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Best Practice Factory for Freight Transport in Europe: Demonstrating How 'Good' Urban Freight Cases are Improving Business Profit and Public Sectors Benefits

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Abstract

The objective of this study is to better understand why selected urban freight solutions represent innovations that are technically feasible, economically profitable in different contexts, sustainable, transferable, and with tangible beneficial impacts. A total of 15 solutions are evaluated in the fields of Urban Consolidation Centre, clean and electric vehicles, IT solutions, use of urban waterways, and others. Three solutions are analysed more thoroughly, the Cityporto Padova, the Basel Exhibition Centre logistics support system, and the Berlin laboratory area test of the Bentobox. This paper ends with a transversal analysis of the solutions observed, and with methodological conclusions.

Keywords: Urban freight innovations; best practices; assessment methodology; consolidation; clean vehicles

1. Introduction

This paper is based on work being carried out in the EC-funded project entitled, "Best Practice Factory for Freight Transport" (BESTFACT) which commenced in 2012 and runs for four years. The project is examining best practice in urban freight transport, green logistics, co-modality, and e-Freight.

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The objective of this paper is to answer the following question: how to better assess and understand the benefits of best practices and innovations in urban freight transport that contribute to meeting policy objectives of reducing environmental impacts and at the same time improving company profitability? A number of studies have been published on methodologies and technologies for improving freight transport efficiency and the resulting environmental impacts (BESTUFS 2007, Browne, Allen, Nemoto, Patier and Visser, 2012). The core innovation of the approach presented in this paper is to extend such best practice assessment methodologies towards more business oriented factors that are necessary to consider when implementing strategies within the industry and when applying more environmental and carbon efficient solutions within cities (BESTFACT, 2013).

Two of the core problems faced by existing sustainability strategies in urban freight transport are the relatively small market share of clean technologies and the slow diffusion of technical innovations. Like in other business sectors, the technology innovation cycle in freight transport and logistics starts with a new idea, then progresses to prototype development and trial, and eventually leads to a full-scale industry or citywide utilisation. But when it comes to clean solutions and electric vehicles, there is a tendency for innovations to remain stuck at the level of small-scale field tests, and this is not well understood. The vast majority of the urban freight sector continues to use diesel trucks and vans, and fleet modernisation is slow (Dablanc, 2007).

The key practical output of this study is to give decision makers a better-informed knowledge base of success stories and a better understanding on why some solutions are more profitable and beneficial than others in the market. In achieving this objective, it is necessary to revise the existing methodological approach of best practice evaluation to include a wider range of systematic and new information (Browne, Allen, Nemoto, Patier & Visser, 2012). Emphasis will be put on transferability criteria and on the costs and benefits of public and private sector initiatives.

It is also necessary to test and verify the effects of using this methodology in different business cases, economic fields and geographical situations in order to fully appreciate the fitness for purpose of this method and its usefulness for decision makers in different contexts. One of the key objectives of this paper is the observation of 15 promising measures evaluated by the end of 2012. In this paper, 3 of these initial cases and results are presented with an intermediate level of detail, illustrating the application of the methodological innovations, and preliminary conclusions and lessons learnt are drawn.

2. Methodology

The purpose of the best practice methodology developed in the project is to continue to further improve existing approaches; to identify the challenges and strategic targets in freight logistics transport chains; to establish an improved framework for best practice data collection and monitoring; to identify and collect data on recent and on-going freight transport solutions; to evaluate these solutions, identifying success factors and barriers; and to derive from these relevant information of best practices systematic lessons on how to increase their transferability.

The first step in the evaluation process was the initial data and information collection. Twelve BESTFACT partner institutions in ten European countries searched for and identified a series of cases that fulfilled the minimum specification. They selected first some cases that had a positive response to the elementary questions: Is it an innovation? Is it targeting both private benefits and public policy objectives? and is the information publicly available? For example, the partner from France selected 6 new cases in the fields of shared consolidation centres, electric vehicle use, intermodal city deliveries, and cycle freight that were matching the selection criteria. The list obtained as a result of this stage included 93 cases submitted by partners. Thus it was necessary to narrow down the selection.

The second step involved a multi-criteria assessment (MCA) along four categories: innovation and feasibility, magnitude of impacts, information accessibility, and transferability.

Using a scoring system between 0 and 3, each criterion was marked by three experts independently, so that an average value was given to each case. For example, a case on consolidation centre networks received a transferability score of 3 for ‘robustness’, because the case is ready for broad implementation, there is a documented transfer between different domains available, and the framework for transfer is clearly known. Tables 1 to 4 present in detail the criteria used in the MCA for the selection of the ‘Best Practices’.

The four criteria lead to a set of four marks, and the average is calculated using a weighting in order to get a more balanced result. This weighting is calculated according to the findings of the European BESTFACT online survey of experts on the importance of topics and objectives for freight transport policies and business solutions. In this survey, the responses on the importance of the topics Innovation, Impacts, Transferability and Data Availability were not very different, so the weighting for each of the 4 criteria is around 25%.

