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Definition of necessary indicators for evaluation

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CITYLAB consortium by Living Lab			
Living lab	**Municipal partner(s)**	**Industry partner(s)**	**Research partner(s)**
Brussels	Brussels Mobility	Procter & Gamble Services	Vrije Universiteit Brussel
London	Transport for London	TNT Gnewt Cargo	University of Westminster
Oslo	Oslo kommune	Steen & Strøm	TOI
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Southampton	Southampton City Council	Meachers Global Logistics	University of Southampton
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Executive summary

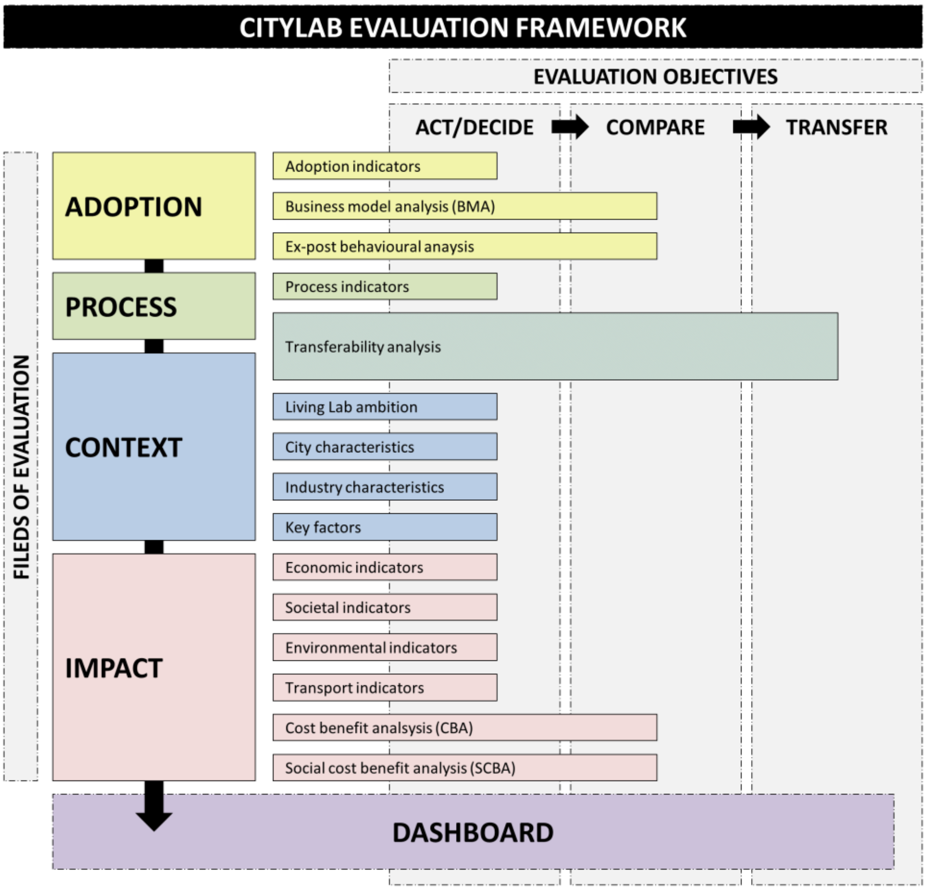
The objective of the CITYLAB project is to develop knowledge and solutions that result in roll-out, up-scaling and further implementation of cost effective strategies, measures and tools for emission free city logistics. In a set of living laboratories, promising logistics concepts will be tested and evaluated, and the fundament for further roll-out of the solutions will be developed. This requires thorough evaluation. This deliverable describes the project's evaluation framework and the indicators and evaluation methods it consists of.

The evaluation activities within CITYLAB serve three different objectives: (i) Facilitate the Living Lab methodology within CITYLAB (Act/Decide), (ii) Identify cost-effective strategies, measures and tools for emission-free city logistics (Compare) and (iii) Roll out the CITYLAB solutions to other CITYLAB cities (Transfer).

The indicators and evaluation methods used within the project can be structured into four fields of evaluation: (i) Adoption, (ii) Process, (iii) Context and (iv) Impact. Each field of evaluation covers one particular aspect of the solutions that influences whether a solution can be considered satisfactory or not and can be transferred or not.

To allow easy monitoring of the different solutions and give access to critical information, CITYLAB develops and updates comprehensive and transparent dashboards for each CITYLAB Living Lab.

The picture below is a graphical representation of the evaluation framework.



1 Introduction

The European Commission's target of CO_2-free city logistics in urban centres by 2030 requires identifying the right combination of sustainable and cost-efficient freight measures that will most effectively reduce freight-related emissions and congestion in cities. CITYLAB has received funding from the European Union's Horizon 2020 research and innovation programme to tackle these challenges. CITYLAB supports seven Living Labs where promising urban freight measures are tested and analyses if and how the seven tested measures can be transferred and scaled to the other CITYLAB cities with the ambition to implement them in at least one other city. This ambition requires thorough evaluation of the seven Living Lab implementations to learn whether they are satisfactory or not and why.

The main aim of CITYLAB's evaluation activities is to support two of CITYLAB's higher objectives: (i) identify cost-effective strategies, measures and tools for emission-free city logistics and (ii) roll out and scale up these strategies, measures and tools. CITYLAB's evaluation framework therefore consists of evaluation methods and indicators that provide the best possible insight into relevant impacts of the CITYLAB measures, the context in which they were applied, how they came about, to what extent they were adopted and whether they could be transferred to other cities. During the past 25 years of research into urban freight measures and solutions, various evaluation methods were tested and accepted as valuable, and multiple indicators were considered to be relevant and useful. That is why the CITYLAB evaluation framework incorporates the accomplishments of existing research on urban freight transport evaluation methods and frameworks (i.e. CIVITAS PLUS II, FREVUE, NICHES, SMARTFUSION, STRAIGHTSOL, SUGAR, TIDE and TRAILBLAZER).

There are, however, two important innovations to CITYLAB that are also reflected in its evaluation framework. First, the framework facilitates the iterative process that is characteristic of the Living Lab approach in which an evaluation phase is followed by an act/decision phase and possibly by a new planning phase. Second, transferability analysis is equally part of the evaluation framework since facilitation of further roll-out of satisfactory measures is part of the CITYLAB project and not a fictional hope for the future.

This document (D5.1 – CITYLAB evaluation framework and indicators) describes and explains the CITYLAB evaluation framework. It consists of the following sections:

- **CITYLAB evaluation framework** introduces the framework and explains and motivates its building blocks (Chapter 2).
- **CITYLAB indicators** lists which indicators are needed to evaluate the CITYLAB urban freight measures (Chapter 3).
- **CITYLAB evaluation methods** describes which evaluation methods are applied in the framework (Chapter 4).

This deliverable primarily targets the CITYLAB project partners that are involved in collecting data for evaluation and require more information on the bigger picture regarding the evaluation framework. Apart from the 7 CITYLAB cities, there is a group of 7 other cities that expressed an interest in exchanging experiences on one or more CITYLAB solutions. The CITYLAB evaluation framework dedicated to urban freight transport measures and the Living Lab approach is useful to them as well. Finally, since the evaluation framework contributes to existing research on evaluating sustainable urban freight transport measures and sustainable urban transport measures in general, this deliverable will also appeal to researchers and policy makers.

2 CITYLAB evaluation framework

This chapter introduces the CITYLAB evaluation framework and explains and motivates its building blocks. The framework is built around three main evaluation objectives that originate from CITYLAB's architecture and four fields of evaluation that support these objectives and are in line with existing research into evaluating sustainable urban transport measures.

2.1 Evaluation objectives

The evaluation activities within CITYLAB serve three different objectives: (i) facilitate the Living Lab methodology within CITYLAB (Act/Decide), (ii) identify cost-effective strategies, measures and tools for emission-free city logistics (Compare) and (iii) roll out the CITYLAB solutions to other CITYLAB cities (Transfer). All evaluation methods and indicators relate to one of these objectives; they form the backbone of the evaluation framework (See Figure 1). Below, the three objectives are further explained.

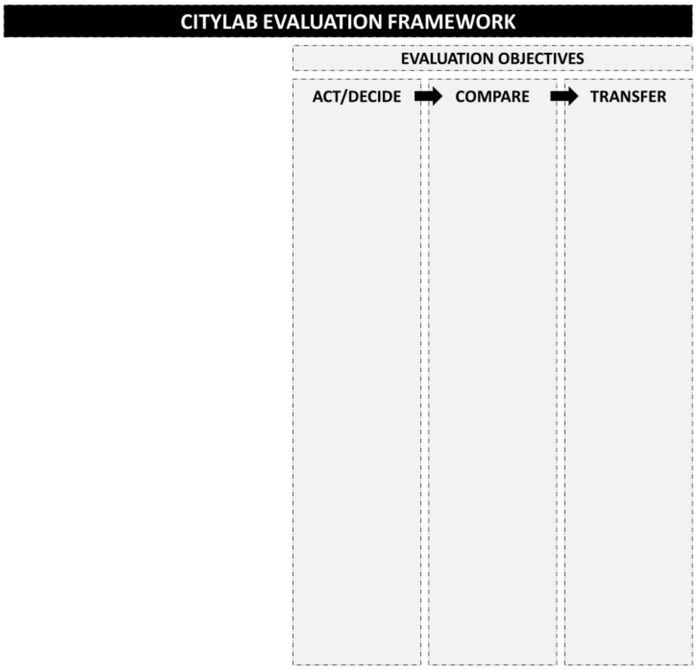


Figure 1 – The backbone of CITYLAB's evaluation framework

The seven European cities (Brussels, London, Oslo, Paris, Rome, Rotterdam and Southampton) that partnered up with CITYLAB are the physical setting for a co-creation process between the local research partner, city partner and industry partner. This co-creation process follows the Living Lab methodology which is an established methodology developed by William J. Mitchell in early 2003 (Zerwas & von Kortzfleisch, 2011). In 2006, the European Commission recognised the methodology as a key tool for enabling open innovation (European Commission, 2010). Since then, Living Labs emerged all over Europe in various waves. At first, they focussed on new ICT tools; in a later stage their focus extended to other fields such as sustainable energy, health care and safety (European Commission, 2010). Despite the fact that the importance of public and commercial stakeholders co-operating to come to sustainable urban freight transport solutions is commonly recognised (Verlinde, 2015), until now, the Living Lab methodology was never explicitly used for urban freight transport measures.

