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Developing an Evaluation Framework for Innovative Urban and Interurban Freight Transport Solutions

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Abstract

This paper presents work carried out in the projects STRAIGHTSOL and SMARTFUSION, both funded within the seventh framework programme of the European Commission. Both projects develop and apply an evaluation framework to assess innovative urban and interurban freight transport solutions. The frameworks will be generic and applicable to any measure within the urban-interurban context and across regions in Europe. To reach that goal, the two projects work together on improvements. This paper discusses their common challenges, approaches, provisional outcomes and differences. Next it looks at the lessons that can be learned from each other.

Keywords: Evaluation; framework; urban freight; innovative solutions

1. Introduction

Urban areas represent particular challenges for freight transport, both in terms of logistical performance and environmental impact. A range of regulatory, technological and logistical measures have been initiated and applied by different actors. Most of them suffer from a lack of systematic evaluation and assessment related to their short and long term effects. This impedes knowledge transfer and the adoption of best practice.

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Urban freight transport solutions are typically local. Many good practices are case based only, and generalization to other situations is limited. Although many initiatives seem successful in pilots and demonstrations, large scale adaptations do often not come off. One of the few larger scale examples is the project, Distripolis in France, in which 85 electric vans are tested in 5 French cities for last mile deliveries of parcels and pallets under real business conditions since 2011 (BESTFACT, 2013).

As of 2013, there seems to be a rather high diversity of different urban freight projects, and possibly there is a slight dominance of public sector supported city logistics activities linking Urban Consolidation Centre with access rules to city centres and with the use of clean vehicles. But also many other activities are to be observed and continue to be developed, such as the implementation of new IT tools supporting routing, navigation, traffic or parking availability. Innovative traffic planning tools are developed, such as Multi-Use lanes put in place in Barcelona and Bilbao in Spain. In order to facilitate the traffic during peak hours, one lane is opened to running traffic and for the same lane a time window is created at low peak times allowing only loading and unloading activities and, at another time window, only resident parking is permitted on this dedicated lane.

New types of logistics facilities such as shared used consolidation centre networks, or rail-barge-road transshipment centres are also planned and constructed in many cities. As well, manufacturers continue to further develop innovative electric vans, trucks and tricycles that are tested in diverse business conditions throughout Europe. The use of alternative fuels such as methane and biodiesel continue to be relevant, as is the recent trend of developing hybrid-electric trucks. Finally intermodal facilities continue to be developed in inner-city areas, aimed at lowering the congestion and reducing the number of trucks on the streets.

Evaluation of the impacts of such solutions is important for both the market actors that want to run profitable solutions and for the local authorities and public sector bodies that would like to see the negative externalities of freight transport being reduced (Browne, Allen & Leonardi, 2011). Most of the trials however, even if these can be designated as ‘best practice’ cases, do not allow a good knowledge transfer and do not lead to the further adoption of the solution tested. Ideally each solution should be adopted and applied by a wide range of market actors in many cities, once it has been successfully tested. The opposite is the case, and it is mostly to be observed that the practices get stuck at the level of small scale trials.

To solve this problem, a transparent evaluation of key impacts and demonstration the benefits of Best Practices for the different stakeholders was developed in BESTUFS (2007) and is being further refined since then (BESTFACT, 2013). The theoretical basis for the evaluation methodology of urban freight innovation has already been developed (Tsamboulas & Kapros 2003; Patier & Browne 2010). Recently more studies have become available that are intending to develop innovative evaluation frameworks, not only in the context of good practice, but also for policy advice purposes, as shown in Adelaide (Suksri & Raicu 2012). Evaluation studies in city logistics were for some time motivated by a lack of systematic knowledge and data available for modelling, understanding and planning purpose (Taniguchi & van der Heiden, 2000; van Duin, Quak & Munuzuri, 2008; Crainic, Ricciardi & Storchi, 2009). Evaluation of ‘Best Practices’ is becoming more widely recognized and is now partly integrated into recent policy developments since the European Commission and many municipalities have set up general policy framework conditions for developing more sustainable urban freight transport, but this remains a challenge (Allen & Browne 2012, BESTFACT 2013).

