WP1: Stakeholder involvement

Deliverable 1.4 (v.2): Stakeholder analysis framework for construction logistics

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MIMIC Deliverable 1.4 (v.2)

Stakeholder analysis framework for construction logistics

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Executive summary

The urban built environment concentrates due to the growing urbanization trend, triggering construction and renovation works in urban areas. Although construction works often revitalize cities upon completion, the associated logistics activities engender a significant financial and environmental footprint if not handled appropriately. Cities have the largest potential to reduce negative impacts through requirements on construction logistics. However, today, there is a lack of knowledge within cities on how to set such demands and how to involve and manage the numerous and varying stakeholders in these processes. This deliverable presents a participatory decision-making framework for the governance of urban construction logistics on economic, environmental and societal levels, building further on the Multi-Actor Multi-Criteria Analysis (MAMCA). The framework was then implemented on a use case in the dense urban Brussels-Capital Region (Belgium), gathering a wide variety of stakeholders in the context of a sustainable Construction Logistics Scenario (CLS) evaluation. Special attention was paid on the identification of implementation barriers and the role of governments to facilitate the introduction and city-wide roll-out of novel CLS. Findings show how different processes are site-, actor- and condition-specific, thereby delivering a common built object which is often based on different motivations and concerns. The study proposes a flexible, replicable and upscalable framework both from an inter- and intracity perspective, which can serve to support (1) the management of processes and CLS, (2) the management of people and the community, and (3) the project and city, in the context of multi-level governance.

This deliverable is part of MIMIC (Minimizing impact of construction material flows in cities: Innovative Co-Creation), a JPI Europe funded research project with demonstration cases in Brussels, Vienna, Oslo and Sweden. Deliverable 1.4 provides guidelines to introduce formal evaluation methods into the co-creation process. The Multi-Actor Multi-Criteria Analysis (MAMCA), designed by Macharis (2000), aims at reaching a consensus among stakeholders and stakeholder groups, hence highlighting which logistics solutions receive the largest support. Deliverable 1.4 aims to formulate how the MAMCA methodology can be implemented within the MIMIC project and, ultimately, within the construction logistics sector. The first iteration of this deliverable, published in September 2019, introduces the MAMCA evaluation method, explains how this method can be applied in the co-creation process in MIMIC and in construction logistics, and provides practical guidelines to carry out the analysis with the help of the online MAMCA software. This updated deliverable builds further on the descriptive package highlighted in the first version, and presents the developed stakeholder involvement framework specifically for the construction logistics sector, taking into account the typical construction logistics dimensions and characteristics, and its implementation in the Brussels-Capital Region.

In light of keeping this deliverable to-the-point, the focus is laid on the framework description and its implementation findinngs. Further details on the methodology, results of criteria weighing exercise and overall workshop dynamics can be retrieved in the journal paper which has been published by Brusselaers et al. (2021):

Brusselaers, N., Mommens, K., & Macharis, C. (2021). ***Building Bridges: A Participatory Stakeholder Framework for Sustainable Urban Construction Logistics.*** *Sustainability, 13(5), 2678. doi:10.3390/su13052678*

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1. Introduction

There is an ongoing urbanization trend, making municipalities focus on densifying cities, hence stimulating construction and renovation works in urban areas. Urban construction intrinsically strongly relies on logistics activities, and these in turn are the source of environmental nuisances. These nuisances, referred to as external costs, come in the form of i.a. air pollution, greenhouse gas emissions, noise pollution, congestion, accidents etc., and are typically not borne by the polluter himself. Despite the fact that construction sites have a positive economic impact in the long run, they thus bear a vast amount of external costs during the site duration. Improved control and coordination of logistics flows to, from and on construction sites can decrease such negative impacts.

Cities have the largest potential to reduce negative impacts through requirements on construction logistics. However, today there is a lack of knowledge within cities on how to set such demands and how to involve and manage stakeholders in these processes. The purpose of the MIMIC project is therefore to demonstrate how SMART Governance concepts can be used as an aid in the construction and city planning processes to facilitate and support construction logistics.