A Living Lab can be defined as a dynamic test environment where complex innovations can be tested. It shows many similarities to a pilot or field test, but following the methodology can be of added value in case of complex situations, such as a multi-stakeholder field or a highly dynamic environment. The Living Lab methodology distinguishes from a pilot approach by systematically implementing various cycles, in which solutions are either adapted or where new solutions are tested. The methodology presents a clear assessment and decision framework to go from one cycle to another. One cycle typically consists of the following phases: (i) planning, (ii) real-life implementation, (iii) evaluation and (iv) act/decision. The act/decision phase is defined as the phase where, based on the lessons learned from the evaluation phase, a decision is made on continuation of the Living Lab into a new cycle and on what amendments will be made in this new cycle. **The first objective of the CITYLAB evaluation activities is to feed the act/decision phase of the Living Lab cycle and, on a higher level, to facilitate the Living Lab methodology within CITYLAB**. The Living Lab methodology and how it is applied within CITYLAB are described in CITYLAB Deliverable D3.1 (Practical guidelines for establishing and running a city logistics living laboratory).

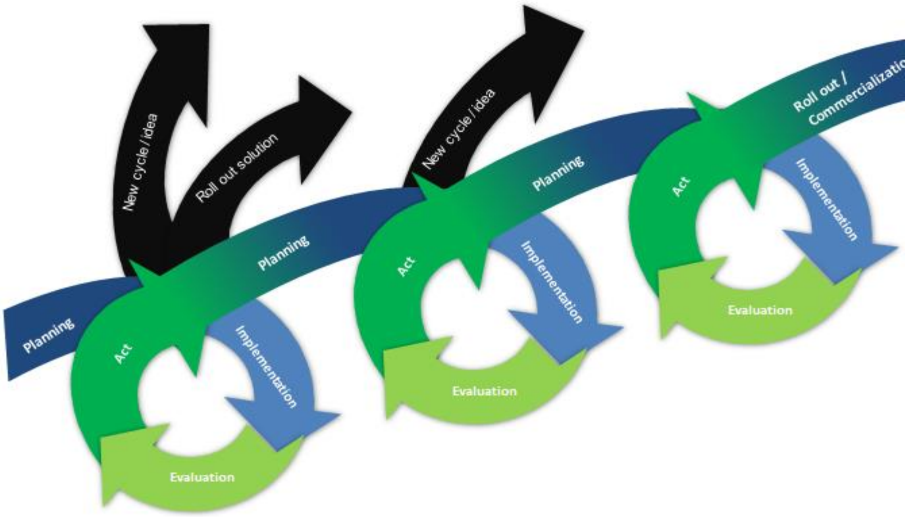


Figure 2 – Schematic overview of the Living Lab environment (CITYLAB Deliverable D3.1 - Practical guidelines for establishing and running a city logistics living laboratory)

Within the Living Labs, innovative urban freight transport solutions that are promising in terms of impact on traffic, externalities and business profitability are tested and implemented. These solutions were identified based on specific previous experiences, on-going projects and preferences of the city authorities and industry partners in the project. The seven implementations belong to one or more of four axes of intervention with potential for increased efficiency in urban freight transport: (i) highly fragmented last-mile deliveries in city centres, (ii) inefficient deliveries to large freight attractors and public administrations, (iii) urban waste, returns trips and recycling and (iv) logistics sprawl. Testing these innovations contributes to the existing knowledge on sustainable urban freight transport solutions if they are also evaluated from that perspective. **The second objective of the CITYLAB evaluation activities is to identify cost-effective solutions that contribute to emission-free city logistics**. To succeed in this objective, the solutions in each Living Lab are evaluated using established evaluation methods that not only allow comparison of the solution to the before situation but also to the other CITYLAB solutions.

Many previous research projects on urban freight transport solutions stopped there. They tested and evaluated solutions but never got to the stage of actually transferring the solutions to other cities. CITYLAB analyses if and how the seven solutions can be transferred and/or scaled to other cities with the ambition to implement them in at least one other city (together with the same or a brand new private partner). It requires a detailed transferability analysis with a high level of practicality. **The third objective of the CITYLAB evaluation activities is**

to facilitate successful replication of the satisfactory CITYLAB measures to at least one other CITYLAB city.

Reaching CITYLAB's three evaluation objectives requires various evaluation methods. Today, evaluating real-life implementations or tests is a generally accepted approach (Allen & Browne, 2012). However, the used methodologies differ from one implementation to another (Patier & Browne, 2010). Most common is that the effect of the change is measured by comparing the before and after values of a number of selected indicators. It has to be said though that no clear approach can be found in what indicators and what measurement units are used in the evaluation of urban freight measures (Patier & Browne, 2010). Some authors have tried to come up with a list of indicators and measurement units with the aim to be able to mutually compare the impact of the different real-life implementations, be it a generic method for all types of urban freight measures or a dedicated methodology for one type of measure (Browne et al., 2005; Patier & Browne, 2010; Balm, Browne, Leonardi & Quak, 2014).

Apart from these before-and-after assessments, other methods that are typically used to evaluate transport-related projects are also used in the field of urban freight transport both for ex-ante and ex-post evaluations. Cost benefit analysis (CBA), which is a tool that determines if a new transport project is a sound economic investment, for example, was often applied to evaluate urban consolidation centres (van Duin et al., 2007). A variation to the CBA is the social cost benefit analysis (SCBA) which does not only take into account the economic costs and benefits but also the monetized costs and benefits to society (Gonzalez-Feliu, 2014). A third method that is used is business model analysis (BMA) which describes the value that an organisation offers to its customers and links that to activities, resources and partners needed to create, market and deliver that value (Osterwalder & Pigneur, 2010). Multi Criteria Analysis (MCA) is a decision-making support tool that evaluates and mutually compares different alternatives on different criteria (Kapros, Panou & Tsamboulas, 2006; Suksri, Raicu & Long Yue, 2012). Finally, Multi Actor Multi Criteria Analysis (MAMCA) is an extension of the traditional MCA and allows the evaluation of different alternatives by explicitly accounting for the objectives of the stakeholders who are involved in the decision-making process (Verlinde et al., 2014; Verlinde & Macharis, 2015). These evaluation methods require input and when before-and-after measurements are not available, social, economic and environmental impacts are estimated using various types of impact model (Filippi et al., 2010).

CITYLAB uses before-and-after assessments for a range of indicators to feed the Act/Decision phase of the Living Lab cycle and to reach its first evaluation objective. The composition of CITYLAB's indicator set is inspired by several previous European research projects. SMARTFUSION and STRAIGHTSOL were two EU-funded projects demonstrating smart and innovative urban freight solutions. Both projects developed an evaluation framework for urban-interurban freight transport that was applied to the projects' demonstrations. These frameworks combined the existing knowledge on evaluating urban freight transport solutions into one whole. CITYLAB's indicator set builds further on these two evaluation frameworks and extends them with the accomplishments of a number of other research projects (e.g. CIVITAS PLUS II, FREVUE, SUGAR, TRAILBLAZER). A detailed indicator list and explanation can be found in Chapter 3 on page 17. To reach its second evaluation objective, CITYLAB uses four established and well-known evaluation methods that have been used before to evaluate transport-related projects and are also used in the field of urban freight transport: CBA, SCBA, BMA and ex-post behavioural analysis. Finally, to reach its third evaluation objective, CITYLAB builds on the accomplishments of the EU-funded research projects NICHES, NICHES+ and TIDE by extending their transferability assessment process in a way that also incorporates matching satisfactory solutions to possible adopter cities. More detailed information on the evaluation methods can be found in

Chapter 4 on page 24. Both the indicators and the evaluation methods are structured into four fields of evaluation which are explained in Chapter 2.2 on page 9.

2.2 Fields of evaluation

Reaching CITYLAB's three evaluation objectives requires a whole range of indicators that have to be evaluated and various evaluation methods. These indicators and evaluation methods can be structured into four fields of evaluation: (i) adoption, (ii) process, (iii) context and (iv) impact. Each field of evaluation covers one particular aspect of the solutions that influences whether the solution is considered satisfactory or not and can be transferred or not. 'Adoption' detects to what extent stakeholders that did not initiate the solution are willing to pay for the solution or to change their behaviour in order to perpetuate the solution. A solution's success does not only depend on characteristics of the solution itself but also on how and where it was implemented. 'Process' relates to the Living Lab methodology and attempts to determine how successfully the implementation followed the implementation plan as stipulated during the planning phase. It allows evaluators to make the important distinction between implementation failure/success and theory failure/success. 'Context' describes important characteristics of the setting in which the solution was implemented. More than any other field of evaluation, it makes the connection between the implemented solution and a possible transfer to another city. Finally, 'impact' assesses and quantifies the changes that can be attributed to implementing the new urban freight transport solution. It concerns changes in the well-being of all stakeholders.