The STRAIGHSOL and SMARTFUSION projects decided to work together on the framework of the impact evaluation in order to increase the chance for the trialed sustainable solutions to be transferred effectively by the market actors and the local authorities.

2. Challenges

2.1. Diversity of stakeholders and objectives

Urban freight transport involves many stakeholders. Citizens who want a livable environment with consumption but without disturbance. The logistic service providers aim for efficient transport operations. The sender of goods is concerned with the service level that it can offer to its customer. The receiver of goods demands certain delivery times and the local authority aims for a safe, clean and attractive city. These are just a few of the criteria that play a

role in urban freight transport. Considering the diversity of the stakeholders and their criteria, there is much to gain with urban freight solutions. It is however very difficult to take into account all the stakeholders simultaneously as they do not aim for the same objective. This makes evaluation complex. A solution can be successful for one stakeholder, while having negative effects for another. This can be shown with an example of off peak delivery. Delivering during the night may be a great solution for the logistic service provider, as the driver can avoid traffic jams. However, it disturbs the consumer sleep during the night time. The overall effect, whether to call it a success or a failure, is therefore, ambiguous. The criteria of stakeholders may also differ between cities. Some authorities are for example more concerned with air quality targets than others.

2.2. Costs and benefits dispersed and difficult to quantify

In line with the above, the costs and benefits of a new solution are scattered among the stakeholders. When a substantial amount of money is invested to develop and test a new solution then it is important that the benefits can be identified. Was or will it be worth the investment? This question is very difficult to answer for urban freight solutions. Firstly, because the ones investing are not inevitably the ones that are receiving the benefits. Secondly, because benefits are not just increased revenues or profit. While the investments are relatively easy to quantify in monetary values, the benefits can be obtained in terms of attractiveness, reliability or traffic speed. The same applies to indirect and external costs. Coming back to the example of night time delivery; whether the time gains of the logistic service provider outweighs the sleep disturbance of the citizen is difficult to determine. The willingness to pay (or receive) for certain positive (or negative) effects is not easily quantified.

2.3. Problem owner undefined

As the various stakeholders are all affected by an inefficient transport system it is difficult, or even impossible, to identify one owner of the problem. It is also often questioned whether the problems should be approached from a public or private sector point of view. The goal of the public authority is to look after its citizens and at the same time to create an economic environment that attracts businesses. Hence, keeping all stakeholders satisfied. The role of local authorities however tends to move from restrictor and legislator, to facilitator and stimulator. Local authorities do not want to interfere too much in the business of the logistics services and transport providers. It has for example been shown that imposing restrictive time windows has a negative effect on the efficiency of fleet and route planning. Besides, the public financial means are often not sufficient to invest in innovative solutions. As a result, the private sector is challenged to come up with their own solutions. However, their goal is to generate revenue. A single operator cannot make a substantial change in the city on its own. If this so, the chance that this would result in a viable business case is near zero. Since there are many environmental and societal effects involved, it is impossible to approach the evaluation from a private business perspective solely.

2.4. Lack of data

Evaluating a new solution is also difficult due to the lack of data. We do simply not have the technologies to measure everything in practice. In the case of night time deliveries, the respective authority may be in favor of the solution if it substantially reduces traffic jams during the day. However, the city may not have sensors or camera's at every road to monitor a change in traffic levels. Also, as evaluations often focus on a pilot test that is carried out on a small scale, some effects are hardly noticeable. Much data therefore has to be derived, modelled or simulated.

2.5. Diversity of context

Next to the diversity of stakeholders, the urban areas where freight transport takes place are very diverse as well. No two cities are alike. They differ in terms of geographic characteristics, density, legislation, culture, etc. The degree to which a solution contributes to the sustainability of an urban area is therefore very case specific. Moving delivery to the night is expected to be less accepted by employees when the crime rate in the area is high.

Drivers will feel less confident about their safety and customers will feel unsure about the security of the goods. An urban freight solution can therefore never be evaluated without an analysis of its context.