Table 1: MCA criteria 1: Level of innovation and technical or economic feasibility

Description of the criteria: Solutions should be innovative and include products, processes, services, technologies, or ideas that are more effective than previous ones, and that are accepted by markets, governments, and society. The experts rated the expected level of innovation (low or high) and also estimated the technical or economic feasibility of a practice (low or high).				Weight: 27 %
Level	3	2	1	0
Segment and rating guidelines	High level of innovation and high feasibility	High level of innovation and low feasibility -or- low innovation and high feasibility	Low level of innovation and low feasibility	Not feasible or not innovative

Table 2: MCA criteria 2: Strength of the external impacts and economic effects

Description of the criteria: Solutions should have a positive strategic impact on business and/or policy targets, and on external social costs.				*Weight: 30 %*
Level	3	2	1	0
Segment and rating guidelines	**High potential**: Positive impact of the practice. High potential for positive effects and justifiable (quantifiable) results.	**Medium potential**: Medium potential (good indication) for positive effects and positive impacts.	**Low potential**: Prognosis of effects difficult but positive impact expected. Anticipation of risks.	**None**: No indication that measurable effects will occur through implementation or sources that prove that no effects will occur.

Table 3: MCA criteria 3: Accessibility of information

Description of the criteria: Access to a minimum of information is needed for consideration in BESTFACT. The information has to allow an assessment and evaluation at least for the inventory phase but better also for in-depth analysis phase.				*Weight: 21%*
Level	3	2	1	0
Segment and rating guidelines	**Full**: access to all needed information, readily available (e.g. direct download) or helpful contacts or affiliated partner	**Broad**: access to first basic information and details available on request, further sources available and free of charge	**Limited**: access on request possible, access only for limited user group, charges to receive information, availability issues	**Not available / accessible**: Possibility of review of the item is doubtful due to restricted information/ no response by contacts

Table 4: MCA criteria 4: Transferability of best practice cases

Description of criteria: Transferability of cases to other domains, situations, framework conditions or business structures has to be secured. At least a partial implementation with certain (necessary) adjustments should be possible outside of the originating environment.				*Weight: 22%*
Level	3	2	1	0
Segment and rating guidelines	**Robust**: Case is ready for broad implementation, documented transfer. Framework for transfer is known.	**Realistic**: New solution implemented in few cases. Case successfully adopted by other domains.	**Expected**: Documentation that suggests transferability through reason and figures. Not tested or applied outside of original source.	**Not applicable**: No indication that a case can be transferred

Table 5 shows the overview of the selection process for the best practice cases.

The length of the list of 93 cases submitted in step 1 does not allow the publication of the descriptions, and these selected solutions are only understandable and presentable on a case-by-case basis. The same applies for the

ranking results of step 2 that can only be understood on a case-by-case basis. The results of the marking and ranking were given to the partners and were used for the final selection of the 15 cases that are further looked at in step 3. As a consequence of the final selection iteration, the 15 cases can be considered as most suitable for following up in greater detail.

Table 5: Overview of the selection methodology for the best practice cases (Source of Tables 1 to 5: BESTFACT 2013)

Step	Description	Author(s)	Result(s)
1	Submission of cases	12 partners	93 cases submitted
2	MCA pre-assessment, ranking and selection of 'best' cases	3 expert evaluators	93 cases are marked, and the 15 'best' are selected
3	Inventory collection	12 partners	15 inventory cases are presented

The third step is the inventory collection for the selected cases, for which all relevant high-level information is collated together into a single document. Each partner in charge of the authorship of a case was asked to use a standard template consisting of a list of questions to be answered. The purpose was to ensure that all key information was collected for each case, thereby facilitating comparisons between similar solutions in different countries and business sectors.

The topics are presented together with the cases below. The future step is the In-depth survey, in which the authors will collect detailed cost information, environmental impact information, and data on benefits and strengths. This detailed level of consistent information was not available in previous studies such as BESTUFS (2007), Browne, Allen & Leonardi (2011).

2.1. Introducing the results

The fifteen cases delivered in the 2012 inventory collection consist of:

- 6 cases on the topic of consolidation centres and electric vehicles
- 3 cases on the topic of innovative IT applications for urban freight routing, fleet and loading management
- 6 cases on other topics such as laboratory area, efficiency of retail deliveries, public private cooperation, multi-use lanes, and use of waterways.

In the next sections 3 representative cases are discussed in more detail. After this, a summary of all 15 cases is presented in Table 6.

3. Urban Distribution Centre and Clean Vehicle Use: The Case of Cityporto Padova

3.1. Summary description

"Cityporto-consegne in città" is an Urban Consolidation Centre (UCC) service operational in the urban area of Padua, Italy. The manager is Interporto Padova S.p.A., which also manages the local freight village, a public-private-partnership whose major stakeholders are the local public bodies (Municipality, Province, and Chamber of Commerce). The service has been operating since 2004. Cityporto now performs about 100,000 deliveries per year (del/year) in 2012 for 60 customers. There was a jump from the level around 60,000 del/year observed in the years 2006-2010, to 95,000 del/year in 2011, due to the recruitment of new customers. The number of parcels delivered was about 400,000 in 2012, corresponding to an average of about 4 parcels per delivery.

