger scale.

### 10.4.3 Value network

***Government involvement:*** When new technologies for parking monitoring are introduced it may not always be possible to make use of existing laws and regulation for surveillance and fining. For example, in the case of EMEL, according to current Portuguese law it is not possible to use sensor data to fine cars that are parked beyond legal time. Therefore, Municipal Regulation will have to be adapted for sensor technologies to be introduced. It is an important design choice whether to make use of monitoring technologies within regulatory frameworks or to introduce technologies where (time consuming) regulatory adaptions are required.

### 10.4.4 Financial model

***Cost/Benefit sharing:*** Parking monitoring has cost and benefits for various stakeholders involved. Shippers and freight receivers (shopkeepers) may benefit from more reliable deliveries. LSPs may benefit from more efficient loading/unloading operations. The municipality may benefit from having a more attractive, accessible and clean city centre. Nevertheless, the investment and operating cost of improved parking monitoring are substantial. It is an important design choice how to deal with the distribution of the cost. On the one hand, the municipality may take responsibility of the cost as they are the ones who are traditionally responsible for the direct cost of parking monitoring. On the other hand, also the parties responsible for the situation may be asked to participate. The authority can introduce a so called ‘business investment zone’. In this structure, all stakeholders who have any interest in the solution will be charged on the basis of their degree of interest. A clear view of the gains is necessary to introduce such a structure. Also, the LSP could be asked for a fixed fee for getting access to loading and unloading places. It is however, important to consider in how far shop owners or LSPs may be discouraged by these types of financial contribution.

## 10.5 Dynamic routing through monitoring

We identify the following design choices as critical when designing a business model for dynamic routing through monitoring (see Figure 56).

