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# CO-DESIGNING RURAL CYCLE LOGISTICS: DEVELOPMENT AND APPLICATION OF A SERIOUS GAME AS A PARTICIPATORY WORKSHOP METHOD

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Public participation has long been both, a legal requirement and a standard practice, in public planning across Europe. It is, however, often perceived more as a burden than a meaningful process by both, policymakers and citizens, especially in terms of motivation. Serious Games have recently been introduced as a strategy to increase public engagement. However, developing such games typically requires months of work, making them unsuitable for many understaffed public administrations. This article investigates how a Serious Board Game can serve as a participatory research method to elicit local knowledge in rural planning. Based on the experience of developing a serious board game and using it in workshops across rural Germany, we will critically reflect the suitability of the approach for participatory planning in rural areas. To overcome the hurdle of developing a serious board game for a particular planning application, the article finally proposes a modular framework and accompanied game materials that can easily be adapted to various planning cases.

***Keywords:*** *Participatory planning, serious game, serious board game, rural planning,*

## INTRODUCTION

Participatory approaches in rural planning have gained increasing attention since the publication of an OECD handbook on public participation in policy-making at the turn of the century (OECD, 2004; Murray, 2016). In recent years, both national policies in Germany and EU regulations have further emphasized the importance of citizen engagement in local and regional development process, often based on successful best practices (e. g. Fioretti et al., 2023; Löwner et al., 2020). While such participatory processes can enrich planning outcomes, they are also resource-intensive, demanding considerable time and commitment from both facilitators and participants. Thus, sustaining motivation among participants is a central challenge. One promising approach to foster engagement and broaden participation is thus the use of Serious Games (SGs).

The term Serious Game (SG), as a specific kind of a game, can be broadly defined as “games that do not have entertainment, enjoyment or fun as their primary purpose” (Michael & Chen, 2006) and has been popularized in 2002 by Sawyer (Wilkinson, 2016). Initially developed mainly for educational purposes, SGs employ gamification techniques to support learning, problem-solving, or decision-making in applied contexts. Although a growing body of studies explores their application, theoretical consolidation and robust evidence remain limited.

Within planning and policy contexts, SGs have been used to strengthen collaboration among diverse stakeholders and to stimulate citizen participation. Both digital formats (Poplin, 2011; Pueyo-Ros et al., 2023) and analog formats such as board games (Mendez, 2024; Tamanini & Gorlt, 2024) have been applied to reach these goals. While most SGs focus on either national or urban planning issues, a smaller number of SGs have been specifically designed for rural contexts, including the digital “Land Use Game” (Hennig et al., 2025) or the board game “Futuregame” (Müller et al., 2019).

Building on this tradition, the RADLÄR project (RADlogistik in Ländlichen Räumen, Düerkop, 2024) developed a Serious Game to address rural planning processes in the field of cycle logistics. Despite limited prior experience in SG design, the team created an accessible tool that embedded relevant knowledge while fostering stakeholder dialogue. The contribution of this article is to present the development and application of this game, evaluate its suitability for rural participatory planning, and propose a modular framework for adaptation to other contexts.

## METHODS

The SG was developed within the German national research project RADLÄR (2024–2027), funded by the Federal Ministry of Transport as part of the National Cycling Plan (NRVP) (Düerkop, 2024). The overarching objective of the project is to explore the feasibility of cargo bikes as a sustainable freight solution in rural areas. To this end, RADLÄR

combines participatory research with simulation-based analyses to identify needs, opportunities, and barriers for their integration into supply chains.

A central methodological innovation of RADLÄR is the design and application of a purpose-made SG in regional workshops with business representatives, citizens, and local administrations. This gamified format enabled participants to reconstruct existing delivery chains, experiment with substituting motorised transport by cargo bikes, and reflect on infrastructural, organisational, and societal challenges (see Düerkop et al., 2025 for more information on the projects methodology and research focus). The workshops were complemented by interviews, simulation studies, and regional use cases, enabling cross-validation of participatory insights with model-based evidence. This triangulation informed practice-oriented recommendations for municipalities and businesses, supporting Germany's transport transition and climate policy goals. Thus, this paper presents the process of the Serious Board Game design and addresses the key research question: Are purpose-made Serious Board Games a feasible tool for participatory workshop in public rural planning processes?