The major clients are couriers and forwarders operating in the city, but also SMEs that usually deliver their products on own account. The service was supported with a grant (subsidy) in the start-up phase (2004-2007) by the City and the Province of Padua, and the local Chamber of Commerce, as stated in a Framework Agreement, which is an example of a successful result of a consultation process among stakeholders involved in city logistics

issues. The deliveries are performed by 11 methane-powered vans; two are equipped for temperature-controlled goods. The UCC is a 1,000 m^2 wide cross-docking depot located within the freight village.

3.2. Costs indications

Costs of Cityporto service for clients and receivers of deliveries are not available at this stage. The amount of public subsidies provided to Interporto di Padova (a public in-house company itself) for the service start-up is available. The City and the Province of Padova, Veneto Region and the Chamber of Commerce of Padova provided a total grant of 360,000 € over a 4-year timeframe (2004-2007). The intensity of the grants decreased year by year. The financial self-sustainability of Cityporto has been achieved at the end of 2007. The Cost-Benefit Analysis made in the assessment of benefits led to a Net Present Value of 273,000 €, extended to a 5-year timeframe (2008-2013), which leads to a Benefit to Cost ratio of 2.94.

3.3. Data availability

The Cityporto case is well documented in the Italian language and has already been mentioned in some international literature (BESTUFS 2007). For the BESTFACT case, consistent data were made available and this will contribute to increase further the potential transferability of the solution. Probably one of the most interesting missing data is the comparison of the average costs of one city centre delivery for a major client before and after using Cityporto services. If the overall mileage is reduced for all customers, it must be assumed that the before-after comparison of the costs per parcel or per delivery are going down as well. On the other hand, the costs of using clean vehicles could overcompensate the gains of overall distance reduction per delivery, and this might lead to an overall economic impact that is not very beneficial. This question is specific to the issues associated with the UCC implementation and its profitability and could only be assessed in very few other cases (Allen, Browne & Cherrett, 2012).

3.4. Main benefits and impacts

The introduction of a public-private urban logistics scheme based on cross docking and consolidation of freight in a UCC brings benefits both in terms of increased transport efficiency and a reduction of polluting emissions. The benefits survey focussed on a 24 month operational period (485 operational days), from July 2008 to June 2010. During this period, 122,170 deliveries were performed by the 10 operational CNG-powered Cityporto vans. The vehicles performed 6,306 delivery trips in total. For all of them, complete data registered by tracking & tracing IT system were available. The Cityporto service led to a decrease of total distance covered by Cityporto customers' vehicles of 727,920 km. Considering the distance covered by Cityporto vehicles (166,478 km) the total annual distance saved is estimated to be 561,442 km. This corresponds to about 220 tonnes of CO_2 saved per year.

3.5. Barriers for implementation

The main barrier to overcome before the implementation was to improve the attractiveness of the service. This was done with a modified access and loading/unloading rule in the city centre. From 2004 onwards, Cityporto vans were allowed to enter the city centre by using the dedicated lanes of buses and taxis, and, unlike diesel freight vehicles, they have no time windows for loading/unloading in the ZTL (Limited Traffic Zone).

These access restrictions changes can also be considered as a success factor, and was a solution designed to ease the classical logistics difficulty of adding an unloading operation at the UCC. Additional unloading within a supply chain is considered a cost increasing factor, and this is a generic, powerful barrier for implementing Urban Consolidation Centres. Usually, this barrier is overcome by better load factors on the final leg (last mile) delivery, since the transhipment activity also enables grouping of the deliveries in consolidated loads. But in this special case, the overcoming of this barrier was also made easier through the removal of tough access restriction rules that diesel vehicles have to respect.

Barriers also exist in attracting such cooperative and efficient city logistics services to more time-sensitive goods such as parcels delivered by express couriers, and perishable goods. Both logistic segments need a time-windows restricted delivery, which is often not compatible with the additional cross-docking operations needed in the UDC.

3.6. Transferability: transfer and upscaling potential, and future plans

Cityporto has proven to be a replicable practice throughout several Italian medium-sized cities. The Cityporto model has been replicated in other Italian cities, where the local City Administrations implemented (or attempted to implement) similar city logistics schemes, even assisted by Interporto di Padova in the design phase. Those cities are Aosta where Cityporto Aosta is running since 2011, Modena with Cityporto Modena in place since 2007, Como with 'Merci in Centro' operational with hybrid electric vehicles since 2009 and Brescia where Eco-logistic Brescia is operational since 2012 with 3 electric vans. However, although operational, those "replicated" models have not reached the volume of deliveries performed by Cityporto Padova yet.

On the upscaling potential, Cityporto has issued a development plan aimed at reaching 160,000 deliveries per year in 2014, a quantitative growth target of 60% in two years. The goal is to increase and improve operations, to develop its range of services, in order to address markets which are usually unexploited by city logistics services, and to make use of the opportunities given by the integration of the Urban Consolidation Centre in the framework of the intermodal terminal and its IT management systems. This upscaling activity is useful for the transferability analysis since it enables a better understanding of how a successful case is capable of changing from a small-scale trial to a full-scale operative industry.

