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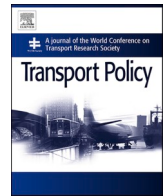To cite this publication, please use the final published version (if applicable).
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A review of case study-based academic literature on public participation in sustainable mobility

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ABSTRACT

Developments to promote sustainable mobility require active and effective public participation projects in which the form of participation (e.g., consulting citizens), the objective of the project (e.g. harnessing local knowledge), and the indicators to assess if the project was effective (e.g., participants' evaluations) are aligned. In practice, this alignment seems to be rare, but scientific research backing up this claim is lacking. For this scoping review, we have collected and analyzed peer-reviewed case studies on public participation projects for sustainable mobility in 14 countries. Per case, we identified forms, objectives, and effectiveness indicators and assessed their level of alignment. Our main findings show a wide variety of participation forms, of which consultation was the most dominant. Cases also often had multiple objectives, and many projects included measures to evaluate their effectiveness. Most relevant and in line with what we assumed, almost all of the projects demonstrated a degree of misalignment between objectives and effectiveness evaluation standards. Although these results do not imply that public participation projects in sustainable mobility are not effective, it does seem to suggest that participation can benefit from a more structured and aligned approach.

1. Introduction

Long-term goals for realizing sustainable mobility goals follow the well-known analyses of the limits on natural resources and the threat of climate change (Banister, 2008; Griffiths et al., 2021). Although these goals seem relatively straightforward, the way to achieve them is not (Köhler et al., 2019) due to the complexity of transforming the mobility system.

Complexity relates to, amongst other things, the large variety of stakeholders with diverging interests, the unpredictability of travellers' behavioural responses, and the disruptive impacts of technological and service innovations (e.g. Lempert et al., 2020). Regional and local-level policymakers encounter additional complexities in complying with national policies trickling down from international agreements. In the Netherlands, for example, the Dutch Climate Agreement (Klimaatakkoord, 2019) strongly influences local and regional sustainable mobility plans. These plans aim to contribute to improving accessibility under the conditions of (i) lower traffic emissions, (ii) reduced public space for parking, (iii) improved road safety, and (iv) improved inclusivity.

The key to reaching these goals is realizing durable changes in mobility behaviour in favour of more sustainable ways of transport. However, patterns in mobility behaviour appear rather persistent and demand that they be changed on a voluntary basis. Without support for the policy framing of the challenges and without reaching a multi-stakeholder agreement on which interventions are effective to tackle these challenges, durable behavioural changes are most likely out of reach. The alternative policy option of top-down enforcement of behavioural change (based on, e.g. pricing, regulation and infrastructural measures) is often less attractive. Finding a good balance between measures that stimulate intrinsically motivated changes in travel behaviour and top-down enforcement ('stick and carrot') is, therefore, a significant challenge (Xiao et al., 2022).

Public participation is an essential precursor for addressing the different complexities and challenges associated with transforming the mobility systems and formulating effective sustainable mobility policies. Beyond facilitating the development of policies that reconcile intrinsic and extrinsic motivational factors, public participation is legally

mandated in numerous countries as part of the policymaking process. In the Netherlands, for instance, the enactment of the Environment and Planning Act (Omgevingswet, 2023) requires the integration of public participation in spatial and infrastructural policymaking as of 2024. Consequently, initiatives that stimulate citizens to become actively involved in decision-making on local and regional development plans are increasingly being taken.

Public participation is also a fundamental component of planning processes in the United States, with federal and state laws mandating varying degrees of citizen involvement. At the federal level, public participation is a key requirement for Metropolitan Planning Organizations (MPOs), which oversee regional-scale transportation planning. At the state level, laws require citizen involvement in the plan-making process but leave the precise methods to the local governments (Burby, 2003; Sciara, 2017). In the European Union, the guidelines on Sustainable Urban Mobility Planning (SUMP) emphasize the need for and relevance of public participation (see, e.g., Rupprecht Consult, 2019), due to which active public participation can become standard practice in many European countries in the coming years.

Various studies argue that effective public participation can increase policy compliance. That is, effective public participation can (1) reduce uncertainty in the policymaking processes at multiple levels of governance, (2) reach better-informed and enriched decision-making, and (3) it can increase public support for policies (Hurlbert and Gupta, 2015; Uwasu et al., 2020; Hsieh, 2022). Public participation approaches claim to use local knowledge to better address community needs (Innes and Booher, 2010; Stewart and Sinclair, 2007; Flipo et al., 2023), build social capital among policymakers and citizens (Hatley, 2013; Runhaar, 2009), induce social learning (Chavez and Bernal, 2008), improve process legitimacy (Fung, 2006), and strengthen the collective identity of communities (Bamberg et al., 2018). Together, they create a context that is assumed to increase the probability of durable behavioural change significantly.

Ineffective public participation, though, can have the opposite results and lead to resistance. If people do not get the opportunity to participate in planning and decision-making – or are denied this opportunity after the promise of voice – they can massively oppose projects, leading to costly delays and even project cancellation (de Vries et al., 2012; ter Mors and van Leeuwen, 2023). An illustration is the mass protests in Stuttgart, Germany, around Stuttgart 21 (S21), which was introduced as the epitome of a sustainable transportation and urban development project (Novy and Peters, 2012). Slaev and colleagues (2019) provide an example of the adverse effects of perceived pseudo-voice in their analysis of citizen participation during the planning of bikeway networks in four Bulgarian cities.

Nevertheless, various concerns exist about the added value of public participation (Cooke and Kothari, 2001), conceived as the balance between the efforts to organize it (efficiency) and the input that it gives to improve policymaking (effectiveness). Public participation appears often time-consuming and costly, whereas the risk of not enhancing the policymaking process or hindering policymaking is considerable (Lowndes et al., 2006). For example, a review study by Ianniello et al. (2019) finds little empirical evidence for the contribution of participation to efficient and effective governmental policymaking. Reflecting on several sustainable urban mobility plans, Rye (2023) demonstrates that participation might sometimes slow down, change or even stop project implementation. Other studies show that social and institutional constraints (such as dominant social habits in a community, the requirements from a formal decision-making procedure, or the limitations in available budgets) can hinder the effectiveness of participation (e.g., Mosse, 1995; Ryfe, 2005; Bickerstaff and Walker, 2001) to the extent that the benefits of participation do not outweigh the related cost (Barnes et al., 2003; Michels and De Graaf, 2010). Recently, Michelini et al. (2023) evaluated participation projects in Germany and also observed unequal involvement of relevant stakeholders and passive engagement of citizens in the implementation of policy measures.

In sum, deciding on sustainable mobility policies often includes public participation since that is increasingly recommended or has become mandatory. Public participation has benefits but can do more harm than good if a poorly designed approach leads to dissatisfied citizens and extra costs or delays. The above conclusion triggers scientific and societal questions on how to design public participation processes for sustainable mobility policies and, notably, which elements in these processes influence the effectiveness of public participation in sustainable mobility projects.

Public participation projects differ in their designs regarding objectives, forms and evaluations (e.g., Arnstein, 1969; Bobbio, 2019; Glucker et al., 2013; Rowe and Frewer, 2004; Rye, 2023; Uittenbroek et al., 2019).

Systematic alignment of objectives, methods and evaluation is considered important for improving the effectiveness of public participation processes. For example, Bobbio (2019, p. 53) states: "different arrangements tend to embed different goals or a different conception of effectiveness, and hence … policymakers have to make a choice (or a trade-off) at any juncture of his/her design-making process", whereas Uittenbroek et al. (2019, p. 2529) conclude " … that a more systematic and deliberate approach, in which both the objectives and the design of public participation are communicated explicitly, and are discussed by participants, increases the chance that the objectives are met".

