mobil.TUM 2024 – The Future of Mobility and Urban Space, April 10-12, 2024

Indicator Development Framework for Innovative Mobility Programs – the Top-Down-Bottom-Up Approach

Matthias Grundei [a *], Carolin Zimmer [a], Maximilian Pfertner [a], David Duran-Rodas [a]

[a]*Chair of Urban Structure and Transport Planning, Technical University of Munich, Germany*

Keywords: *mobility, evaluation, impact, indicators, transport, top-down, bottom-up, co-design*

This work addresses the following topic(s) from the Call for Contributions:

☐ Placemaking to integrate urban spaces and mobility
☐ Promoting sustainable mobility choices in metropolitan regions
☐ Governing responsible mobility innovations
☐ Shaping the transition towards mobility justice
☒ System analysis, design, and evaluation
☐ other: _____

Extended Abstract

Problem statement
The impact evaluation of mobility programs is usually carried out by data collection on specific indicators. Which indicators are to be measured is usually determined top-down (Barabino et al., 2020; Castillo and Pitfield, 2010; Hirschhorn et al., 2018). Although this shows the program's goal achievement, it does not consider whether a compilation of the specified indicators in the individual projects or measures of the program is feasible or meaningful. The top-down specification of indicators also neglects various perspectives, which can overemphasize certain subject areas while other aspects are barely examined.

Research objectives
This research aims to develop a framework for co-creating indicators for impact evaluation of mobility programs. The framework combines top-down and -bottom-up approaches for elaborating indicators for impact evaluation. Top-down implies that selected individuals carried out the development step from a strategic point of view. Bottom-up indicates that a group of representatives from science, industry, and society conducted the design step with the perspective of their projects. The intended Top-Down-Bottom-Up Approach involves incorporating bottom-up feedback following any top-down strategy. In addition, this research intends to evaluate the framework through a case study by establishing a set of program indicators.

Methodological approach
We set up the framework through a case study, the Munich Cluster for the Future of Mobility in Metropolitan Regions (MCube) (MCube, n.d.). The MCube program comprises 11 innovation projects that follow the mission "improvement of quality of time, air, and space" and the vision "enable possibilities together". Representatives from science, business, and society carry out all projects. We arranged several methods in a process to formulate the "Mobility Program Indicators Development Framework (MPIDF)" for the MCube program. The framework and its eight consecutive steps can be seen in Figure 1.
Step 1
In the first step, "program objectives, impact categories, and sub-categories", we analyzed the program objectives, mission, vision, and guiding principles. We derived the impact categories and sub-categories from the core

* *Corresponding author. Tel.: +0049 176 4736 5525;*
E-mail address: matthias.grundei@tum.de

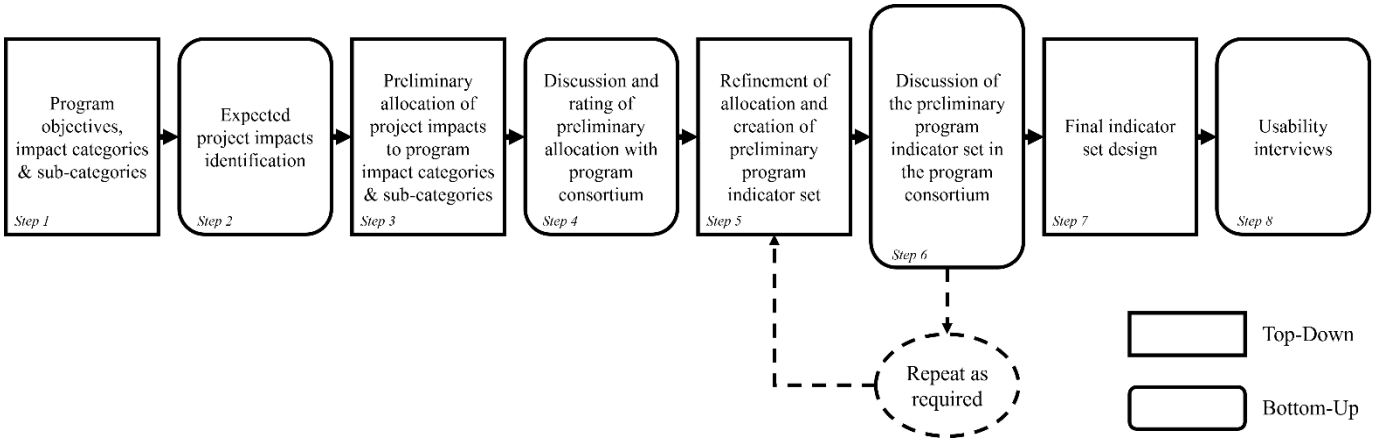

Figure 1: The Mobility Program Indicators Development Framework (MPIDF).

elements of the strategy and their thematic description. We used the identified impact categories and sub-categories as the basis for the deductive thematic analysis in the further process.

Step 2

For the "expected project impacts identification", we conducted a questionnaire with all project partners containing open questions and held a workshop with the project teams during the response period of the survey.