3. Summary of the Projects

There is a clear need for a comprehensive approach to urban freight solutions. Therefore, the European Commission funded two projects in the call GC.SST.2011.7-4. Urban – interurban shipments to develop an evaluation (or impact assessment) framework. The projects STRAIGHTSOL and SMARTFUSION, have the objectives to (STRAIGHTSOL, 2011):

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

The STRAIGHTSOL project started in September 2011 and will run for three years. The project will develop an impact assessment framework for urban freight transport and urban-interurban freight transport interfaces. The framework will be applied to seven field demonstrations during 2013. The demonstrations, taking place in seven European cities, are very diverse. They vary in terms of the innovative solution (technical or logistical driven) and in terms of the context (modality, city, activity). What they have in common is that they want to prove the operational and economic feasibility of an urban freight solution.

In each demonstration an operator and a knowledge or research institute is involved. The parties work closely together in setting up the demonstration and in applying the assessment framework. In addition, the research institutes work closely together across the demonstrations. Based on the evaluation experiences obtained, the framework will be adjusted and improved. The aim is that this will result in a framework that is generic and applicable to any measure within the urban-interurban context and across regions in Europe.

The SMARTFUSON project started in April 2012, also for three years, and will apply an improved impact assessment framework for sustainable solutions. It is focusing on the key question of how to increase the market share of electric freight vehicles in three cities. It is planned that the methodology developed here can be replicated in its full depth for the evaluation of only a limited type of sustainable urban freight solution trials.

The purpose of the new assessment methodology is to link business and sustainability criteria with a before-after approach that would deliver first a more clear vision on the benefits and success factors of this particular electric vehicle technology. But, since not only the fuel consumption, air pollution and noise reduction are the impacts expected, also logistics efficiency and soft factors such as quality of life are targeted, it is necessary to look beyond the pure electric vehicle effects.

This includes the evaluation approach necessary to capture the changes in the local and technical framework conditions surrounding the electric vehicle fleet business, such as reorganizing the UDC and the access rules to the city centre, and to develop a new type of IT routing and scheduling adapted to clean vehicle needs. To this aim, stakeholder participation was organized in order to get a wide agreement on the trials and on the impact evaluation approaches to be followed.

4. Evaluation Frameworks Developed

Next we will separately discuss the evaluation frameworks as they are developed in the projects STRAIGHTSOL and SMARTFUSION.

4.1. Approach and methodology STRAIGHTSOL

The STRAIGHTSOL framework consists of three stages that are fed by initial input on stakeholders, existing concepts and measurement methods. Due to the complex interaction between the different actors in urban transport, a clear view of the stakeholders that play a significant role in the potential success of a solution is crucial. Their criteria and objectives are be taken into account accordingly. In order to measure progress towards the stakeholders objectives, the criteria are translated into measurable indicators.

In addition, knowledge of existing urban and urban-interurban freight solutions helps to elaborate on alternative city distribution concepts. The framework will primarily base its evaluation on operational field data, supported by existing measurement methods where necessary.