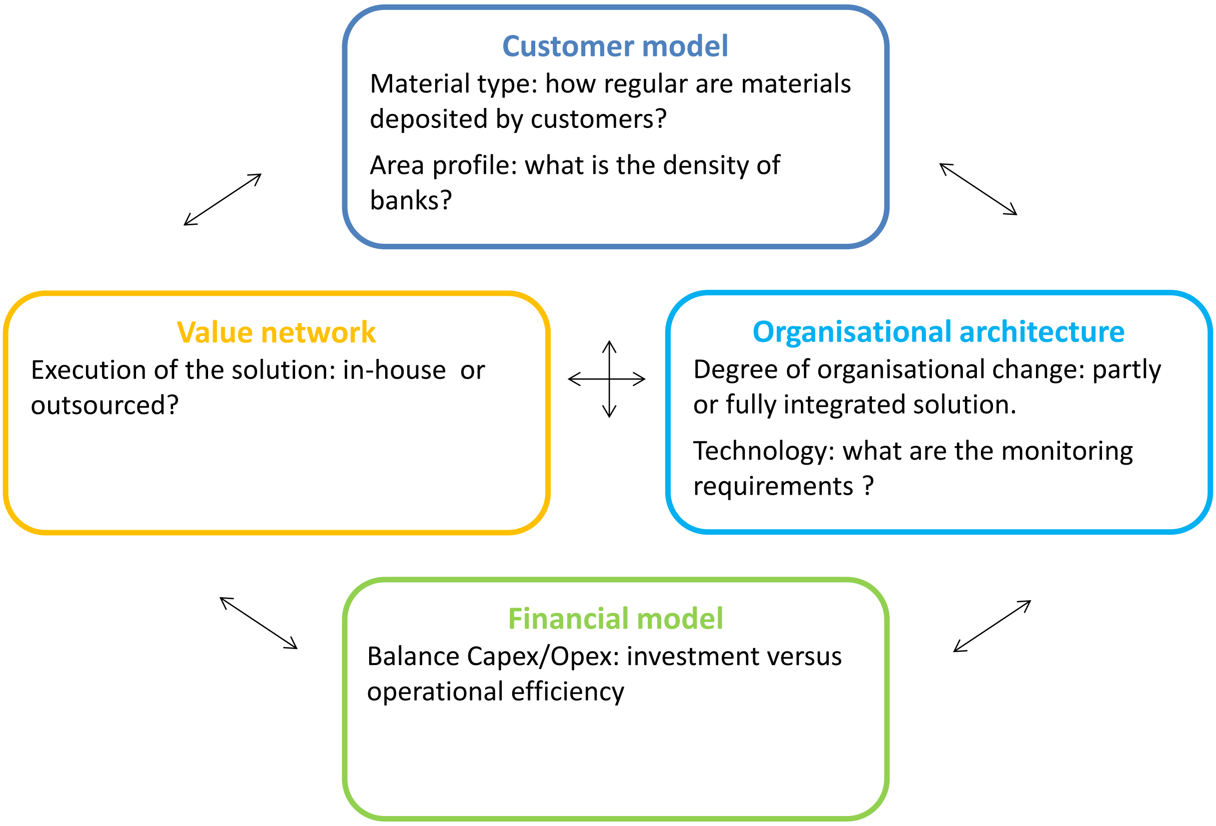



**Figure 56 Critical design choices dynamic routing through monitoring**

### 10.5.1 Customer model

***Material type:*** In determining the value that can be offered by bank monitoring it is important to consider the material type suitability. If materials are deposited on a very regular basis and in regular amounts, such as municipal solid waste, it becomes less interesting than when there is a high fluctuation in material deposit, such as clothes or battery deposits. This does not mean that the solution is not interesting for these sectors, but the predictability of the deposits makes the chance of overfull containers and corresponding challenges smaller.

***Area profile:*** The area type (rural/urban) is highly important to the success of the solution. Density of banks in the urban area is higher and therefore miles driven per bank are lower. This leads to fewer possibilities to save miles due to dynamic routing. Less differentiation in routing will have less impact on superfluous miles. The solution will therefore have more impact on a rural areas compared to for example the inner city of London. Furthermore, the size of the service area equipped with sensors is important. By scaling the area equipped with sensors, vans can work across area borders and therefore more variety of efficient routes can be created.

### 10.5.2 Organisational architecture

***Degree of organizational change:*** A small dynamic/innovative firm is more likely to implement a new operational process. A traditional firm with embedded operational processes which are executed by a lot of employees within the organization will have more difficulties with the implementation of the solution. Furthermore, it will make a difference whether the solution is partly or fully integrated in the organization. For example, in the case of Oxfam, only the logistics department was part of the solution and not the Oxfam shops selling the clothes. Fixed agreements with the Oxfam shops about clothes pick-up and delivery could therefore not be changed. As a result, routes could not be planned in the most dynamic way. If the solution is integrated in the organisation a higher optimalisation can be reached.

***Technology:*** Technology is a crucial part of the monitoring solution. In the case of Oxfam, sensors were used to monitor the banks. Nevertheless, obtaining reliable remote monitoring data was a major issue due to connection problems. Banks are often located outside and have to cope with different weather conditions and security threats. Depending on the area, region and sector, different requirements may exist with respect to the technology used and the robustness of the banks.

### 10.5.3 Value network

***Execution of the solution:*** The implementation of the solution is a relatively complex one. Sensors have to be installed and maintained, new planning and routing software has to be installed on top of existing software and a dynamic planning system has to be operationalized. Depending on the focus of the firm implementing the solution there may be a high, medium or low match with the current organization. Therefore a decision will have to be made to either execute the solution in-house or outsource it. In case there is a low match, an organization may decide to partly of fully outsource the solution to a third party. In the case of Oxfam, sensor supplier SmartBin played a key role in the implementation and maintenance of the sensors and supported in the process of remote monitoring and dynamic planning.

### 10.5.4 Financial model

***Balance CAPEX/OPEX:*** The solution dynamic routing through monitoring is especially focused on lowering direct and indirect transport costs. Therefore, the right balance between investments and operational cost relating to monitoring and the corresponding operational efficiency has to be sought. The potential decrease in transportation cost is very much dependent on the waste type and area it concerns and the degree of implementation of the solution in the organization.

## 10.6 Silent deliveries in off-peak periods

Figure 57 shows the design choices that we identified as critical when designing a business model for off-peak deliveries with silent equipment. These design choices are based on the demonstrations of Colruyt and Delhaize.

