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User-centric vision for mobility in 2030: Participatory evaluation of scenarios by the multi-actor multi-criteria analysis (MAMCA)

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Abstract

Mobility4EU is an EU-funded project that will deliver a vision for the European transport system in 2030 and an action plan with a roadmap to implement that vision. The entire process is organized within a structured participatory approach that engages a broad stakeholder community into the consultation processes. At the heart of this process lies the Multi-Actor Multi-Criteria Analysis (MAMCA) to assess the preferences of fourteen stakeholder groups across the whole transport and mobility spectrum with regards to four mobility scenarios for 2030. The outcome of the MAMCA is a visualisation of the ranking of these scenarios per stakeholder group, demonstrating what synergies we can build upon and what conflicts should be addressed during the last step of the consultation, a consensus building workshop. Here stakeholders come to a common vision for transport in 2030 based on the most supported scenarios. The aim of this paper is to present the methodology and the results of the evaluation of the four scenarios and highlight the synergies and conflicts between the various stakeholders.

Keywords: scenario building; multi-actor multi-criteria analysis; participatory evaluation

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1. Introduction

Mobility4EU is an EU-funded project that will deliver a vision for the European transport system in 2030 as well as an action plan containing a roadmap to implement that vision. It is based on the identification and assessment of societal trends that will influence demand and supply of future transport as well as on the compilation of a portfolio of promising cross-modal transport solutions that address these challenges. The entire process is organized within a structured participatory approach that aims to engage a broad stakeholder community related to transport into the consultation processes. Central in this process is the Multi-Actor Multi-Criteria Analysis (MAMCA) to assess the preferences of fourteen stakeholder groups across the whole transport and mobility spectrum with regards to mobility scenarios for 2030. As a first step, four narrative scenarios were created based on three stakeholder workshops to depict trends influencing transport in Europe and collect the emerging technological, organisational and policy-related solutions. Then relevant stakeholders were identified and divided into stakeholder groups encompassing all transport modes, users, manufacturers and policy makers and each having its own objectives and evaluation criteria. Next a weighting of the criteria was carried out through an online survey and the impact of the scenarios on the stakeholders' criteria was evaluated and validated by an expert panel. The outcome of the MAMCA evaluation is a visualisation of the ranking of the scenarios for each stakeholder group that indicates what synergies we can build upon and what conflicts should be addressed during the consensus building workshop, which is the last step of the consultation process. Within this last workshop, stakeholders were presented with the results of the MAMCA evaluation and came to a common vision for transport in 2030 based on the most supported scenarios. The aim of this paper is to present the methodology and results of the MAMCA process, to discuss the evaluation of the scenarios and to highlight the synergies and conflicts between the various stakeholders

2. Building a transport vision based on Multi-Actor Multi-Criteria Analysis: methodology and results

2.1. Methodology

In order to obtain a widely supported and consensus–based action plan, the Multi-Actor Multi-Criteria Analysis (MAMCA) methodology (Macharis, 2009) is used to consult a broad stakeholder community representing the main mobility actors in Europe. MAMCA is an enhancement of the traditional multi-criteria decision-analysis (MCDA) techniques, allowing explicit stakeholder involvement in the evaluation process. In the MAMCA, alternatives are evaluated on the criteria which are based on the various objectives of the different involved stakeholder groups. MAMCA distinguishes itself from traditional MCDA methods by the non-aggregation of the criteria of the stakeholder groups. As a result, the weighting and the evaluation of the alternatives are carried out separately for each group. The structure of a MAMCA process is depicted in Fig. 1 and consists of seven steps starting from a scenario building process and ending with a consensus building exercise that will deliver the preferred scenario, which will be the most important building block for creating a vision for transport in Europe. For the implementation of the MAMCA process, a dedicated software platform developed at the Vrije Universiteit Brussel was used. This software does not only contain algorithms for the processing of gathered data but also offers an online user interface to collect input from stakeholders and hence it was used to collect data from a wide range of transport stakeholders through Europe[†]. In the next sections, the MAMCA process as applied in the Mobility4EU project and the results of the consecutive steps will be explained in more detail.

