Conceptual framework for participatory evaluation: MAMCA

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Reading guide

This deliverable presents the multi-actor multi-criteria analysis framework which will be used as a core methodology within the CIVIC project. It gives a brief overview of the theoretical background for the methodology and provides access to further literature for advanced reading. It also discusses development paths that will be explored within the civic project for enhancing participation of stakeholders within the setting of construction logistics in urban areas.

This deliverable is primarily targeted towards the CIVIC project partners that are involved in the demonstrations and will deploy the MAMCA within the local demonstration context as a tool for participatory multi-stakeholder evaluation.
1. Introduction

1.1 Background CIVIC

Construction is required to create more attractive, sustainable and economically viable cities. This includes the expansion of infrastructure, development of new residential areas and renovation of buildings. However, construction-related transport has a negative impact on people who live, work and/or travel in the vicinity of construction sites.

CIVIC (Construction In Vicinities: Innovative Co-creation) facilitates and supports transport to, from and around urban construction sites that minimises disruptions in the surrounding community and optimises energy efficiency. This is done by 1) evaluation of alternative measures in a multi-actor participatory setting; 2) optimisation models for planning and impact assessment using smart data; and 3) development of smart governance concepts for successful and efficient implementation of these tools.

Over the last five years, strategic research has led to increased understanding on potential energy efficient measures for construction related transport. However, practical improvements are barely implemented in the field, mainly due to the sensitive, multi-actor environment in which decision-makers work. By combining innovation and implementation with applied research, CIVIC will support the movement from “research to market” through experiences from the four European cities that will host demonstration sites for the project: Brussels, Vienna, Amsterdam and Stockholm (see Table 1).

Table 1 Demonstration overview

<table>
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<th>CIVIC Demonstration projects</th>
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<tr>
<td>Brussels</td>
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<tr>
<td>Within Brussels, transport infrastructure related projects of varying sizes are a continuous challenge for the public services involved with significant impacts on mobility and logistics. These projects lend themselves very well as demonstrations for CIVIC. VUB will work closely together with Directory Coördinatie van de Bouwplaatsen (DCB) and Cell Communication of the Brussels Regional Public Service for Mobility (hereafter shortly referred to as Brussels Mobility) as key implementation partner in selecting an appropriate project and in working out a participation process for urban construction sites that involves all affected stakeholders. The demonstration in Brussels will be the 1st demonstration, focusing on participatory decision making.</td>
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<tr>
<td>Amsterdam</td>
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<tr>
<td>Amsterdam has many historic buildings and dwellings that require renovation to improve energy efficiency and functionality. The Real Estate Department of the University of Amsterdam (LOI partner) is renovating their inner city campus buildings (until 2020) and will build a new campus building in a very busy and polluted street (start in 2016). The current and upcoming challenges faced, are very much in line with the goals of CIVIC, including the need for logistics criteria for governance and tender purposes. The logistics implementation partners Deudekom and Transmission aim to increase and optimize their construction logistics activities. The demonstration in Amsterdam will be the 3rd demonstration, incorporating both participatory decision making as well as optimized transport planning.</td>
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<tr>
<td>Vienna</td>
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<tr>
<td>Green field projects such as Seestadt Aspern, a newly built area of Vienna for 20,000 people, enable the adoption and implementation of novel concepts for more sustainable living. Since Seestadt Aspern is not built at once, logistics to and from building sites can be analysed based on available data from Bernard Engineers. For ongoing construction work, the analysis will influence dynamic optimisation models to further improve logistics processes regarding nuisance, assessment of environmental effects, and costs for building companies. The demonstration in Vienna will be the 2nd demonstration, focusing on optimized transport planning.</td>
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</table>
In addition, all demonstrations will also implement innovative impact assessment methodologies, in order to gain a more detailed insight into actual effects of construction logistics on stakeholders and the environment. The specific ambition for implementation in CIVIC is that the first actual impact takes place before the end of the project. This is achieved through the involvement of stakeholders of local construction projects planned for 2016-2018, both within the consortium and as implementation partner with a letter of intent. These partners are real estate, logistics and transport companies, including their clients and suppliers. The local projects create a learning cycle towards full implementation, where each performed demonstration will feed in knowledge and experience to the next demonstration. An active focus on future deployment by actors outside the project consortium is equally important and will be ensured through knowledge transfer workshops and meetings with local and regional authorities and other types of implementation partners. Next to implementation, CIVIC will create knowledge on how participatory MAMCA, optimisation models and innovative dialogue tools can be effectively used in the assessment of energy efficient measures. This is done through applied research covering different political, legal and social environments. It will result in the development of new governance concepts, with recommendations for FQP (Freight Quality Partnerships) and tender procedures. The combined insights will provide strategies for policies and interventions that support new levels of governance implementations in the future.

The results of the two and a half year project are the identification of energy efficient transport solutions to, from and around construction projects, by implementation of participatory analysis; increased understanding among all stakeholders of the impacts of improved logistics and mobility; and recommendations for smart governance concepts, which go beyond urban construction as they create a supportive platform for all urban development decision processes.

