Development of an assessment matrix for evaluating public participation procedures

Jonathan Matthei[1], Leon Streyl[1], Philip Balcar[1], Peter Bohnenkamp[1], Sven Mackenbach[1], Katharina Klemt-Albert[1]

[1] Institute for Construction Management, Digital Engineering and Robotics in Construction, RWTH Aachen University, Aachen, Germany
matthei@icom.rwth-aachen.de, leon.streyl@rwth-aachen.de, philip.balcar@rwth-aachen.de, p.bohnenkamp@icom.rwth-aachen.de, mackenbach@icom.rwth-aachen.de, klemt-albert@icom.rwth-aachen.de

Abstract

Public participation is crucial for designing livable cities and accelerating planning procedures. A key challenge is the complexity of planning documents, which are often difficult for non-experts to understand. Digital participation and techniques like 3D visualizations and Building Information Modeling (BIM) offer promising solutions to enhance the comprehensibility and acceptance of construction projects.

This study aims to develop an assessment matrix for participation procedures that enables the quality and effectiveness of such processes to be comprehensively evaluated. A systematic literature analysis is first used to identify success factors and challenges of public participation as well as specific success factors and challenges for digital forms of participation (e-participation). These success factors are divided into the categories of resources, communication and process-related aspects, while challenges are categorized into stakeholder-specific and overarching aspects.

Based on these findings, an assessment matrix is created to evaluate public participation in the context of planning and approval procedures. The assessment matrix includes parameters such as background information, the participation process, planning documents, and responses and their respective impacts. This matrix will be applied in the BIM4People research project, funded by the Ministry of Digital and Transport (BMDV), to identify improvements in current participation processes and explore how BIM models can optimize them.

Keywords

Building Information Modeling (BIM), e-participation, evaluation matrix for public participation, success factors and challenges of public and e-participation

1 Introduction

"*A good city is like a good party — people stay longer than really necessary because they are enjoying themselves*" - Jan Gehl [1]

Public participation plays a central role in the design of livable cities and infrastructures. Nevertheless, such participation processes regularly lead to conflicts, particularly in the case of complex infrastructure projects. Protests, resistance and legal disputes on the part of citizens are often the consequences, which can have a negative impact on the progress and success of such processes [2].

One of the major factors contributing to these conflicts are planning documents, which are often complex and difficult to understand, especially for people who are not familiar with technical drawings. The traditional presentation of planning documents is often in the form of textual elaborations and two-dimensional drawings that are difficult for the non-expert to access [3]. This barrier can make participation in planning processes considerably more difficult, as those affected often find it difficult to grasp and understand the full dimensions of the planned projects.

In this context, new possibilities for participation and visualization of construction projects, such as 3D visualizations and Building Information Modelling (BIM) models, offer promising approaches for improving public participation [4]. These technologies promise to provide more vivid and intuitive representations, making planning documents more comprehensible and potentially increasing transparency and public acceptance. To systematically evaluate the effectiveness of participation processes, various approaches and guidelines have been developed in the past [5–7]. However, these primarily focus on traditional, non-digital formats or specific types of participation. A comprehensive framework that incorporates both traditional and digital participation formats—while

enabling a comparative analysis of text-based, two-dimensional, and three-dimensional planning documents—has not yet been established.

With this background, an assessment matrix for planning and approval procedures is developed that makes it possible to systematically evaluate the quality of such public participation processes. It provides a structured method for evaluating various aspects and parameters that play an important role in such processes. The matrix is used to systematically identify weaknesses and potential for improvement in order to make the entire process both more efficient and more citizen friendly.

In order to develop this assessment matrix, a comprehensive overview of the success factors and challenges of public participation and digital participation opportunities, so-called e-participation measures [8], is first required. Analyzing these factors makes it possible to determine the relevant parameters that are important for the evaluation of the planning documents. Once the success factors and challenges have been analyzed, the specific assessment parameters can be derived and integrated into the assessment matrix.