3.7. Success factors

Cityporto's main success factor is the location of the UCC within the freight village. The UCC has a good reputation among operators, is located near their logistic platforms and sufficiently far from shops in the inner city. The Cityporto model is now replicated in other medium-sized Italian cities (Modena, Aosta, Como, Brescia).

Besides public support and favourable regulations that were providing good starting conditions for the UCC, the major success factors are more managerial and linked to the effectiveness of the operations. The business partners recognize the commercial neutrality of Interporto Padova as UCC manager. This neutrality makes sure that there is no market distortion towards one of the logistics service providers or customers of the service, and therefore this element is a key to increase the market share of the UCC towards new, future clients.

There was a successful development of a dedicated IT System for Cityporto services that is effective and efficient in terms of compatibility with the IT and billing systems of the customers and operators.

4. An Improved IT Device: The Case of the Logistics Tool for Delivery Management at Messe Basel

4.1. Summary description

On the Basel Exhibition Centre (Messe Basel), exhibitors, stand builders and other suppliers have to use a new booking system and to register online and in advance for all deliveries, pick-ups and transports to the facilities. The domestic logistics operator exclusively handles all logistics processes on all buildings and premises of Messe Basel. Confirmed and registered vehicles receive a delivery pass, which contains a date and fixed time slot for delivery, information about the loading, company and vehicle information. This information is coded for faster checking.

At the designated time, the vehicle has to check in at the exhibition centrecentre check point, where all delivery information and cargo is verified and a parking space is assigned. Upon verification, an access pass is handed to the driver including directions to the optimum delivery zone, where the loading is transhipped. The time allotment for a vehicle in the delivery bay depends on type of vehicle and load. After transhipment, the truck has to be removed from the exhibition centre and takes a new trip.

The registration for deliveries or pick-ups is generally free of charge if performed regularly 7 days in advance. On shorter notice, up to 24h ahead, it incurs a charge; the scale depends on the specific event and ranges between €80 and €420. A developed online tool, available in 5 languages (German, English, Spanish, French, Italian), needs to be used for booking of timeslots for deliveries. The login needed for the tool is sent to exhibitors upon registration for an exhibition event. An access pass has to be printed in electronic PDF format and presented upon delivery.

4.2. Costs indications

Development costs are included the development of the IT tool and complementing equipment. The costs of developing the solution also extend to the development of new processes, logistics analysis and restructuring phases starting from the previous situation. The next cost positions for the development of the new solutions were education, qualification and training of personnel, minor infrastructural adjustments at the check point with new signage, new equipment: scanners, printers at the check point and the information campaign. The implementation phase is responsible for the majority of costs.

4.3. Data availability

At this moment there is little cost-benefit data available that would help demonstrate the costing situation, and the time and other resources saved, when using the new IT system of the exhibition centre logistics. A comparison of the situation before and after the introduction of the system from the point of view of the end-user and from the point of view of the IT user would lead to further benefits and further promote this tool. Such a before-after analysis and such a cost-benefit analysis could be envisaged. However, the available data tends to demonstrate a beneficial practical impact on the Messe Basel organisation and logistics operation, thus fulfilling both objectives of reducing negative externalities such as congestion which is in the public interest, and increasing the profitability of the businesses involved.

4.4. Main impacts and benefits

The acceptance was high, for the first Trade Fair event at Messe Basel, where the tool was in use, almost 90% of the about 7,000 trips were pre-registered. The basic functionalities of the tool are already providing clear benefits and are easily implemented. In addition, the case helps to increase efficiency in all logistics related processes and will eventually support monitoring. The major traffic benefit is the reduction of congestion on major local, national and international routes (inner city roads and motorways). For peak delivery and pick-up days related to major exhibitions, 15 km of congestion was measured prior to the implementation due to trucks blocking the highway exits in order to reach the checkpoint. This congestion is now effectively avoided for each event. Automated billing and invoicing related to all logistics activities reduce the time of logistical operations considerably. Efficiency gains are reflected in time gains within the occupancy schedule on the exhibition premises. Through consolidation eventually additional events can be held at the Messe Basel, leading to increased capacity utilization and increased revenue.

4.5. Barriers for implementation

The main problem was the support of the customers, stand builders, exhibiting companies, and Trade Exhibition event agencies, since a major part of planning ahead was required. Before, this planning of the operational dimension of the Messe Basel deliveries was dealt with on a more short-notice and day-to-day basis by the in house logisticians. An early and open communication strategy helped to overcome these problems and allowed the benefits for all users of the tool to be demonstrated. The 3 minutes handling time of each arriving transport is to be reduced to one minute. The current duration is due to the lack of calibration between IT equipment and IT software which prevents a faster data processing.