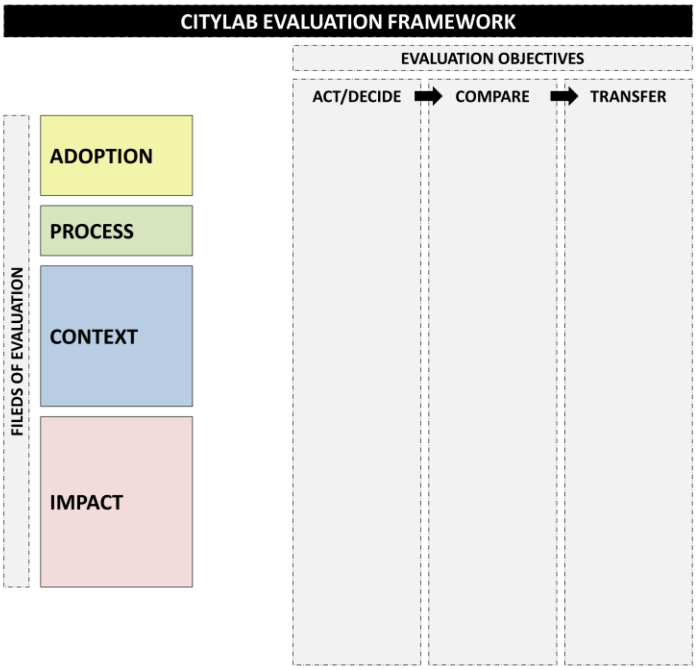


Figure 3 – Fields of evaluation in CITYLAB's evaluation framework

Each field of evaluation contributes to at least one of the three CITYLAB evaluation objectives (act/decide, compare and transfer). In the next subsections, each field of evaluation is discussed in more detail.

2.2.1 Evaluation of adoption

In urban freight transport, two types of stakeholders can be distinguished: (i) public stakeholders who are not directly involved in the freight transport movements in their city and (ii) commercial stakeholders who are not primarily driven to create or enjoy an attractive urban environment (Melo, 2004; MDS Transmodal Limited, 2012). In CITYLAB, the innovative solutions are initiated and primarily implemented by a commercial stakeholder who envisages a win-win situation. This stakeholder is driven by the (long term) commercial benefit of the company and develops solutions that will appeal to (new or existing) customers. At the same time, the commercial stakeholder thinks the solution will also benefit society and possibly also other commercial stakeholders which is why the solution is tested within CITYLAB. Customers, other commercial stakeholders and sometimes also society can be considered as non-initiative taking stakeholders, who are expected to, at least to some extent, change their behaviour or operations when the solution is implemented. Apart from how the solution impacts these stakeholders, they might or might not be willing to change and adopt the solution. Impact analysis might, for example, reveal that the solution would be economically beneficial to a particular commercial stakeholder in the long run; if that stakeholder does not dispose of the necessary resources to immediately implement the solution, he won't be inclined to adopt the solution.

Evaluating adoption and adoption willingness is therefore crucial to identify sustainable urban freight transport solutions. In existing evaluation frameworks (e.g. STRAIGHTSOL, CIVITAS PLUS II, SMARTFUSION) adoption is not a separate field of evaluation. However, some impact indicators of these frameworks relate to adoption and adoption willingness. CITYLAB covers this aspect through a range of adoption indicators evaluating users' feedback on the solution and assessing to what extent the solution is adopted by the target group. The two evaluation methods that fit this evaluation field are BMA and ex-post behavioural analysis.

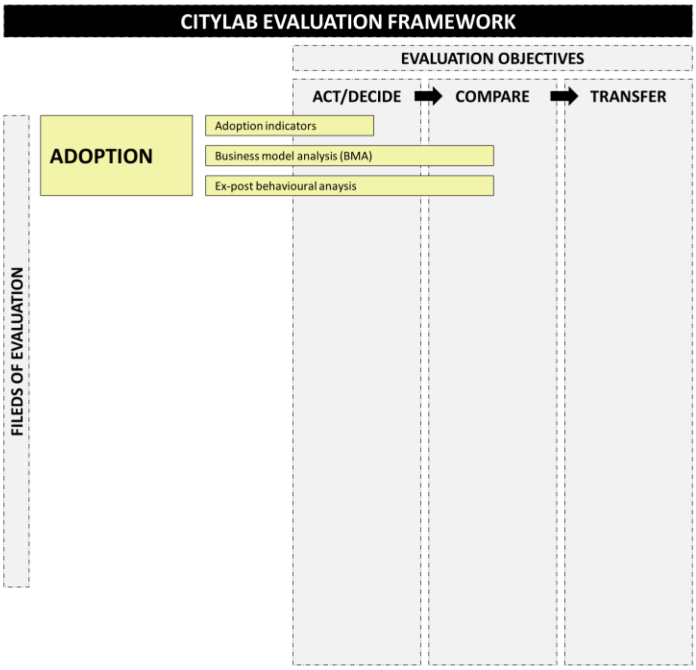


Figure 4 – Evaluation of adoption in CITYLAB's evaluation framework

2.2.2 Process evaluation

One of the important steps within the Living Lab approach is to analyse a Living Lab cycle once it is rounded off (CITYLAB Deliverable D3.1 - Practical guidelines for establishing and running a city logistics living laboratory). The aim of that step in the cycle is to understand what went well and what went wrong during the Living Lab cycle and, most importantly, whether the process can be linked to success or failure. It gives insight into how the impacts of the tested solution were achieved. CITYLAB adopts eight process indicators that are primarily qualitative and mainly inspired by the Living Lab methodology. The indicators were also verified against process indicators within the CIVITAS evaluation framework. Although some aspects of process evaluation were mentioned, the freight transport evaluation frameworks of STRAIGHTSOL and SMARTFUSION did not really focus on process evaluation. The evaluation method that fits this evaluation field is the transferability analysis which will build on insights into how impacts were achieved.

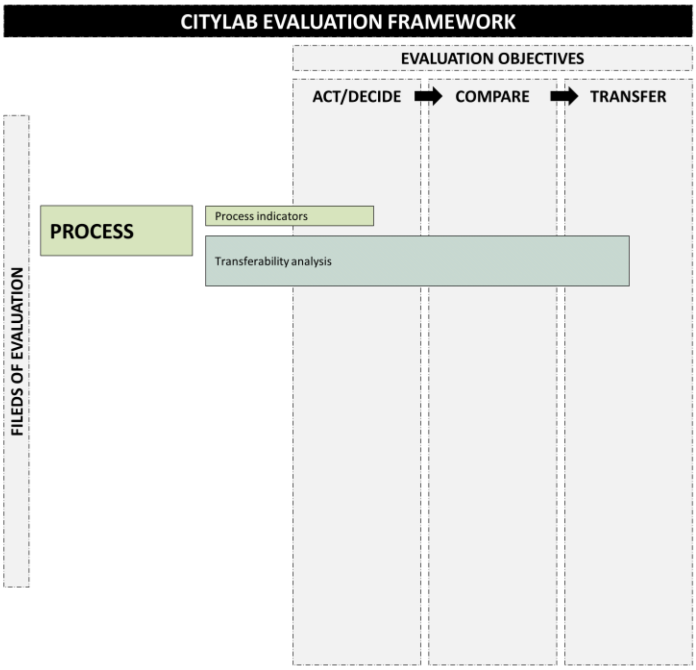


Figure 5 – Process evaluation in CITYLAB's evaluation framework

2.2.3 Context evaluation

Because of the fact that CITYLAB aims to transfer satisfactory solutions to other CITYLAB cities, its evaluation framework also needs to include a thorough description of the context in which the solution was implemented and an analysis of which key context factors contributed to the success or failure of a solution. Despite the fact that both STRAIGHTSOL and SMARTFUSION incorporated transferability in their evaluation frameworks, their context indicators were very general (qualitative with use of categories) and not conceptualized and/or used as input for a transferability analysis. CITYLAB focuses on the potential to improve existing urban freight transport evaluation frameworks and fully incorporates this aspect. CITYLAB groups context indicators into four categories: (i) city characteristics (ii) industry characteristics, (iii) Living Lab ambition and (iv) key factors. One of the first steps of the Living Lab approach is that the Living Lab owner and participants[1] develop a common vision and define their Living Lab ambitions and objectives. These ambitions and objectives

[1] Living Lab owner is a real or virtual organisation appointed to lead the whole Living Lab process and to act on behalf of the Living Lab. It is suggested to have one or two people appointed to this role. The Living Lab owner will take the lead in setting up, organising, conducting and monitoring the process of the Living Lab. Ideally this role should be undertaken by city authorities. Very often, Living Labs are set up by a group of motivated people united together to reach the outset goal. This project team often includes representatives of the Living Labs stakeholders, users and customers. At the same time it does not provide a full necessary coverage of all inputs/competences. Therefore, if the Living Lab is set up within a framework of the project (like in the case of the CITYLAB), another group needs to be distinguished: Living Lab participants. (CITYLAB Deliverable 3.1 - Practical guidelines for establishing and running a city logistics living laboratory)

reflect problems they identify within their urban context as well as their own objectives and general solution directions and are therefore valuable in a context evaluation process. City and industry characteristics aim to portray the general and higher-level context in which the solution is implemented. The city characteristics of CITYLAB are inspired by STRAIGHTSOL, BESTUFS, CIVITAS PLUS II and FREVUE. Incorporating industry characteristics is based on the observation within STRAIGHTSOL that whether a solution is satisfactory or not depends on which type of commercial stakeholder took the initiative for the implementation (industry, scale, etc.). Apart from these rather fixed and circumstantial characteristics, there are also some key factors that change while implementing the solution and refer to issues that need to be addressed for successful implementation of the solution. One of the tasks in WP2 (Task 2.3) reviews and analyses success factors of existing urban freight initiatives related to the four CITYLAB axes of intervention. Within that task, success factors are categorised into five categories: (i) strategic, (ii) operational, (iii) ethical, (iv) legal/regulatory and (v) technological. This same categorisation is used for evaluating key factors for the CITYLAB solutions. These context indicators, together with the process indicators, provide input for the transferability analysis which is the evaluation method that fits this field of evaluation.