The detailed methodological procedure for developing the assessment matrix is described in the following chapter. The identified success factors and challenges are then highlighted, and the developed assessment matrix is presented. Finally, the key results are discussed and summarized. This section also contains an outlook that shows the context in which the assessment matrix is to be used as an example.

2 Methodology

To develop the assessment matrix, a systematic literature analysis was carried out based on the approach of Webster and Watson (2002) [9] and Vom Brocke et al. (2009) [10].

According to Webster and Watson, a literature search essentially involves searching scientific databases using keywords. The authors recommend using a backward and forward search to find relevant literature. A forward search looks for literature that cites the literature already found. In a backward search, on the other hand, the literature found is searched for cited literature in order to include it after checking its suitability [9].

Vom Brocke et al. (2009) take up these approaches and at the same time note that only a few detailed methods and standardized procedures exist for literature research. They emphasize the difficulty of searching for literature at a time when more and more sources and literature are being published every year. In their explanations, the authors emphasize the importance of a careful literature review. Strict documentation and presentation of the research processes is required in order to make the procedure comprehensible and reproducible [10]. Therefore, the systematic literature analysis of this study is based on three phases.

In the **first phase** of this study, search criteria and search parameters are defined. The databases SpringerLink, ScienceDirect, and Scopus were selected as the foundation for the literature search. Scopus and ScienceDirect, as predominantly English-language databases, were used exclusively for English-language literature. In contrast, SpringerLink was specifically chosen to cover German-language sources. Google Scholar was included as it is considered to cover German-language literature more efficiently than comparable databases [11]. Moreover, its inclusion ensured that relevant insights from non-academic sources, such as municipal master plans and governmental reports, were also captured, as these can provide valuable findings for the research context. However, Google Scholar does not provide literature directly but refers to other databases [12].

The literature search is based on predefined keywords to systematically identify relevant sources. Keywords related to public participation, including ‘public participation’ and ‘citizen participation,’ as well as their German equivalents, were selected. Additionally, terms associated with e-participation, such as ‘e-participation,’ its German translation, and ‘digital participation,’ were included. This targeted selection ensures a comprehensive review of relevant literature in both English and German.

To refine the search scope, only open-access sources classified under the subject area *Engineering* were considered. In Scopus, the presence of the respective keyword was required, while in ScienceDirect, the term *participation* had to appear in the title. Additionally, the search was limited to the last 15 years (2008–2023) to ensure relevance, as scientific findings are continuously updated. Given the rapid innovation cycles in e-participation technologies, a more recent timeframe is particularly relevant. [13]. Furthermore, by 2008, over three-quarters of German households had broadband access, establishing the foundation for digital participation.[14]. This approach resulted in 979 identified sources.

In the **second phase**, duplicates were first removed. The remaining sources then underwent an abstract screening to assess their relevance. After this process, 169 sources met the criteria and were selected for detailed analysis.

In the **third phase**, the success factors and challenges for both public participation and e-participation were analyzed. Based on the respective success factors and challenges, 23 evaluation parameters were then derived.

The entire procedure, including each phase from initial literature search to the development of the assessment matrix, is summarized in the following figure.