Within the project call text, CIVIC addresses the topic “smart governance and smart citizens”, specifically the following two questions:

**How to enable and encourage broad participation and engagement by all stakeholders in all aspects of a city’s life?**

While stakeholders are getting more involved in decisions related to urban design, stakeholder participation with regards to urban mobility and logistics is only applied in a fragmented and limited manner, if applied at all. Most of the times, there is only one-way communication on expected impacts from measures already decided upon. Effective participation requires understanding and the feeling of “having a voice” among stakeholders. With this vision, CIVIC uses the MAMCA methodology which enables to take into account all stakeholders’ concerns at an early stage, as well as the assessment of potential solutions on individual stakeholder level. This enables stakeholders to make better informed decisions and supports them to engage in defining solutions that are both more energy efficient and have a broader acceptance base. Such an approach can create win-win situations for all stakeholders, as by simultaneously alleviating burdens for local community members and optimizing efficiency in operations for contractors, logistics service providers (LSP’s) and transport companies. The methodology is facilitated through an online...
decision making platform using innovative MAMCA software, which provides an interactive method to weigh stakeholder objectives, evaluate options and provide easy-to-understand visualizations of evaluation outcomes. Smart data and transport solutions form input for participatory decision making. Planning, predicting, optimisation and assessment models are essential to increase the understanding among stakeholders on the impact of logistics and mobility measures for efficiencies and externalities in an accurate way.

**What governance concepts are needed for efficient and successful implementation of smart city technologies?**

Participatory decision making and energy efficient processes in urban development projects need to be supported with new governance strategies for successful implementation by both market participants and policy makers. CIVIC has identified four aspects that these new governance concepts should provide:

1. **Identification of the problem owner(s):** the large number and diversity of stakeholders within urban development projects, including different departments within public authorities, make it difficult to assign a single problem owner, and as such, to assign responsibilities. Smart governance concepts should take into account by whom and how strategic ‘ground rules’ are made.

2. **Assigning control and responsibilities:** Next to the ‘ground rules’, governance concepts should define roles that are accountable at an operational level. Hybrid structures and public private partnerships should be considered to match the dynamics of urban development projects.

3. **Formulation of sustainability criteria (performance management):** smart governance concepts should guide the formulation of performance indicators (e.g. for energy efficiency and stakeholder participation in tender procedures), taking into account different phases of urban development projects as this determines the degree of detail that can be assessed.

4. **Guidance for sharing costs and benefits:** the implementation of smart city technologies often requires a redistribution of costs and benefits, which are not always easy to quantify. Smart governance concepts incorporate and assist in this challenge.

**1.2 Work Package 1: Participatory MAMCA**

The activities within the CIVIC project are divided in six work packages (WP). The overall structure is presented in Figure 1.
**Applied research**: applied research is carried out in WP1, 2 and 3. It concerns the development of concepts and methods for participatory decision making (WP1), optimizing logistics processes (WP2) and smart governance (WP3). The applied research activities are closely connected to the demonstrations and assessments that are carried out in WP4 for two reasons: first, as the work in WP1-3 provide the concepts that are demonstrated; and second, as the assessment of demonstrations is used for further improvements and adaptations on the concepts.

**Implementation and results**: The activities in WP4 relate to implementation and assessment of progress and results, this is achieved through practical demonstrations with real-faced issues. The demonstration and assessment activities are deliberately combined in one work package to ensure that the assessment of results is carried out in close collaboration with the target audience, and thus, emphasize the practical applicability. WP5 supports the demonstrations by providing visualizations of concepts and results. The experiences and assessment in WP4 are given back to WP1-3, where revisions and further improvements are then made. This shows the learning cycle towards full implementation. Results are disseminated externally through knowledge exchange sessions with experts, in relevant journals and to a wider public through the CIVIC website and popular media. WP5 increases the impact of research and implementations both within the duration of the project as well as after the project’s end.

The objectives of **WP1** are:

- To set up a participatory platform based on MAMCA methodology interactively involving all stakeholders.
- To provide guidelines for participatory evaluation of alternative measures for demonstrations in WP4.
- To update the adapted MAMCA platform based on feedback from demonstrations (WP4).
- To increase participation (which should result in an increased citizens’ acceptance of proposed alternatives)
This deliverable D1.1 deals with the conceptual framework for stakeholder involvement that will be set up based on the MAMCA methodology and facilitated through an online decision making platform using the innovative MAMCA software providing an interactive method to weight stakeholder objectives, evaluate options and provide easy-to-understand visualizations of evaluation outcomes.

1.3 Structure of deliverable

This deliverable starts with a brief overview of the theoretical background for the methodology. In order to allow interested parties to delve deeper into the MAMCA methodology, access to further literature for advanced reading will be provided. It also discusses development paths that will be explored within the civic project for enhancing participation of stakeholders within the setting of construction logistics in urban areas. Some practical guidelines for working with the MAMCA online platform are added in Annex. It should however be stressed that main assistance for MAMCA deployment during demonstrations will be provided by experts from VUB-MOBI, who will function as a helpdesk during the preparation, implementation and assessment phase.