This idea of alignment in public participation processes reflects the more general claim in the school of ex-ante and ex-post policy analysis that the systematic alignment of policy goals, methods for analyzing policy options, choosing among these options and monitoring and evaluating their impacts is essential to increase the effectiveness of policy making. The idea is not only underlined in classical, mostly expert-oriented, approaches to policy analysis (e.g. Walker, 2000; Enserink et al., 2022) but also influences more recently developed concepts of participatory policy intervention approaches. For example, Franco and Montibeller (2010) discuss the issues that should be considered when designing a facilitated modelling intervention process. They observe that the number of studies systematically assessing the outcomes of such approaches is quite limited.

However, in our experience as researchers and consultants for various sustainable mobility projects in the Netherlands, we noticed that these three elements are often not all present or aligned. This observation also comes to the forefront in a recent publication from the Dutch Ministry of the Interior and Kingdom Relations about public participation (Boogaard et al., 2024). However, literature backing up the hypothesis that misalignment between forms, objectives and effectiveness evaluation is standard practice worldwide is missing. This knowledge gap basically triggers research in two directions. The first is to explore what insights the academic literature on public participation projects about sustainable mobility has to offer. Until now, such a review is lacking (a.o. Rye, 2023). Secondly, it is relevant to investigate public participation processes in real-world practices to understand choices for and experiences with approaches in different real-world cases. We travel both avenues of research, but given the size limitations of publishing, we will focus on the first research direction in this paper.

More specifically, the present article reports the findings of a review of academic papers on case studies of public participation in sustainable mobility in 14 countries. We focus on forms, objectives and indicators of effectiveness and assess their level of alignment. It is appropriate to systematically review scientific reflections on public participation projects because they provide an objective perspective: the authors that have studied the reports and programmes do not have a stake in the (effectiveness of the) public participation, in contrast to the policymakers involved. We left non-academic reports out of our scope, as they

can be biased for political or strategic reasons, and objectivity is of the essence for this review. We aim to answer the following research questions[1]:

(1) Which *forms* of public participation were chosen? And what *public* did these forms involve?
(2) Did the projects clearly articulate *objectives,* and if so, what were these objectives?
(3) Did the projects specify *effectiveness indicators*, and if so, how were they assessed?
(4) Are these indicators logically related to objectives?

The structure of this article is as follows. In Section 2, we present a conceptual basis for the analysis of the reported case studies. Section 3 describes the applied method, and Section 4 presents the findings of the analysis. In Section 5, we reflect on the findings and formulate issues for discussion and in Section 6, the conclusions are offered.

2. Theory to analyze public participation

This section elaborates on the key concepts and frameworks that constitute the basis for the analysis of the forms, objectives and evaluation criteria of public participation in sustainable mobility projects. We analyzed participation forms using Sherry Arnstein's ladder of citizen participation (Arnstein, 1969). We added the concepts of mini-public and maxi-public to this one-dimensional framework to specify the public involved. We further enriched the ladder with the conceptualization of objective types by Uittenbroek et al. (2019). To assess the alignment between design choices, we focused on whether evaluation criteria fit the objective types.

2.1. Forms and levels of public participation

Public participation refers to a variety of implementation forms that depend on levels of engagement from the public involved. In our study, these levels of engagement derive from one of the most frequently quoted articles on public participation: Arnstein's ladder of citizen participation (Arnstein, 1969). Arnstein presented a relatively straightforward (one-dimensional) conceptualization of different levels of power for the engaged public at various steps of the ladder, where each higher step adds power to the previous one. The choice for this concept in this study for the identification of forms and public participation levels is motivated by the dominant reference to Arnstein's ladder in real-world (Dutch) practices of policy making (e.g. Bobbio, 2019). However, we realize that debates in the literature suggest that public participation settings are (or should be) significantly richer than those indicated in Arnstein's basic framing of public engagement. These debates and possible findings in our literature review might cause the need in the future to switch to more elaborated framings of public participation, such as those presented by Fung (2006). We will address this need in the discussion section.

For our review, we only selected cases with public participation at the upper five steps of Arnstein's ladder. In total, Arnstein's ladder consists of eight steps. The lower three steps (called Manipulation, Therapy, and Informing) fall outside our study's scope since they concern citizens as non-participants or receivers of information instead of being actively involved in decision-making. Hence, we focus on the following five levels of participation:

- *Citizen Control*: the public can control the complete participation process, setting goals, defining problems, generating ideas, evaluating them, and deciding how to proceed.
- *Delegated Power*: the public can make independent final decisions.
- *Partnership*: the public can provide additional input on decisions ('deciding together').
- *Placation*: the public can provide new ideas ('developing together').
- *Consultation*: the public only provides feedback on existing ideas, plans or policies.

2.2. Public involved in participation

Our review identifies whether the mini-public, maxi-public, or both were involved in participation because this distinction is often made in public participation projects (Farrell et al., 2019). Additionally, it provides a more nuanced picture of who is involved in the participation, thereby enriching the Arnstein ladder and relating to the form and objective of participation. Some forms (e.g. workshops) are only possible with the mini-public, and others better fit the maxi-public. The distinction can help explain why certain forms and aims are chosen. The maxi-public refers to all members of the public affected by the policy that results from the participation process. Including members of the maxi-public can be time-consuming, costly, or practically infeasible (Stern and Dietz, 2008). However, examples of forms to include the maxi-public are a referendum or online survey. The mini-public is always a subset of the maxi-public (e.g., Bobbio, 2019; Farrell et al., 2019). It refers to the ensemble of (invited) actors directly interacting with each other within a public participation process, including, e.g. (governmental) stakeholders, residents, traveller groups, and companies (Curato et al., 2021). Some research focuses on the representativeness of mini-publics of the broader maxi-public (Barnes et al., 2003) or participation forms that include both deliberative mini-publics and broader consultation of the maxi-public (e.g., Itten and Mouter, 2022).

2.3. Objectives of public participation

The literature (e.g., Bobbio, 2019; Glucker et al., 2013) describes three types of objectives in participation processes: normative, substantive, and instrumental. *Normative objectives* express the rights of citizens to have a say in decisions that affect them. *Substantive objectives* focus on enriching the decision-making process with participants' knowledge. *Instrumental objectives* are about the ease of implementing outcomes from participation. Uittenbroek et al. (2019) have elaborated these three overarching categories into nine participation objectives, making them valuable frames for our review. Since it is one of the few – well-cited – participation studies that focus on objectives, we take this work as inspiration. Note that we focus on the objectives of the empirical case studies described in the academic papers, not the research objectives of the authors of the paper. Table 1 presents a brief description of the public participation objective types based on Uittenbroek et al. (2019).

2.4. Indicators of effectiveness

We will investigate the indicators that are applied in the cases to evaluate the effectiveness of the described public participation projects (i.e. effectiveness indicators) to explore their alignment with the projects' objectives (research question 4). Since no comprehensive overview of indicators of effective public participation is available in the literature, we conceive effectiveness as achieving one of the nine objectives mentioned in Table 1. Consequently, indicators of effective participation should describe how these objectives are assessed or measured (Rowe and Frewer, 2004). For example, participants' evaluation of understanding each other's perspectives could measure the achievement of the social learning objective, and a similarity between the results of different participation events could indicate information

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[1] Our study analyzes how public participation projects are presented in academic literature, so we rely on secondary data. This means that for the research questions, we rely on how our data items are reported in papers.