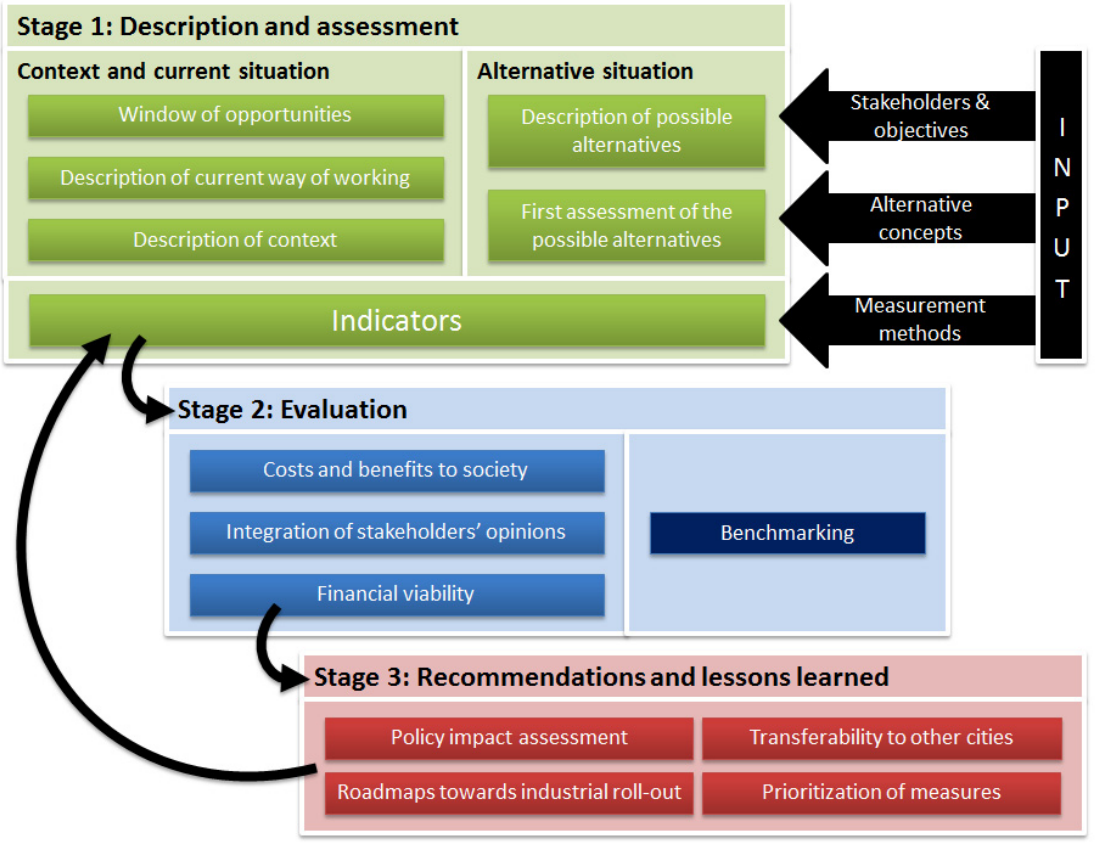

Fig. 1. The STRAIGHTSOL assessment framework. (Source: STRAIGHTSOL, 2012)

Stage 1: The first stage in the STRAIGHTSOL framework, "Description and assessment" aims at identifying the context, the current situation and to explore possible alternatives for the current situation. In order to be able to properly assess the different options, a set of common indicators has been developed in STRAIGTSOL (2012). The indicators measure the progress towards the stakeholders objectives. As there are often many indicator options for measuring an impact, the selection and description of the right indicators is very important. The indicators are categorized according to four impact areas: economy, environment, society, and transport. The distinction of impact areas allow for a more efficient and consistent data collection and evaluation process. A data collection template is provided to complete phase 1 which captures both before and after data.

Stage 2: The second stage of the framework, "Evaluation of alternatives" aims to perform an overall evaluation of the current situation and the various alternatives. The evaluation covers different perspectives as it looks at benefits and costs to society, it assesses the financial viability for the operator and it integrates the stakeholders' opinions. This is carried out by a social cost benefit analysis (SCBA), business model analysis (BMA) and Multi Actor Multi Criteria Analysis (MAMCA) respectively.

A SCBA answers the question whether an investment in a project is justified, taking all the costs and benefits for society into account. SCBA goes beyond financial impacts. SCBA is grounded in welfare theory and takes a wide societal perspective by including the external costs and benefits of transport into the analysis. The impacts of the project on travel times, employment, road safety and environmental pollution for example could be important elements to justify the investments (STRAIGHTSOL, 2012).

A BMA is basically a description of how an organization does business. It describes the value that an organization offers to its customers, and the activities, resources and partners required for creating, marketing and delivering this value (Osterwalder & Pigneur, 2010). At the same time, it describes the cost structures and revenue streams of the orgnaization accordingly. In STRAIGHTSOL the business model canvas of Osterwalder & Pigneur (2010) is used to compare the business as usual with 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).

The MAMCA is an extension of the existing Multi Criteria Analysis (Fandel & Spronk,1985; Guitoni & Martel, 1998). The MAMCA allows the researcher to evaluate different alternatives with regards to the objectives of the different stakeholders that are involved in the decision making process. The methodology was developed by Macharis (2000, 2005 & 2007) and has been used for many applications, mainly in transport related decision making problems (for an overview, see Macharis et al., 2009).

The combination of the three methodologies assures that all essential aspects for project assessment are included in the evaluation. The evaluation phase also enables benchmarking: by comparing the outcome of different alternatives, the best solution for a given situation can be identified. It is possible to use all methods or only one or two, depending on the scope of evaluation and the questions addressed. It is recommended to perform the analyses in parallel though, as valuable information can be exchanged between the methods. The evaluation activities of stage 2 in STRAIGHTSOL will be completed by the end of 2013.