The MIMIC project builds further on the findings of the CIVIC (*Construction In Vicinities: Innovative Co-creation*) project (2017), and will result in increased understanding among authorities on how different types of construction logistics affect the environment and urban traffic flows. Further, the implementation of smart governance concepts will enable a supportive platform for urban development decision processes, including tools such as a stakeholder analysis using the Multi-Actor Multi-Criteria Analysis (MAMCA). This deliverable is focused on the description of this methodology, designed by Macharis (2000) and further developed within the MOBI Research Centre.

Due to the complex nature of the construction logistics sector and the many stakeholders involved, the first goal of the project and the MAMCA is to map how all these actors interact with each other, the main criteria they propose, and how important they are in their own evaluations. Based on their preferences, the Multi Actor Multi Criteria Analysis (MAMCA) will show the support of each stakeholder group for the different solutions in order to lead stakeholders towards a decision that create a consensus. Hence, MIMIC aims to create knowledge and awareness how MAMCA, optimization models and innovative dialogue tools can be implemented effectively to assess energy efficient solutions in construction logistics.

2. Methodology

This overview of the Multi-Actor Multi-Criteria Analysis (MAMCA) methodology, designed by Macharis (2000), and its theoretical background, are part of this deliverable's first iteration, published in September 2019 (Brusselaers et al., 2019). This first version also provides a definition of the stakeholders within the decision-making process and the MAMCA methodology, allowing to take into consideration the stakeholders' different points of view, with the different steps of the MAMCA methodology. It shows the relevancy of this methodology as a tool to solve complex decision-making problems and reaching a consensus amongst stakeholders in the construction logistics sector.

The MAMCA methodology can be divided into two main phases (Macharis, 2005; Macharis et al., 2009); the first one being mainly analytical and trying to gather all the necessary information in order to conduct the analysis. The second phase is the synthetic or exploitation phase and entails the actual analysis, during which the extent to which the different alternatives contribute towards the stakeholders' objectives is evaluated. These two phases are then respectively subdivided in four and three steps (Macharis et al., 2009), as represented in Figure 1.

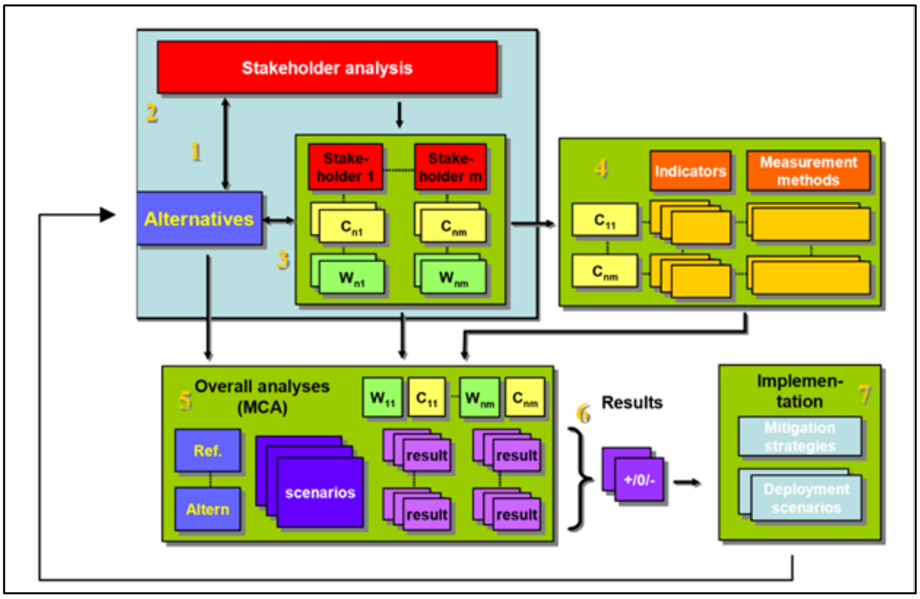

Figure 1. The steps of multi-actor multi-criteria analysis (Macharis et al., 2009)