Table 1

Public participation objective types (Uittenbroek et al., 2019).

Objective Type	Objective Description
Normative objectives	Those affected by policy decisions should have a
1. Influence decisions	say in them
2. Democratic capacity	Teach the public 'citizenship' skills and allow
	practice
3. Social learning	Deliberation allows reflection beyond personal
	preferences
4. Empower marginalized	Give a voice to those who do not have one
Substantive objectives	Provide environmental and socially relevant
5. Harness local knowledge	information
6. Incorporate value-based	Provide experimental and value-based
knowledge	information
7. Information robustness	Compare information from different sources
Instrumental objectives	Generate support for solutions and authorities
8. Generate legitimacy	
9. Resolve conflict	Allow for early identification and resolution of
	conflicts

robustness. The review of case studies will reveal if – and how – the participation processes have established effectiveness indicators.

3. Methodology

To find answers to the research questions mentioned in Section 1, we adopted a scoping and systematic literature review methodology with a replicable and transparent protocol as described by Arksey and O'Malley (2005). We followed the steps prescribed by the protocol: identify relevant studies, select studies, chart descriptive data, and discuss the findings.

3.1. Data collection through literature review

To start, we used a broad set of search terms to cover relevant literature. We specified search terms (see Table 2) to include some variation and synonyms of 'public participation' and 'sustainable mobility'. We used an iterative process to refine these key search terms and the Boolean operators to narrow the search.

We systematically searched three databases: Web of Science, Scopus and Greenfile. The first two databases provide a broad range of scientific and peer-reviewed papers. The latter is a smaller database containing research on human impact on the environment and sustainability. Operators and symbols within the search string were adapted to fit each database, keeping the search terms the same across all searches. In addition to systematic searching, we used a single-step snowballing procedure: citations and references from key papers were studied to find more potentially relevant papers. This procedure resulted in 22 additional papers. The identification and search for literature concluded in December 2023. Table 3 shows the number of papers resulting from each consulted source.

To filter the 1363 identified papers, we applied four rounds of selection: applying database filters, removing duplicates, title/abstract screening, and full-text screening. The complete process of paper selection followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement for systematic reviews (Moher et al., 2009). Fig. 1 illustrates the paper selection process.

The first round involved applying two database filters to the search results: (a) only papers written in English are included, as these papers are accessible to a broad international audience; (b) scientific journal publications or book chapters with peer-review was adopted as a baseline for study quality. Then, we excluded 441 papers for being duplicates. The third round consisted of screening a paper's title and abstract to check for reference to the combined concepts of public participation, mobility, and sustainability. We included only papers discussing two-directional public participation processes in the context of

policymaking on sustainable mobility systems, hence corresponding to the selected steps of the ladder of Arnstein as introduced in Section 2.1. Each of the authors screened a random selection of papers to ensure the reliability of the screening process, resulting in 101 papers.

The final selection round involved a full-text screening of the remaining 101 papers. On a paper-by-paper basis, the authors assessed the content of each study. We excluded 15 papers that the databases wrongfully identified as peer-reviewed journal articles and 21 papers that described public participation without providing empirical data on the participation process. Then, 27 papers mentioning participation without reference to an interactive participation process between the public and policymakers, as well as six papers describing a public participation process for broader urban development with minimal attention to mobility, were excluded. Finally, we excluded seven papers describing public participation in research rather than policymaking processes. The selection process resulted in a set of 25 papers for in-depth analysis. The publication year of the included papers ranges from 1997 to 2023. Papers covering transport, land use planning, and sustainability have been published in various journals. In the following paragraph, we explain how the analysis of the papers was done, specifically regarding the classification of public involvement, objectives and indicators.

3.2. Data analysis of selected papers

To answer the research questions presented in the Introduction, we analyze the selected papers and identify the reported forms of public participation and public involved (RQ1); the reported articulated objectives (RQ2); and reported effective indicators to assess whether objectives were reached (RQ3). In order to say something about the relation between objectives and indicators (RQ4), we use different classifications.[2]

For the classification of public participation projects in levels of participation (Arnstein's ladder, see Section 2.1), we analyzed the reported power the citizens received. We started at the first level (i.e. citizen control) and checked whether citizens could control the participation process, for example, had the possibility to change the goals of the participation activity. If this was the case, the first level applied. If not, we continued with the second level (i.e. delegated power). For the second level, we questioned whether participants had a mandate to make independent decisions in the end. If this was the case, the first level applied. If not, we continued with the third level, etc. The classification of forms followed the classification of levels of participation. In case multiple levels applied to a particular public participation project, we identified the highest level, reasoning from citizen control, as the main level.

The classification of objectives and indicators used the typology of public participation objectives, see Table 1, introduced by Uittenbroek et al. (2019). Again, we started with the first type to evaluate whether the objective or indicator fitted this type. If this was the case, we noted it down, and independent of whether the first type applied, we continued with the second type until all types were checked. Public participation objectives and indicators can cover multiple objective types.

The second author mainly performed the classifications, but in case of no evident classification, this was discussed with all authors together until an agreement was reached. Disagreements about classifications entailed, for example, the level of the Arnstein ladder; in particular, the levels' placation' and 'partnership' were sometimes difficult to distinguish. The analysis of the connection between objectives and indicators of effective public participation was discussed with all authors. Any disagreements were resolved by returning to the papers and earlier

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[2] We rely on secondary data, thus on reports about forms, objectives and indicators. Checking actual forms, objectives and indicators with the individual project owners is beyond our scope.

Table 2
Full search string used to query the databases.

Search Terms
TS=(((Citizen OR public OR communit* OR civic) NEAR/5 (participat* OR engagement OR inclusion OR interact* OR consultation OR involv*)) OR "participat* govern*" OR "interactive govern*" OR "deliberative govern*" OR "deliberative democracy" OR "deliberative-participat*" OR "participat* polic*" OR "participat* planning")
AND TS=((mobility OR transport* OR traffic OR "passengers transport" OR train OR bus OR busses OR taxi OR metro* OR car OR cars OR automobil* OR bike* OR walk* OR pedestrian OR vehicle*) NEAR/10 (sustainab* OR green OR ecological OR eco-friendly OR inclusive* OR transition* OR "climate adapt*"))

Table 3
Unfiltered total search results (by December 2023).

Database	Number of Results
Scopus	659
Web of Science	643
Greenfile	39
Snowballing procedure	22
Total	*1363*
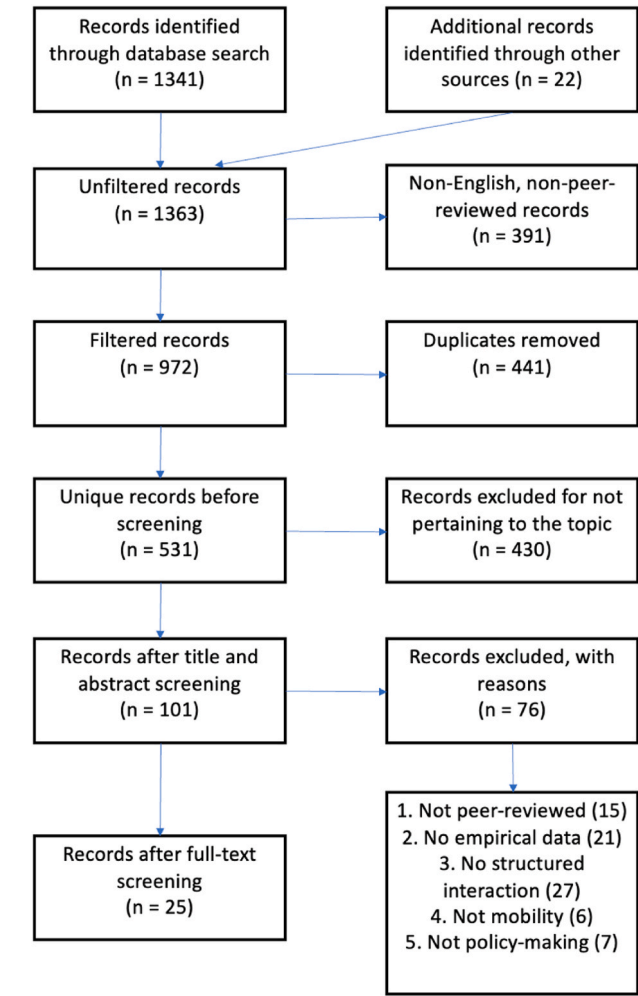
Fig. 1. PRISMA flowchart of the study selection process.

classification of objectives and indicators. During this discussion, multiple papers, including their classifications and why this was classified as such, were examined.