Stage 3: The final stage of the framework, "Recommendations and lessons learned" aims to give recommendations for large scale implementation and it will enable decision makers to mutually compare specific measures or initiatives. It will furthermore describe the steps that are required to move from demonstration to market uptake and to reach long-term objectives. This will enable different actors to plan and coordinate further deployment of measures and to make the innovation happen in practice. The activities relating to stage 3 in STRAIGHTSOL will take place mainly in 2014.

4.2. Approach and methodology STRAIGHTSOL

SMARTFUSION aims to advance beyond the state-of-the-art in four key innovative aspects: green vehicle technologies, urban consolidation centres, planning and telematics in urban delivery, and regional and urban freight policies. The new technologies, logistics and market concepts and policies are combined and tested in demonstrators in Newcastle (UK), Berlin (Germany) and Como (Italy). One of the objectives consists of providing tools for the assessment and market uptake of these selected urban freight innovations, and providing quantified evidence of the extent to which the solutions lead to lower the external costs of freight, and reduce environmental impacts. This is achieved through the development of an innovative and standardised data collection, analysis and impact assessment methodology that could be potentially used by other types of initiatives, other city-regions, businesses and supply chains beyond the SMARTFUSION project.

The first part of the SMARTFUSION evaluation methodology is the so called, Design and Monitoring Framework (DMF) that aims at preparing the first and second steps of the impact evaluation:

1. Assessing with stakeholders what are the main problems to be solved, what will be the more detailed design of the trial, and what are the expected impacts and benefits of each of the freight transport solutions to be tested

2. Select with stakeholders which key indicators need to be assessed in order to see the benefits, impacts and success factors of the trials.

Once these basics and fundamental evaluation settings are in place, the data collection and analysis can take place in the next three steps:

3. Collecting information about the characteristics of each company's operation and market in which the solution on electric urban freight will be tested.
4. Collecting information about the characteristics of each city.
5. Developing and applying a calculation model for the evaluation of the impacts and benefits of the logistics solutions.

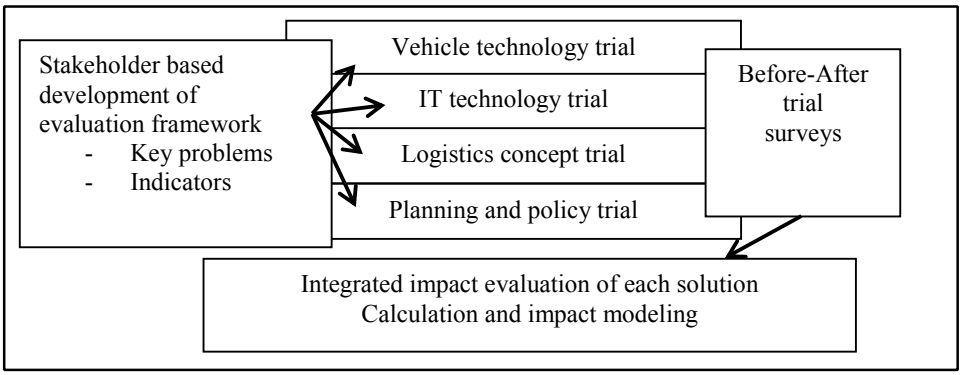

Fig. 2. The SMARFUSION evaluation framework. (Source: Smartfusion, 2013)

Unlike previous projects, one key methodological innovation is that each evaluation includes "before" and "after" analysis of each of the freight transport solutions tested for each company in each city. Data collected in the before and after trials include essential transport indicators on business types, fleet size, mileage, tonnage or delivery units per day, load factor, empty running, fuel use and, optional indicators such as workforce, price of vehicles and equipment, inventory costs, transport costs per unit, place and time of deliveries, and regulatory

framework conditions.

Survey forms filled in by stakeholders at local workshops ensure that transparent, compatible and consistent data is collected for each trial in each city. The results of the "before survey" is used as reference for the second part, the "after" data collection and impact evaluation.