Within this framework, the SG served as the core participatory method, stimulating discussion while eliciting regional expertise and exploring economic, regulatory, and practical considerations in a structured setting. The game development was thereby iterative: after each of the six workshops, participant feedback on design and functionality was integrated into subsequent versions, making the SG a continuously evolving tool.

The workshops served as empirical case studies within a qualitative research design. Data were collected from workshop protocols, annotated maps, and facilitator notes. Subsequently, the retrieved qualitative material is analysed and cross-validated with model-based simulation results and interview findings from the broader RADLÄR project. This procedure, which is beyond the scope of this article, ensured both internal consistency and triangulation across data sources.

The workshops themselves followed a two-stage structure. First, participants were provided with an informative introduction to cycle logistics, including technologies, business models, and societal trends. This knowledge transfer, supported by a handbook, ensured that all stakeholders could engage in the SG on an equal footing, fostering informed debate rather than purely opinion-driven exchanges. Second, the SG was played, during which participants contributed local knowledge from their own contexts, particularly regarding perceived potentials and barriers for the adoption of cycle logistics. In this way, the game design combined two methodological pillars: (1) informing players to create a shared knowledge base, and (2) eliciting region-specific perspectives to enrich the overall analysis. Building on the RADLÄR project, this paper not only presents the design and application of a Serious Board Game, but also investigates its methodological role as a participatory research instrument in rural planning. Accordingly, the study pursues two central research questions: (1) Can a Serious Board Game effectively elicit local knowledge and foster collaboration among heterogenous stakeholders in rural cycle logistics? and (2) How could a Serious Board game be designed for a specific rural planning problem to address the key questions at hand, while motivating a broad set of heterogenous players to engage with it? By addressing these questions, the paper contributes to the broader discussion on design-based and participatory research methods in rural planning and, in particular, sustainability transitions.

## DESIGNING THE SERIOUS BOARD GAME

### *1. Initial Conceptualisation and Structuring*

The first step in developing the SG was to identify its key elements and define the balance between expected inputs and outputs within the scope of the RADLÄR project. On the input side, two dimensions were considered essential. First, results from desk research on technological and societal trends, as well as emerging use cases, provided a structured knowledge base. Second, regional knowledge contributed directly by participants was regarded as equally important, ideally representing the three stakeholder groups: municipal staff, business representatives, and citizens.

The expected outputs were predetermined by the project's objectives: to identify potentials and barriers for the adoption of cycle logistics in rural regions in general, and in the project's model regions in particular. From the outset, the game was therefore not designed as a neutral data collection tool but as a motivational instrument that would actively encourage participants to articulate their views. In this sense, the central function of the SG was to engage stakeholders in a playful, interactive process that stimulated both reflection and knowledge-sharing around the future role of cycle logistics (see Figure 1).

### *4. Pre-Kick-Off Event*

Building on the defined SG components (inputs, outputs, and desired actions), a brainstorming session was conducted during a pre-kick-off meeting of the project with all project partners. The purpose was to clarify which types of information and considerations would be relevant for the different partners and their respective tasks throughout the project. This exercise helped to further specify and enrich the individual components of the game, particularly the intended outputs. However, at this early stage, the session did not yet establish functional connections between the components, nor did it provide a concrete vision of the SG's overall form and structure.

### *3. Post-Kick-Off*

At this stage, all project partners were invited to contribute ideas on how the previously defined components of the Serious Game could be connected in a coherent format. To facilitate this exchange, an online brainwriting exercise was established and remained open for almost three months. The extended timeframe gave partners the opportunity not only to add their own contributions but also to revisit and build on the suggestions of others, creating a dynamic and iterative collection of ideas.