This deliverable is primarily targeted towards CIVIC project partners that are involved in the local demonstrations and will deploy the MAMCA within the local demonstration context as a tool for participatory multi-stakeholder evaluation.

2. Methodological background of MAMCA

2.1 Introduction

This section aims to provide a brief overview of the methodological background for MAMCA method. It starts with a summary overview of MAMCA. It continues with defining the concept of stakeholder in a decision-making process and subsequently describes the MAMCA methodology which allows to take into account the stakeholders’ different points of view. The different steps of the Multi Actor Multi Criteria Analysis (MAMCA) are described into detail and it is explained why this analysis is an appropriate tool for solving complex decision making problems.

2.2 Summary overview of MAMCA

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<tr>
<td><strong>What</strong></td>
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<td><strong>Outcome</strong></td>
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## Methodology

<table>
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<th>Main criteria</th>
<th>Dependent on the project &amp; the different stakeholders that are involved in the analysis.</th>
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<tbody>
<tr>
<td>Oriented towards which stakeholders</td>
<td>No exclusion. All kinds of stakeholders can be included</td>
</tr>
<tr>
<td>Monetarisation necessary</td>
<td>Is it necessary to monetize indicators? NO</td>
</tr>
<tr>
<td>Possible to deal with qualitative data</td>
<td>YES</td>
</tr>
<tr>
<td>How is sustainability threatened?</td>
<td>Each stakeholder and each criterion (specified by all SH’s) is weighted in the methodology. Sustainability is part of the criteria set → most ‘supported’ alternative gets the highest priority</td>
</tr>
</tbody>
</table>

## Experience / Use of the tool

<table>
<thead>
<tr>
<th>Scale of projects where the tool can be used</th>
<th>Intercity / Regional / Country / International / European / All</th>
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<tbody>
<tr>
<td>Easy to apply on different projects?</td>
<td>YES: Why?</td>
</tr>
<tr>
<td>Interesting for planners?</td>
<td>YES: Why?</td>
</tr>
<tr>
<td>Some examples of successful projects (theme – scope)</td>
<td>- Straightsol (freight transport – EU)</td>
</tr>
<tr>
<td>Challenges</td>
<td>- Time-consuming to elicit the preferences of the stakeholders and to let them participate</td>
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### 2.3 Stakeholder concept

Williamson (1991) first introduced the concept of stakeholders in the field of strategic management. With the emergence of corporate social responsibility (CSR) it became clear that stakeholders needed to be taken into account by firms’ decision making (Donaldson & Preston, 1995). A stakeholder is a person, or a group of individuals, who is able to influence the objectives of an organization or can be influenced themselves (Freeman, 1984). In public decision making there are often multiple stakeholders, besides the government, like private investors and citizens who all
have different interests concerning the decision-making problem. That is why it is necessary to explicitly involve these stakeholders in order to evaluate a particular decision problem (such as e.g. the choice of an urban freight delivery solution) with regards to the objectives of each stakeholder.

It is clear that complex processes like the evaluation of urban and inter-urban freight transport concepts (such as construction logistics) involve multiple stakeholders who need to be involved explicitly in the decision-making process. This involvement will boost the rate of acceptance of a certain project proposal when the point of view of all stakeholders is taken into account (Walker, 2000). Implementing this extra dimension in the traditional Multi Criteria Analysis (MCA) is possible according to (Banville et al, 1998) by improving the integration of socio–political aspects into the decision-making process. This integration is possible when using Group Decision Support Methods (GDSM), like the Multi Actor Multi Criteria Analysis (MAMCA) elaborated by Macharis (2005).

The combination of stakeholder involvement and MCA has known a significant evolution over the years. The goal of GDSM is achieving a consensus between the different stakeholders involved in the decision-making process (Leyva-Lopez, 2010). In reality, this approach might have many pitfalls: each stakeholder has its own unique point of view and expected outcome of a certain project. Over the years, many GDSM have been developed that rely on MCA to support a group decision making problem (for an overview, See Alvarez-Carillo et al, 2010). The difference between these methods is mainly based on the manner in which the information is brought together. Overall, there are three methods for GDSM (Ampe & Macharis, 2008). The MAMCA can be viewed as a type three GDSM due to its explicit stakeholder involvement. Stakeholders have the ability to define their own criteria and to allocate weights to them.

Stakeholder involvement can be organized in many ways. It can be integrated into the whole analysis by performing well defined and structured steps. But in reality, this is often not the case, as (policy or company) decisions are often taken top-down. Stakeholder input is traditionally only used in the first phases of the analysis in order to build an initial framework. Another possibility is that stakeholders are involved at the end of the analysis to provide feedback with regards to the outcome. A combination of the previous methods has also been applied in some cases. Despite the increasing attention for stakeholder involvement and GDSM, the idea of explicitly including them is a rather new concept. It is also possible that the level of stakeholder integration may vary depending on the MCA technique. Most of the time, the traditional MCA is expanded with extra steps before or after the MCA. A MCA can also be completely reformed or extended to allow for stakeholder participation (Ampe & Macharis, 2008).