The first step highlights a clear problem definition and formulates the alternatives to take into account. The current situation ('business as usual') is included as a benchmark. The second step provides a listing of all relevant stakeholders, including their objectives, which will later be translated into criteria during step three. The objectives or criteria can be identified through a literature study and stakeholder consultation. Once these criteria have been determined, a crucial step is to identify how important every criterion is. This is achieved by assigning weights to the different criteria and is done by the stakeholders themselves. The fourth step attempts to couple one or more measurable indicators to each criterion, hence allowing to evaluate each alternative with regards to each criterion. These indicators can either be quantitative or qualitative in nature, depending on its respective criterion. The aggregation of the information from the previous steps happens in step five, and results in an evaluation matrix. The actual results are part of step six, and are generated using a Multi Criteria Analysis (MCA), allowing the researcher to analyze the (dis)advantages associated to every alternative. The seventh and last step seeks to actually implement the results, revealing the alternatives that receive overall stakeholder support. This last step is primarily aimed at the policy maker.

3. Stakeholder framework for construction logistics

The framework, presented in Figure 2, is part of the development of the SMART Governance Concept in construction and city planning processes, to facilitate and support logistics to, from and on urban construction sites to improve mobility and reduce the negative impact of construction sites on the surrounding community. This provides the added value to enable these actors to overcome the institutional barriers that prevent the uptake of more sustainable Construction Logistics Solutions. The framework consists of four main actor groups, each operating within and across their inter-relational spaces, and with their respective most impactful (clusters of) criteria. These elements can be modified according to the local context and the stakeholders involved in the construction programme, project and/or portfolio.