The objective of the final calculation and integrative assessment is to perform the evaluation of each logistics solution tested using the data and information collected "before" and "after" the trials, and to compare and contrast these evaluation results between the solutions tested for each company and city. This provides an overall assessment of the impacts of each freight transport solution, and how these results are potentially affected by i) characteristics of the company's operation and technology to be developed, and ii) characteristics of the city and regulatory framework.

The core part of the last sub-task is the application of the calculation model, based on efficiency outputs, calculating the benefits of each solution in quantitative terms linking logistics and business factors with sustainability issues, such as fuel use per delivery, parking duration per stop, traffic impact, time savings, costs savings per unit and impacts on external costs. The results of this last task are the intermediate evaluation results for each logistics solution tested, and the integrative, transversal evaluation.

5. Application of Evaluation Frameworks

5.1. Application of STRAIGHTSOL framework

The STRAIGHTSOL impact assessment framework, which has been developed during the first year of the STRAIGHTSOL project, will be applied to at least six live demonstrations. The demonstrations will take place in 2012 and 2013. The demonstrations are:

- *DHL demonstration near Barcelona:* DHL Supply Chain will operate an urban consolidation centre (UCC) to improve the performance of the last mile freight deliveries in L'Hospitalet de Llobregat. The aim is to reduce the number of vehicles entering the city centre while maintaining service levels. The loads of several carriers are consolidated at the UCC and then distributed to the retailers by DHL. One of the challenges in the demonstration is to find a sufficient number of retailers to participate. The local partner is Consorci Centre D'innovacio Del Transport (CENIT).
- *TNT Express demonstration in Brussels:* TNT Express demonstrates the use of a mobile depot in combination with electric tricycles to deliver and pick-up parcels in Brussels. The mobile depot looks like a trailer/truck and have all kinds of depot facilities. From here, electrically supported tricycles, can do their roundtrip, without being disturbed by or contributing to the congestion. The local partner is Vrije Universiteit Brussel (VUB).
- *Oxfam demonstration in England:* Oxfam tests the use of remote monitoring sensors (infra-red) placed in charity textile donation banks in England. The sensors provide twice-daily reports on the fill levels. These data will be used to improve the efficiency of collection strategies and to identify problems associated with theft from banks and vandalism. The local partner is University of Southampton.
- *GS1 Norway in Oslo:* GS1 demonstrates how automatic data capture can improve visibility to all actors in the supply chain. The demonstration takes place in a shopping centre in Oslo. The expectation is that more visibility leads to more efficient and predictable deliveries for a consignee as well as shorter waiting-, delivery- and loading times. The local partner is Transportokonomisk Institutt (TOI).
- *EMEL demonstration in Lisbon:* The EMEL demonstration considers controlling mechanism for unloading activities in Lisbon. Two solutions are demonstrated, one on each side of the road. These are 1) adapted parking meters and 2) loop vehicle detection sensors. The difference with the other demonstrations is that EMEL is a governmental organization. The local partner is Instituto Superior Tecnico (IST).
- *Kuehne and Nagel demonstration in Thessaloniki:* K+N demonstrates the use of GPS devices in rail wagons transporting good from central Europe to Greece. The aim is that the sensors provide real time information on delivery data and cargo status such that urban distribution can be planned accordingly The local partner is Centre For Research And Technology Hellas (CERTH).

- *Colruyt and Delhaize demonstration in Brussels:* Colruyt and Delhaize are the two biggest Belgian food retailers. During the demonstration, they will deliver to five supermarkets at night. As Brussels is very congested during the day, it is expected that off-peak delivery saves time and fuel. The demonstration aims to achieve this without additional noise nuisance. The local partner is Vrije Universiteit Brussel (VUB).

The partners involved in each demonstration use the data collection template to collect the required data for phase 1, before during and after the demonstration. TNO is leading the overall evaluation in phase 2, together with TOI and VUB.

5.2. Application of SMARTFUSION framework

In three European cities Newcastle (UK), Berlin (Germany) and Como (Italy) the business conditions were very different and the SMARTFUSION trials and impact evaluations were designed according to the results of the local stakeholder's consultation, following the initial approach.