As stakeholder participation is considered to be a crucial element within CIVIC, we will use a methodology where stakeholder input is seen as the most crucial element of the analysis, namely the Multi Actor Multi criteria Analysis (MAMCA), developed by Macharis (2000 and 2005). For the actual identification of relevant stakeholders in relation to construction logistics, we refer to the Demonstration Deliverables D4.2-5 and governance deliverables D3.x

2.4 Multi Actor Multi Criteria Analysis

The proposed methodology to be applied in CIVIC is the Multi Actor Multi Criteria Analysis (MAMCA) which is an extension of the existing Multi Criteria Analysis (Fandel & Spronk, 1985) (Guitoni & Martel, 1998). The MAMCA allows the researcher to evaluate different alternatives (policy measures, scenario’s, technologies ...) with regards to the objectives of the different
stakeholders that are involved in the decision-making process. This way, the MAMCA allows an explicit inclusion of the stakeholders in the analysis. The methodology was developed by Macharis, 2000, 2005 & 2007) and has been used for many applications, mainly in transport related decision making problems (for an overview, see (Macharis et al., 2009)).

The MAMCA consists of two main phases (Macharis, 2005; Macharis et al., 2009). The first phase is mainly analytical and tries to gather all the necessary information to perform the analysis. The second phase is the synthetic or exploitation phase and consists of the actual analysis. These two phases are then divided into respectively four and three steps (Macharis et al., 2009). This can be seen in Figure 2. The first step is to give a clear problem definition and to determine the alternatives that need to be taken into account. In the second step, all the relevant stakeholders are determined as well as their objectives. These objectives are then translated into criteria in the third step. When the criteria are determined, it is crucial that the researcher finds out how important every criterion is. Weights need to be assigned to the different criteria in order to continue with the analysis. The fourth step tries to couple one or more measurable indicators to each criterion. These indicators allow evaluating each alternative with regards to a given criterion. These indicators can be either quantitative or qualitative, depending on the criterion. The fifth step performs the aggregation of the information of the previous steps into an evaluation matrix. The actual results are given in step six and are generated by using a Multi Criteria Analysis. This allows the researcher to analyse what the advantages and disadvantages of every alternative are. The seventh and last step is the actual implementation of the result and is aimed at the policy maker.

Below, each step is discussed in more detail.

*Figure 2: The MAMCA methodology (Macharis, 2005)*

### Step 1: Alternatives
Determining the relevant alternatives is the starting point of the whole analysis. These alternatives are determined in relation to a given problem. An important aspect is who decides on the alternatives. If the stakeholders are involved in (co-)creating the alternatives, there is clearly a link between Step 1 and Step 2, as first the relevant stakeholders to be involved in alternative creation/identification should be assessed. Therefore, a double arrow connects “Alternatives” and
“Stakeholder analysis”. If alternatives are identified top-down by for example local government, the chronology between Step 1 and Step 2 is stricter. These alternatives can be policy measures, scenarios, strategies or other actions that are able to solve the problem at hand. Often, a business-as-usual (BAU) scenario is included, which allows to evaluate the selected alternatives against this BAU scenario. The alternatives are then translated into concrete scenarios that will serve as a basis for the whole analysis in the following steps. In other words, the scenarios are the clarification of the alternatives. In the context of urban freight policy, the alternatives could for example be: business-as-usual (no additional policy), implementation of restricted time windows, mandatory use of Urban Distribution Centre or incentives for electric delivery vans.

**Step 2: Stakeholders**

Once the alternatives are determined, all the relevant stakeholders need to be identified through a stakeholder analysis. According to Freeman (1984) a stakeholder is a person who has a certain interest (financial, legal, social, environmental ...) in the consequences of a certain decision or measure. It is crucial to determine what the objectives of each stakeholder are in order to perform the analysis. Their vision on the problem definition is crucial and it is possible that they could come up with a new alternative. This enriches the overall analysis (Ampe & Macharis, 2008). Stakeholder identification is an essential part within CIVIC, as urban construction logistics related issues typically involve a wide variety of involved parties, such as residents, shops, local authorities, commissioners, (sub)contractors, utility companies, and logistics service providers. For a specific list of stakeholders: see Deliverables D4.2-5.

Explicitly including the stakeholders in the analysis is necessary due to two main reasons. First of all, the quality of the final decision might not be guaranteed by the researcher alone. This is due to the fact that he/she has limited access to important sources of information concerning the decision problem. Secondly, including stakeholders might be useful when the decision problem is highly controversial, as the selected alternative will be more broadly supported when stakeholder concerns are explicitly considered (Ampe and Macharis, 2008; Macharis, 2005; Macharis, 2007; Macharis et al., 2009). A clear identification of stakeholders and their criteria is crucial for arriving at widely supported solutions. In order to allow for a meaningful analysis, the number of stakeholder groups should be kept at a manageable and interpretable level.