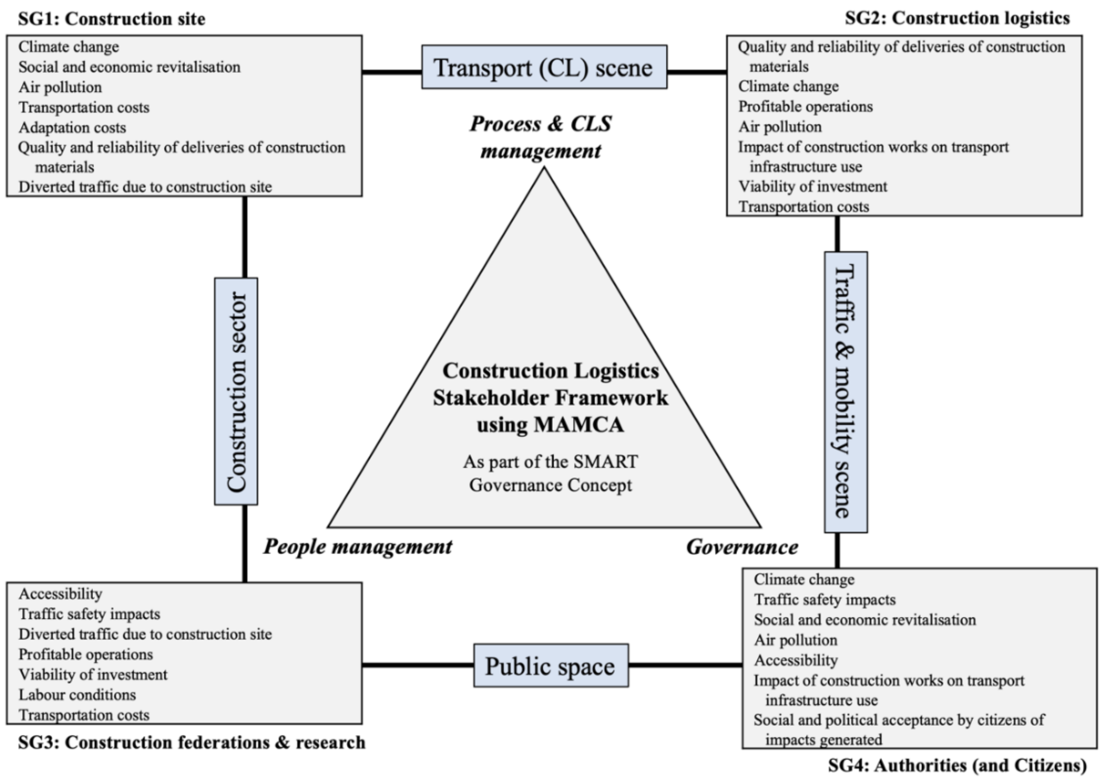

Figure 2. Construction Logistics Stakeholder Framework and its different inter-relational spaces within the SMART Governance concept.

The results, such as the ones presented in the use case in the Brussels-Capital Region, serve to support:

(1) *The management of processes and Construction Logistics Scenarios (CLS):* Through logistics scenario evaluation and allowing for input for detailed impact assessments, aiming to decrease the impact of construction logistics activities on the stakeholders in urban areas and increase the efficiency and effectiveness of the construction process through better planning of logistics both at the site as well as the transport to and from site;

(2) *The management of people and the community:* Getting insights on the effectiveness of measures before the start of the project from a multi-actor multi-criteria perspective, going

from government of construction processes to governance through stakeholder involvement;

(3) *Governance:* enable the inter-actor implementation of participatory decision-making and sustainable construction logistics solutions through improved knowledge and develop new business opportunities, through the development of markets for third party construction logistics providers. Specifically, the multi-actor multi-criteria perspective on implementation of novel construction logistics solutions should enable the elimination of the financial, policy and organizational barriers that prevent current uptake of these solutions.

In the development of the framework, special attention was paid on the identification of implementation barriers and the role of (local) government to facilitate introduction and city-wide roll-out of novel construction logistics concepts. As stakeholders are so numerous and varying in the sector, this paper presents a flexible, replicable and upscalable framework both from an inter- and intracity perspective. This research thus contributes in accompanying the private and public sectors towards changes in a multi-level governance context and implement sustainable urban Construction Logistics Solutions carried by the majority of the stakeholders from the start of the project.

Next, the results of the implementation of the framework in the Brussels-Capital region is explained.

4. Use case implementation in the Brussels-Capital Region

The developed Stakeholder Framework has been tested and implemented by including urban construction logistics actors from the City of Brussels, and exemplified by means of the City Campus construction site in Anderlecht. Its main results are presented in Figure 3, and its detailed explanations can be found in Brusselaers et al., 2021.