4. Findings

We present the findings by categorizing the forms and public (4.1.1), objectives (4.1.2) and indicators of effective public participation (4.1.3).

We report on the relationship between objectives and indicators of effective public participation to analyze the alignment between these elements (4.2).

4.1. Overview of the reviewed cases

All 25 reviewed papers include the empirical analysis of at least one public participation case, defined as a structured interaction between the public and policymakers. We refer to the reviewed cases by the numbers attached to them in Table 4. Since two papers describe the complete participation processes of two separate cases, these are further denoted as 17a/17b and 19a/19b in the findings (resulting in 27 cases). The cases employ primarily qualitative research methods in case studies; only one case uses exclusively quantitative methods, and some cases combine both in a mixed methods approach. Cases describe public participation in 14 different countries, with most representation from Europe and some from North America and Chile. Notably, cases from Asia and Africa are absent in the included cases. In terms of geographical scale, most cases describe public participation cases on a city or metropolitan level and a few at regional and national levels.

In terms of the sustainable mobility planning context, where public participation can be seen as relatively necessary because such policies require changes in the behaviour of citizens, 8 cases were about a sustainable mobility plan or policy for a city area, 3 cases concerned plans or policy for a regional area, and 1 case addressed a national plan or policy; 4 cases were about cycling initiatives, 2 cases related to bus corridors, 2 cases concerned automated vehicles, 1 case addressed a parking and traffic schema, 1 case reported a highway plan, 1 case was about street development, 1 case related to congestion tax policy, 1 case concerned speed reduction, 1 case addressed a green corridor and 1 case reported on commute and smart mobility planning. Table 4 reports brief descriptions and unique aspects of the cases.

4.1.1. Forms of and public involved in public participation

This subsection answers research question 1, analyzing what forms and levels of participation are chosen and who is involved. The 27 reported cases mention 47 public participation events. Most cases describe the use of several forms of participation, ranging from one to seven forms, with a majority of two to four. Table 5 describes the variety of different forms present in the cases by classifying the forms using levels of participatory power and the involvement of the maxi- or mini-public. As the reader might observe, some forms could span multiple levels of Arnstein's ladder. This is possible as, for example, the results of a participatory workshop in which alternatives are developed for the design of a new bike lane (i.e. placation) can also be used as input for a survey with a larger group of people (i.e. consultation).

One notable finding is the absence of participation events on the highest level of participatory power: *citizen power*. In none of the reviewed cases was the public allowed to set their own goals and decide on policies.

In the *delegated power* category, the maxi-public was addressed in the form of a single yes/no referendum (9) or a large regional discussion meeting with a plenary voting system for making decisions (14). The citizens' jury addressing the mini-public (1) consisted of a small group of randomly selected citizens with decision-making power on ideas resulting from earlier participation events.

At the *partnership* level, maxi- and mini-publics are equally

Table 4

Overview of cases: Reviewed case number, author(s), year of publication, and brief description.

Case	Authors, Year	Location	Description
1	Franceschini and Marletto (2015)	Bari, Italy	Extensive evaluation of dialogue meetings and a citizens' jury for the selection of a parking and traffic scheme.
2	Gil et al. (2011)	Azores, Portugal	Street interviews and stakeholder workshops to develop a shared sustainable mobility plan.
3	Ibeas et al. (2011)	Santander, Spain	Mega focus groups and regular focus groups to discuss general mobility issues and evaluate sustainable cycling initiatives in a medium-sized city.
4	Boisjoly and Yengoh, 2017	Montreal	Various public meetings, workshops, and citizen forums to gather mobility issues and solution ideas for a socially sustainable local transportation plan.
5	Carteni et al. (2020)	Southern Italy	Participation in a listening stage to gather preferences and a consultation stage to deliberate on policies for a regional transportation master plan.
6	Gugerell et al. (2018)	Vienna, Austria	Testing a serious game to engage citizens with sustainable mobility planning and increase social learning.
7	Henke et al. (2020)	Cesena - Venice, Italy	Comparison of cost-benefit analysis and participatory multi-criteria analysis policy outcomes for a sustainable highway plan in the coastal area.
8	Hernandez-Gonzalez and Corral (2017)	Tenerife, Canary Islands	Consultation of extended peer communities (experts, citizens, and policymakers) in interviews and focus groups to formulate sustainable mobility policies.
9	Hysing (2015)	Gothenburg, Sweden	Citizen dialogue meetings followed by a public referendum for a congestion tax policy.
10	Van Brussel and Huyse (2019)	Antwerp, Belgium	Citizen science measurement of air quality as a public engagement tool for sustainable mobility policies.
11	Marletto and Mameli (2012)	Italy	Comparison of a national survey and stakeholder dialogue policy outcomes for a sustainable urban mobility plan.
12	Lehmkuhler et al. (2020)	Berlin, Germany	A field lab experiment to engage travellers on sustainable street redevelopment.
13	Milakis and Athanasopoulos (2014)	Athens, Greece	Multi-criteria analysis with expert cyclists to decide on a new cycle network plan.
14	Niemeier et al. (2015)	Sacramento, California	Blueprinting process of small citizen planner meetings and larger regional meetings to develop and select a regional mobility vision for a region.

Table 4 (*continued*)

Case	Authors, Year	Location	Description
15	Russo et al. (2020)	Calabria, Italy	Combining seminars, tabletop discussions and serious games in one process to construct shared mobility objectives among stakeholders.
16	Sagaris (2014)	Santiago, Chile	Twelve years of cycling participation activities under the banner of Living City.
17a	Sagaris (2018)	Santiago, Chile	Long-term citizens' observatory to manage participation activities for a bus rapid transit corridor in a metropolitan city.
17b		Temuco, Chile	Short-term citizens' observatory to manage participation activities for an integrated mobility plan of a regional city.
18	Sagaris and Ortuzar (2015)	Santiago, Chile	Collaborative training, workshop, and plenary roundtable process to update a cycling master plan and increase cycling behavior.
19a	Stilgoe and Cohen (2021)	United Kingdom	Dialogue sessions with the public, policymakers, and experts to investigate the future potential of automated vehicles.
19b		United Kingdom	Dialogue day to explore the impact automated vehicles may have on future mobility.
20	Kovachev et al. (2018)	Bulgaria	Comparison of participation activities for sustainable urban mobility plans of Bulgaria's four largest cities.
21	Taylor and Tight (1997)	United Kingdom	Process of public meetings, exhibitions, and interactions with community representative groups to develop measures to reduce speeding in four U.K. city neighbourhoods.
22	Corr et al. (2023)	Kilkenny City, Irelans	Community involvement for the development of a sustainable urban mobility plan.
23	Lampkin et al. (2023)	South-West England	Citizen panels focusing on the future of commuting, the flow of the daily commute and the inclusion of publics in smart mobility planning.
24	Fuenzalida-Izquierdo et al. (2023)	Santiago, Chile	Using PPGIS in participatory workshops related to a major bus corridor proposal.
25	Kotzebue (2022)	Hamburg, Germany	Using PPGIS in a web-based participation tool in green corridor project.

addressed. The maxi-public is involved through, e.g., public hearings (17a, 17b) and debates (20) that inform, consult, and co-decide with large groups of citizens. Continuous partnerships between policymakers and the maxi public get shaped as citizens' observatories (17a, 17b) and installing community representative groups (21). Regarding the mini-public, most partnerships take place in workshops that use decision-support tools, including multi-criteria methods (7, 8, 11, 13), scenario building to discuss futures (15) and design thinking to develop a solution to predefined problems (15, 19a, 24).