**Step 3: Criteria and weights**

Initially, the criteria are determined based on the previous steps, for each stakeholder group separately (Macharis, 2007). Criteria are thus not (necessarily) the same for different stakeholder groups: for a private company the criteria will be more economically oriented such as costs and return on investment, while for local government they will usually include as well more social and environmental criteria, such as emissions and noise nuisance. In a traditional MCA these criteria represent the general effects of a certain alternative but this is not the case in a MAMCA (Ampe & Macharis, 2008). When these criteria per stakeholder group are determined, they can be summarized by using a hierarchical tree (Macharis, 2005).

Determining the criteria per stakeholder group however is not enough. It is obvious that not every criterion is equally important for a given stakeholder. This is why this step also consists of allocating weights to the criteria (Macharis, 2005; Macharis, 2007; Macharis et al., 2009). There are different methods available for determining the weights (for an overview, see (Nijkamp et al., 1990). Often, the Analytic Hierarchy Process (AHP) developed by (Saaty, 1988) will be used to
allocate the weights. AHP uses pairwise comparisons, where all the criteria are matched one–on–one. By using a 9-point scale, the stakeholders’ preferences are expressed. These relative preferences are then put into a matrix and normalized. This leads to a priority vector that represents the relative weights on a ratio scale. This method is able to use theoretically valid weights and is praised by users for its reliability and ease of use (Wang & Yang, 1998). But other methodologies exist and might be appropriate; depending on the circumstances (number of stakeholder groups and criteria, time and budget constraints,…). Determining the criteria from a stakeholder–based perspective has one main advantage. When performing a MCA, the criteria are supposed to be independent or non–redundant. However, research has shown that there often is a certain level of dependence (Ozturk, 2006). The MAMCA solves this issue by letting the stakeholder determine the weights of the criteria (Macharis et al., 2009). This allocation of weights will be described in detail in the demonstration Deliverables D4.2-5. In order to keep the process of weighting manageable, also here it is advisable to keep the number of criteria limited. It is possible that a stakeholder consists of several members. In order to determine the weight for a given stakeholder group, a common weight can be achieved through consensus. If this appears to be too difficult to achieve, the researcher is able to calculate an overall weight by taking the geometric mean of all the individual scores (Macharis et al., 2009).\footnote{The geometric mean of n numbers is given by multiplying these numbers and getting the nth square root of the product.}

By introducing an extra dimension to the decision-making problem, there is one main issue. The question arises whether the stakeholders should also be weighed. The initial assumption is that every stakeholder is equally important. But depending on the decision-making problem this assumption might not be optimal. The researcher always has the possibility to perform a sensitivity analysis to see if the assumption of equal importance is valid (Macharis et al., 2009). This discussion will also be tackled in WP3 regarding the smart governance concepts.

**Step 4: Indicators**

The fourth step consists of “operationalizing” the criteria by using measurable indicators. This allows the researcher to measure and evaluate how much a certain alternative performs on a given criterion. In other words, a scale is created by using indicators in which the contribution of an alternative can be measured (Macharis, 2007, Macharis et al., 2009). Most of the time these indicators are of a quantitative nature (such as amount of €, number of decibels or kilogrammes of CO\textsubscript{2}), but it is also possible to use qualitative indicators (such as perceived safety or visual attractiveness of a solution) (Macharis et al., 2009). It is also possible that several indicators are used to measure the performance of an alternative on one single criterion and vice versa that one indicator can be allocated to multiple criteria (Macharis, 2007). The indicator selection process is fully described in CIVIC Deliverable D4.1 (“Assessment framework”) and the “operationalisation” of the indicators in a local context will be discussed in the relevant demonstration Deliverables D4.2-5.

**Step 5: Analysis and ranking**

To evaluate the different alternatives there are many different MCA methods available. Especially the MCA methods of the so-called Group Decision Support Methods are very useful to apply in the MAMCA methodology. These methods involve the PROMETHEE methods (Brans, 1982; Macharis et al., 1998), ELECTRE (Roy & Bouyssou, 1988) and AHP (Saaty, 1988). The main advantage of these GDSM is that they offer a certain freedom to the stakeholders in terms of defining their own
criteria, weights and preference structure and only at the end of the analysis the different points of view are being confronted (Macharis et al., 2009).