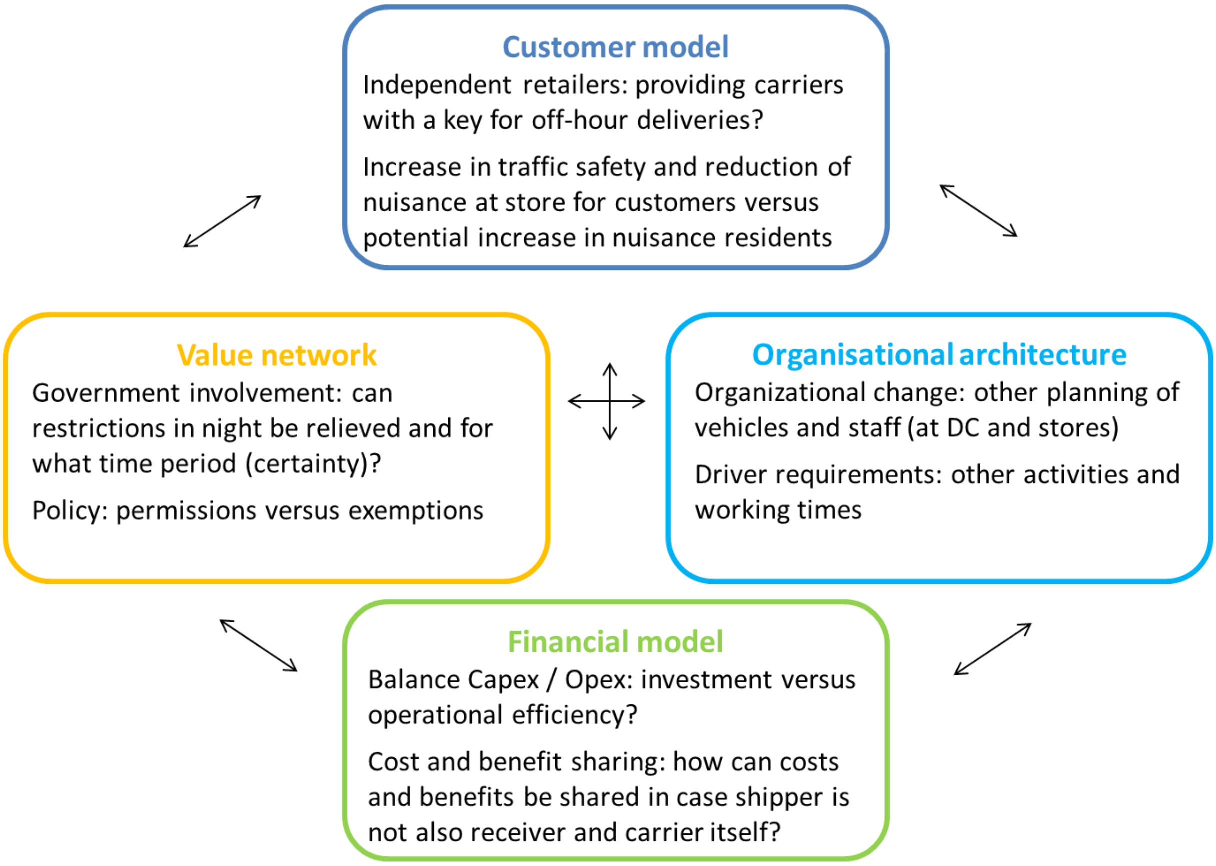



**Figure 57 Critical design choices silent deliveries in off-peak periods (night)**

### 10.6.1 Customer model

***Independent retailers:*** The benefits of night deliveries (off-peak deliveries) with silent material are obvious in the demonstrations, where the shipper (i.e. retail chain's DC) and receiver (retail chain's store) are part of the same company, which actually controls the carrier's activities as well. For night deliveries to independent and / or small retailers, the design choices are expected to be more difficult (as was also experienced in Straightsol with a not-continued demonstration of TNT Innight). In the case where shipper and receiver are part of one retail chain, that controls the carrier, it is easy to rearrange the costs and benefits, as well as to arrange the security issues. For the case where independent retailers are supplied by several LSPs, both cost and benefits sharing could be an issue, as well as the fact that goods cannot be formally receipt. Another challenge may be that a retailer  may have to provide many LSPs with keys or invest in other ways to receive goods during periods of absence. The independent retailer is left with the costs and the issues, whereas the main benefits are with the carrier (i.e. operational cost reduction). In most cases this LSP is hired by a shipper, and not by a retailer, with the result that it is difficult to arrange cost-benefit sharing easily in order to make this solution feasible for this type of retailer – shipper – carrier relations.

***Nuisance for customers versus residents:*** Although silent material is used, noise nuisance is always mentioned as an issue for night deliveries. The design choice for this solution should, however, also consider other nuisance, such as traffic safety; a result of night deliveries is that the delivering trucks do not share parking areas with visiting public (as the shop is closed, no customers are around) or that these trucks hinder fewer vulnerable road users (cyclists and pedestrians), as these are not at the urban road at these times. So depending on the location of the stores delivered during the nights, the improvement on one side (direct customers that are less disturbed by truck in the surroundings) might go against that of direct neighbouring residents (who might be disturbed by unloading activities, but are often also enjoying the benefits that were mentioned at customers).

### 10.6.2 Organizational architecture

***Organizational change***: the use of night time deliveries requires changes from the stakeholders that are planning the transport and operating the vehicles, as well as the staff that are receiving the goods. Depending on the flexibility (as well as the availability of flexibility in the planning software) at the planning department, night deliveries may be easy or difficult to include in the operations. Due to longer operational hours, vehicles are less idle at the depot, and both vehicle planning and driver planning are more difficult, besides, not all vehicles (only silent trucks and trailers) and all drivers (only drivers that did the training for silent deliveries) can be planned. Next, loading and unloading at the stores takes more time (as the driver has to do everything himself). At the stores changes to the staff planning are also required, as stocking the store can be done early in the morning (and not at the time the delivery is made).