Step 3

In the "preliminary allocation of project impacts to program impact categories and sub-categories" step, we conducted a deductive thematic analysis with the survey answers and the workshop results. We coded the expected project impacts from the questionnaire and workshops by the categories identified in Step 1. The result was a list of expected impacts within the impact categories and sub-categories of the program.

Step 4

For the "discussion and rating of preliminary allocation with program consortium", we examined the catalog of expected impacts in a workshop with all projects of the mobility program.

Step 5

In the fifth step, "refinement of allocation and creation of preliminary program indicator set", we processed the expected impacts lists in a top-down manner. We use deductive coding to divide the results into expected impacts that should be refined and expected impacts that are no longer considered in the process. We also sorted all qualitative comments to the corresponding impacts for the subsequent revision.

We elaborated on the list of expected impacts. Existing relevant literature on indicators in the context of mobility was used for this process (Dziekan et al., 2013; Engels et al., 2020; Litman, 2007; Rupprecht Consult, 2019; WBCSD, 2020). For indicators we could not derive from existing sets, we used peer-reviewed scientific literature for indicator formulation (Consonni et al., 2021; Cornet et al., 2022). As a last step, we merged or shortened the indicators based on the workshop results. This resulted in an initial catalog of 23 indicators. Subsequently, we created the first document, the MCube Impact Evaluation Indicator Guide, and sent it to the program consortium for feedback.

Step 6

We then discussed this result through a workshop in the step "discussion of the preliminary indicator set in the program consortium". Representatives from the academic community dominated the workshop. To achieve a better balance in the indicator guide, we obtained feedback in written form from three representatives from industry and society. The questions in the written feedback were based on those from the workshop.

Step 7

In the step "final indicator set design", we used the workshop results and the written feedback for a top-down adjustment of the indicator guide. We utilized deductive thematic coding to assign the qualitative statements on improvement to the indicators. General points for discussion and ideas for new indicators were also identified. The result was a catalog of 23 improved indicators.

Step 8

As a final step of the MPIDF, we conducted usability interviews with MCube projects. We chose this method to obtain in-depth feedback on the applicability of the indicators. In the interview, we also discussed the methodology

for data collection and defined milestones for the impact evaluations. We analyzed the last step's results by deductive and inductive coding.

Results

By applying the MPIDF to the case study, we developed a list of indicators for the MCube mobility program, (Table 1). Through the top-down steps, we provided a framework for indicator development, (Table 1) under Category and Sub-category. The workshops (Step 4 and Step 6) show the advance and concretization of the individual indicators, (Table 1) under Impact Indicators, through bottom-up participation. Through the usability interviews, we identified that the indicator set is understood as a guideline. The projects' leaders rate the indicator set as "very helpful". However, we also found in the interviews that a more specific elaboration of project indicators is desirable. Accordingly, we recommend further developing project-specific indicator sets, building on the MPIDF and the program indicator set.

The developed indicator set is used in the MCube program for the impact evaluation. We will improve and adapt the MPIDF in the next seven years of the mobility program.

Table 1: Final indicator set for impact evaluation of the mobility program MCube.

Category	Sub-category	Impact Indicators	Literature base
Quality of Time	Accessibility	Travel time	Engels et al. (2020), Intraplan & VWI (2022)
		Access to mobility services	Bayerisches Staatsministerium für Wirtschaft, Infrastruktur, Verkehr und Technologie (n.d.), Bundesamt für Raumentwicklung ARE (2022), Büttner et al. (2022), Engels et al. (2020), WBCSD (2020)
		System usage	Engels et al. (2020)
	Experience quality	Travel experience	Consonni et al. (2021), Cornet et al. (2022)
		Usability of travel time	Consonni et al. (2021), Cornet et al. (2022)
Quality of Space	Safety	Number of accidents	Engels et al. (2020)
		Perceived road safety	Engels et al. (2020)
	Diversity of use	Efficient use of space	Städtekonferenz Mobilität (2021)
		Mixture of spatial functions	European Commission(2022), Gillis et al. (2015)
	Quality of stay	Diversity of use of public spaces	Project for Public Spaces (n.d.)
		Comfort and image of places to stay	Project for Public Spaces (n.d.)
Quality of Air	Global climate protection	Energy efficiency	Engels et al. (2020), European Commission(2022), Gillis et al. (2015), WBCSD (2020)
		CO_2 emissions	Engels et al. (2020), HBEFA (n.d.), Schröder et al. (2023), Umweltbundesamt (2022)
	Local emission limits	NO_x emissions	Engels et al. (2020), HBEFA (n.d.), Schröder et al. (2023)

		PM emissions	Engels et al. (2020), HBEFA (n.d.), Schröder et al. (2023)
		Noise	Engels et al. (2020), Umweltbundesamt (2021)
	Individual health protection	Stress level	Furth (2012), Montgomery County Planning Department (2020)
Enable possibilities together		Acceptance	Engels et al. (2020)
		Inclusion	Bolz et al. (2022)
		Participation	Arnstein (1969), International Association for Public Participation (IAP2) (2018), Laurian and Shaw (2009), Rowe and Frewer (2004)
		Cooperation	Engels et al. (2020)
		Influence on planning and decision-making processes	Engels et al. (2020), Laakso et al. (2017)
		Contribution to the problem analysis	Engels et al. (2020)

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