Step 6: Results
The eventual outcome of the MAMCA is a classification of the proposed alternatives revealing their strengths and weaknesses. It might be useful to perform a sensitivity analysis to test the robustness of the results (Macharis et al., 2009). The overall classification is however not the only result the MAMCA provides. It results also in a ranking per stakeholder, leading to an identification of the most important stakeholders in the decision-making process along with their criteria. It will be possible to evaluate for each stakeholder which elements have a positive or negative effect on the sustainability of the proposed alternatives. The results will show who is (more or less) in favour of the implementation of the city distribution concept and who has doubts or is even straightforward negative about it. This stakeholder-based approach might be very valuable when taking a final decision (Macharis, 2005, 2007). As the MAMCA is often organized as an interactive process using workshop(s), it also allows to provide insight in how actors are looking at a problem and facilitates to capture feedback from the actors when discussing the results. Gaining insight in the scoring of criteria by other stakeholders can enhance acceptance of particular alternatives, as stakeholders realize the impact of their preferred alternative on the criteria of other stakeholders.

Step 7: Implementation
The final step is taking actual measures and implementing them. By taking into account the feedback of the stakeholders and implementing it in an efficient and effective way, a final strategy can be set up by the policy makers. When the decision is made, steps have to be taken to implement the chosen alternative by creating deployment schemes. The information on the points of view of each stakeholder, received from the previous steps indeed helps to define the implementation path. It might be possible that this step leads to the definition of new or adjusted alternatives which leads to a restart of the whole analysis (Ampe & Macharis, 2008; Macharis et al., 2009).

Conclusion
This methodology looks at the different possibilities evaluating the alternatives on the criteria of the different stakeholders. The analysis gives a clear idea of advantages and disadvantages of certain measures or concepts according to the different stakeholder groups. MAMCA is therefore very well suited to complex decision-making processes such as those involved in mobility policies and transport sectors where many stakeholders from several areas and backgrounds are involved. It allows decision makers to arrive at a comprehensive and coordinated vision with regards to complex scenarios.

The MAMCA methodology has already proven its usefulness in several transport related decision problems. It was used i.e. to cope with an intermodal terminal location decision problem, for a study on the choice between waste transport alternatives in the Brussels region, for the location choices of a new high speed train terminal, for the evaluation of different driver assistance systems in the ADVISORS project, for the evaluation of DHL’s hub strategy at Brussels airport, in the project ‘Night Deli’ for the evaluation of different night distribution scenarios, in the assessment of spatial data infrastructure strategies, for deriving implementation priorities for innovative road safety measures, for the evaluation of stimulating measures for the purchase of more environmental friendly vehicles and for the evaluation of road pricing schemes (see Macharis et al., 2012 for references). As the MAMCA is a decision support tool, it cannot replace the actual decision of selecting an alternative, but it proved to be very valuable in identifying the issues that require
specific attention when selecting a particular alternative (e.g. noise disturbance of night-time deliveries for residents).

With the online MAMCA software, accessible on [www.mamca.be](http://www.mamca.be), the different steps of the methodology are easily followed and a good visualisation of the problem is generated. The example below visualizes how different stakeholder groups evaluate different sustainable mobility scenarios in the Belgian city of Leuven. As will often be the case, no scenario scores highest for all stakeholders. The “carfree city centre” might be preferred by most stakeholders, but scores (not surprisingly) very poorly for car users, who even would prefer to keep “business as usual”. However, notwithstanding this exception, this particular MAMCA clearly demonstrates that alternatives are considered an improvement when compared to business as usual, so there is a clear potential for implementing an alternative. A “smart kilometer charge” might be a reasonable compromise, although it might require some adjustments towards the commercial services and offices, in order for them to be fully acceptable. But even for this stakeholder group, the alternative scores higher than business as usual. On the stakeholder level, MAMCA allows to see how a particular alternative is scoring on the selected criteria of a stakeholder group. In this way, the implementation path can take into account on which criteria for which stakeholder group, additional action might be required.

Figure 3: MAMCA example: evaluation of mobility scenarios in a Flemish city (VUB-MOBI, 2014)

As this example illustrates, MAMCA does not necessarily allows to identify the ultimate overall preferred solution, but enables to define implementation paths for selected solutions that take into account the concerns of stakeholder groups. In this way, increased acceptance of imposed measures by all stakeholder groups can be achieved.

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2 In the annex, the slides and instructions of the MAMCA training held during the CIVIC meeting in Brussels on 30th of August 2016 are added. These documents give a first introduction to the MAMCA software.
3. Sources for further reading

Below some sources for further advanced reading can be found. A short description of the main focus of the paper is given. Full paper versions can be found on Projectplace.

Technical paper on PROMETHEE approach (outranking method).

Additional technical paper on the PROMETHEE procedure.

Classification scheme and comprehensive literature review in order to uncover, classify, and interpret the state of research on PROMETHEE methodologies and applications in 2010.

Analysis of applications of PROMETHEE-GDSS and further developments for enhancement of its applicability. The analysis is structured along a strengths, weaknesses, opportunities and threats (SWOT) analysis and on the basis of this analysis recommendations are given

Short introduction to the basic principles of AHP

Introduction of the MAMCA methodology by an overview of other evaluation methods for transport projects in the past and illustration by means of two practical cases.

Policy related paper describing the MAMCA methodology and how it was applied in the “Flanders in Action Process”.