Most participation events are categorized as *placation*. Interestingly, we observed twice as many events addressing the mini-public as the maxi-public. These maxi-public forms of participation include public events that, for example, consist of large markets with booths for

Table 5
Overview of public participation forms clustered by level of citizen power and engaged maxi- or mini-public.

	Participation Form (Case Number)	
	Maxi-public	Mini-public
Delegated power	Referendum (9) Regional discussion and voting (14)	Citizens' jury (1)
Partnership	Citizens' observatory (17a, 17b) Public hearing (17a, 17b) Public debate (20) Community representative group (21)	Multi-criteria Delphi method (7) Multicriteria workshop (8, 11, 13) Design workshop (15, 19a, 24) Scenario tabletop (15)
Placation	Mega focus group (3) Public market event (10) Citizen science measurement (10) Seminar (15, 16, 20) Cycling experience (16) Public event (16, 20, 21, 22) Plenary roundtable (18) Online policy ranking (20) Open mailbox (20)	Dialogue meeting (1, 5, 11, 16, 17a, 17b, 19a, 19b, 20, 21) SWOT workshop (2) Discussion focus group (3, 10) Regional meeting (4) Citizen forum (4) Game session (6, 15) Evaluation meeting (6, 8, 18) Charettes (8, 16) Criteria focus group (13) Futuring focus group (14) Participatory mapping (17b, 18, 25) Workgroup (18) Expert conversations (19a) Automated vehicle experience (19a)
Consultation	Opinion poll (1) Street interview (2, 18) Website comments (4, 25) Survey (4, 5, 6, 11, 20, 21, 23) Field lab experiment (12) Street panel (12) Field visit (17a, 17b) On-street audit (16, 18) Citizen panel (23) Intervention trial (23)	Consultation meeting (4, 22) Stakeholder interview (8, 12, 22, 24) Interactive planning tool (24, 25)

providing information, collecting feedback, and gathering ideas from the visiting public (10, 16, 20, 21, 22). Alternatively, seminars are organized that provide information and collect ideas from visitors in a plenary way (15, 16, 18, 20), or online tools are used as open mailboxes (20), a focus group platform (3) or for policy ranking (20).

More frequently applied participation forms on the placation level address the mini-public using workshops for organizing dialogues (1, 5, 11, 16, 17a, 17b, 19a, 19b, 20, 21), focus group discussions (2, 3, 10, 13, 14, 18) and evaluation of ideas (4, 6, 8, 18). Some mini-public workshops use a specific structure for discussion, including applying a design approach (8, 16), a Strength Weakness Opportunities and Threats (SWOT) analysis to assess alternatives (2), participatory geographical mapping (17b, 18, 25) and playing a serious game (6, 15).

For the *consultation* level, an over-representation of participation events addressing the maxi-public is observed. These maxi-public consultation forms most commonly describe online or phone surveys (4, 5, 6, 11, 20, 21, 23), an online opinion poll (1) and collecting comments on a dedicated website (4). In-person, maxi-public consultation forms include street interviews or audits (2, 16, 18), field visits to assess the challenges of cycling in car-centric areas (17a, 17b) and a field lab experiment on a street redesign (12). Mini-public consultation forms consist of stakeholder interviews to ask about their preferences (8, 12, 22, 24) and a consultation meeting with a select group of residents (4).

In conclusion, in most cases, the public has a low to moderate voice in influencing sustainable mobility policy. None of the events gives

citizens complete control over the participation process, and only a few of them delegate part of the power. Broad maxi-publics and select mini-publics are present in roughly an equal number of events. Forms at the consultation level dominate attempts to reach the maxi-public, while forms at the placation level notably focus on engaging with mini-publics.

4.1.2. Objectives of public participation

Research question 2 aims to investigate whether clear objectives for participation have been formulated and what these objectives are. A total of 36 unique objectives are described in the 27 case studies of public participation. Four cases report a single objective, 13 cases describe two objectives, and 10 cases present three unique objectives. Table 6 (second column) categorizes the objectives into normative, substantive and instrumental objectives and the nine underlying types, as specified by Uittenbroek et al. (2019). Since the cases from the literature make no clear distinction between the objectives of integrating local knowledge or value-based knowledge (types 5 and 6 in Table 1), these two objectives are combined in our analysis and labelled 'local or value-based knowledge'.

The reviewed cases identify a roughly equal distribution among normative, substantive, and instrumental objectives, although the objectives are not always explicitly described. Cases tend to focus more on *how* the public participation process occurred than *why* it was initiated. The most identified objectives are to give citizens the opportunity to contribute to decisions, integrate knowledge and generate legitimacy. Participation events often aim to increase citizens' influence on policymaking that affects their environment, collect local preference data to make better decisions and create public support for sustainable mobility policies.

4.1.3. Indicators of effective public participation

This subsection deals with research question 3, seeking an answer to whether and what indicators of effectiveness of public participation are applied in the case studies. The 27 reviewed cases measure 42 unique effectiveness indicators (Table 6, third column). Nine cases measure one single indicator, nine describe two indicators, seven use three indicators, and two include four different indicators of effectiveness.

Although not all included cases explicitly describe the measurement of indicators, all evaluate the effect of the participation process in some way. As far as effectiveness indicators are used, a large variety is reported with attention to one or some of the objective types in Table 6. Generating local or value-based knowledge and legitimacy are most common, whereas empowerment of the marginalized is reported least often. Effectiveness indicators of the *generate legitimacy* type appear to be the most diverse. They include institutional legitimacy in the form of policymakers' evaluations of organizational capacity for sustainable mobility policies (10), assessment of how sustainable public participation-based policies are (14), and calculation of the number of cycling facilities realized due to public participation in cycling network plans (18).

Most of the indicators are assessed through a combination of objective measurements and subjective evaluations of policymakers (e.g., evaluating the level of transparency of a participation process) or participants (e.g., their feelings of empowerment). Some indicators measure the inclusion of participation results in following policy documentation or the degree of overlap between results from different participation activities. Only two reviewed cases (also) include behavioural change as an indicator of effectiveness. None of the studies explores benchmarks or norms for determining what indicator score should be considered effective.

4.2. Connection between objectives and indicators of effective public participation

The fourth research question aims to assess the alignment between objectives and indicators of effective public participation. One could

Table 6
Overview of public participation objectives and indicators clustered by objective types.