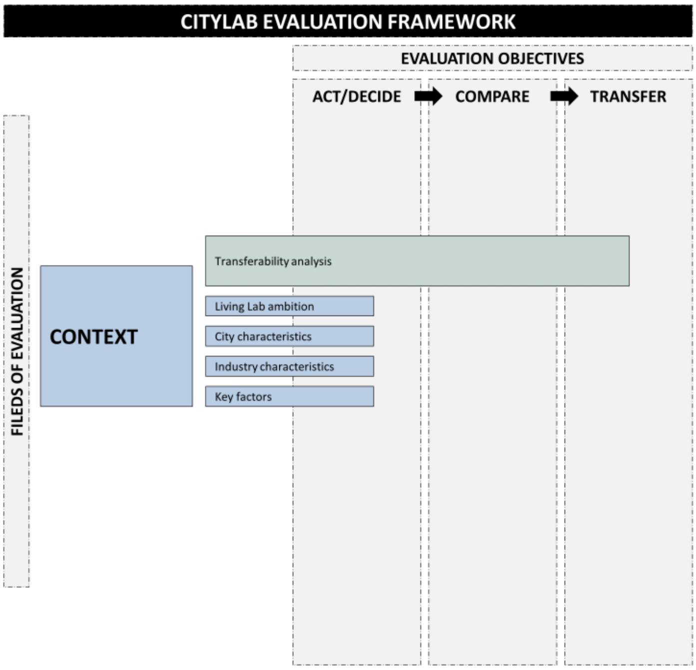


Figure 6 – Context evaluation in CITYLAB's evaluation framework

2.2.4 Impact evaluation

Impact evaluation assesses and quantifies the changes that can be attributed to implementing the new urban freight transport solution. It concerns changes in the well-being of all stakeholders, both public and commercial. The interests of public stakeholders can be categorised according to the triple-bottom line of sustainability: environmental, social and economic interests (Quak, 2008). The stakes of the different public stakeholders can be mutually conflicting. Compared to city dwellers, for example, tourists and visitors will care less about air quality and pollutant emissions (MDS Transmodal Limited, 2012). Commercial stakeholders are all involved in supply chains of which the first or last part is taking place in an urban environment (Allen et al., 2000). Their aim is to provide the best possible service to their customers at the lowest possible cost (Quak, 2008; Behrends, 2011). Usually, these actors are private companies organising their own operations as efficiently as possible to cut costs. From the perspective of a city, however, the urban transport part of that logistics service can be very inefficient (Dablanc, 2009; Quak, 2014). That is not the case for full-truckload transport between a retailer's distribution centre and one of the retailer's outlets. It is the case, however, for many own-account transport operations where average loading rates are much lower (Dablanc, 2009). It shows that also the stakes of the different types of commercial actors can mutually differ. More and more, there is a consensus that pilot programs and trials must be evaluated from the perspective of all stakeholders (Ystmark Bjerkan et al., 2014).

Following STRAIGHTSOL, CITYLAB incorporates the multi stakeholder perspective in its evaluation framework by evaluating progress towards stakeholder's criteria in the evaluation field 'impact'. Within STRAIGHTSOL, the criteria of the different stakeholders were categorized into four impact areas to enable cross-demonstration evaluation and to avoid collecting the same data several times: (i) economy, (ii) environment, (iii) society and (iv) transport, (Balm & Quak, 2012). This categorisation was based on the results of BESTUFS II and CIVITAS POINTER (Balm & Quak, 2012). CITYLAB uses the same subdivision for its impact indicators. The two evaluation methods that fit this evaluation field analyse the overall impact of the solution from the perspective of commercial stakeholders through the CBA and combine that with the perspective of public stakeholders through the SCBA.

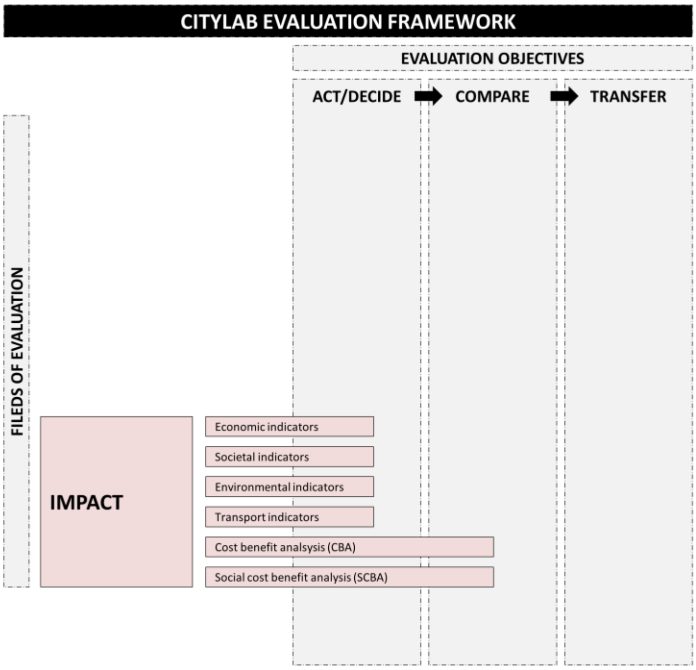


Figure 7 – Impact evaluation in CITYLAB's evaluation framework

2.3 Dashboard

CITYLAB is ambitious in its evaluation objectives. To be able to reach these objectives we structured the evaluation activities into before-and-after assessments for a range of indicators on the one hand and five established higher-level evaluation methods on the other. These activities will generate a lot of information. This information will be made available to people involved in the Living Labs, all CITYLAB partners and followers and urban freight transport researchers through deliverables, workshops, presentations and journal or conference papers. A downside of this is that they are usually written in retrospect, focussed on one particular solution (in case of presentations and papers) or quite lengthy (in case of deliverables). As part of its evaluation framework, CITYLAB aims to address this issue by giving instant access to critical information by developing and updating comprehensive and transparent dashboards for each CITYLAB Living Lab. A data driven or digital dashboard is a concept created to display information in a more user-friendly, visually pleasing manner. The idea followed the study of decision support systems which are computer-based information systems that support business or organisational decision-making activities. Today, dashboards are used in many fields to visually display to what extent an organisation is reaching its goals.

Introducing dashboards within CITYLAB has three reasons:

- The dashboards visualise the input of the evaluation activities for the act/decide phase in the Living Lab cycle. They display the Living Lab ambition and the extent to which the current implementation contributes to that ambition.
- CITYLAB is a research program funded by the European Commission to contribute to the Commission's target of essentially CO_2-free city logistics in urban centres by 2030. The dashboards monitor to what extent a certain solution contributes to that target.
- By displaying the most relevant process and context indicators, the dashboards give insight in transferability options of the tested solutions. In most other evaluation frameworks, this aspect is often separated from the impact analysis and does not receive much attention.

The CITYLAB dashboards will show a graphical presentation of a selection of indicators from each field of evaluation and will be updated each time the implemented solution is adjusted and/or context or process are changed. Developing the dashboards is part of Task 5.2 (CITYLAB dashboards) and is reported on in D5.2 (CITYLAB dashboards).

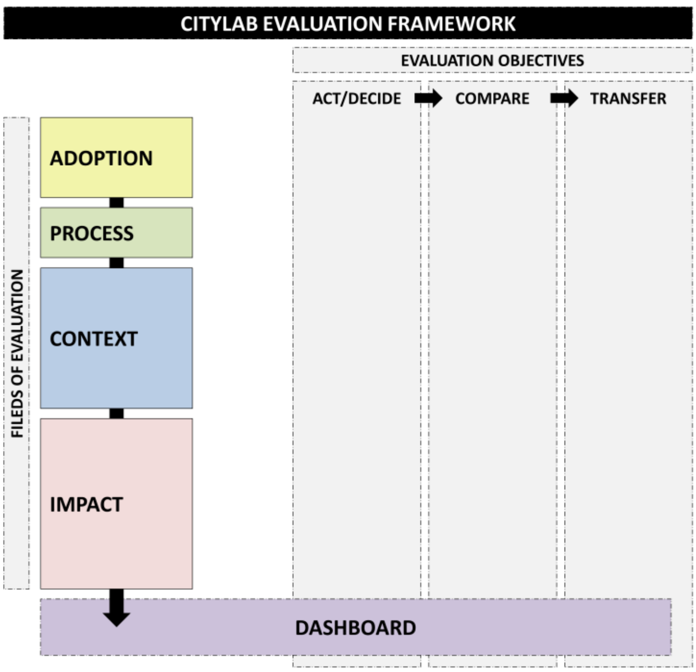


Figure 8 – Dashboard in CITYLAB's evaluation framework

2.4 Organisation of the evaluation activities

Figure 9 schematizes CITYLAB's evaluation framework in its whole. The various outcomes of the evaluation activities provide insight in the potential of the seven CITYLAB solutions and will be input for CITYLAB's WP6 which is set to promote the replication and take up of the satisfactory solutions.