2.2. STEP1: Scenario building

The process started with the consolidation of dominant trends (Mobility4EU, 2016a) and potential future solutions (Mobility4EU, 2017a) into four scenarios that depict the potential future of the European transport system. These narrative scenarios were built using the intuitive logics method and further refined and validated at a stakeholder co-creation workshop (for more details see Keseru et al. (2016); Mobility4EU (2016b). Intuitive logics is based on the estimates (intuition) of experts as a reference point (Wack, 1985). Scenarios are hypothetical, they are based on assumptions about the future and they include possible, probable and desirable future changes (Kosow & Gaßner, 2008).

In order to develop the potential scenarios, we selected trends that have the *highest uncertainty and the highest impact (so called pivotal uncertainties)* based on a survey of 33 transport experts. These stakeholders were selected

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to represent different transport modes, operators, users and providers. Two groups of trends, namely ***policy & legislative framework*** **and** ***lifestyle & user behaviour*** emerged as pivotal uncertainties. They provided the basis for the development of four alternative scenarios. Four preliminary scenarios were created (see schematic representation in Fig. 2). They were then discussed with the involved stakeholders at a scenario building workshop (for details see Mobility4EU, 2016b). The stakeholders evaluated the feasibility of the combinations of societal trends and matched potential technological and policy-related solutions with them in each scenario to complete the scenario building process.

The process resulted in four scenarios: *Data world* (low regulation level, high level of private initiatives, flexible and individualistic lifestyles), *Digital nomads* (high level of government regulation and flexible and individualistic lifestyles), *Slow is beautiful* (low regulation level, protectionist markets, local sharing initiatives), *Minimum carbon* (healthier and active lifestyle based on sharing, high level of government regulation to reduce carbon emissions). The scenarios are briefly described below. For the full scenario descriptions please consult Keseru et al. (2016).