Theoretical foundation of the MAMCA, together with several applications in the field of transport appraisal

Overview of the use of Multi-Criteria Decision Analysis (MCDA) for transport project appraisal.

MACHARIS, C., BERNARDINI, A., 2015, Reviewing the use of Multi-Criteria Decision Analysis for the evaluation of transport projects: Time for a multi-actor approach, Transport Policy, 37, 177-186

Use of MAMCA methodology complemented with an electronic group decision support system (GDSS) through a workshop in Leuven, Belgium where four scenarios to improve mobility in the city centre were evaluated based on the preferences of 34 stakeholders. Findings show that criteria weighting, the set-up of the evaluation matrix, the ranking of alternatives and implementation can be enhanced with the MAMCA approach.


4. Enhancement of MAMCA methodology

4.1 Link to ERANET/JPI goals

CIVIC aims to contribute to the JPI objectives directly as the project enables different stakeholders with different priorities to operate together on city developments. The project connects logistics and construction companies, citizens’ representatives, public authorities, property owners and developers, and researchers from various disciplines. In addition, CIVIC aims to contribute indirectly to the broader JPI objectives (i.e. attractive, sustainable, economically viable urban areas) as it supports the management of processes and people within construction projects that improve the quality of life in urban areas. In addition, the methodological concepts developed within CIVIC have the potential to be transferred to other areas of urban policy where different stakeholders with diverging interests and priorities are involved (such as city distribution, urban planning, traffic safety), enlarging the possibilities of the developed methodologies to increase urban quality of life.

The CIVIC goals are visualised in Figure 4.

Figure 4: Goals of CIVIC

<table>
<thead>
<tr>
<th>1. Management of processes:</th>
<th>Accurate insight into consequences for and from construction related transport planning measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Management of people:</td>
<td>Early insight into the effectiveness of measures from a multi-actor multi-criteria perspective</td>
</tr>
<tr>
<td>3. Smart governance:</td>
<td>enable the implementation of participatory decision making and energy efficient transport measures</td>
</tr>
</tbody>
</table>

Aim: Support efficient, sustainable and broadly endorsed transport to, from and around urban construction sites that minimise disruptions in the surrounding community and optimise energy efficiency.
The MAMCA framework described in this deliverable contributes to achieve CIVIC goals. The general goal of CIVIC is to facilitate and support efficient, sustainable and broadly endorsed transport to, from and around urban construction sites that minimises disruptions in the surrounding community, improves construction productivity and optimises energy efficiency. The evaluation of alternative logistics/mobility measures in a participatory multi-actor multi-criteria analysis (MAMCA) is defined as one of the main contributors to achieve this goal, as it facilitates the management of people as well as the management of processes. The first is achieved through the stakeholder analysis and identification, and through the weighing of their objectives/criteria, the second is included through the selection of relevant indicators for measuring the impact of alternatives. The selection of indicators and the linkages between the methodological tools and demonstration assessments is discussed in detail in Deliverable 4.1 (“Assessment framework”).

4.2 Developments within CIVIC

Within the CIVIC project, the MAMCA methodology will be enhanced and adapted as follows:

1. **Stakeholder identification**: provide more accurate representation of stakeholders through identifying specific subgroups by clustering them into relevant groups based on available data (e.g. age (citizens), delivery frequency (companies)) to increase representativeness of all stakeholders involved.

2. **Problem identification**: develop structured way of identifying problems with an increased stakeholder participation (local knowledge of citizens and specific needs of contractors/LSP’s).

3. **Co-creation of alternatives**: create alternative solutions together with stakeholders (incl. citizens). This also provides the framework conditions of scenario evaluation and optimisation in WP2.

4. **Identification of stakeholder objectives and criteria**: combine interactive workshops and an online participatory platform to assess the importance (weights) of the stakeholders’ criteria.

5. **Estimation of impacts of alternatives**: assess how the impact of alternatives can be estimated on stakeholders’ criteria through stakeholder input concerning indicator selection and data provision.

6. **Results, visualization and feedback loop**: enhance involvement of stakeholders into discussion of results by providing them with visualizations of outcomes and online and offline (workshop) forum for discussion. Feedback of evaluation outcome to WP2 where detailed logistics solutions are optimized.

Figure 5 gives a visual representation of potential development paths for improving the participatory MAMCA evaluation framework.

*Figure 5: Enhancement paths for participatory MAMCA (VUB-MOBI, 2016)*
The adapted MAMCA framework will be applied to the demonstration projects in WP4 and will also provide input for WP3 where it will be embedded into a smart governance concept. This work approach allows for a gradual adaptation of the participatory platform as the methodology will be optimized in a stepwise manner to reflect the outcomes of monitoring of the different demonstration projects in WP4.