Finally, other organization skills might be required in communication with local authorities (as well as with residents in the neighbourhood of stores) in order to get the exemptions for doing the actual night deliveries. In normal operations, many of the retail chains are not used to communicate with local authorities.

***Driver requirements:*** next to requirement to the planning department and skills, the night delivery solution also requires considerable flexibility and changes form (some) drivers. Drivers have to accept other working hours, and although the demonstration showed that less stress was perceived during the night, working at unsocial times might have some other impacts for both the driver and the employer. For example working time regulations will change depending on the number of hours that the driver works during the night. Also the frequency of night shifts in a time period may be restricted as well as the number of nights that drivers are allowed to work straight off. Often, bonus payments apply for working at unsocial hours. Next, drivers have to carry out other activities during the night than during the day, such as opening stores and unloading on their own. They might also feel more insecure, as they have more responsibilities, as well as higher (perceived) change on vandalism or theft during nights. Another issue is that drivers might feel more vulnerable, as there will be no one to assist them in case of any accidents, for example when they hurt themselves during unloading.

### 10.6.3 Value network

***Government involvement***: Although the demonstrated solution seems relatively easy from an organisational point of view (since one stakeholder effectively controls shipper's, carrier's and receiver's activities), one other stakeholder is essential to make this solution work in practice: the (local) authorities. Without the approval to deliver during the night, investments in silent materials do not yield. Since most supermarket chains (as well as other retail chains) have stores in many different cities, this requires quite some discussions with different authorities that might have other considerations and ideas, which could make large scale implementation of this solution difficult, and time-consuming for the retailer and / or carrier. Therefore, cooperation with local authorities is essential for this solution. And with that, also the cooperation with local residents, as the local authorities (usually claim to) act on their interests. In case residents start complaining (e.g. noise nuisance), local authorities are probably less likely to continue cooperating in this concept.