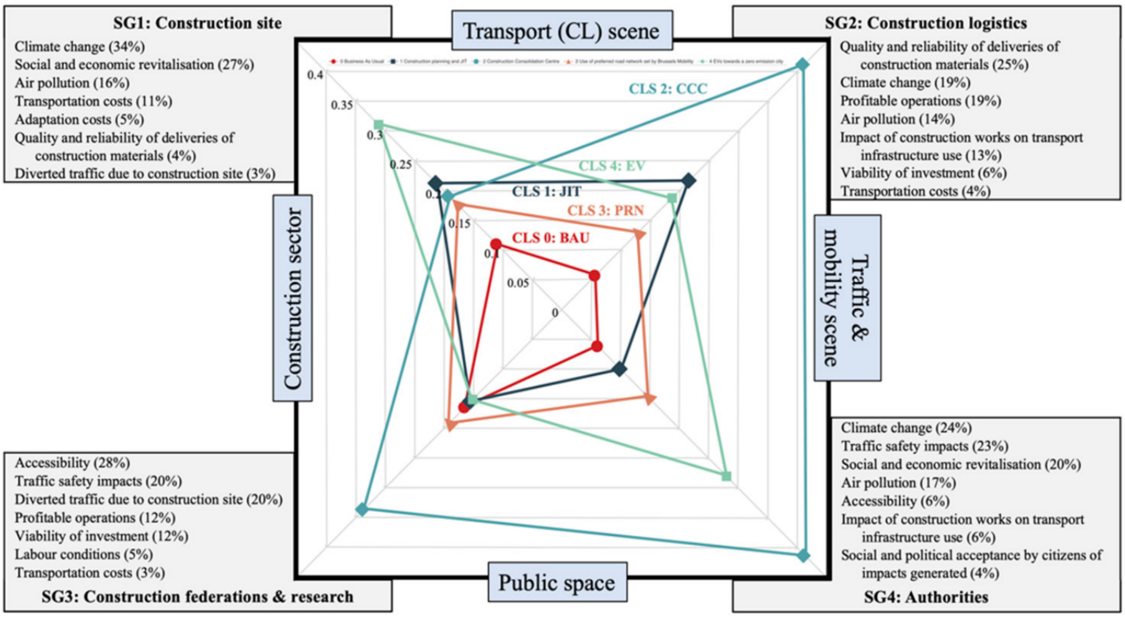

Figure 3. Results of the urban construction logistics stakeholder assessment for the City of Brussels (Brusselaers et al., 2021).

Overall, the discussion of results in the BCR provided insights in 4 main domains:

(1) **The political agenda of the city**: the highest transport external costs on the political agenda are air pollution, climate change, traffic safety and congestion, as also highlighted in the Brussels mobility and logistics plan (Brussels Mobility, 2020). Omnipresent in this workshop is the notion that these external effects should be a mitigating element across all future logistics scenarios implemented in the sector and are planned to be enforced in future tendering and policy regulations. The city development agency already stated that it will adjust future tendering procedures to be stricter in the construction logistics handling. While such enforcements will initially go along with a price increase, it is also expected to reduce overall construction-related costs upon and after completion of the construction site. There is however an overall consensus across the stakeholder groups that environmental criteria will become more important in the future, and further simulations and incentives need to be implemented as to render mitigating solutions more financially appealing and feasible for private companies.

(2) **Local and global pollutants and their mitigation strategy**: although prioritized on the strategic level, air pollution and climate change were found difficult to evaluate, because

of a general lack of data and figures in the sector and missing rigorous impact assessments on innovative construction logistics solutions (Brusselaers et al., 2020). Currently two separate measures are in place to reduce or contain negative externalities, in particular for air pollution levels, in the Brussels-Capital Region (BCR). A first one is the kilometre charge, which is mandatory for road vehicles with a maximal authorized mass higher than 3.5t and is applicable on the entire BCR road network. The second one is the Low Emission Zone (LEZ) and is only applicable to vehicles with combustion engines and a maximal authorized mass of less than 3.5t, with little differentiation between prices between EURO standards. A more differentiated (e.g. a tax distinction between combustion and electric drivetrain or temporal usage differentiation) and intelligent solution packaged in a homogenous system could potentially be the key to tackling air pollution concentration levels from freight transport more efficiently, and push transporters towards the use of more sustainable vehicles.

(3) **Congestion, accidents and road safety**: the Brussels-Capital Region aims for more safety and space for every road user by refurbishing certain road axes. However, rethinking the implementations of freight transport is key as to avoid road network bottlenecks.