	Objectives (n=36)	Indicators (n=42)
Normative objectives		
Influence decisions	Increase the direct role of citizens (1, 2, 10, 20, 22, 23, 24)	Implementation of participation results in planning documents (1, 3, 20)
	Let citizens decide on policy introduction (9)	Policymaker evaluation of citizen influence (2, 9, 14)
	Explicitly involve citizens in the process of selecting among different plans (14)	Participant evaluation of their role in developing the mobility plan (17b)
	Form a shared base for a sustainable mobility plan (3)	
	Consider the influence and the interactions between the main stakeholders (7)	
	Cause alterations in projects in response to citizens' input (17a, 17b)	
Democratic capacity	Increase transparency of policy-making process (9)	Citizen evaluation of empowerment (4, 19a, 19b)
	Increase the role of civil society organizations in sustainable transport innovation (16)	Planner evaluation of process transparency (9, 22)
	Improve empowerment of citizens' observatories (17a, 17b)	Planner evaluation of dialogue facilitation in workshops (14)
		Frequency of horizontal citizen-government deliberations (16)
Social learning	Create mutual understanding about sustainability priorities (11)	Depth of social learning among participants (4, 6, 24)
	Create social learning to cause a change in the planning paradigm (4)	Stakeholder evaluation of understanding differing opinions (1, 8)
	Increase sustainable urban mobility literacy (6)	Perception of participants (24)
Empower marginalized	Attract a geographically representative sample of participants (3)	Involved citizen group size and representation (3, 23)
	Foster the inclusion of social aspects: social equity (4)	Inclusion of relevant stakeholders in the participation process (2, 23)
		Reach a diverse audience (10, 23)
		Diversity of participants (24)
		Interdependence (24)
		Presence of Authentic Dialogue (24)
Substantive objectives		
Local or value-based knowledge	Improve the generation of knowledge (1)	Stakeholder evaluation of novel idea generation (1)
	Listen to the needs of users (5, 13)	Stakeholder evaluation of local knowledge integration (8)
	Collect citizen and/or stakeholder information for improved decision–making (2, 8, 11, 13, 15, 22, 23, 24)	Traveller evaluation of street redesign (12)
	Include experiential user input to develop a new cycling network plan (18)	Understanding the problems of users (2)
	Gather new ideas from locals (12, 22, 23, 24)	Policymaker evaluation of inclusion of bottom-up information in planning (15, 18, 19a)
	Explore the role of automated vehicles in citizens' future lives (19a)	Policymaker evaluation of responsiveness to local mobility situation (19b)
	Collect detailed and large-scale air quality data (10)	Evaluation of participants contributions (25)

Table 6 (*continued*)

	Objectives (n=36)	Indicators (n=42)
	Express both spatial and social values (25)	Identification of types of participants (25)
Information robustness	Increase robustness of obtained results (8)	Overlap between dialogue meeting and citizens' jury (1)
	Reach unambiguous final results (1)	Overlap between Cost-Benefit Analysis results and participatory multi-criteria method results (7)
	Reduce the risk of planning fallacy (7)	Overlap between dialogue meetings and public referendum results (9)
		Overlap between results from citizen and stakeholder dialogue meetings (11)
		Overlap between PPGIS and other participation events (25)
		Time for which the tool was available (25)
Instrumental objectives		
Generate legitimacy	Promote sustainable mobility (3)	Level of organizational capacity for sustainable mobility policies (10)
	Increase public support for sustainable mobility policies (10, 12, 14, 20)	How sustainable transport policies are implemented (14)
	Increase the legitimacy of congestion tax policy (9)	Increased cycling facilities (18)
	Improve support for public transport (17a, 17b)	Attitude and behavioural change of citizens (10)
	Increase automated vehicle acceptance (19a)	Increased cycling attitudes and behavior (16)
	Increase cycling behavior (18)	Participant evaluation of project future potential (17a)
	Increase institutional support for sustainable mobility vision (14)	Public opinion [media] of transport plans (20)
	Building trust for automated vehicle technologies among stakeholders, citizens, and policymakers (19b)	Political and public support (16)
		Evaluation participation form popularity (21)
Resolve conflict	Develop shared objectives among stakeholders (15)	Level of consensus among stakeholders and users in a workshop (5, 13)
	Create consensus around the design solution before implementation (5)	Conflicts between stakeholders during the participation process (21)
	Develop shared solutions to reduce speeding among stakeholders (21)	Participation process effort, time, and money (5)

expect a complete overlap between the objectives formulated at the beginning of the project and the indicators to evaluate the objectives because, theoretically, policymakers only measure effectiveness for the objectives they aim to achieve. Unfortunately, most of the reviewed cases do not specify which indicators measure which objectives. Often, a collection of objectives is stated at the beginning of the process, and some evaluation is performed at the end. A sharp link between an evaluation measure and specific objectives is lacking. Because explicit links between objectives and indicators are insightful for those who aim to start a participation process, we have analyzed to what degree effectiveness indicators of a specific type used in a case study evaluated corresponding objectives of the same kind, referring to the classification by Uittenbroek et al. (2019) (see Table 1). We assume that the objective and indicator of effectiveness are aligned when a case has formulated (a) an objective of a specific type (e.g., resolving conflict) and (b) an effectiveness indicator that measures precisely this objective (e.g. whether the conflicts are resolved).

Fig. 2 illustrates the relationship between objectives and indicator types for each reviewed case. When objectives and effectiveness
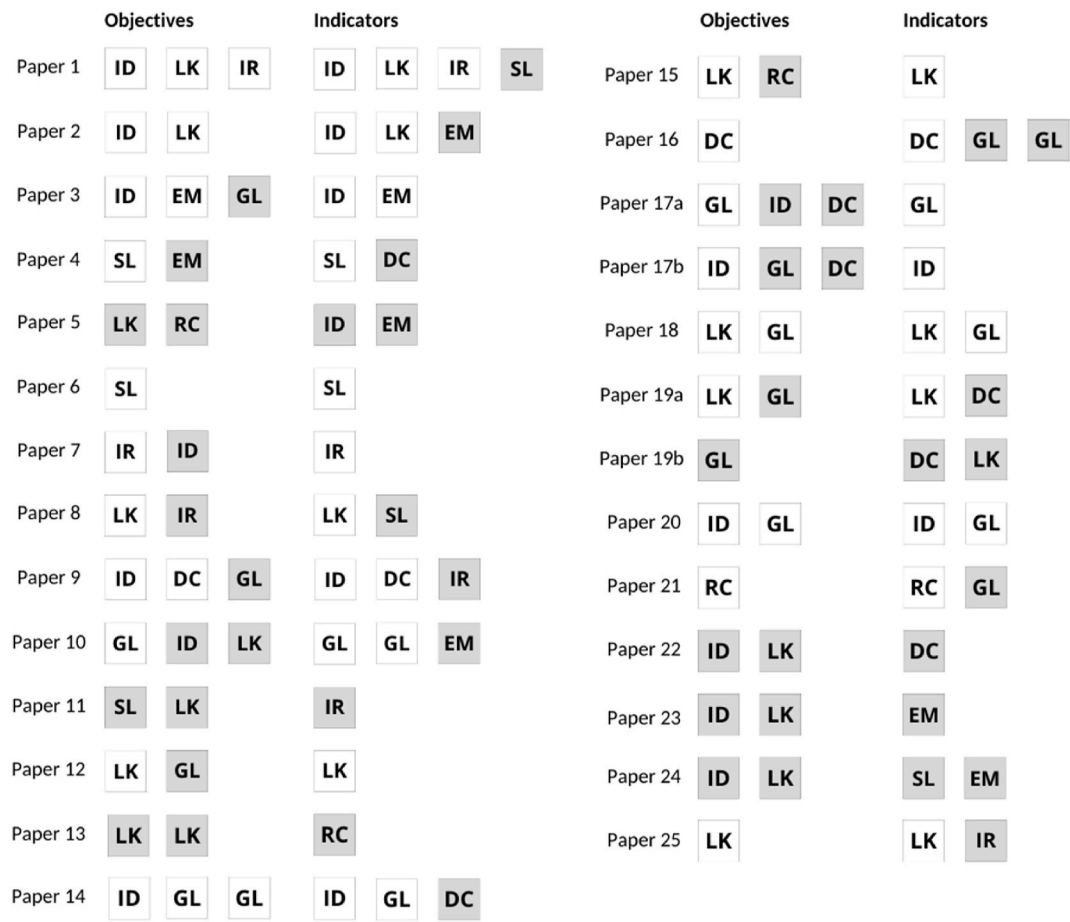
Fig. 2. Relationship per case between participation Objectives and Indicators of effectiveness (overlap types in white; deviating types in grey). Abbreviations stand for Democratic Capacity (DC), Empower Marginalized (EM), Generating Legitimacy (GL), Influence Decisions (ID), Local or value-based Knowledge (LK), Information Robustness (IR), Resolve Conflict (RC), Social Learning (SL).