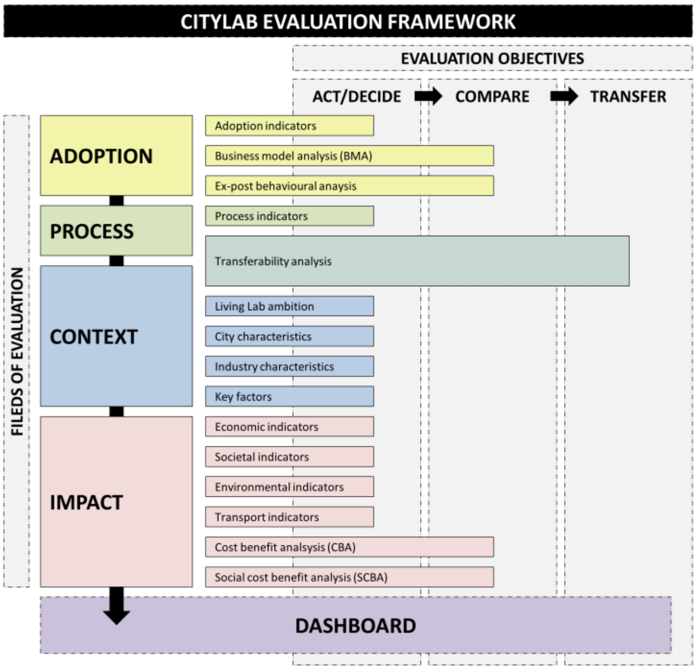


Figure 9 – CITYLAB's evaluation framework

Multiple actors play a role in successfully filling in this evaluation framework. CITYLAB is a partnership of public, private and research partners. In each of the seven CITYLAB cities, a Living Lab is established as a co-creation of the local CITYLAB research partner, city partner and industry partner. These three partners have a primary role in executing the evaluation activities:

- As Living Lab owner and/or participant, they are responsible for developing the evaluation and monitoring system for the Living Lab cycles, which means defining the objectives, framework and methods to be used in order to perform the evaluation. The CITYLAB evaluation framework and indicators (listed in Chapter 3) provides a joint basis for that. However, the particular circumstances of their Living Lab context and/or solution might require additional indicators or evaluation activities. They also have to agree on how to quantify the indicators and on which measurement methods should be used (both for the common CITYLAB indicators as well as for their own additional indicators).
- Their second role consists of collecting sufficient high-quality data. These data feed the before-and-after assessments as well as the various evaluation methods. It means that it does not suffice to collect data of when the solution was implemented. There is an equal need for before data and data on the process towards implementing the solution. Following the Living Lab methodology, an important aspect of this role is analysing gaps in the available data by comparing if the data currently available is enough to perform the evaluation of indicators according to the CITYLAB evaluation methods. If data gaps are identified, additional data collection has to be performed. In case it is not possible to collect additional data, simulation or modelling tools can be used.
- Their third role consists of processing the data according to the evaluation methods they adopted in their evaluation and monitoring system.

The division of roles between the local CITYLAB partners is entirely up to them. Based on their nature, each partner may be better placed to be responsible for certain aspects of the evaluation activities. Further, within CITYLAB, each of the selected evaluation methods will be applied by one of the research partners for all Living Lab implementations (Table 1) VUB leads CITYLAB's evaluation work package (WP5) and is responsible for developing a generic CITYLAB dashboard as well as customizing that dashboard for the seven CITYLAB Living Labs. These dashboards are continuously updated throughout the project.

Table 1 – Overview of CITYLAB evaluation methods and the responsible research partner.

CITYLAB evaluation method	Responsible research partner
Before-and-after assessments	TOI
Business model analysis (BMA)	TNO
Ex-post behavioural analysis	UR3
Transferability analysis	DLR
Cost benefit analysis (CBA)	TNO
Social cost benefit analysis (SCBA)	TNO

3 CITYLAB indicators

CITYLAB evaluates how the CITYLAB implementations score on a range of indicators to feed the Act/Decision phase of the Living Lab cycle and to reach its first evaluation objective. These indicators can be structured into four fields of evaluation: (i) adoption, (ii) process, (iii) context and (iv) impact. Each field of evaluation covers one particular aspect of the solutions that influences whether the solution is considered satisfactory or not. ‘Adoption’ detects to what extent stakeholders that did not initiate the solution are willing to pay for the solution or to change their behaviour in order to perpetuate the solution. A solution’s success does not only depend on characteristics of the solution itself but also on how and where it was implemented. ‘Process’ relates to the Living Lab methodology and attempts to determine how successfully the implementation followed the implementation plan as stipulated during the planning phase. It allows evaluators to make the important distinction between implementation failure/success and theory failure/success. ‘Context’ describes important characteristics of the setting in which the solution was implemented. More than any other field of evaluation, it makes the connection between the implemented solution and a possible transfer to another city. Finally, ‘impact’ assesses and quantifies the changes that can be attributed to implementing the new urban freight transport solution. It concerns changes in the well-being of all stakeholders. In Section 2.2 on page 9 we explain the reasoning behind the different categories of indicators. In this Section, the different indicators are listed and defined.

The indicators listed here are the compulsory CITYLAB indicators. They are collected for each implementation to allow comparison and to assure the quality of the further evaluation activities. However, the particular circumstances of each Living Lab context and/or solution might require additional case-specific indicators. For the solution in Rome of Poste Italiane, for example, apart from the compulsory indicators, ‘Willingness to pay’ is also evaluated. Willingness to pay is defined as the amount of money an agent would pay to obtain a desired good or service. It measures the demand for the good or service considered for acquisition. Evaluation results of both compulsory and case-specific indicators are part of D5.3 Impact and process assessment of the seven CITYLAB implementations.

How to quantify the compulsory indicators and suitable measurement methods are not defined here because of the variation in nature and scale of the seven CITYLAB implementations. It is the responsibility of the Living Lab owners and participants to define that. Most of the existing evaluation frameworks that inspired this list of indicators did define measurement methods to be used.

Documents used for CITYLAB’s indicator list:

- STRAIGHTSOL Deliverable D3.3 – Description of indicators, KPI’s and measurement methods (http://www.straightsol.eu/deliverables.htm)
- STRAIGHTSOL Deliverable D3.4 – Description of evaluation framework and guidelines for use (http://www.straightsol.eu/deliverables.htm)
- CITYLAB Grant Agreement (Description WP5)
- CITYLAB Deliverable D2.3 – Guidelines on (i) success factors of past initiatives and (ii) achieving higher levels of effective public private cooperation. Preliminary project results.
- CITYLAB Deliverable D3.1 - Practical guidelines for establishing and running a city logistics living laboratory.
- CIVITAS Deliverable D4.10 – Applied framework for evaluation in CIVITAS PLUS II (http://www.civitas.eu/sites/default/files/Results%20and%20Publications/civitas_wiki_d4_10_evaluation_framework.pdf)

- Töpfer, A. (2012). Impact evaluation methods in Civitas for urban freight measures. (http://www.civitas.eu/sites/default/files/20120703_civitas_freight_measures_evaluation.pdf)
- BESTUFS report – Quantification of Urban Freight Transport Effects I (www.bestufs.net/download/BESTUFS_II/key_issuesII/BESTUF_Quantification_of_effects.pdf)
- FREVUE Deliverable D1.1 – Central Assessment Framework (http://frevue.eu/wp-content/uploads/2014/05/20140307-FREVUE-D1-1-Central-Assessment-Framework.pdf)
- Lindholm, M., Bling, M. (2014). "Assessing knowledge and awareness of the sustainable urban freight transport among Swedish local authority policy planners". *Transport Policy*, 32, 124-131.

3.1 Adoption indicators

Table 2 – CITYLAB Adoption indicators

Indicator		Description	Reference
Adoption indicators			
1	Adoption willingness	'Adoption willingness' is the ratio of the number of users relative to the total number people/companies that were invited to adopt the solution.	- STRAIGHTSOL - CITYLAB WP5 description - CIVITAS
2	Adoption rate	'Adoption rate' is the ratio of the number of users relative to the total number of people/companies in the target market.	
3	Technical feasibility	'Technical feasibility' is the degree to which non-initiative taking commercial stakeholders are technically able to adopt the innovation.	
4	Economic feasibility	'Economic feasibility' is the degree to which non-initiative taking commercial stakeholders financially benefit when adopting the innovation.	
5	Legal feasibility	'Legal feasibility' is the degree to which non-initiative taking commercial stakeholders are legally able to adopt the innovation.	
6	Operational feasibility	'Operational feasibility' is the degree to which non-initiative taking commercial stakeholders have to change their operations to adopt the innovation.	
7	Political acceptance	'Political acceptance' is the degree to which the innovation has the passive or active support by the local authorities.	

3.2 Context indicators

3.2.1 Living Lab ambition

Table 3 – CITYLAB Context indicators – Living Lab ambition

Indicator		Description	Reference
Context indicators			
Living Lab ambition			
8	Ambition	'Ambition' lists the Living Lab ambition and goals.	

3.2.2 City characteristics

Table 4 – CITYLAB Context indicators – City characteristics

Indicator		Description	Reference
Context indicators			
City characteristics			
9	Population size	'Population size' is the actual number of individuals in a population.	- CITYLAB T3.1 - STRAIGHTSOL - BESTUFS - Lindholm & Blinge, 2014 - CIVITAS - FREVUE
10	Population density	'Population density' is a measurement of population size per unit area.	
11	Household size	'Household size' refers to the average number of persons per private household.	
12	Residential land use	'Residential land use' is the ratio of land used for residential purposes compared to total land use.	
13	Commercial land use	'Commercial land use' is the ratio of land used for commercial purposes compared to total land use.	
14	Industrial land use	'Industrial land use' is the ratio of land used for industrial purposes compared to total land use.	
15	Transportation land use	'Transportation land use' is the ratio of land used for transportation purposes compared to total land use.	
16	Road density	'Road density' is the length of the urban area's total road network per unit area.	
17	Congestion level	'Congestion level' refers to the annual delay totals on the road network in the urban area under study related to free flow travel time.	
18	Goods volumes	'Goods volumes' refers to the average volumes of goods entering and leaving the urban area under study.	