4.6. Transferability: transfer and upscaling potential, and future plans

The management system could be used for all delimited areas of the fair facilities, with limited space and with high traffic intensity, and where the use of a single logistics service provider is compulsory. The deployment phase is estimated to be about 2 years, until all fairs have been held at least once with the new processes. The solution could be most likely transferred and used on all trade fairs in Europe or other comparable campuses. Other domains of application, where the use of the IT solution would provide efficiency gains, could include harbours, airports or larger public events. For the upscaling of this very specific logistics tool to a more general managerial tool that can be combined with other IT systems, further integration of additional functionalities is planned. Especially the automated invoicing for billable registered transport, also including a function to handle all fines that are incurred due to misuse or missed time slots, will further extend the practicability of the tool.

4.7. Success factors

A series of steps led to the successful implementation and acceptance of the new IT system. There was first the idea of getting an optimal operative process that dictated functionality, design and development of the logistics tool. An open and early communication strategy targeted all actors involved. A thorough and stepwise testing took place before implementation. Close cooperation of stakeholders made sure that all needs were respected (operators, city's urban planning department, IT department, project developers, marketing, customers). The key to the implementation, use and acceptance of the new tool was the communication between all relevant actors. The tool was first used for the largest exhibition in Basel (Baselworld) and required the trade fair management to identify all relevant actors to be addressed with information concerning the use of the new tool.

A 7-page guidance document with descriptions of processes, time planning, necessary procedures and fees was distributed to identified exhibitors, stand builders, external logistic service providers and suppliers. Included were the access details to use the online tool. A major challenge was to reach all actors since different exhibition events have different management units with separated contact databases. Optimisation and consolidation of the actor database is envisaged. Also a user friendly documentation and unification of guidelines for the use of the logistics tool, procedures and a new fee catalogue have been set as goals for the further smoothening communication processes.

5. Berlin Tests of BentoBox in the Laboratory Area for Urban Logistics Innovations

5.1. Summary description

The urban freight 'laboratory area' is a small residential and mixed-use business and retail area in a central borough of Berlin, Germany, in which innovative freight transport solutions are tested, studied and presented. The Bentobox technology consists of the use of a new locker bank for storing parcels, and of electrically assisted bikes for final delivery. Bentobox tests were performed in the laboratory area. The project leader, the Senate Department for Urban Development and Environment of Berlin, seeks to use this area for further tests, including e-mobility and smart freight solutions (Weber, Bruening, Menge, Chiadò & Corongiu, 2012, Menge, 2012). Advantages of a laboratory area are the visibility of developments through the local concentration, and an increasing efficiency and time savings of the trials of different solution by sharing and using contact networks and local knowledge, and joint collection and usage of basic data (socio-economic structure data, traffic data, environmental data) that are required for suitable impact analyses as well as scenarios. The Berlin laboratory area is an inner city borough with clearly defined borders, high density and diversity of traffic and space utilization, spatial competition of different usages, and distinct potential for conflicts of interest among different stakeholders. The area has a high potential for reduction of negative externalities generated by urban freight movement, by using innovative transport concepts and vehicle solutions. A regular update is available.

'Steglitz/Friedenaus' was selected as the laboratory area. First a diary of deliveries was carried out during one week in the spring of 2011. A total of 106 retail and catering companies were contacted, with a 65% response rate

(69 diaries). The collected information included time and duration of each delivery, name of the supplier, type of delivery and vehicle class. Further steps in the collection of delivery data included large shopping centres, comparing these with retail enterprises. An evaluation of the amount of time for critical supplies is foreseen.

For the Bentobox, wheeled boxes are loaded with merchandise for shopping malls in the depot. Then these boxes are delivered to an automated locker bank within the shopping mall, before or after opening hours. The driver inserts the boxes into the locker bank, which triggers an automated alert notifying the customer of delivery by SMS or email. Customers can pick up their merchandise 24/7 at their convenience. The Bentobox solution is used as a consolidation point for inner-city distribution. An engineering and construction company (Constin) provided the space for its installation. The Bentobox trial was operated by Messenger Transport, a freight transport carrier using mostly cycles. Two types of electrically-assisted bikes were used in the Bentobox test: Cargo (e)-bikes with a load capacity of up to 70 kg; and Cruiser bikes with a capacity of 250 kg (the dimension of a EURO pallet) and a 80 km range.

5.2. Data availability

The data made available with the trials tends to demonstrate a very successful and beneficial application potential for the increased use of cycle deliveries in the last mile of the transport. Most of the car and van transport could be replaced and some of the trips could be consolidated. Therefore it seems to be enough evidence available that the objectives of sustainability and profitability have been reached.

One of the more difficult conditions to be fulfilled for wider scale transfer seems to be the better understanding of the business costs and benefits for different markets and local configurations, and the better understanding of the changes in economy and traffic. This could be done for example by applying a more advanced cost-benefit calculation methodology. This would include new freight data to be collected with a before-after comparison of the key indicators distance per unit and time per unit delivered.