(4) **Modal shift**: the environmental costs that could be avoided by using alternative modes of transport are obvious if the manufacturing company is located close to the waterway. It is worth pointing out that this last condition restricts IWT of construction materials to companies who are initially located close to an inland waterway axis. Also, its end destination (i.e. the construction site) should be located close to a transshipment point (such as a CCC), allowing to reduce overall costs and generating enough volume to be bundled on barge (for neighboring construction sites). It is thus not always feasible to ship (all types of) materials through water. Although trucks are still top of mind in Belgium, initiatives guide construction sites in identifying suppliers close to waterways, and how to include clauses into tender documents and asking for options for environment-friendly solutions. In this way, these services aim to provide a transparent view on (a) the total logistics cost and (b) the service levels of using the waterways. The construction logistics decision-making, comparing different logistics solutions and taking into consideration all points of view, should be conducted in order to evaluate both the cost perspective and the added value services that e.g. a CCC can provide, as to highlight potential benefits and drawbacks to construction sites and the different actor groups. However, commonly (often rooted) agreements between construction firms and scattered material manufacturers pose complications in consolidating goods efficiently. While these vertical interrelations can be financially more appealing, these could also lead to more inefficient transports, as more vehicle-kilometres are covered, hence not taking into consideration the extra incurred external costs.

5. Link with Smart Governance Concept 2.0

The Smart Governance Concept 2.0, developed within the MIMIC project, combines the different deliverables of the MIMIC project in to a hierarchical process (Janné et al., 2021a; Janné et al., 2021b) and is shown in Figure 4. The hierarchical process is taking place on the strategic, tactical and operational level. The levels are connected to each other through input, output and feedback loops. The other deliverables within the MIMIC project are mechanisms within the process levels or part of the feedback loops. When tested in the tree cases the Smart Governance Concept 2.0 proved very useful as a way to show where further initiatives are needed to increase the speed of implementing sustainable construction logistics in cities, urban development projects or single projects.

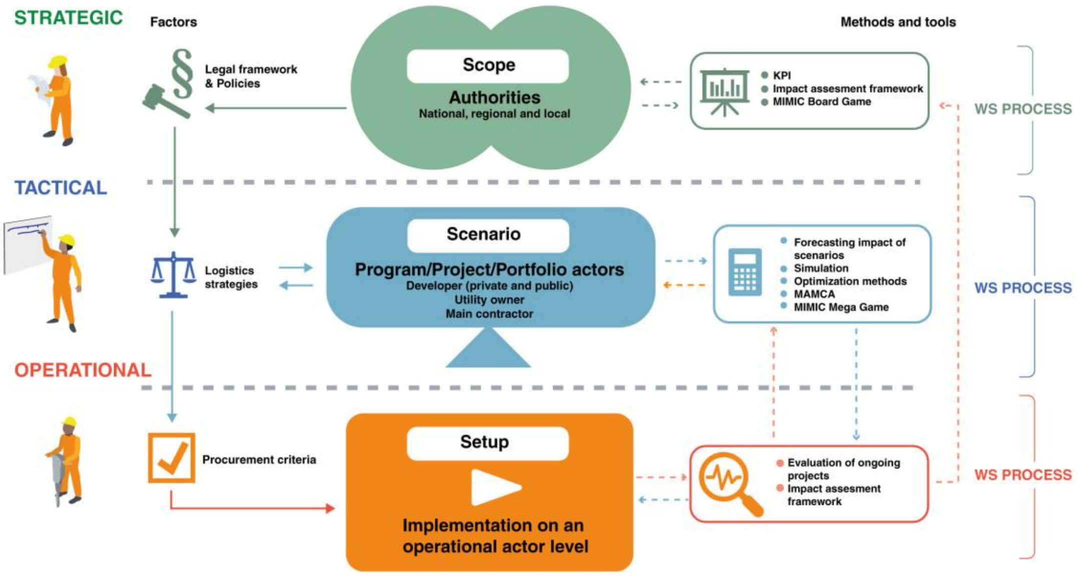

Figure 4. The Smart Governance Concept 2.0 and its 3 hierarchical planning levels: Strategic, Tactical and Operational (Fredriksson et al., 2021; Janné et al., 2021).

Stakeholder involvement is an important aspect on all 3 hierarchical levels within the smart governance concept.