***Policy:*** one way to make life easier for actors that plan to invest in low-noise material for night deliveries, could be to change the way it is determined which stores can be delivered during the night and which cannot. Currently, all is arranged by case-by-case exemptions. For industry partners it would be easier if permissions were granted based on a set of measures that have to be taken by both the retailer and his carrier (e.g., use low noise material, no direct residents living in *x* meter of the loading location, etc.). So, in case night deliveries would be arranged by permissions instead of exemptions, the industry parties know in advance if it would pay off to invest or not. Furthermore, it would no longer be necessary to have the many and time-consuming meetings with different (local) authorities. Going from arranging night deliveries by exemptions to permissions, is going from a situation where local authorities say 'no, unless …' to a situation where these authorities say 'yes, if…'.

### 10.6.4 Financial model

***Balance Capex / Opex***: the off peak deliveries during the night result in clear operational benefits; however it requires some capital investments in more silent vehicles, trucks and rolling material (e.g. roll containers). Therefore, the right balance between investments and operational cost savings should be sought. Both the investments as the revenues from operational benefits result from the number of stores that can be delivered during the night. Based on that number, vehicles and other material can be adapted. The potential decrease in operational costs is very much dependent on the amount of changes that have to be made in the current operations (e.g. longer opening hours, working with two drivers instead of one during the night, etc.). Especially, when only a few stores are delivered during night hours, and the majority of the operations do not change, these costs might be relatively high.

***Cost and benefit sharing***: off peak deliveries result in costs and benefits for different stakeholders; in the demonstrated cases, different stakeholder roles were combined in one company, which made the cost and benefit sharing relatively easy. As was already discussed in section '10.6.1 Customer model', the sharing of costs and benefits is more difficult in the case where the retailer is not part of a retail chain. In this case, the investments (truck, trailer, material) are made by a LSP that can also get the operational benefits. However, the risks are with the retailer, who has to permit the LSP (and other LSPs) to enter the store in their absence, so the retailer cannot officially receive the goods (and check). Besides, the retailer has to allow letting the LSP's driver enter the store (so the driver requires a key or code). In case security measures are in place (to reduce the risks), extra investment costs are for the retailer, but no direct benefits can be identified for the retailer.

# 11 Conclusion

Many urban transport initiatives in the past did not succeed over a long period of time, partly due to insufficient attention for the business aspects of a solution. In this deliverable, the business models of the demonstrated solutions of the STRAIGHTSOL project have been thoroughly evaluated through quantitative and qualitative analysis. Furthermore, scenario analysis has been done with regard to the business models used in the pilots to scale up the demonstrations. Based on the pilots and scaled business models from the demonstrations, business model concepts with corresponding critical design choices were defined for innovative and sustainable urban-interurban transport solutions.

In theory, the demonstrated concepts certainly have the potential to provide solutions for urban interurban transport challenges. In practice hower, the success very much depends on the viability of the solution in a specific market context and the fit of the solution with the organisational architecture of the organisation(s) involved. Below the main conclusions of the specific business models of the individual demonstrations are provided.

## 11.1 Conclusions of individual demonstrations

### 11.1.1 Urban Consolidation Centre in L'Hospitalet de Llobregat, Barcelona – DHL

In the pilot of DHL, a part of the warehouse of DHL was transformed into an urban consolidation centre (UCC). The aim of the measure was to reduce the number of vehicles entering the city centre by combining the deliveries at the consolidation centre outside of the city. In the case of DHL a completely new business model was created as the solution was not offered before. The viability and fit analysis for all stakeholders demonstrated that the solution has positive impacts on market perspectives for each stakeholder, especially for the city council since most of the benefits were social benefits. It also fits to each stakeholder's organization except for stakeholder DHL SC Spain, who was the executer of the initiative. The yearly costs for a large-scale implementation of the solution are substantial and there are no revenue streams which can cover these costs. In order to cover these costs, DHL SC Spain should change its business model and find other stakeholders who are willing to share either the costs or the benefits. This requires a new way of organization of the market. In the report recommendations are given about potential solutions. The first one is an agreement with the receivers with other value added services for which they would like to pay, the second consist of an agreement with other LSPs for cost or benefit sharing, the third one of an agreement with shippers (paying to UCC for last mile delivery instead of LSP's), the fourth one of a combination with other logistic solutions such as electric vehicles or bicycles to decrease the costs and the last one of active involvement of the municipality to restrict the entrance of other carriers in the city centre.