19	Share of commercial vehicles	'Share of commercial vehicles' is the ratio of the total number of commercial vehicles on the road network relative to the total number of vehicles on that road network. A commercial vehicle is defined as any type of motorised road vehicle, that by its type of construction and equipment is designed for, and capable of transporting goods, whether for payment or not.	
20	FTE's dedicated to UFT	'Full-time equivalents dedicated to urban freight transport' expresses how many people are full-time employed by local authorities to work on urban freight transport-related topics.	

3.2.3 Industry characteristics

Table 5 – CITYLAB Context indicators – Industry characteristics

Indicator		Description	Reference
Context indicators			
Industry characteristics			
21	Sector	'Sector' describes the industrial sector in which the private company initiating the innovation operates according to the NACE classification system.	- CITYLAB T3.1 - STRAIGHTSOL - BESTUFS - Lindholm & Blinge, 2014 - CIVITAS - FREVUE
22	Stakeholder	'Stakeholder' describes whether the private company initiating the innovation is a supplier, a receiver, a transport service provider or a facility owner.	
23	FTE's	'Full-time equivalents' expresses how many people are full-time employed by the private company initiating the innovation.	

3.2.4 Key factors

Table 6 – CITYLAB Context indicators – Key factors

Indicator		Description	Reference
Context indicators			
Key factors			
24	Strategic	This indicator describes key strategic factors for the tested implementation.	- CITYLAB T2.3
25	Operational	This indicator describes key operational factors for the tested implementation.	
26	Ethical	This indicator describes key ethical factors for the tested implementation.	
27	Legal/regulatory	This indicator describes key legal/regulatory factors for the tested implementation.	

28	Technological	This indicator describes key technological factors for the tested implementation.	

3.3 Process indicators

Table 7 – CITYLAB Process indicators

Indicator		Description	Reference
Process indicators			
29	Duration	'Duration' refers to how long the Living Lab has been continuing	- CITYLAB T3.1 - CIVITAS
30	Delays	This indicator compares the planned living lab cycle to the actual living lab cycle and monitors possible delays.	
31	Availability of resources	'Availability of resources' compares resources used to organise the Living Lab to available resources.	
32	Consultation	'Consultation' is used to assess to what extent Living Lab owner, customers, users and stakeholders mutually consulted.	
33	Participation	'Participation' compares planned interventions of or consultations between Living Lab owners, customers, users and stakeholders to actual interventions and consultations.	
34	Facilitators	'Facilitators' is used to list persons or organisations that helped developing the Living Lab throughout the process.	
35	Lessons learnt	'Lessons learnt' is used to summarize lessons learnt throughout the process.	
36	Barriers	'Barriers' is used to describe barriers encountered throughout the process.	

3.4 Impact indicators

3.4.1 Environment

Table 8 – CITYLAB Impact indicators – Environment

Indicator		Description	Reference
Impact indicators			
Environment			
37	Air quality	'Air quality' is the healthiness and safety of the atmosphere which can be described by the level of pollutants in the air. The main air pollutants considered are: Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Particulate matter (PM2.5 and PM10)	- STRAIGHTSOL - CIVITAS

38	Carbon dioxide	'Carbon dioxide' (CO_2) is the most significant greenhouse gas (as it contributes to about 80% of total EU greenhouse gas emissions) and is considered as one of the most important causes of climate change. CO_2 enters the atmosphere through the burning of fossil fuels in transport and industries.	
39	Noise level	The indicator 'Noise level' is used to capture the outdoor sound level caused by human activities, including transport.	

3.4.2 Society

Table 9 – CITYLAB Impact indicators – Society

Indicator		Description	Reference
Impact indicators			
Society			
40	Employee satisfaction	'Employee satisfaction' is used to describe whether employees are happy and contented and fulfilling their desires and needs at work. The indicator should be analysed for each industrial partner.	- STRAIGHTSOL - CIVITAS
41	Spatial consumption	'Spatial consumption' refers to the amount of public outdoor space that is dedicated to logistics activities such as loading, unloading and handling.	
42	Traffic safety	'Traffic safety' is described by the number of traffic accidents, injuries and deaths.	
43	Crime	This indicator refers to the number of goods that get stolen or deliberately damaged while being carried or stored between shipper and receiver.	
44	Business climate	The indicator 'Business climate' indicates how state, regional and local policies, relationships and local communities support business development.	

3.4.3 Economy

Table 10 – CITYLAB Impact indicators – Economy

Indicator		Description	Reference
Impact indicators			
Economy			
45	Costs per received item	'Costs per received item' are the average costs paid by the shipper for the transportation of a good or service unit.	- STRAIGHTSOL - CIVITAS

46	Costs per delivered item	'Costs per delivered item' are the average costs (directly or indirectly) paid by the receiver for the transportation of a good or service unit.	
47	Operating benefits	'Operating benefits' are the operating revenues minus the operating costs. The average operating benefits can be expressed by dividing the operating benefits for example by vehicle-km or by units of goods/services delivered. This indicator should be assessed for each industrial partner.	
48	Return on investment	'Return on investment' is the ratio of money gained or lost on an investment relative to the amount of money invested. This ratio should be assessed for each industrial partner.	
49	Enforcement costs	'Enforcement costs' are the amount of money spent by the local authority to enforce other parties to comply with changes in the transport system and/or legislation.	
50	Customer satisfaction	'Customer satisfaction' is used to describe whether customers are happy with the service they are provided with. The indicator should be analysed for each industrial partner	

3.4.4 Transport

Table 11 – CITYLAB Impact indicators - Transport

Indicator		Description	Reference
Impact indicators			
Transport			
51	Average vehicle speed	'Average vehicle speed' is described by the distance (km) travelled in a certain time period (hour).	- STRAIGHTSOL - CIVITAS
52	Network use	'Network use' is the ratio of actual and potential traffic flow of a network.	
53	Freight kilometres	'Freight kilometres' is the average number of vehicle kilometres driven to deliver an item.	

4 CITYLAB evaluation methods

To reach its second evaluation objective, CITYLAB uses four established and well-known evaluation methods that have been used before to evaluate transport-related projects and are also used in the field of urban freight transport: Business Model Analysis (BMA), Ex-post behavioural analysis, Transferability analysis and (Social) Cost Benefit Analysis ((S)CBA). In Section 2.2 on page 9 we explain how these evaluation methods relate to the four fields of evaluation. In this section, the different evaluation methods are explained in detail.

4.1 Business Model Analysis (BMA)

Business Model Analysis is part of the Adoption evaluation field in the CITYLAB evaluation framework because it aims at describing how an organisation offers values to its customers. The method explicitly takes a business perspective and could therefore also be placed in the field of impact assessment. The method overlaps with the cost benefit analysis.

4.1.1 Business Model

In the most basic sense, a business model is the method of doing business. There are many different definitions in literature on business models. Based on an extensive literature research, Osterwalder (2004) distinguishes four areas (including nine building blocks) that a business model must address. Chesbrough (2010) argues that this approach to construct maps of business models (See Figure 10) is useful to experiment with different business models. Osterwalder and Pigneur (2010) define the term business model as follows:

> "A business model describes the value an organisation offers to various customers and portrays the capabilities and partners required for creating, marketing, and delivering this value and relationship capital with the goal of generating profitable and sustainable revenue streams" (Osterwalder & Pigneur, 2010).

4.1.2 Business Model Canvas

The four areas that have to be considered in a business model are: product, customer interface, infrastructure management, and financial aspects. These areas are composed by the nine building blocks presented in Figure 10. The value proposition of a business model shows the overall view of a company's offered products and services that are of value to a customer. Osterwalder defines the client segment as the group of customers to whom the company aims to offer value. The distribution channel is the way the company gets in touch with its customers, the link between the company and the customer is described as client relationship. Figure 10's left-hand side shows the key activities (value configuration) which describe the activities and resources necessary to create value, the key resources (capability) which is the ability to execute a repeatable pattern of actions necessary to create value and the partner network which is defined as the "voluntarily initiated cooperative agreement between two or more companies in order to create value for the customer" (Osterwalder, 2004). Finally, at the bottom of Figure 10 there are two building blocks that describe the financial aspects of a business model; i.e. the cost structure that represents all costs in the business model and the revenue flows that represent the way the company makes money through a variety of revenue flows. Osterwalder's building blocks show the relevant parts that have to be considered in developing and comparing business models, as well as their relations. In order to describe an organisation's business model, Osterwalder and Pigneur (2010) propose a single reference model, which is known as The Business Model Canvas. This strategic management and entrepreneurial tool exists of nine building blocks:

1) the customer segments
2) the value proposition for each segment
3) the channels to each customers
4) the customer relationships that are established
5) the revenue streams that are generated
6) the key resources that are required to create value
7) the key activities that are required to create value
8) the key partners
9) the cost structure

It is, however, not just sufficient to enumerate the nine elements. What a company should do, according to Osterwalder, is to map them out on a pre-structured canvas. This is called the Business Model Canvas. The tool helps to map, discuss, design and invent new business models.