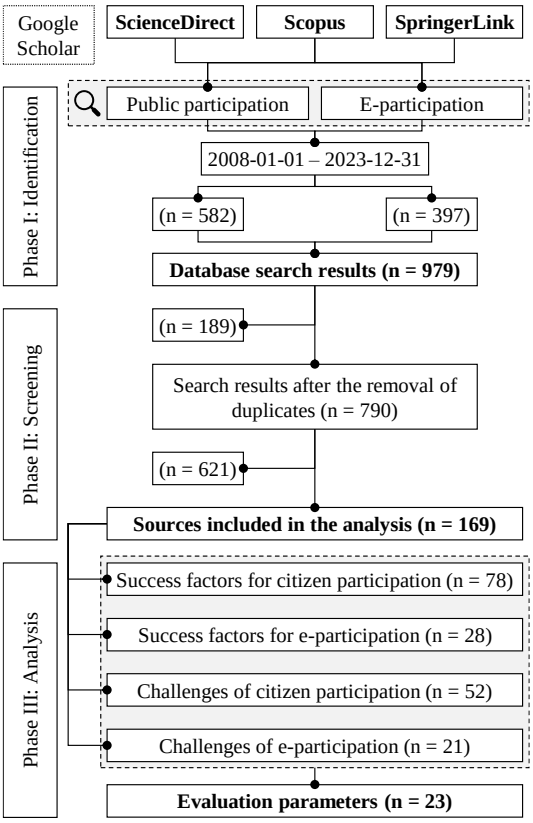

Figure 1. Methodology Findings

The first step is to define the terms 'success factor' and 'challenge' for a shared understanding in evaluating public participation processes. Success can be perceived subjectively by different actors, with citizens viewing success as the assertion of their interests, while organizers may see functional participation as successful [15]. In 1988, Lutz Hildebrandt defined the 'success factor' as a key variable linking performance indicators and planning units [16].

The following definition can be derived from this regarding the success of public and e-participation:

Success factors in public participation and e-participation measures are those variables that help to make the participation process as pleasant and simple as possible for all those involved, as well as creating a feeling of satisfaction and promoting and strengthening user behavior.

According to the Oxford English Dictionary, challenges are defined as demanding situations or tasks designed to test one's abilities or character. Lazarus and Folkmann, on the other hand, write that the evaluation of challenges focuses on the winning or growth potential of an encounter (and is characterized by pleasurable emotions such as eagerness, excitement and enthusiasm) [17]. The focus/stimulus of challenges is therefore to achieve the desired goal by completing the demanding task. However, there is always the risk of failing at the task or that the desired goal is not achieved. Challenges in the context of public and e-participation measures can therefore be defined as follows:

Challenges in public participation and e-participation measures are all matters that could lead to more successful participation but involve a lot of effort and are not guaranteed to have a positive impact.

2.1 Success factors for public participation and e-participation

The study identified 78 success factors for public participation and 28 specifically for e-participation measures. Following an inductive categorization method as outlined by Mayring [18], these success factors can be grouped into three main categories: "Resources," "Communication," and "Process-related Aspects." Each main category further divides into several subcategories (see Figure 2 and 3).

	Success factors for public participation		
	Resources	Communication	Process-related aspects
	1	2	3
a	Personnel n = 6	Real participation n = 8	Traceability in the process n = 4
b	Organisational n = 17	At eye level n = 10	Preparation and follow-up n = 10
c	Range n = 7	Create clarity n = 9	Quality and continuity in the process n = 7

Figure 2. Success factors for public participation

	Success factors for e-participation		
	Resources	Communication	Process-related aspects
	1	2	3
a	Personnel n = 3	Avoiding frustration n = 3	Preparation and follow-up n = 2
b	Organisational n = 2	Exchange medium n = 12	Quality and continuity in the process n = 5
c	Range n = 1		

Figure 3. Success factors for e-participation

In the area of public participation, **resources** are crucial to the success of participation processes. Resources are understood as 'certain means that are necessary to achieve a goal' [19]. Human resources, such as the stakeholders involved, play a key role. Social competence from authorities is a crucial success factor, as it facilitates communication and interaction with citizens, improving the process's effectiveness [20]. Another example is the involvement of external, neutral moderators. These help to promote the acceptance of procedures and minimize barriers to participation, as they act as impartial mediators [21]. The availability of technical support plays a decisive role in the area of e-participation measures. Technical support ensures that all participants receive the necessary assistance with digital matters [22]. This makes a significant contribution to ensuring that sufficient support is provided when giving feedback, which is an important assessment parameter in the evaluation of participation processes.