indicators are aligned, the specific type is represented in white. Mismatches are indicated in grey. A mismatch contains types that are introduced as objectives but are not evaluated, or the other way around when there are effectiveness indicators but they are not introduced as objectives in the first place.

To illustrate Fig. 2, in case (1), the three objectives are of the types: influence decisions (ID), local or value-based knowledge (LK) and information robustness (IR). The four effectiveness indicators mentioned in case (1) belong to the types: influence decisions (ID), social learning (SL), local or value-based knowledge (LK) and information robustness (IR). We observe an overlap between objectives and effectiveness indicators in the categories ID, LK, and IR. However, also, an additional effectiveness indicator of the type of social learning (SL) is reported. Hence, this case measures more effectiveness indicator types than objective types.

Fig. 2 shows that most cases demonstrate some overlap between the types of objectives and effectiveness indicators, suggesting a relationship between the two. There are only three cases (6, 18, 20) with a complete overlap, meaning that stated objectives at the beginning are evaluated during and after public participation, and nothing more or less.

The other 24 cases show some mismatch between types of objectives and effectiveness indicators. We distinguish between limited mismatch, missing evaluation of particular objectives, and complete mismatch. First, limited mismatch means that additional aspects for which the participation process was not designed were measured. In six cases (1, 2, 14, 16, 21, 25), additional effectiveness indicators on top of the indicators needed to evaluate the initially stated objectives were

described. The second category entails cases where some of the objectives are not evaluated at all. In eleven cases (3, 4, 7, 8, 9, 10, 12, 15, 17a, 17b, 19a), objectives were specified which were not measured by the applied effectiveness indicators. Finally, a complete mismatch refers to the inclusion of effectiveness indicators that do not evaluate the objectives stated in the beginning. Cases 5, 11, 13, 19b, 22, 23, and 24 fall in this category, and there is no way of concluding whether the public participation process, with objectives, has been effective or not.

Considering the types of objectives that are evaluated in the total of cases, we observe that the objective types regarding influencing decisions (ID), using local or value-based knowledge (LK) and generating legitimacy (GL) are more frequently stated as objective than evaluated and used as indicators. In contrast, democratic capacity (DC) is reported more often as a type of effectiveness indicator than stated as a primary objective.

The findings will be discussed in the next section before we conclude the paper and present directions for future research.

5. Discussion

In this section, we first discuss the findings of this paper. Second, we discuss the strengths and limitations of this study. Finally, we discuss the practical implications.

For this scoping review, we collected and analyzed peer-reviewed case studies on public participation projects for sustainable mobility in 14 countries. Per case, we identified reported forms, objectives, and effectiveness indicators and assessed levels of alignment. Cases often had multiple objectives, and many projects included measures to

evaluate their effectiveness. Most relevant and in line with what we assumed, almost all of the described cases demonstrated a degree of misalignment between objectives and effectiveness evaluation standards.

Our main findings show a wide variety of participation forms, of which *consultation* was the most dominant. From the data, we cannot conclude why consultation appears to be the dominant level of public participation. However, we think of a number of reasons. The mobility system is a complex system that, in terms of policy development, is traditionally dominated by experts. These professionals might be hesitant regarding the influence of non-experts. Consultation might be considered as an adequate approach to find a balance between the expertise of involved professionals and the ideas from the public and to keep the necessary speed in the policy preparation and implementation process. Consultation is seen as a one-way direction of communication with the public with the primary aim of collecting feedback on professionally developed plans or ideas. However, it provides limited room for essentially new ideas. As a result, it potentially has a limited impact on the direction of the projects, has a reasonably low time investment, but still enable the public to participate.

In line with the dominance of consultation as a form of participation is the absence of events on the highest level of participatory power: *citizen power*. In none of the reviewed cases was the public allowed to set their own goals and decide on policies. This finding contrasts with what we incidentally have seen in Dutch practice. For example, citizens facing traffic safety problems in their direct neighbourhood are increasingly invited to share ideas on how to solve that. And increasingly, car-less people are invited to share ideas on how to organize a mix of shared and public transport services to enable access to critical services (e.g., Slimmer Reizen, n.d.). A possible reason why the highest level of participatory power is not given to participants is that the political context does not allow for it. In a representative democracy or top-down decision-making context, policymakers are formally the ones who ultimately decide. Another explanation could be that policymakers are hesitant to give citizens full power because at public engagement in final decision-making could lead to policies that do not align with public or organizational sustainability objectives.

We described the actual participation forms used at the different power levels and observed that the same form, for example focus groups or workshops, could be used at various power levels. The actual impact on decision making seems dependent on the way these forms are operationalized and applied in the context of a real-world case and the experiences the program or project leaders have with a specific participation form. In future research, this aspect of using a form in a variety of ways that fits the aim of the process could be further studied.

Our finding regarding the absence of *citizen power* as a level of participation in our review does not necessarily imply that decision-makers did not integrate the goals and wishes of citizens. We found that the objective of most participation events was formulated as (i) to increase citizens' influence on policymaking, and (ii) to collect local preferences to make better decisions and create public support for sustainable mobility policies. The indicators for evaluation most commonly found, however, were not in line with these objectives. They appeared to evaluate the process, often in a subjective manner. For example, we identified indicators that assessed the level of transparency of a participation process or participants' feelings of empowerment instead of whether or not public support had increased.

These findings suggest that in general policymakers may not rigorously consider the design of participatory projects. This could be due to constraints such as limited knowledge, budget, or time, though other factors may also play a role. For instance, specific indicators of effectiveness may be easier to collect but less meaningful in assessing actual impact. For example, surveying participants within a mini-public on their perceived experience is more straightforward and less time-consuming than measuring the broader public's satisfaction with the implementation of a mobility policy. Additionally, the use of easily

obtainable yet misaligned indicators might serve to confer a superficial sense of legitimacy to a process—an instrumental objective—rather than providing a substantive evaluation of its effectiveness. However, such practices may lead to a boomerang effect, where ineffective public participation fosters resistance rather than engagement (de Vries et al., 2012; ter Mors and van Leeuwen, 2023). Research is necessary to gain deeper insights into the factors influencing the design choices in public participation processes. Future studies could explore this by analyzing real-world cases and conducting interviews with policymakers to understand their decision-making rationales better.