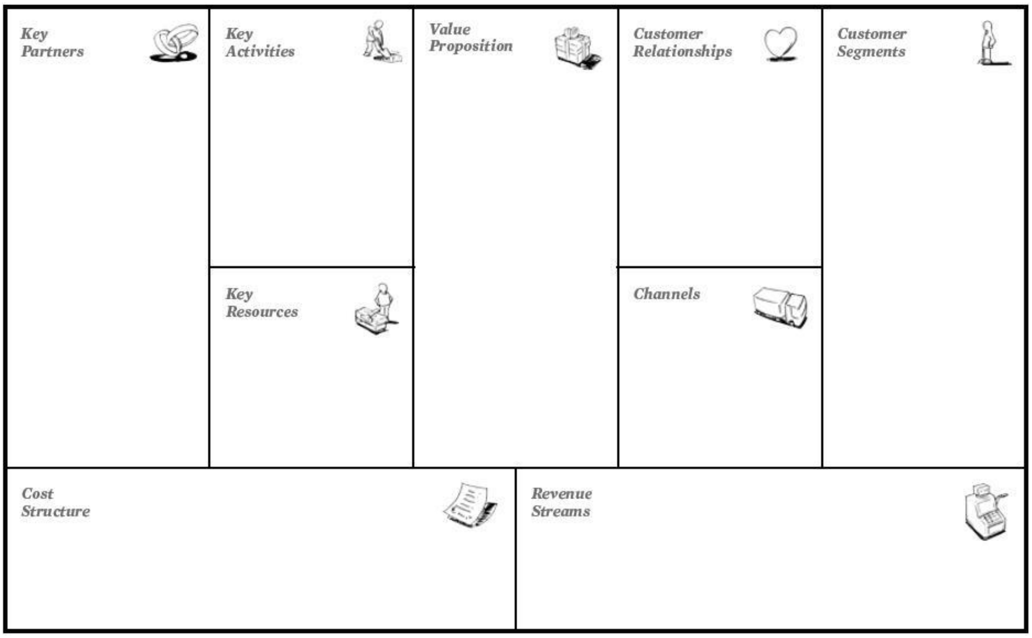


Figure 10 – Business Model Canvas (Osterwalder and Pigneur, 2010)

As shown in Figure 10, the customer is on the right half side of the framework, as well as the channels and relationships that are required for a product/service to reach the customer. The partners, activities and resources that are needed to make a product/service are on the left side. In the middle is the most important piece, namely the product/service that is of value to the customer. The cost structure represents all the costs incurred by the organisation to run the business model, namely with the key partnerships, activities and resources. The revenue streams describe how the business model generates money for the organisation.

4.1.3 Use of the business model framework in CITYLAB

The business model framework can be applied to a particular concept by answering several questions for each block as shown in Figure 11. The main user of the business model is the actor that incurs costs to offer a product/service in return for revenue. This actor is referred to as “the organisation”. When the business model framework is applied to the CITYLAB implementations, the (logistic) operator is considered as “the organisation”. Hence, the framework is applied from the operators’ perspective.

<table>
<tr>
<td rowspan="2">Key partners
Who are the organisation's key partners and suppliers?
Which key resources are we acquiring from partners?
Which key activities do partners perform?</td>
<td>Key activities
What key activities do our value propositions, distribution channels, customer relationships and revenue streams require?</td>
<td rowspan="2">Value proposition
What value does the organisation deliver to the customer?
Which one of our customer's problems are we helping to solve?
Which customer needs are we satisfying?</td>
<td>Customer relationships
What type of relationship does each of the customer segments expect?
What type of relationships are established?</td>
<td rowspan="2">Customer segments
For whom is the organisation creating value?
Who are the most important customers?</td>
</tr>
<tr>
<td>Key Resources
What key resources do our value propositions, distribution channels, customer relationships and revenue streams require?</td>
<td>Channels
How are customer segments reached and how do they want to be reached?
How are the channels integrated? Which ones are most cost-efficient?</td>
</tr>
<tr>
<td colspan="2">Cost structure
What are the costs associated with the business model?
Which key resources are most expensive?
Which key activities are most expensive?</td>
<td colspan="3">Revenue streams
For what value are the customers willing to pay?
For what do they currently pay?
How are they paying?
How would they prefer to pay?</td>
</tr>
</table>

Figure 11 – Business model template

4.1.4 Limitation of business perspective

The definition of Osterwalder assumes that the goal of an organisation is to generate revenue streams. However, when it comes to urban and interurban freight transport, societal and environmental impacts are of great concern as well. For example, the reduction of pollution, noise, congestion and traffic accidents. When applying the business model canvas to urban logistic concepts it becomes clear that the model does not capture those externalities. For this reason, a 10th building block has been added to the model in the EU project TURBLOG (TURBLOG, 2011a) . By defining the 10th building block 'Externalities', the Urban Logistics Business Model has been created. We do not use this extended business model canvas in the CITYLAB project, since the externalities are already specifically addressed in the SCBA. We use the business model to evaluate the business perspective of the solution. The field of urban freight logistics can be characterized by the large number of pilots and projects that do not succeed or never exceed the really limited scale of the case study. Many of these initiatives lack a good, viable and / or feasible business model. Therefore, we specifically examine the business models of an implementation in the CITYLAB framework for several reasons:

1) By emphasizing and examining the business models used in different demonstrations we can discover good, viable and/or feasible business model for the context of urban freight transport. These lessons can be used by others to improve urban freight transport.
2) By examining the business model used we possibly can determine why certain solutions are not used on a large scale and why others might be. Showing the financial impacts will help rationalize the potential solutions in the urban freight transport field.
3) Examining the business model of a demonstration provides us with the possibilities, as far as possible, to look at and consider other actors, channels and / or segments that might be involved to make the business model financially feasible.

Finally, obviously it is possible to include externalities as well in the business model. An example could be that local authorities 'value' an improved air quality by providing a subsidy for an initiative. If this is the case, such subsidies should be provided to other stakeholders that improve air quality as well, otherwise it would be in conflict with European (and national) policy on competition.

4.2 Ex-post Behavioural Analysis

Ex-post behavioural analysis is part of the Adoption evaluation field in the CITYLAB evaluation framework. It aims at evaluating the degree of acceptance of the CITYLAB solutions calculating stakeholders' reactions after having experienced the innovations proposed.

Methodologically, ex-post behavioural analysis is based on both econometric models and standard and widely-accepted statistical techniques. The latter will be used to obtain indicators such as users' acceptance and satisfaction while the willingness to pay (WTP) indicator relies on discrete choice modelling (Train, 2003).

Under the micro-economic approach, from a user's perspective, it is interesting and useful to investigate intervention policy acceptability and stakeholders' behavioural reactions. Marcucci et al. (2012) describe the development of a survey instrument to study ex-ante policy acceptability. Examining users' preference structures and calculating WTP measures might enrich cost-benefit analysis (Marcucci et al., 2013). Gatta and Marcucci (2014) illustrate a method to define an acceptable and improving policy change equally impacting the different stakeholders involved while accounting for heterogeneity. Sensitivity to policy interventions is another relevant issue. When analysing possible behaviour changes, the use of advanced techniques dealing with preference heterogeneity is recommended. Marcucci and Gatta (2012) propose a structured way to investigate alternative methods to account for preference heterogeneity in choice experiments by assuming its influence to impact the systematic component of utility, the stochastic one or both.

WTP is the amount of money an agent would pay to obtain a desired good or service. As a point estimate, it represents the price that makes the consumer indifferent between buying and not buying a product/service. In a choice modelling framework, typically assuming linear-in-attributes utility functions, the marginal effect on WTP for a change in a given attribute, characterising the good or service to be acquired, is obtained dividing its coefficient by that of cost. Since model estimation yields an estimate of the true coefficients, the computed WTP is itself an estimate with a given probability distribution. Thus, it is desirable to calculate confidence intervals in addition to point estimates. This is not trivial since the finite sample distribution of the WTP estimator is not known. When maximum likelihood estimates are used for the coefficients, the distribution of WTP is the ratio of two correlated, asymptotically normal, distributions. The distribution of the ratio of two normal variables has been derived by Fieller (1932) and Hinkley (1969), and shown to be approximately normal when the coefficient of variation of the denominator variate is negligible (Marsaglia, 2006). More recently, Daly et al. (2012) showed that WTP is itself a maximum likelihood estimate, its distribution is asymptotically normal and the Delta method gives an exact measure of its standard error. Gatta et al. (2015) provide some guidelines for choosing, under different conditions, an appropriate method to construct confidence intervals for WTP, in finite sample contexts. They comprehensively and systematically comparing all the methods used in the choice modelling field, as well as proposing other methods borrowed from different research areas described in Gatta et al. (2014). The comparison is carried out through a Monte Carlo study, within a multinomial logit framework where data are generated under different scenarios mimicking real situations in which the finite WTP distribution is potentially highly skewed and far from normal. Two real data sets (Gatta and Marcucci 2007; Marcucci and Gatta, 2012) are also used to illustrate the practical relevance of the issues raised in the simulation study. This analysis particularly appropriate in the realm of urban freight transport policy evaluation where a stakeholder-specific approach coupled with privacy concerns and high interviewing costs usually provoke sample sizes for estimation purposes (Marcucci and Gatta, 2013; Marcucci et al., 2015).

4.3 Transferability Analysis

4.3.1 Background and Aim

In the CITYLAB project each solution will be implemented initially in one living lab. Based on the proof of success done in the previous evaluation tasks, the aim is to transfer solutions to other living labs. Task 5.6 will therefore perform a transferability analysis focusing on the potential for rolling out solutions to other CITYLAB cities. This step will be based on the evaluation process in WP 5 and the urban freight status mapping in WP 2. The transferability analysis is part of the Context evaluation field as well as the Process evaluation field within CITYLAB's evaluation framework.

Different European projects have dealt with transferability aspects in recent years. In the CIVITAS Programme, a transferability methodology has been developed, which was further refined in TURBLOG. The SUGAR project used another approach to transfer best practice related to urban freight logistics. Furthermore, the projects NICHES and NICHES+ considered issues of transferability (see Barrera 2013 and TURBLOG 2011b).