5.3. Costs indications

The establishment of the laboratory area in Berlin has not generated dedicated additional costs for the municipality. Survey costs occur to a limited extent, however. Indications on the Bentobox costs generated for the end-user suggest that there will be no additional delivery costs for the receivers of the parcels. For the company, indications suggest that the costs of installing and running the Bentobox would be compensated by the general efficiency of the service (Weber, Bruening, Menge, Chiadò & Corongiu, 2012).

5.4. Main impacts and benefits

The Laboratory area benefits for the local authority are efficient public spending, improved utilization of infrastructure, and high acceptance and influence of policy measures. In particular for the Bentobox test, it has been estimated that 85% of the conventional light commercial vehicles' routes have been effectively replaced by cargo bike services. It was possible to include different types of logistics operations in the Bentobox trials and this was made possible through different local logistics service providers. Not only most of the trips made by car or vans could be replaced by cycle trips, but also using the Bentobox as a consolidation point could contribute to consolidate some of the direct trips. This also led to an additional traffic and emission reductions.

5.5. Barriers for implementation

The willingness of key business to take the economic risks involved in testing the Bentobox solution in Berlin is a precondition that has to be fulfilled in order to start the trial. Once the trial was successfully terminated, the company decided to start another trial in another city so the technology is not yet available in Berlin. The conditions for the large-scale deployment and use of the Bentobox in Berlin could therefore not be fully understood.

5.6. Transferability: transfer and upscaling potential, and future plans

Even if the trial was considered a promising operative success in Berlin and Lyon, it is too early in 2013 to apply the use of the Bentobox on a large scale. Therefore, this case delivers only limited insights and understanding on how the solution can be upscaled to an industry wide solution, and which conditions would need to be fulfilled in order to do so. The same applies in transferring it to other businesses or to cities other than Berlin.

5.7. Success factors

The reduction of data collection/monitoring costs and the time savings during the trials were the main success factors during the application of the Berlin laboratory area concept. The visibility of the solution tested has improved. Sharing data and contacts and using local knowledge were key factors for the evaluation of the solution tested. Political will and need to act was present. For the Bentobox tests, the flexibility of the distribution system and the willingness of the business decision makers to undertake this type of trial were the main success factors.

6. Overview and Further Cases

The following overview presents all fifteen cases for the solutions that were selected and inventoried in 2012 in the urban freight cluster of BESTFACT. Table 6 shows the technical feasibility and the public sector benefits of the applications. It is more difficult to show how some cases can contribute to lower the private costs of customers and improve the profitability of the logistics services using the new solution. Since most cases are running for a period of time that is long enough to allow economic observations, and that a non-profitable case would have been dropped, it can be assumed that the private costs situation is beneficiary for the organisations.

Regarding transferability, which seems to be even more challenging to assess than the cost-benefit situation, the level and quality of information obtained is variable, but it tends to show that most of the solutions seem to be transferable. However, only a few solutions have been effectively transferred to a larger scale, such as electric vehicles of Distripolis in France or the Binnenstadservice cooperation concept in The Netherlands.

Table 6: Fifteen Best Practice Cases for Urban Freight Transport in Europe in 2012 (Source: BESTFACT 2013)

Name	Main characteristics	Costs	Data availability	Impacts & benefits	Barriers	Transferability	Success factors
Gnewt Cargo-cycle	Electric vehicles and cycles	Not higher for clients. Profitable	Costs, traffic, benefits, emissions	Low traffic, noise and emissions	Private decision	High, confirmed	100% electric, forwarder decision
Distripolis	81 electric vans, >20 tricycles, UCC in 5 cities	+ 14% costs per parcel	Partly on traffic reduction	Low noise and pollution	Private investment decision	High, confirmed	100% electric fleet
Cityporto Padova	11 natural gas vans; UDC	Profitable since 2007	Well documented	Low pollution, traffic saving	Additional handling at UCC	Adopted by 5 cities in Italy	Access rules; good location
Basel Trade Fair IT tool	Planning delivery slots	Not available	Congestion, feasibility	Reduce congestion	Acceptance of customers	Given but not confirmed yet	Good communication
DPD Stuttgart	Standard battery electric van	Higher than diesel	On feasibility and emissions	Low noise and pollution	Private investment	Given and confirmed	Manufacturer decision
Binnenstad-service	UCC network	Lower costs for operators	Costs, traffic, benefits	Traffic savings	Willingness and behaviour change	High, confirmed	Cooperation and rules
Berlin laboratory area and Bentobox	Test area for cycle deliveries	No additional costs	Benefits, traffic, emissions	Efficient public spending	Private decision to start the trial	Given but not confirmed yet	Reduction of data collection costs and time
Multi-Use lane	In Bilbao	Not available	Partly on traffic and congestion	Traffic savings	Public decision	Given, this is a transfer from Barcelona	One way streets >2 lanes
Franprix en Seine	In Paris	Not available	Traffic, benefits, emissions	Traffic savings	Limited area	To be confirmed	Supermarket chain decision
Maribor waste management	IT routing and scheduling	Lower costs	Routing and time savings	1/5 of traffic reduced	Public decision	To be confirmed	New algorithm
Cargohopper Utrecht	Electric vehicle	Not available	Partly on benefits & emissions	Low noise and pollution	Public investment	One case is running longer	100% electric, 3 m3 capacity
Zero Emission Boat	In Utrecht	Not higher than diesel	Costs, traffic, benefits, emissions	Low noise and pollution and distance	Limited area	One case is running longer	Beer for 60 customers
Cooperation of retailers	Lithuania supermarkets	Not available	Partly on traffic	Traffic and time saving	Private decisions	To be confirmed	Common use of network of depots
ILOS	Planning route with floating car data	Not available	Traffic and trip time reduction	Time and traffic saving	Integration to navigation systems	Given but not confirmed yet	Shorter route according to instant traffic
iLadezonen	Vienna loading bay management	Not available	Ongoing data collection	Time and traffic saving	Prototype only	To be confirmed	User friendly