### 11.1.2 City Logistics Mobile Depot in Brussels – TNT Express

In the demonstration TNT tested the use of a mobile depot to make their last mile deliveries more environmentally friendly and less hindered by congestion. The mobile depot was transported daily between the TNT Express hub to a predefined parking area in the city. From there, last-mile deliveries and pick-ups were carried out with cargo bikes and/or small electric vans. The Business Model Canvas clearly shows that TNT Express does not have to change its entire business model for this solution. It is their aim to fit the new solution within their existing value proposition and key activities. New activities are outsourced to a (new) subcontractor. The benefits in terms of emission savings have been identified. However, the investment and operational costs appear to be too high to make the solution financially viable. This has to do both with the organizational fit (the expenses increased considerably) and market readiness: there are no increased revenues. Hence, the mobile depot has no financial value at this moment. Existing non-financial benefits are: 1) improved image, because of innovative and environmental friendly character and 2) social benefits in terms of emissions, noise and safety. These benefits might be reasons to continue with the concept and to look for possibilities to develop a positive business. In line with this, three potential follow-up directions are provided in the report. In the first place, it should be researched whether the authority could support by providing a location or whether a shared mobile depot could be exploited. The second point is to find out whether it could be possible to pay or get paid for environmental costs/benefits. Another option could be to find value added services that can be undertaken from the mobile depot, in order to increase revenues. Lastly it could be considered to re-negotiate subcontracting activities taking the most optimal freight profile of the urban area into consideration.

### 11.1.3 Remote 'Bring-Site' Monitoring near London – Oxfam

In the Oxfam demonstration, remote monitoring was used to exploit the potential of dynamic routing. Remotely monitoring banks using fill-level sensors provided Oxfam with insight into the real-time amount of goods placed in the banks. As a result of the business model, investment in sensors and a new software system and the organisational acivities of Oxfam had to be adapted. Furthermore, a partner had to be sought for the installement and maintenance of the sensors and support in dynamic planning. The potential financial business case of Oxfam is negative when the pilot area is scaled to the operating area of Oxfam due to higher overall costs. The social busienss case is slightly positive due to an increase in routing efficiency and therefore a decrease in $CO_2$ emissions as a result of optimized planning. The solution inquires organizational change (planning /management) and the connectivity of the sensors should be improved. Automating planning processes should decrease management time. Finally, a well organised change management program with regard to the organisational fit challenges and fast developments in sensor quality with regard to the market perspective challenges should be able to make the solution a success.

### 11.1.4 Rail Tracking and Warehouse Management in Thessaloniki – Kuehne-Nagel

The transportation by K+N comprises interurban-urban rail transport of goods from Central Europe to K+N premises in Sindos, Thessaloniki, Greece and consequent urban distribution of goods by truck to Thessaloniki. In the demonstration, GPS devices were installed on the wagons during rail transportation, which provided the opportunity to have real time reporting for improved transport planning last mile deliveries. The changes in the business model especially relate to the investment in GPS devices, roaming cost and the organisational activities that come along with the solution. Furthermore, partnerships had to be sought for the new tracking system equipment and the telecommunication network providers. The business case demonstrates negative impacts on financial resources of Kuehne Nagel. Although the innovation brings some cost reductions, they are not enough to compensate for the costs generated by the innovation as there was still inefficiency in the transport planning for last mile delivery resulting in less cost reduction than expected. Furthermore, the return of GPS devices back to Sopron is a too costly cost item since the devices are sent by airplane. According to the results of viability and fit analysis, the innovation has the potential to be beneficial for all the stakeholders. However, since the costs and execution of the solution remain by Kuehne Nagel it makes the innovation a poor fit for their organisation. As a potential solution to this challenge K+N could charge their customers for the improved service. Furthermore, the implementation of the solution could be transferred to rail railway operators, charge their customers (K+N, but also others) for the service that they deliver and reach economies of scale as cost can be spread among different customers.