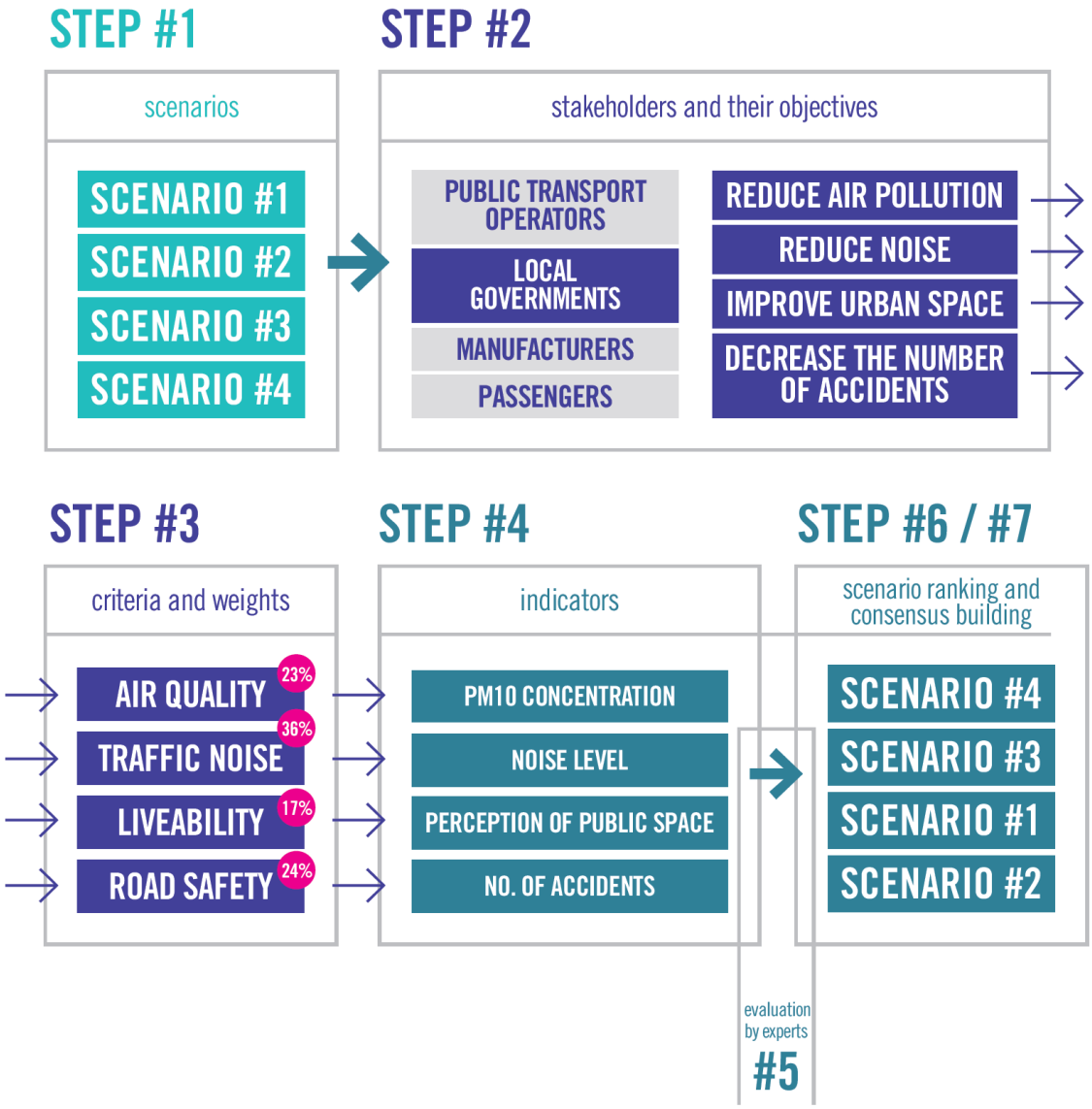

Fig. 1 Schematics of de MAMCA process with an example (the example is hypothetical)

1. *DATA WORLD*
   Harmonisation of regulations and technology standards at the European level is limited. The activities of companies in the transport and mobility sector are less strictly regulated. Government support for innovation is limited, innovation mainly comes from private companies, which collect, own and manage transport data. People are becoming increasingly flexible with an accelerated pace of life.

Individualisation leads to smaller household size and flexible employment. This scenario mainly includes solutions that increase efficiency and profitability of private actors in transport and enable large private corporations to provide integrated mobility services.

2. *DIGITAL NOMADS*
   There is a high level of standardisation of regulations and technology standards at the European level. The activities of companies in the transport and mobility sector are more strictly regulated. The boundaries between private life and work disappear as people become always online and available. The solutions in this scenario enforce cooperation between private and public actors to reduce carbon emissions and increase efficiency. Full digitalisation and automatization of the transport system is supported by government regulation and funding. Integrated mobility services are strictly regulated to provide a balanced set of transport options to users.

3. *SLOW IS BEAUTIFUL*
   European policy focuses on enabling local initiatives rather than supranational standardisation. Innovation is less supported due to scarce financial resources. People more and more turn to eco-friendly local cooperative production of food and energy, urban gardens and peer-to-peer services. Bottom-up initiatives of local communities thrive with few legal limitations on local sharing and production initiatives. The solutions in this scenario aim to restrict local road traffic and enable local initiatives to share mobility resources. The approach to digitalisation and automatization is more cautious.

4. *MINIMUM CARBON*
   Due to the severe pressure of climate change governments want to fundamentally change the behaviour of their citizens and companies to steer them to reduce carbon emissions and move them away from fossil fuels. Burn-out from fast-paced work have turned people towards healthier and active life. The solutions support strict regulation of carbon emissions both for freight and passenger transport. The focus is on reducing travel demand and provide accessibility to work and services within local self-sustaining neighbourhoods.