7. Transversal Analysis

7.1. Reaching the target of integrating business and public sector interests

The study provides systematic information and a structure to better understand why each solution is an innovation that is technically feasible and economically profitable in different contexts, while at the same time makes sure that it is a sustainability solution with tangible beneficial impacts. The main public benefit is the contribution to reduce the negative externalities of transport, a question that is at the core of local policies and

public sector interests. The study also warns decision makers about barriers and limitations that would need to be taken into account when one tries to reproduce the same solution in a different context. It gives hints about the boundary conditions that are necessary to be put in place if the solution should lead to a success story. The reliability of some replicable outcomes is encouraging: It means that if decision makers respect these conditions, and if they would apply the solution in a different context, they should get the same benefits. It prepares the way for successful implementation and contributes towards an increase in the market share of sustainable solutions.

7.2. Overcome the barriers for implementation

In the cases presented above, most of the barriers that needed to be overcome have to do with information and cooperation, with investments and with decision-making. In order to become successful solutions, there is however little evidence that a typical model exists that would enable to overcome all existing barriers. Probably the most cited problem solving approach is the dialogue between city authority and multiple stakeholders, integrated together with a good preparation of public support for private initiatives (Holguin-Veras et al. 2005). But even if this is a successful approach when dealing for example with the implementation of a new urban distribution centre, this seems not appropriate when dealing with routing software or with cooperation among supermarket chains. Therefore, it is appropriate to search for solutions to overcome barriers for the implementation of these beneficial solutions. Further solutions to overcome the barriers are: making the benefits become visible to the broad public; decid with a more clear understanding of costs; be aware of the replicable dimension of the success stories; obtain the best possible data. These solutions will be explained below.

7.3. Make the benefits visible to a broad audience

The positive impacts are one of the key reasons why the solutions have been developed in the first instance. Not only the air quality and the traffic jam, but also the inefficiencies have been long lasting problems that are far from being properly resolved in most European freight companies and so, the cities, the markets and the clients are waiting for clean solutions that are at the same time profitable and more effective.

The results show a medium level of detail on what are the benefits that could arise from a combination of Urban Distribution Centre and clean vehicles in Padova, from a new logistics planning software in the Basel Trade Fair, or from testing the Bentobox in the Berlin laboratory area. This level of detail should be enough to allow decision makers to replicate these trials in their cities or in their businesses. However, further details could also help. When a coherent before-after data collection demonstrates effectively what were the changes when the solution was applied, then the benefits become even clearer. Private and public benefits need to be assessed together, and this gives decision makers the most accurate information possible. However, a detailed before-after comparison and a thorough analysis of costs and benefits could not be performed in any of the BESTFACT cases; but the intermediate level of detail of the interview responses obtained tends to demonstrate beneficial impacts for each case. More work is needed on this question. To make the benefits visible to a broader audience promotes good practice and tends to increase its transferability.

7.4. Decide with a more clear understanding of costs

Experimentations show that if costs are affordable for the customers and profitable for the operator, this increases the chance of success. At the same time, together with the analysis of transferability, cost analysis of freight trials is a point where the understanding is the least developed. A prototype, or a solution tested at a very small scale, is always expensive, when looking at the costs per item delivered in the starting phase. Startup investment is a big economic hurdle, and the question is to take it or not take it into account when calculating the long-term costs that will be on the market when the solution becomes viable.

Not every trial is designed to demonstrate economic viability. Most cases are designed to showcase the technical feasibility of a solution, and eventually tangible, beneficial impacts. However, if confronted with the question of extending the trial in case of success, the question of costs is crucial and the absence of real cost data

means that decisions are taken on the basis of theoretical assumptions, which is risky. Costs data obtained with a trial under real market conditions are beneficial for the future transfer of Best Practice solutions.

Ideally, beside managerial tools such as cost-benefit analysis or Net Present Value calculations, the cost dimensions would be calculated together with freight data such as costs per item delivered, for the client, or in costs per km driven, for the variable costs, and/or in total costs per vehicle per year, for the operator perspective. These costs would be compared in a before-after analysis with the situation before the solution was implemented, so the economic impact for the business and the profitability of the solution become more visible.