- *Como trial:* In Como, the local authority 'City of Como' organized together with the 'Region Lombardia' a stakeholder consultation with participants from local businesses and with international experts. The stakeholders were representing the public run Urban Consolidation Centre using clean vehicles 'Merci in Centro', the Small and Medium Enterprise association, the logistics associations, the Chamber of Commerce of Como, owners from shops and businesses located in the city centre, the manufacturer Centro di Richerche FIAT (CRF), the IT developer PTV, and the academics and consultancies of UoW, Panteia and Gruppo Clas. The results started with the analysis of the key problems to be targeted, and focused on the elements low load factors, inefficient transport, access rules, quality of life and attractiveness of the city centre.

  The activities designed in the Como test are corresponding to three trials elements run in parallel, the UDC use and access rule change, the technology test of the new routing system adapted to clean vehicles, and the use of a battery electric van including a new profiler that will be giving information on the battery charge level expected on different routes.

  The three tests elements of regulation change, logistics concept and technological features aim to increase the use of clean vehicles in city centre and to transship more goods through the Urban Consolidation Centre 'Merci in Como'. To this aim, the change in the access rule is planned to enable a more flexible delivery time throughout the pedestrian zone for the clean vehicles. This proposition is following the model of the Padua consolidation centre 'Cityporto Padova' that is getting free access all day to the central shopping area (BESTFACT 2013).

  It is planned that the indicators will be collected as foreseen on sustainability and business criteria before and after the tests, and that the new technology will be available for testing in early 2014. So far, the stakeholders and the trials have adopted the new methodology of impact evaluation without major change and the Como trial is expected to deliver the results as foreseen.
- *Berlin trial:* In Berlin, the multi-stakeholder consultation is initiated by the Municipality and includes among others representatives from the local Logistics Centre BEHALA, a company which is running a large rail-barge-road transshipment facility and a last-mile logistics business close to the city centre. The Berlin trial is aiming at using hybrid electric trucks for inner city freight movements between this Logistics Centre and the final customers, shops and retailers located in the city centre at a distance of about 5-7 miles. The stakeholders consulted in Berlin for the planning of the trials are: the manufacturer Volvo, the IT provider PTV, the Logistics Association, municipality fleet managers, logistics companies, UoW, Panteia and Gruppo Clas.

  The main problems to be tackled by the tests will be the transport inefficiency, pollution and noise and the high costs of clean vehicle use compared to the market price advantages of diesel vans and trucks. The technological developments will be also including more efficient use of the infrastructure and the application of a new routing and scheduling support device that will be adapted to the type of fuel currently used onboard the hybrid vehicle. This technology feature aims at increasing the load factors and the efficiency of the delivery trips.

One major difference between Berlin and other cities is the lack of congestion problems, even in peak time, and the opportunity to use an existing large inner-city consolidation centre for transshipment of goods.

In Como and Newcastle, it will be required to slighly re-organize the transshipment according to the needs of the Smartfusion tests, and this will involve the active participation of local logistics businesses. But in Berlin, the tests can be started immediately with the new vehicles replacing the existing fleet of trucks, and using the existing facility.

According to the stakeholder workshops and the main logistics participants, it is foreseen that the project will lead to the expected outcomes in terms of evaluation, because the willingness is given to collect data that include sustainability and business criteria, before and after the trials of the new solution. The exact list of criteria will depend on the technological developments achieved before the trial will start. None of the Smartfusion criteria mentioned above in the framework description seems to be excluded a-priori.

- *Newcastle trial:* In Newcastle, the electric vehicles will be tested for deliveries to the University, starting from a new consolidation centre. This centre is planned in the immediate surroundings of the University area located near the city centre. The stakeholder participation includes the Newcastle City Council and the Newcastle University. The business leaders are the electric vehicle manufacturer Smith Electric, the logistics company Clipper Logistics, the stationery retailer Office Depot. The academics and consultants are UoW, Panteia and Gruppo Clas, with Panteia more focused on the planning, Gruppo Clas on the trial implementation and UoW more focused on impact evaluation.

  The planning of the trial foresees that several weeks of deliveries to all University buildings and facilities will be performed under real business conditions with one electric van, starting from a new University Consolidation Centre (UCC). All single deliveries to the different parts of the Campus should be delivered first to the UCC, and then distributed with a clean vehicle to the final receiver.