Organizational success factors include the general willingness of the authority to carry out participation [23]. This willingness is reflected in the openness of the authorities to actively involve citizens in decision-making processes. Other factors are the existence of a harmonious relationship between the costs and benefits of participation [20] and the general accessibility of information [24]. In the context of e-participation measures, it is also necessary to ensure barrier-free online access [23].

Outreach is another aspect of successful participation processes. The success factors in this sub-category include the use of various media to disseminate information [20] and widespread publicity for the implementation of a participation process [25]. Another success factor for e-participation measures is the awareness of and attention generated by digital participation opportunities [26].

The **communication** category refers to the direct exchange between the participants and the participating institutions. Both verbal and non-verbal exchange is crucial here.

In this context, various success factors can be identified that ensure genuine participation. Key success factors include avoiding the impression of a fictitious participation [27] and a recognizable prospect of success through the investment [24]. This knowledge motivates active participation and increases the willingness to get involved in the process. A concrete evaluation parameter that captures this aspect of communication is the consideration of feedback in further planning. This shows the participants that their contributions are taken seriously and are actually incorporated into the decision-making processes.

Furthermore, success factors that build trust are crucial, including openness to communication, willingness to discuss, and avoiding specialized terminology [20].

Clear communication is also conducive to extensive participation and a process that is perceived as fair. Unclear statements and feedback can lead to false expectations, which should be avoided [28]. A key evaluation parameter that ensures this clarity is the thematic response to feedback from the public. If the authority's feedback specifically addresses the points raised, misunderstandings can be avoided and the satisfaction of those involved can be increased.

In the area of e-participation measures, there are additional factors to consider that help to avoid frustration when using digital technologies. One decisive factor is a user-friendly interface that makes it easier for users to find their way around digital platforms [29]. In addition, it is important to provide visual and auditory content to cater for different learning and communication styles and to facilitate access for all user groups [26].

The category of **process-related aspects** includes factors that influence 'traceability in the process', 'preparation and follow-up' and 'quality and continuity in the process'.

Transparent procedures and the provision of background information are necessary for traceability in the process [21]. Transparent procedures enable those involved to clearly understand the progress and decisions within the process. This evaluation parameter increases the confidence of those involved in the process and ensures that they feel they are taken seriously. To achieve this goal, the planning documents themselves must also be relevant, comprehensible and transparent.

Preparation and follow-up include early activation and mobilization of the public [15] and the start of participation before irreversible decisions are made [24]. This enables a well-founded opinion to be formed and promotes the quality of the contributions. In this context, the procedure and the key points of participation must be known [30].

In order to ensure high quality and continuity in the process, it is of central importance that comprehensive information on participation is provided [21]. In addition, proactively taking up feedback during the planning phase is a key success factor. This ensures that the feedback from those involved is taken into account and integrated into further planning, which increases the effectiveness and acceptance of the entire participation process.

E-participation also benefits from limiting anonymity for accountability and conducting objective fact-checks to maintain accurate and current information [31].

2.2 Challenges of public participation and e-participation

Using Mayring's inductive categorization method [18], the study identified 52 challenges in public

participation and 21 specific to e-participation. These are categorized as "Stakeholder-specific" and "Overarching challenges" (see Figure 4).

	Challenges of public participation and *e-participation	
	Stakeholder-specific challenges	Overarching challenges
	1	2
a	On the authority side n = 12 *n = 7	Representation n = 7 *n = 1
b	Interaction with the citizen side n = 13 * n = 7	Framework conditions n = 12 *n = 4
c	Citizen side n = 8 *n = 2	

Figure 4. Challenges of public participation and e-participation

Stakeholder-specific challenges in public participation are categorized into three sub-categories: public authorities, citizens, and their interactions.