7.5. Be aware of the replicable dimension of the success stories

The first part of the analysis of transferability is not to look at already implemented transfers, but to analyse how the case observed demonstrates in itself its potential replicability. If for example the company that initiates a new solution invests a lot of effort and finance into a new project, and claims that it has become self-sustaining after a short period of time, this seems to suggest that the solution could be easily replicable. However, to be more certain, the boundary conditions need to be looked at more in detail: Questions to be asked in this context are: what is the size of the business? Is it a typical case for a general cargo operator, or is it a much specialised market? Further questions are needed to understand under which conditions the success story can be replicated with similar chances of succeeding in achieving its targets.

7.6. How good and representative are the cases?

One of the main scientific weaknesses of the case study approach is that it neither gives indication on the market size for the solution envisaged, nor can it says anything about the magnitude of the potential impacts. This study cannot resolve this problem, but it can state that the problems are relevant and that the solutions really contribute towards a lowering of the magnitude of the problems. Certainly, when asked about how much the problem has been reduced, for example asking about the reduced CO_2 or traffic jams in city centre as a percentage of the total traffic, the response for each case would be tiny and insignificant. When speaking about the deployment of innovations and the upscaling of a small trial to an industry scale, the effects cannot be large and immediate, and have to be considered in the long term. However, for the future, foreseen impacts could make a real difference and therefore it seems possible to combine a case analysis with an expected high future impact.

7.7. How good is the assessment methodology?

The findings are integrative. By adding the questions of costs and benefits to the classical sustainability analysis of practices, this study tends to demonstrate the compatibility of different types of knowledge that used to be presented separately in previous surveys (Allen, Browne & Cherrett, 2012). The study findings are not confidential. The classical argument of confidentiality was raised in past surveys as barrier when dealing with costs and benefits in financial terms in business surveys (McKinnon, 2009). Here, in most cases the managers in charge of the projects were not reluctant to publish internal cost information.

The study continues to develop systematic evaluation methods for freight solutions. McKinnon developed in long years of UK and European research different benchmarking and Key Performance Indicators studies for sustainable freight solutions (for example McKinnon, 2009), and urban freight survey methods have been refined since many years to answer a broad variety of questions, starting with a modelling approach (Taniguchi & van der Heiden, 2001; Ambrosini & Routhier, 2004; Crainic. Ricciardi & Storchi, 2009). The evaluation method developed in the project further refines ex-ante and ex-post approaches. Both ex-ante and ex-post methods were used in urban freight research already, for example by Filippi, Nuzzolo, Comi & Delle Site (2010). The businesses were asked here to compare the situation before and after the implementation of the solution, and this was leading to satisfactory outcomes for the impact analysis. The in-depth surveys and the foreseen BESFTACT actions will continue to develop this approach aiming at a more robust assessment of the profitability and environmental impacts.

There is a primacy of practical findings. The purpose of the study is not only to demonstrate a new methodological development, but in the first instance to provide a study result that is useful for practitioners and decision makers. So the scientific objective, to demonstrate the usefulness of this method in achieving this practical objective, is not to be seen as a methodological development that is innovative in itself (not 'l'art pour l'art'), but as a method leading to a practical consequence. The main innovative methodological features were the structuration of the topics according to the outcomes of the online expert survey, and the link of the expert statements with the selection process of the most relevant solutions. So the selection as such was commercially independent and relevant for the public sector interests, but it was not an end point, more an intermediate step to make sure that the outcomes and the findings are really demonstrating the usefulness and future potential of 15 key cases. The method, therefore, was making sure that these cases are in resonance with the expectations of the business leaders and policy makers in 2012.

The study has a limited availability of costs-benefits data. Since it was not the purpose of the data collection to perform 15 comprehensive cost-benefits analysis, only a partly completed cost dataset is available. This challenge will be addressed for further steps. However, as long as there is no widely acknowledged method on cost-benefit assessment in urban freight that includes sustainability criteria as well as public interests, further methodological development will be required.

8. Conclusion

Many solutions are available that demonstrate both a high level of innovation and a high technological or economic feasibility. There is a slight dominance of consolidation and clean vehicle projects in the ranking and the perspective of the experts, so that out of 15 projects, 6 were on clean vehicles and urban consolidation centres. Other topics such as use of waterways, multiuse lanes, cooperation and networking, and use of IT systems, also demonstrated interesting technical or managerial innovations, and in this sense the trials have shown under real market conditions that the solutions are applicable. Very few cases demonstrate a large-scale transfer, and the solutions are mostly limited to another company, an upscale within a company or a limited transfer to another city. High qualitative benefits for the public sector and profitability for businesses were demonstrated in most of the cases.

The biggest difficulty is the collection of quantifiable data, especially for the before-after comparison. Data collection in urban freight remains a challenging task (Ambrosini & Routhier, 2004). One of the main future tasks will be to obtain data on a successfully transferred case and on a success in terms of growth and upscale from a small scale trial to an industry wide solution.

The success factors are helpful for practical decision-making. To obtain a truly useable, scientific classification that makes a difference for business leaders and decision makers in local administrations, much more than 15 inventory cases will need to be assessed in detail and a much higher amount of information will need to be processed.

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