An important question in the early strategic stages of the Smart Governance Concept 2.0 is to identify which actor has the lead of the development of a construction logistics scope, scenario or setup as the project evolves. In other words, the notion of who 'owns' or has the power or responsibility over a process is introduced. The strategic level mainly involves municipal, regional and national authorities in the fields of construction transport and logistics, urban mobility and urban planning. However, all main actors (such as the main contractor, developer and municipality) can, at a strategic level, present a strategy of construction logistics including goals and scope of the project. There is nonetheless a distinction to made between the different actors' degree of involvement, responsibility and their geographical reach (such as on the project, company or city level). At this level, the scope is clearly defined by the governance of the involved authorities. Thus, at the strategic level, the main actors that are to be involved or considered in the process initiated in the Smart Governance Concept 2.0 are identified. The stakeholder identification will also be used on the tactical and operational levels, where a more in-depth collaborative analysis is done, however knowing main stakeholders early on favouring the chances of success in a given project. The desired output at a strategic level is therefore a document presenting the identified scope, which serves as Input on the tactical level. The latter is achieved by building further on stakeholder cohesion, by including the right decision-makers and organize educational activities on the importance of urban construction logistics solutions or collaborative exercices. Tot his end, the stakeholder framework plays a crucial role.

On the tactical level are mainly logistics service providers (LSP), logistics consultants, project contractors and developers involved, whose main responsibility lie in the conception of logistics scenarios in line with (1) the defined scope on the strategical level and (2) efficient transport and construction logistics planning to, from and on site as input for the operational level. Urban construction logistics processes are site-, actor- and condition-specific, and although there is often a common built object across the various stakeholders, this is often based on different motivations and concerns. Therefore, crucial in this step is the inclusion of a broad spectrum of stakeholders in the decision-making process. The stakeholder framework (MAMCA, using qualitative and quantitative approaches) aims to identify the importance of different logistics elements to find the most suitable scenarios to send out to LSP for offerings or to put as procurement criteria to contractors.

On the operational level, the specific construction logistics setup needs to be presented including a business model and governance structure. Though, there is a need to develop checklists and drafts of these plans at an early stage of the project. At this stage, the construction planning includes workers as well as the broader surrounding community. This operational scenario analysis can also allow for a logistics setup better suited to the stakeholders needs.

Furthermore, there is a direct intercommunication between the impact assessment and stakeholder frameworks, as the impact assessment can be calibrated according to the criteria's degree of impact for various stakeholder groups (allocation of criteria weights), as shown in Figure 5. Hence, a sensitivity analysis tailored the specific local context is possible, and further enhances the interplay to suit the involved actors.