In the "CIVITAS guide for the Urban Transport Professional" the methodology developed in NICHES+ which uses a six step approach is described (see CIVITAS 2012, p. 105). The methodology of NICHES+, which uses results gathered in NICHES, was further developed in the project TIDE, where seven transferability assessment steps are shown (see NICHES+ 2011 and TIDE 2013). For CITYLAB, we will use the approach described in TIDE. However, further development of this approach will be necessary concerning the analysis in the adopter cities.

In the project TURBLOG, transferability was understood as the ability to transfer/adopt in a given city successfully measures previously adopted elsewhere while achieving comparable results (see Barrera 2013 and TURBLOG 2011b). TIDE (2013, p. 13) describes transferability as the process of verifying the chances of a successful implementation of a measure which was successfully implemented in a pioneer city to an adopting city at operational level.

4.3.2 Methods

The TIDE transferability methodology, which will be applied in CITYLAB, has seven steps (see TIDE 2013 p.14):

STEP 1: Mission statement/objectives and scoping

STEP 2: Clarification of the impacts of the measure

STEP 3: Identification of upscaling/downscaling need

STEP 4: Identification of the main components and characteristics

STEP 5: Identification of the level of importance of characteristics

STEP 6: Assessment of the characteristic in the context of adopter city

STEP 7: Conclusions

As demonstrated in TIDE, there are different sources of information required for the transferability assessment:

- Literature: Documents and literature are seen as best sources of information relating to the measure form the pioneer city. In CITYLAB, sources of information will mainly be deliverables of other WPs that characterise CITYLAB solutions and cities.
- Interviews: As not all information is published and available from literature, we will rely on contacts to involved actors in CITYLAB living labs as well as in adopter cities.
- Workshops: Input from different stakeholders will be discussed in workshops which are planned in CITYLAB.

- Field visits: Visiting sites is a useful method to gather first-hand experiences of implementations and impacts.

For the consecutive steps of the transferability analysis, the following issues need to be taken into account as described in the TIDE project. Further details on this will be given in Deliverable 5.6.

4.3.2.1 STEP 1: Mission statement/objectives and scoping

The defined missions of the CITYLAB implementations and the scope of the respective measures will be summarized in the first step. Source for this will be CITYLAB WPs 3 and 4. The objectives and scope of the measures must be clear to the adopter – in our case all CITYLAB cities. Relevant information to adopter cities will be given in CITYLAB workshops.

4.3.2.2 STEP 2: Clarification of the impacts of the measure

The impact of the measures will be identified and quantified in previous steps of WP 5. Impacts may vary according to the different measures implemented in CITYLAB and could include different changes (e.g. in efficiency, safety, environment, accessibility). This step will use results of previous tasks in Work Package 5.

4.3.2.3 STEP 3: Identification of up–scaling/down–scaling need

Due to different context conditions in the adopter cities and the pioneer cities, it is important to determine whether scaling of measures is necessary. CITYLAB workshops should provide room for discussion of this issue.

4.3.2.4 STEP 4: Identification of the main components and characteristics

Main components that can contribute to the success or failure of measures will be identified in different areas. The components will be broken down into characteristics. A starting list for this is given by TIDE. This step will be done in close cooperation to previous tasks of WP 5.

4.3.2.5 STEP 5: Identification of the level of importance of characteristics

The components and characteristics identified in step 4 will be judged from the viewpoint of the adopter cities concerning their level of importance. Interviews and workshops will be sources of information for this step.

4.3.2.6 STEP 6: Assessment of the characteristic in the context of adopter city

The difficulty experienced in implementing the measures in the pioneer cities will be transferred to the context of the adopter cities and scored by the pioneer cities as well as the adopter cities. Again this will be discussed in interviews with pioneer and adopter cities.

4.3.2.7 STEP 7: Conclusions

The TIDE transferability analysis in its final step draws conclusions about the potential for transferability considering the identified factors and assessment values ascribed to each of them. As a result, the CITYLAB transferability chart overview will be developed and published in Deliverable 5.6.

The seven steps of the TIDE methodology are summarised in a transferability assessment template which is shown in Figure 12. The steps are still generic and the rest of the parameters depend on the implementation considered for transfer to other cities.

Step 1
Mission statement/objectives and scope

Step 2	
Impact of the measure (depend on the measure)	Comments, including contribution to successful implementation

Step 3
Up-scaling or down-scaling required?

Step 4		Step 5		Step 6
Components (depend on the measure)	Characteristics of the components (depend on the measure)	Importance in current context	Comments, including contribution to successful implementation	Likely support or constraint for transferability in the adopter city

Step 7	
Conclusions	Comments

Figure 12 – TIDE transferability assessment template

As CITYLAB aims to transfer the implemented solutions from one CITYLAB city to other CITYLAB cities, the steps of analysis concerning the adopter cities are of great importance in the project. The further development of the related methods especially concerning the analysis of processes in the adopter cities will be described in CITYLAB Deliverable 5.6.

4.3.3 Expected Results

As a result of the transferability analysis Deliverable 5.6 (Assessment of roll-out potential of CITYLAB solutions to other CITYLAB living labs) will document the possibilities for implementing the CITYLAB solutions to other CITYLAB cities. Deliverable 5.6 will include the assessment of the growth potential of CITYLAB solutions as well as the transferability analysis for roll-out to other CITYLAB cities.

The CITYLAB transferability chart overview will show which of the CITYLAB measures have potential for successful implementation in other CITYLAB cities.

4.4 (Social) Cost Benefit Analysis ((S)CBA)

The cost benefit analysis and social cost benefit analysis are part of the Impact evaluation field of CITYLAB's evaluation framework. The main goal of a cost benefit analysis is to assess whether investments in a project are justified. Transport projects often appear not to be feasible from a financial point of view since the financial revenues do not make up for the financial costs. The social cost benefit analysis (SCBA) however, goes beyond financial impacts. The 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, which are not taken into account into a financial analysis, could be important elements to justify the investments.

A social cost benefits analysis (SCBA) answers the question whether an investment in a project is justified taken all economic costs and benefits for society into account from a welfare economic point of view. This makes a SCBA broader and more appropriate for project justification than financial analysis that 'only' investigates the project's financial cash flow in order to calculate suitable return rates.

4.4.1 Advantages and disadvantages of the SCBA methodology

Compared to other appraisal methods, SCBA has two main advantages. First of all, in a SCBA all impacts are expressed in monetary terms and compared against each other. Secondly, the SCBA method analyses the impacts of a project over a long period of time and on a large geographical scale. This results in a realistic view on the total impact of a project in terms of welfare. A project is considered acceptable if the net benefits are positive (Hicks-Kaldor compensation test). However, this compensation approach of SCBA can also be seen as a disadvantage. In the end of the process the costs of one stakeholder can be compensated by the benefits of another. Hence, the redistribution effects for individual shareholders do not become clear from the analysis.

The following sections describe how a SCBA is conducted, by the following steps:

1. Determine alternatives to be examined
2. Determine project impacts
3. Monetize project effects
4. Determine discounted costs and benefit flows
5. Determine net present value and analyse the results
6. Conduct sensitivity analysis

4.4.1.1 Alternatives to be examined

The SCBA-methodology requires at least two alternatives to be considered: the reference and the project alternative. The project impacts concern the differences between both alternatives.

4.4.1.2 Three categories of impacts

In the SCBA the following three categories of impacts are assessed:

- **Direct impacts**: The direct impacts are those impacts that directly relate to the project and occur within the transport market. Besides the project investment expenditures and maintenance costs, direct impacts concern the impacts on operational costs, service quality and traffic level.
- **Indirect impacts**: Indirect or wider economic impacts are the consequence of the continued effect of direct impacts on the economy. For example, infrastructure projects result in a change in accessibility of regions and will have impacts on production and productivity levels, on creation of jobs and on housing prices and regional image. As direct impacts are 'passed' through the economy, this does not automatically result in a welfare increase. As a consequence, wider economic impacts may only be valuated if these impacts are additional to direct impacts.
- **External impacts**: External impacts are not directly related to the transport sector, such as impacts on the environment and on traffic safety. These impacts are valued by society nevertheless and are therefore included in a SCBA. The external impacts are valued using social monetary unit costs.

4.4.1.3 Monetize effects

All impacts should be assessed as much as possible in monetary terms. Physical effects such as time savings, CO_2 emissions and accidents are valued using index numbers. When monetization is not possible, the effects should be included qualitatively.

4.4.1.4 Discount rate

As the costs and benefits of the project occur at different periods in the project; all cost and benefit flows should therefore be discounted using a social discount rate (between 2 to 6%).

4.4.1.5 Analyse results

When the net present values are calculated, there are three different methods that can be applied to assess the results. Table 12 shows these three methods.

Table 12 – Methods to assess results SCBA

Method	**Criterion**
Total Net Present Value: the value of total costs and benefits should be larger than zero.	*Total net present value* > 0
Benefit-Cost Ratio: the benefit-cost ratio shows to what extent the benefits exceed the costs. The benefit-cost ratio is larger than one for a beneficial measure and below one for a non-beneficial measure.	*Benefit – cost ratio* > 1
Internal Rate of Return: the IRR is the discount rate at which the benefits and costs are equal. The IRR should outweigh the social discount rate.	*IRR > social discount rate*

4.4.1.6 Sensitivity analyses

In order to test the robustness of the results of a SCBA, it is recommended to conduct sensitivity analyses. This includes changes in parameters, such as:

- Higher/lower volumes of traffic
- Investments and/or maintenance costs: in practice investments are often more expensive than planned
- No wider economic impacts: since the level of wider economic impacts are often subject to discussion
- Project delay

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