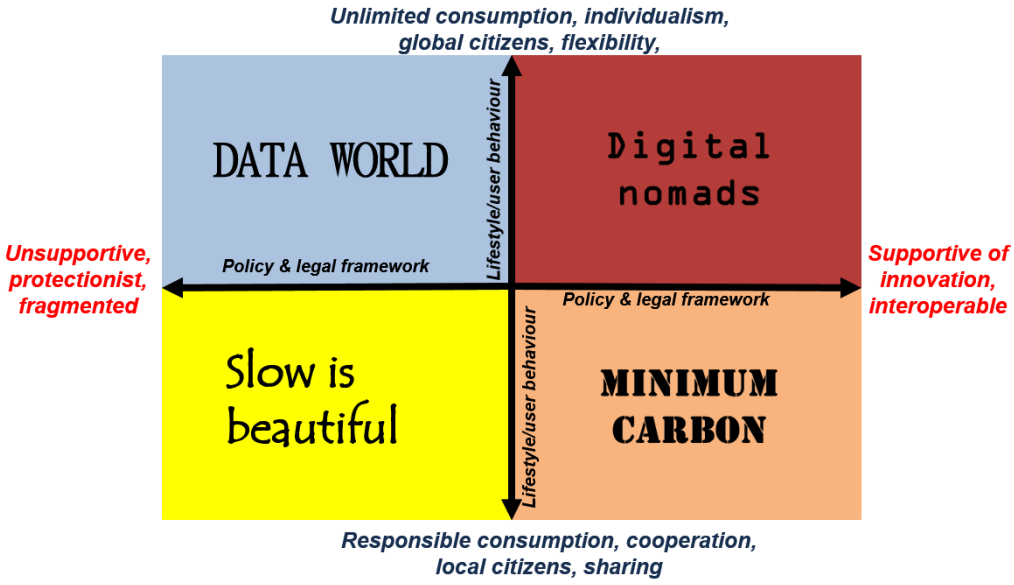

Fig. 2 The four scenarios

2.3. STEP2 Identification of stakeholders and their objectives

After the development of the scenarios, they need to be evaluated by a wide group of stakeholders with respect to their respective objectives. Therefore, an intensive stakeholder mapping exercise was carried out: all stakeholder groups that are relevant for the evaluation were identified and their objectives were identified through an online survey (e.g. reduction of air pollution, reduction of noise, reduction of the number of accidents etc.). The objectives

were translated into simple criteria (e.g. reduction of traffic accidents = traffic safety, reduction of air pollution = air quality). Stakeholder groups were selected to cover all transport modes encompassing both private and public actors related to infrastructure, vehicles, services and users while avoiding overlap across the groups. Stakeholder groups are distinguished from each other by their distinct objectives. The result of this exercise can be seen in Table 1.

Table 1. Stakeholder groups as identified in MAMCA process in the Mobility4EU project

Stakeholder group	Explanation
S1: Terminal infrastructure for freight and passengers	Stakeholders that are active in the management or operation of inland and seaports, airports and logistics centres
S2: Network infrastructure for freight and passengers	Stakeholders that are active in the construction, management, operation of roads, railways, waterways
S3: Private and commercial vehicle manufacturers	Manufacturers of cars, trucks, private boats (including suppliers of parts, electronics, etc.)
S4: Public transport vehicle manufacturer	Manufacturer of buses, railway vehicles, urban transport vehicles
S5:IT/ITS solutions developers	Developers of information and communication technology and intelligent transport systems solutions including data collection and management services & traffic management
S6: Passenger service operators	Operator of public transport (local and long distance) and car sharing services
S7: Representatives of disabled and/or elderly transport users	Representatives of people with disabilities (physical, visual, hearing, speaking, mental) and older transport users
S8: Representatives of public transport passengers (land transport)	Representatives of public transport passengers (bus, rail, urban transport)
S9: Representatives of pedestrians and/or cyclists	
S10: Shippers of goods	Organisations that ship goods to receivers (retailers, wholesalers, goods manufacturers)
S11: Freight service operators	Logistics companies and freight forwarders
S12: Local policy makers, transport authorities	Policy makers, transport authorities at the local level (municipalities)
S13: National or regional policy makers	Policy makers, transport authorities at the regional and national level
S14: Future generation	People born after 2000 (Generation Z)