Public authority challenges mainly involve internal structures and processes, including resource shortages that hinder effective participation implementation in terms of staff and finances [32]. Additional challenges arise in the area of e-participation measures. E-participation introduces technical and organizational challenges, requiring authorities to develop and maintain digital platforms. [33]. Managing large volumes of digital data also demands effective systems for collection, analysis, and interpretation. [26].

There are numerous challenges on the citizens' side, with a central problem being insufficient information about participation opportunities and the underlying procedures [20]. In addition, there is often a lack of trust in the authorities based on previous experience of insufficient consideration of citizens' opinions [29]. In this context, it is essential to ensure the credibility of the planning documents. Consistent and complete planning documents are crucial for this. In addition, the fulfilment of technical requirements for e-participation measures poses a challenge. Many citizens do not have the necessary digital skills or access to suitable technology to participate in online participation procedures [26].

The interaction between authorities and citizens also harbors specific challenges. A frequent problem is dealing with different interest groups [34] and the scope of information provision [29]. These difficulties can lead to time and financial burdens on the one hand and make it difficult to satisfy individual concerns on the other. With regard to e-participation measures, there are additional challenges, particularly in terms of ensuring the credibility of these measures. The credibility of e-participation processes is often questioned as there are concerns regarding the manipulability of online surveys and polls [35].

Overarching challenges include representation and framework conditions, which are crucial for the effectiveness and legitimacy of participation processes.

A common issue is the dominance of well-organized, vocal groups, which can overshadow diverse perspectives [21]. Additionally, proponents of a project are often underrepresented, with participation processes frequently attracting more opponents, leading to an imbalanced discourse [21].

The framework conditions of public participation processes are also of crucial importance. A frequent challenge is the lack of clarity about the influence of citizens' opinions on the actual decisions [28]. In addition, the high complexity of construction projects poses a further challenge [29]. Construction projects often involve complex technical, legal and economic aspects that can be difficult for laypeople to understand. Consequently, more vibrant, clear and understandable documentation and feedback are crucial and consequently represent concrete evaluation parameters.

E-participation faces challenges like software dependency [26], where functionality and usability are crucial, and resistance to change from both citizens and authorities unfamiliar with digital tools [36].

3 Assessment matrix

The assessment matrix includes aspects, parameters, descriptions, and a scale from 1 to 6. Aspects are broad categories, with parameters serving as specific criteria. The scale evaluates the degree of fulfillment, from 1 (not fulfilled) to 6 (fully fulfilled), allowing for a detailed assessment of strengths and weaknesses.

The assessment matrix includes four aspects: (i) background information, (ii) participation process, (iii) planning documents, and (iv) response and impact. These were derived from the identified success factors and challenges. Since evaluation parameters often influence multiple factors, a direct one-to-one mapping was not possible. The matrix focuses on evaluating public participation and e-participation from the citizens' perspective to help identify strengths and weaknesses for the initiators.

The 'background information' aspect ensures citizens understand the process, deadlines, and project details. The 'participation process' evaluates citizen involvement and support. The 'planning documents' aspect assesses the quality and review challenges of the provided information. The 'response and impact' aspect examines how authorities respond to citizen input and its impact.