Our analysis reveals that none of the reviewed cases explored benchmarks or norms for determining what indicator score should be considered effective. This result is noteworthy because one could expect some *performance measurement* for participation projects, as often occurs in other governmental projects. Performance measures assess if a project reaches its desired outcomes with systematic data collection and analysis. Policymakers involved in participation projects could benefit from specifying performance measures and making objectives and indicators explicit – and aligned - before the participation process. This assumption on the potentially positive effect of consistency of the design and evaluation process specification is in line with suggestions from Ianniello et al. (2012, 2019) and Uittenbroek et al. (2019). Ianniello and colleagues also argue that standardizing evaluation criteria (for example, in terms of the level of consensus or participation satisfaction) is essential to facilitate more systematic comparisons between participatory processes. Consistently and explicitly aligning forms, objectives and evaluation acknowledges the importance of, and willingness to adopt, public participation as part of the public decision-making process. Not sufficiently addressing these issues could cause situations where public participation becomes a goal in itself, with the risk of increasing disappointment of the public and policymakers. In the end, this might cause a recovery from traditional top-down policy strategies.

With regard to limitations in the review, we first need to mention the absence of cases from Asia and Africa, as well as the exclusion of non-English literature. Both might cause a lack of academic case descriptions from certain countries and continents. This lack might affect the comprehensiveness of the literature review as well as the generalizability of the conclusions.

Secondly, the focus of this review is on academic literature and does not include practice-oriented case descriptions. Due to this choice, we likely have missed relevant cases that have not been published in academic journals (yet). To find out whether we missed relevant insights from such cases requires discussing these issues of alignment with practitioners who are/were actively involved in these processes. This requires interviewing these practitioners to enable the reconstruction of the primary decision-making process for the design of the public participation approach. This helps to clarifiy the motivations of policymakers to define objectives, choose forms, and select evaluation criteria.

From such case analyses, the question can be answered whether patterns in practice correspond with those found in the literature review. Do practical case analyses provide a better understanding of the mechanisms underlying decision-making in practice? To what degree do the characteristics of the sustainable mobility challenges influence this process? The scope of the analysis should be widened to find answers to these questions, as compared to the scope applied in this review. For example, next to the motivations of policymakers it is also relevant to investigate institutional and psychological barriers and enablers that contribute to the design of a public participation process. Widening the scope is also expected to result in a better understanding of what indicators and their scores actually point to effectiveness. Moreover, a content-richer analysis can add more detail to the rather abstract categorization into objective types, power levels, and mini- and maxi-publics, as adopted in this paper.

The need for a widening of scope is related to the third limitation of the present scope due to the focus on Arnstein's ladder. As argued, the

choice for this concept in this study was motivated by the dominant reference to Arnstein in real-world (Dutch) practices of policymaking (e. g. Bobbio, 2019). We enriched the scope by including the typology of objectives as elaborated by Uittenbroek et al. (2019), as well as the distinction between mini- and maxi-public. Nevertheless, the analyses suggest that the dominant one-dimensional perspective on public participation does not fully satisfy. Notably, the variety of forms and their related design issues, as well as the observation that often different consecutive steps in a public participation process are made, do not seem to match well with the chosen perspective. Perhaps a switch to more elaborated framings of public participation, such as presented by Fung (2006), is needed to grasp reality better.

A fourth limitation is that many cases in this study describe short-term or one-off participation projects. Special attention should also go to the investigation of longitudinal participation processes, applying different forms to engage both mini- and maxi-public while providing novel ways to enlighten and discuss the complexity of sustainable mobility transitions. Novel ways, for example, include the use of animation techniques, living labs, vision-making (Jittrapirom et al., 2023), gaming (Aubert et al., 2019) or Group Model Building (Rouwette et al., 2002). A significant challenge for the future involves digitalization and artificial intelligence (AI) that enable new forms of participation in sustainable mobility. An example is Participatory Value Evaluation (Mouter et al., 2021), where citizens engage via online platforms to inform decision-making. Such tools enhance accessibility by allowing participation from anywhere, potentially broadening demographic representation. However, concerns remain about digital inclusion, as not all citizens have equal digital access or skills. Furthermore, AI aids in processing large datasets, offering policymakers valuable insights but raising ethical issues like algorithmic bias, transparency, and privacy. Also, digital tools must balance efficiency with capturing qualitative input, as voluntary participation can skew representativeness. Digital participation tools thus require careful design, emphasizing transparency, inclusivity, and responsible AI use to ensure legitimacy and trust. Collaboration among researchers, policymakers, and developers is crucial to address these challenges and unlock the full potential of digital participation.

The results of our review can be translated into recommendations for policymakers and designers of public participation processes for sustainable mobility. Policymakers in mobility planning still lack experience with (specific forms of) public participation and may feel uncomfortable sharing power or responsibilities with the public. This review provides them with an overview of the existing variety of public participation forms and citizen power levels. Guidelines for policymakers on which forms of public participation can achieve specific objectives do not exist, and it remains an open question to be studied in future research. Literature suggests that some standardization of objectives and evaluation indicators might help policymakers involved in public participation for sustainable mobility to reduce the effort required to start and improve existing public participation initiatives. Only rigorous evaluations of public participation processes can provide an answer to the question whether sustainable mobility policymaking is suitable or too complex for straightforward guidelines and standard design practices or for providing the public with high levels of power (see Hurlbert and Gupta, 2015).

6. Conclusion

This study investigated the (alignment of) applied forms, objectives, and effectiveness indicators of public participation in the context of processes of preparation of policies for sustainable mobility. The analysis, based on a systematic literature review, is novel and adds to the intensifying scientific and practical debate on how to improve public participation in the context of sustainable mobility policymaking. An improvement that is increasingly argued for. The study includes a diverse range of cases, both geographically and thematically,

strengthening the findings of the study. Moreover, the findings have many practical implications that contribute to the improvement of public participation processes in policy design.

In terms of answers to the research questions, the analysis shows that a wide variety of public participation forms are used. The reviewed descriptions of real-world practices in the scientific literature involved both maxi-publics and mini-publics. In terms of Arnstein's ladder, the applied forms in the case descriptions we reviewed allowed participants to perform limited to moderate participatory power. Consequently, the influence of the public participation processes on decision-making appeared to be limited. Nevertheless, several claims of effective participation in various cases were observed. In many instances, however, these claims appear not to be based on a systematic measurement using targeted effectiveness indicators. This observation is linked to observable inconsistencies between forms, objectives and effectiveness measurement. The analysis showed that cases often had multiple objectives of diverse objective types. They also provided effectiveness indicators to evaluate the process that spanned a variety of objective types. However, we observed that in many cases, objectives and effectiveness indicators did not match consistently. Misalignment ranged from adding an extra indicator to a complete mismatch between stated objectives and indicators. We found that most of the described cases included unevaluated objectives or unrelated indicators of effectiveness.

These findings triggered several discussions, suggesting the need for further research. We notably emphasized the need for in-depth analyses of practical cases of public participation in the context of the preparation of policies on sustainable mobility. Case analyses contribute to understanding better the factors determining or influencing decisions by designers of such processes on goals, methods, indicators, and the evaluation of results. The analysis helps to understand to what degree more general conditions in the policymaking process and factors related to the complexity of sustainable mobility are influential. Next, we also argued that the scope of such in-depth case analyses should be widened as compared to Arnstein's ladder in order to enrich these analyses with insights into institutional and psychological mechanisms influencing the design and performance of public participation processes. Finally, we argued that it makes sense to experiment with novel forms of public participation that enable more creative involvement of the public. Reported experiences with these novel forms of public participation suggest that they have the potential to contribute significantly to the quality of policymaking.

Data availability

No data was used for the research described in the article.

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