2.4. STEP3: Criteria and weights

In the next step, each stakeholder has to attach weights to the criteria that have been derived from objectives related to their own stakeholder group, thus ranking the importance of each of his/her objectives. This weighting was achieved through an online survey with the participation of 224 stakeholders from 28 European countries representing private and public companies, research organisations as well as European national, regional and local associations and local, regional and national governments. Prior to the online version, the weighting method was also demonstrated to the stakeholders in a workshop [MAMCA Weighting Workshop, Brussels, 22 November 2016; for details see Mobility4EU (2016c)].

Survey participants used the interactive elicitation feature of the MAMCA software to compare all possible combinations of the criteria previously identified for their group using a nine-point scale based on the analytic

hierarchy process (AHP) (Fig 3). The analytic hierarchy process is a theory of measurement of priorities in decision making facilitated through pairwise comparisons of criteria (Saaty, 1994). Weights to the criteria are not attached directly but it is a result of the criteria pair comparison task performed by the stakeholders, and computed in the MAMCA software.

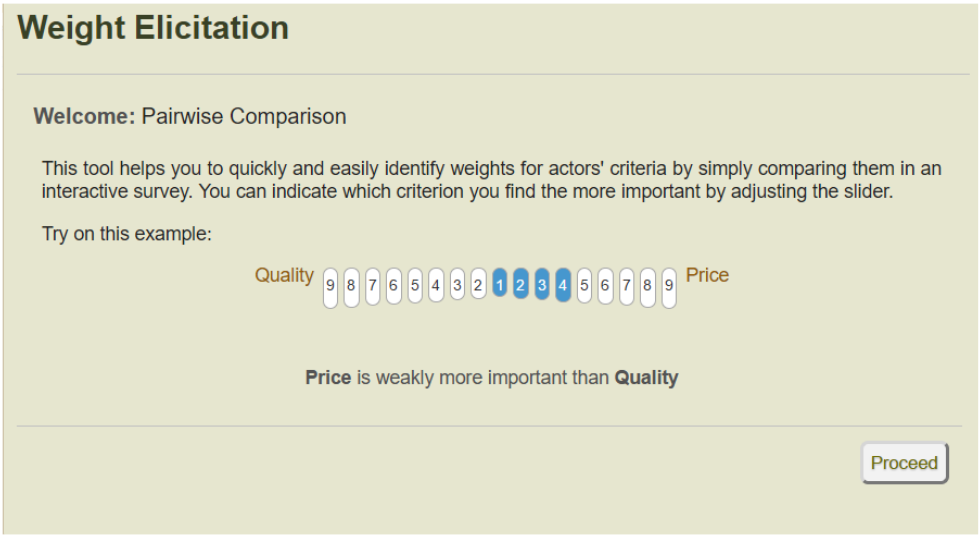

Fig. 3: Weight elicitation tool in the MAMCA software

2.5. STEP4: Indicators

In the fourth step, indicators and measurement methods for each criterion were identified in collaboration with a panel of international experts. Indicators are the key parameters to qualify the performance of a scenario i.e. how a certain future scenario would impact a certain criterion (e.g. number of car accidents is an indicator for the criterion 'traffic safety') compared to the current situation.

2.6. STEP5: Evaluation by experts

The scenarios were evaluated by international experts based on qualitative assessment (e.g. slight improvement, significant improvement, etc.). In this manner, the impact of each scenario on each criterion was assessed using the indicators, to see e.g. how the scenarios affect traffic safety, greenhouse gas emissions etc.

2.7. STEP6: Scenario Ranking

In this step, the MAMCA software produces a ranking of the four scenarios for each of the stakeholder groups. Therefore, it considers the evaluation of the experts on the impact of each scenario on each of the criteria, and combines it with the weighting the stakeholders have provided. The output of this exercise can be seen in Fig. 4 where ranking of the scenarios is given for each stakeholder group. It can be noticed that the scenarios Digital Nomads and Minimum Carbon are the highest rated for most of the groups. It points out the importance of government intervention and support in developing the transport system as both scenarios propose a pronounced role of governments in supporting digital innovation and interoperability (Digital Nomads) or introduce strict regulations to limit CO_2 emissions (Minimum Carbon).