  As in Como and Berlin, the IT technology will be applied to support routing and scheduling according to the specific needs of the use of electric vehicles. It is aimed at increasing efficiency and load factors for the deliveries. According to the stakeholder workshops, the evaluation is planned to include a data collection before and after the trial, and to include all Smartfusion indicators and criteria foreseen in the framework.

6. Discussion

STRAIGHTSOL and SMARTFUSION share the same objective; developing an assessment framework to evaluate solutions for urban and interurban freight delivery. In this process, the projects need to deal with the same challenges that were formulated in the beginning of the paper. Table 1 summarizes how the projects deal with the challenges. Considering that the approaches differ, the projects can clearly learn from each other.

Table 1. Challenges and approaches in both projects.

Challenge	STRAIGHTSOL	SMARTFUSION
Diversity of stakeholders and objectives	An identification of stakeholders is part of stage 1. At the start of the evaluation process.	Leading stakeholders are project partners, other groups were added to the consultation
Costs and benefits dispersed and difficult to quantify	A social cost benefit analysis is performed to capture the costs and benefits to society.	A Before-After data collection will make sure to capture cost data together with logistics and external social costs data
Problem owner undefined	The business model canvas is applied for multiple actors, including the value proposition to society.	The design and monitoring framework aims at defining key problems with the stakeholders, and develop the solutions accordingly.

Lack of data	Data needs are defined and notified at an early stage, such that partners can anticipate on the needs as much as possible.	The data are collected before and during trials by SMARTFUSION partners, manufacturers and IT providers, the logistics companies involved in the trials, the city authorities and local stakeholders. To supply data is an essential & agreed point of the trial frameworks.
Diversity of context	A description of the context is part of stage 1 and the transferability to other cities is part of stage 3. The context is not explicitly part of the evaluation methods in stage 2 though. Seven cities are involved in the project. Also the demonstrations and operators are very diverse.	Information about the company, market and characteristics of each city is collected during step 3 and step 4. The evaluation in step 5 looks at how these factors affect the results. The context is limited to three cities and to electric vehicles, new IT devices adapted to clean vehicles, Urban Consolidation Centres and new access regulation

Both projects ensure that both the public and the private perspective are taken into account. A strength of the SMARTFUSION project is the early inclusion of stakeholders in the consultation and the distribution of surveys at workshops. The KPI framework developed in STRAIGHTSOL, is based on the different stakeholders and their criteria. Collecting sufficient input on the stakeholder's opinion has been a challenge in STRAIGHTSOL though. The improved framework should include more guidance on this topic.

According with the public perspective, both STRAIGHTSOL and SMARTFUSION recognize the need to include social costs and benefits. The method to quantify and compare these costs and benefits to financial impacts will be a new challenge during the application of the framework.

Both projects develop the framework in parallel with live demonstrations that take place, such that the assessment framework can be tested and improved within the project life time. A great difference between the projects is that within SMARTFUSION, all demonstrations relate to the use of electric freight vehicles, whereas in STRAIGHTSOL the solution directions are very diverse and include different modalities. Nonetheless, both projects intend that the framework can be applied to a variety of initiatives and measures, with different circumstances in the future.

In addition, the identification of limiting and success factors of those circumstances should be part of the evaluation and recommendations, to ensure that good practices can be shared across cities, modalities and sectors. This is recognized in both projects.

7. Conclusions

The number of initiatives that aim to improve urban freight transport grow rapidly. To make sure that the obtained results grow as fast as well, we should make sure that we do the right things and that we know how. To avoid twasting money, effort and time on implementing measures and initiatives that will not (likely) be successful in the future, knowledge transfer across cities is very important. The knowledge should be based on a transparent evaluation, identifying the relevant impacts and measurable indicators that represent the key objectives of all stakeholders.

As there is not one problem owner of urban freight transport issues, such a thorough evaluation is often lacking. During the last decade, research institutes and consultants have taken a role to support the different actors in evaluation. In doing this, they work not only together with market actors and municipalities, but also with each other.

The evaluation frameworks developed in the STRAIGHTSOL and SMARTFUSION projects will be improved based on the experiences from each project's demonstrations. A next step will be to apply the frameworks to the other project's demonstrations and to work closely on improvements.

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