Opportunities to extend the application of the participatory MAMCA method to other (urban) problem areas will be investigated as well.
References


Multi-Actor Multi-Criteria Analysis (MAMCA)
MAMCA Methodology

Let’s MAMCA: www.mamca.be

Source: Macharis, 2000 en 2004
Login

Create a Project
List of projects

Alternatives

• **Business as usual**: truck and van deliveries to and from construction site from 7 am until 5 pm

• **Bundled deliveries**: Bundled deliveries in designated (limited) time slots during the day with larger diesel truck

• **Inland waterway**: Logistic flows via inland waterway by barge and last mile with (smaller) electric trucks

• **After-hour deliveries**: After-hour deliveries (off-peak) to a maximum extent (before 7 am and after 5 pm) and longer working days
Add Alternatives

Actors

• Residents
• Local government
• Contractor and utility companies
• Institutions and companies
  • Schools
  • Companies/shops
  • Institutions of public use (such as hospitals, fire department & police)
• Transport infrastructure users
  • Car users
  • Bicyclists
  • Pedestrians
  • Public service entities
Add Actors

Invite Actors and Surveyors
Criteria

- Residents:
  - safety
  - noise
  - emissions (air pollution and climate change)
  - dust
  - accessibility of home
  - accessibility of (public) transport
  - construction time (duration of annoyance)

Criteria

- Local government
  - level of responsibility
  - enforceability of measures
  - impact on voters
  - construction time (duration of site)
Criteria

- **Contractor and utility companies**
  - construction time
  - Costs
  - accessibility of construction site
  - safety
  - allowed working space

Criteria

- **Institutions and companies**
  - accessibility for employees
  - accessibility for “clients” (e.g. students, patients, visitors etc.)
  - accessibility for suppliers/services (e.g. ambulances)
  - safety
  - noise
  - air pollution
Criteria

- Transport infrastructure users
  - connectivity losses
  - time losses
  - safety
  - construction time (duration of annoyance)

Add Criteria

- Residents:
  - safety
  - noise
  - Emissions

- Local government
  - level of responsibility
  - enforceability of measures
  - impact on voters

- Contractor & utility companies
  - construction time
  - Costs
  - accessibility of construction site
Weigh the criteria

Let’s try one method per group

Evaluation
Multi-Actor Analysis

![Graph showing multi-actor analysis with various groups and scores](image)

Multi-Actor Analysis

![Graph showing multi-actor analysis with various groups and scores](image)
Multi-Actor Analysis

MAMCA Workshops

- Arrange people in groups
- Ask for accounts from us
- Internet connection
- Devices (e.g. laptops, iPads)
- Handouts (if necessary)
Let’s MAMCA:
Go to http://www.mamca.be
Use the provided login information to log in
Create a project by providing a name. We suggest to choose PROMETHEE as the evaluation type.

**Step 1: Alternatives**
We suggest to add 3 alternatives in this test project.

- **Business as usual**: truck and van deliveries to and from construction site from 7 am until 5 pm
- **Bundled deliveries**: Bundled deliveries in designated (limited) time slots during the day with larger diesel truck
- **Inland waterway**: Logistic flows via inland waterway by barge and last mile with (smaller) electric trucks

**Step 2: Actors**
We suggest to add 3 actor groups.

- **Residents**
- **Local government**
- **Contractor and utility companies**

- Invite a participant (yourself perhaps) to the ‘Residents’ group to see how the survey looks.

**Step 3: Criteria**
Add criteria for each of the actor groups.

- **Residents**:
  - safety
  - noise
  - Emissions

- **Local government**
  - level of responsibility
  - enforceability of measures
  - impact on voters

- **Contractor & utility companies**
  - construction time
  - Costs
  - accessibility of construction site

**Step 4: Weighs**
Allocate weight to the criteria of each group.
Experiment each of the three functions, “Pairwise Comparison”, “Equalize Weights” and “Enter Weights Manually”, for each of the actor groups

**Step 8: Evaluate the criteria for the different alternatives**
Please fill in this evaluation table. Choose the appropriate qualitative evaluation from the dropdown list for each alternative and criteria. The meaning of the labels is explained in this table:

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very negative</td>
<td>The implementation of the alternative would have a very negative impact on the criterion</td>
</tr>
<tr>
<td>Negative</td>
<td>The implementation of the alternative would have a negative impact on the criterion.</td>
</tr>
<tr>
<td>Slightly negative</td>
<td>The implementation of the alternative would have a slightly negative impact on the criterion.</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Neutral</td>
<td>The implementation of the alternative would have no impact on the criteria. Choose this option also if a criterion is not relevant for your evaluation.</td>
</tr>
<tr>
<td>Slightly positive</td>
<td>The implementation of the alternative would have a slightly positive impact on the criterion.</td>
</tr>
<tr>
<td>Positive</td>
<td>The implementation of the alternative would have a positive impact on the criterion.</td>
</tr>
<tr>
<td>Very positive</td>
<td>The implementation of the alternative would have a very positive impact on the criterion.</td>
</tr>
</tbody>
</table>

For some criteria, data was collected during the test phase of the demonstration. If there is data available, choose “set parameters” and edit the “Scale Preference” to quantitative.

**Step 9: View the analysis**

You can now discover the evaluation outcomes or download the evaluation report.