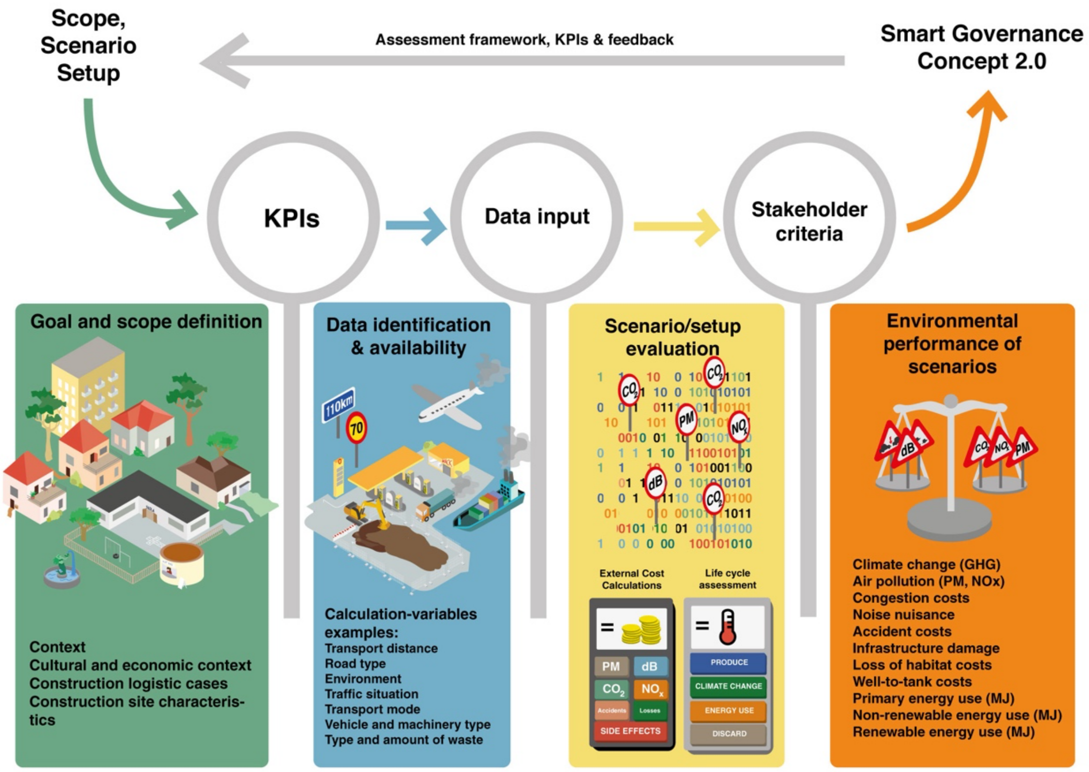

Figure 5. Off-site and on-site construction logistics impact assessment framework (Brusselaers, Fufa & Mommens, forthcoming).

Further explanations on this Smart Governance Concept 2.0 can be found in:

- *Janné, M., Fredriksson, A., Billger, M., Brusselaers, N., Fufa, S., Al Fahel, R., & Mommens, K. (2021).* ***Smart Construction Logistics Governance - A systems view of construction logistics in urban development.*** *57th ISOCARP World Planning Congress, (November).*
- *Janné, M. Fredriksson, A., Fufa, S., Brusselaers, N. & MacIntyre, S. (2021).* ***MIMIC Deliverable 4.2: Smart Governance 2.0.*** *Retrieved via https://www.mimic-project.eu/sites/default/files/content/resource/files/d4.2_smart_governance_2.0_final.pdf*

Further explanations on the Impact Assessment Framework can be found in:

- *Brusselaers, N., Fufa, S. & Mommens, K. (forthcoming).* ***Environmental impact assessment framework for on-site and off-site construction logistics.***
- *Brusselaers, N. Fufa, S. & Mommens, K. (2021).* ***MIMIC Deliverable 2.2: On-site and off-site construction logistics impact assessment framework.***

6. Conclusions

Cities have the largest potential to reduce negative impacts through requirements on construction logistics. However, today there is a lack of knowledge within cities of how to set such demands and how to involve and manage the numerous and varying stakeholders in these processes. To better monitor and manage construction logistics flows, cities and municipalities need to adjust tendering and procurement procedures in order to reduce the impact of urban mobility. So far, stakeholder participation is utilized in a very limited and fragmented way, and little to no attention is paid to the costs and nuisances caused by the logistics activities during the construction works.

The study explored how cities and stakeholders can act towards the reduction of multi-dimensional impacts, contributing to a more sustainable construction logistics supply chain. Specifically, the authors present a Construction Logistics Stakeholder Framework within the governance of urban construction works, which was adapted from the Multi-Actor Multi-Criteria Analysis (MAMCA) [28], mathematically underpinning stakeholders' preferences and improve the group decision-making process in a multi-actor, multi-criteria construction logistics governance setting. The framework was then deployed in the context of a use case in the Brussels-Capital Region (BCR), Belgium. The case study evidences how different processes are site-, actor- and condition-specific, thereby delivering a common built object. Often however, although facing the same result, different motivations and concerns are at play.

The complete framework description and results can be retrieved in:

Brusselaers, N., Mommens, K., & Macharis, C. (2021). ***Building Bridges: A Participatory Stakeholder Framework for Sustainable Urban Construction Logistics.*** *Sustainability, 13(5), 2678. doi:10.3390/su13052678*

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