Aspect	Assessment parameter	Description	Ranking					
			1	2	3	4	5	6
Background-information	Familiarity with the procedure	Assesses whether the course of the procedure is known.						
	Awareness of dates and deadlines for participation	Evaluates whether the relevant deadlines and dates for participation have been clearly communicated.						
	Sufficient information on the project	Measures whether sufficient information has been provided about the project.						
	Feeling of sufficient participation present	Assesses whether the feeling of having been given sufficient opportunities to participate.						
Participation process	Sufficient information for providing feedback	Checks whether the provision of information on participation was adequate.						
	Sufficient support for providing feedback	Measures the extent to which support measures were available for the submission of feedback.						
Planning documents	Accessibility of the planning documents	Evaluates the accessibility of the planning documents.						
	Completeness of the planning documents	Checks whether the planning documents contain all the necessary information.						
	Comprehensibility of the planning documents	Checks the comprehensibility of the planning documents.						
	Attractive visual presentation of the planning documents	Evaluates the clear presentation of the planned impacts in the planning documents.						
	Clarity of the planning documents	Evaluates the clarity of the planning documents.						
	Relevance of the planning documents	Evaluated whether all relevant information was easy to find in the planning documents						
	Consistency of the planning documents	Measures the consistency within the planning documents provided.						
	Credibility of the planning documents	Assesses the credibility of the planning documents.						
	Comprehensibility of the planning documents	Checks whether the presentation of the impacts in the planning documents is comprehensible.						
	Transparency of the planning documents	Evaluates the transparent presentation of decisions in the planning documents.						
	Appropriate timeframe for reviewing the planning documents	Measures whether the time available for reviewing the planning documents was sufficient.						
	Financially unproblematic inspection of the planning documents	Evaluates whether access to the planning documents was associated with financial barriers.						
Response and impact	Comprehensibility of the feedback	Measures the comprehensibility of the feedback received.						
	Thematic response to the feedback	Evaluates whether the feedback has been answered thematically.						
	Satisfaction with the feedback received	Checks whether the feedback could satisfy the individual concerns.						
	Discussion of the feedback	Checks to what extent the submitted feedback has been discussed.						
	Feeling of integration of feedback into the planning process	Evaluates whether there is a feeling that the feedback has been taken into account in further planning.						

1 = Not achieved 2 = Barely achieved 3 = Partially achieved 4 = Well achieved 5 = Almost fully achieved 6 = Fully achieved

Table 1. Assessment matrix for evaluating public participation procedures in planning and approval procedures

4 Discussion and Conclusion

Public participation is a crucial factor in accelerating planning and approval processes, significantly contributing to the success of complex infrastructure projects. Despite its importance, dissatisfaction and complaints remain common. Digital participation formats offer new opportunities to improve the comprehensibility and acceptance of these processes. However, existing evaluation approaches often focus on traditional, non-digital participation methods or specific participation types, lacking a comprehensive framework that equally considers both conventional and digital formats. A holistic evaluation approach is essential to systematically assess the transition to digital participation and analyze its potential and challenges in a structured manner.

This study aimed to develop an assessment matrix that systematically evaluates the quality and effectiveness of public participation processes in the context of planning and approval procedure, identifying weaknesses and potential areas for improvement, particularly regarding digital visualization techniques. A systematic literature review was conducted to identify relevant success factors and challenges, which were categorized into four dimensions: 'resources,' 'communication,' 'process-related aspects,' and 'stakeholder-specific and overarching challenges.' The resulting assessment parameters were incorporated into the matrix, which consists of four core aspects: background information, participation process, planning documents, and response and impact.

The developed assessment matrix serves as a structured tool for objectively evaluating public participation processes. It enables a systematic comparison of different planning document formats—whether text-based, 2D, or 3D visualizations—contributing to a deeper understanding of their effectiveness in participation processes. Since the matrix is designed for use in both analog and digital participation formats, it offers a flexible means of identifying and addressing shortcomings. If certain aspects—such as comprehensibility or accessibility—receive low scores, particularly in relation to the format of planning documents, alternative representations (e.g., replacing text-based or 2D plans with 3D visualizations) can be tested. The matrix then facilitates a systematic evaluation of whether these adjustments lead to improvements in specific assessment parameters, ensuring that participation strategies can be iteratively refined based on empirical findings.

This structured evaluation fosters dialogue between citizens and decision-makers, ensuring that participation processes not only meet formal requirements but also align with the needs and expectations of stakeholders. By applying the matrix, targeted recommendations for improvement can be developed to enhance the quality and acceptance of public participation processes. Additionally, incorporating free-text input allows for capturing qualitative feedback that extends beyond predefined assessment parameters, further refining the evaluation and optimization of participation strategies.

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