### 11.1.5 Retail Supply Management and Last Mile Distribution in Oslo – GS1

The aim of the GS1 Norway demonstration was to 1) demonstrate smarter solutions for information collection and sharing between stakeholders in the supply chain by use of GS1 standards, and 2) demonstrate the usefulness of a joint buffer storage facility in shopping centres. The business models of the shipper, LSP, shipping mall and retailer will change when the solutions are implemented. The viability-fit analysis shows that even though the solution is a differentiating and value adding service that the Shopping Centre could offer, the organisational (un)readiness, raises the question whether the Shopping Centre is the appropriate actor to carry out the required activities. The cost benefit analysis shows that the solution of the buffer storage and information sharing has a positive business case for different scenarios. However, the difficulty is that costs and benefits are not equally distributed among the stakeholders. In order for the solution to become successful the costs and benefits need to become more transparent and redistributed so that the actor that invests, will also gain, either in terms of cost savings or increased revenue streams. Different scenarios of cost and benefit sharing are exploited. The most potential one is the scenario where the basis is an external facilitator responsible for the governance of the solution and redistribution of cost and benefits between shop owners, LSPs, shippers, the shopping centre and the facilitator itself. However, the feasibility of the solution depends on the value that can be generated in the specific context and willingness to pay of these stakeholders for this value.

### 11.1.6 Real time parking monitoring in Lisbon - EMEL

In the EMEL Lisbon demonstration, two real time parking monitoring solutions were exploited. The first solution is the contactless card, purchased by an Adapted Parking Meter (APM), which permits loading and unloading activities for thirty minutes. The second solution is the instalment of Vehicle Detection Sensors (VDS) on the ground that automatically registers when a car is parked in the loading/unloading area. The business model of EMEL changes substantially when the solutions are introduced. EMEL will need to invest in software and hardware that needs to be operationalised by the organisation in terms of real time monitoring and control of the loading/unloading activities by the planning staff and ground agents. Key partners have to be involved to install and maintenance both technologies. The financial business case demonstrated that a return on investment will not be reached with the solutions. A limited fixed fee for trucks cooperating in the scheme can help to make this solution financially feasible.

Because of the high investment cost and impact on the organisation (new suppliers), the organizational readiness is fairly weak. On the other hand, the viability (market perspective) of the solution is high, as it can potentially solve many of the existing challenges in Lisbon. Some changes regarding technical solutions, cost sharing mechanism and stakeholder participation must be made before the solution can become a success.

### 11.1.7 Night delivery in Brussels – Colruyt and Delhaize

Colruyt and Delhaize, the two biggest food retailers in Brussels, have demonstrated night delivery in Brussels. The analysis has showed that the solution has great potential in terms of financial and (non)financial benefits. Avoiding traffic congested peak hours reduces time and fuel. A more equal distribution of deliveries over 24 hours therefore directly reduces the operational expenses. It furthermore reduces polluting emissions in the city and stress among drivers. Capital and HR investments have to be made to get approval to deliver at night. But over time, these investment are (more than) compensated considering that the solution allows for a more efficient use of vehicles and DC operations. From a financial and external cost perspective, the demonstrated solution seems to become a success when it is scaled, with a (social) cost reduction of approximately 8%. Though there are several political, social and behavioural aspects that can prevent a successful implementation of the solution. The key prerequisites for success are: 1) approval from the municipality 2) acceptance from the neighbourhood and 3) acceptance from and satisfaction among receivers.

Currently, approval for night delivery is often arranged in terms of case-by-case exemptions. For industry partners it would be easier if permissions were granted based on a set of measures that have to be taken by both the retailer and his carrier. In case night deliveries would be arranged by permissions instead of exemptions, the industry parties know in advance if it would pay off to invest or not. It furthermore would reduce the many and time-consuming meetings with different (local) authorities that currently take place for each individual case.

## 11.2 Business model concepts

Based on the demonstration assessments the following four business concepts were extracted alongside the corresponding most relevant business model design choices in order to develop successful business model concepts for urban and interurban transport solutions.