On the other hand, there is a clear disagreement on which of these two scenarios should be supported through future policies. It reflects the stance of major stakeholders on whether the transport system should support an individualistic model of society and mobility by satisfying an increasing travel demand, or a mobility system where resources are shared in order to tackle increasing carbon emissions. Local and national policy makers, pedestrians and cyclists and public transport vehicle manufacturers support the Minimum Carbon scenario. Many of the actors related to manufacturing and infrastructure operation and construction (terminal and network infrastructure operators, private vehicle manufacturers) would prefer the Digital Nomads scenario, which aims to fulfil increasing travel demand by building new infrastructure and further develop private vehicle technology (e.g. autonomous

electric vehicles). This line of division between these two groups is a clear working point for the consensus building workshop in step 7.

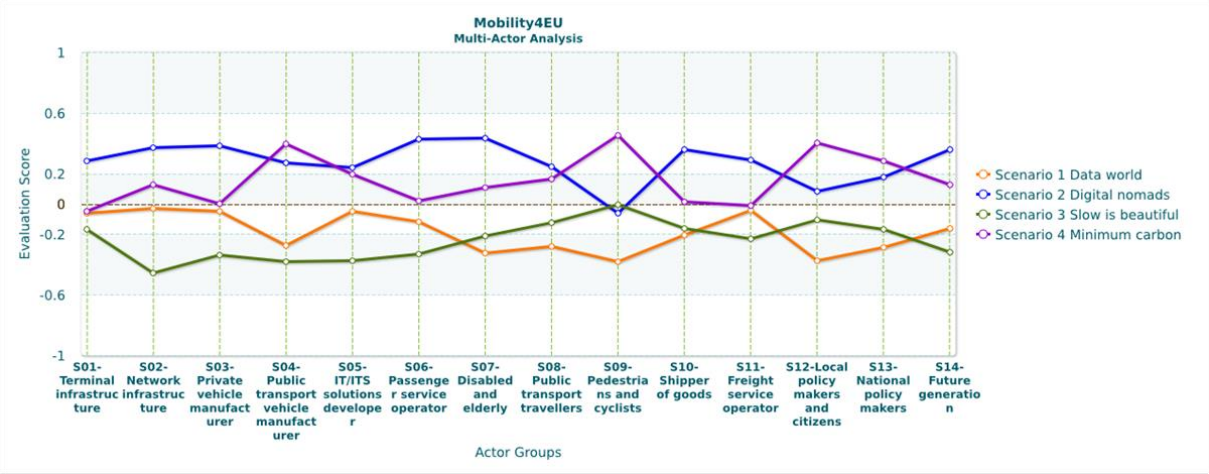

Fig. 4: results of the scenario ranking.

2.8. STEP7: Consensus building

The results of the MAMCA was discussed with the stakeholders at a dedicated workshop (24 October 2017, Brussels) where the outcome of the evaluation process was presented to-, and discussed with them. Since MAMCA does not produce an ultimate ranking of the scenarios this workshop served as a consensus-building platform where all stakeholders came to the consensus that a combination of the two most preferred scenarios i.e. Digital Nomads and Minimum Carbon best represents their objectives for the future of transport in the EU. This preferred combined scenario will be the key building block for creating a vision for transport in Europe in 2030.

3. Conclusions

A thorough consultation of the European Transport stakeholder community in combination with the MAMCA method has led to insights into the preferred vision for the transport system of Europe 2030. Full-scale digitalisation of the transport system is key for all stakeholders, however opinions about measures that support individual or collective mobility differ. The consensus building workshop has generated a list of recommended organisational, technological, financial measures that support the final scenario. These measures will be used to create the vision for the transport system in the next step of the Mobility4EU project.

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