**Table 36 Conclusion critical design choices**

| | **Critical design choices** | | | |
|---|---|---|---|---|
| **Business concept** | *Customer model* | *Organisational architecture* | *Value network* | *Financial model* |
| **Urban Consolidation Centre** | Segmentation: focus on receiver market or logistic market?<br>Scaling: customized city solution or general solution with large geo coverage? | Location ownership: resource sharing or new location?<br>Last mile delivery: which vehicles to use?<br>Personnel model: subcontractor or employee involvement? | Governance: single party or cooperation?<br>Regulation: stimulation or enforcement by government? | Cost sharing: distribution between receivers, LSPs, shippers and city council?<br>Benefit sharing: distribution between receivers, LSPs, shippers and city council? |
| **Data sharing in the supply chain** | Value proposition: to whom in the supply chain is the solution offered?<br>Customer channels: which customer interface is most suitable? | Data sharing: how to create trust in relation to data sharing sensitivity?<br>Suitability technology: which technology has the best fit in the supply chain? | Governance model: single party within the supply chain or neutral orchestrator? | Cost sharing: distribution between shop owner, LSP, shipper, shopping centre?<br>Benefit sharing: distribution between shop owner, LSP, shipper, shopping centre? |
| **Dynamic routing through monitoring** | Waste type: how regular is waste deposited by customers?<br>Area profile: what is the density of banks? | Degree organisational change: partly or fully integrated solution.<br>Technology: what are the monitoring requirements? | Execution of the solution: in-house or outsourced? | Balance Capex/Opex: investment versus operational efficiency |
| **Automatic parking monitoring** | Value proposition: single solution or integrated model?<br>Area suitability: density of shops, road/parking space architecture? | Organisational participation: single party or distributed participation? | Government involvement: can regulation be enforced based on new technologies? | Benefit sharing: distribution between shop owners, LSPs and city council?<br>Cost sharing: distribution between shop owners, LSPs and city council? |
| **Silent deliveries in off-peak hours** | Customer relationship: how to deal with unattended deliveries? | Organisational change: are employees with other working times? | Government involvement and policy: exemptions versus permissions? | Benefit sharing: should efficiency gains be shared with receiver? |

## 11.3 Discussion and recommendations

Though the overall gap experienced in urban transport relating to logistical and environmental challenges is common, the interest of a party to participate or invest in a the various business concepts is dependent on his specific operational gap or challenge in urban delivery. This gap may be experienced by a receiver, LSP, shipper or governmental organisation. From the demonstrations it has become clear that the four main customer profiles (receiver, LSP, shipper and governmental) often mentioned in literature are of a too high level to make conclusions about the potential of urban transport concepts. A receiver may be the same party as the shipper, creating another demand for a solution for his logistical challenge than when the shipper, LSP and receiver are three different parties. Though beyond the scope of this deliverable it would be interesting and also important to exploit and develop archetype profiles of the different combinations of roles and corresponding business models and experienced challenges. Consequently, common or complementary challenges could be combined into value adding and sustainable concepts.

Furthermore, it is important to consider that different types of models may exist within one concept. For example, different UCC types may exist, which creates potential to suit locations to the specific context and challenges. They may be at the border of a city (DHL case) offering space and easy access to the UCC location. A UCC could also be located more close to the city centre of an urban area (mobile depot - TNT Express). This creates potential for alternative transport modes. In addition, a UCC may be located in a shopping district (GS1), where common space may be utilised for consolidation and additional logistic services.

Furthermore, cooperative urban transport models and new technologies that focus on sharing data may offer solutions to urban transport challenges, but also generate new challenges with regard to business continuity and privacy of data. Technology requires stability and accountability, therefore, continuing research and development is necessary to improve new technologies. Privacy challenges with regard to data sharing may both come from physically cooperating with competitors (e.g. UCC) as new technologies that focus on data sharing (e.g. RFID techology) within the supply chain. Potential solutions lay in neutral governance models and encryption of data. Nevertheless, this is an area that needs further exploitation.

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