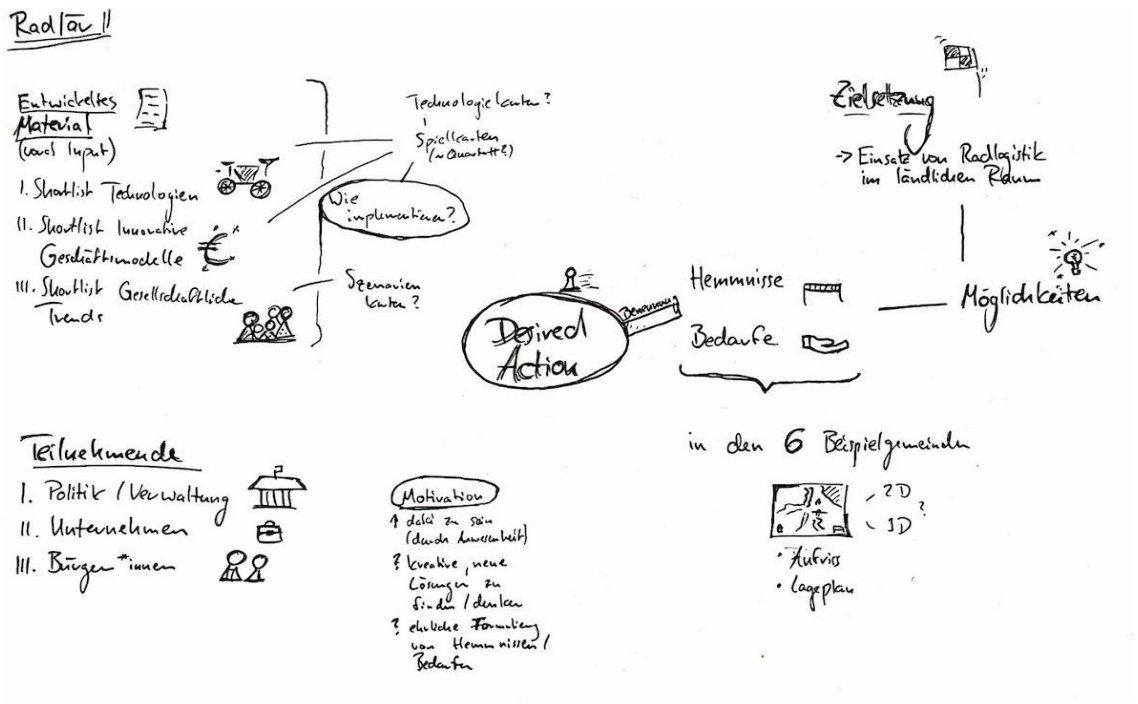


**Figure 1**. First conceptional draft of the project- and SG component-fit

Over the course of this process, the character of the ideas gradually shifted from abstract considerations to more tangible proposals for the outline and game mechanics. One proposal suggested a card game inspired by Top Trumps, where each card would represent a technology, business model, or societal trend, thereby integrating the input elements directly into gameplay. Another idea focused on designing "challenge scenarios" - for instance, delivering groceries from a supermarket to households with a cargo bike - which players would attempt to solve by strategically selecting from the available technologies, business models, and societal trends. By the end of the process, the collection of ideas had formed a preliminary design space that set the foundation for the subsequent prototyping phase.

***4. EMPAMOS: Motivational analysis***

To refine the design of the RADLÄR game, the EMPAMOS methodology was employed. EMPAMOS is an evidence-based tool designed to identify demotivating structures, referred to as "misfits", and to strengthen motivation through targeted use of game elements (Hofmann et al., 2021; Voit, 2024; Voit et al., 2020). While EMPAMOS has primarily been applied in and is explicitly designed for non-game contexts, it also offered valuable insights for this project. In practice, the methodology analyses how specific mechanics (e.g., rules, progression systems, rewards) interact with psychological needs such as autonomy, competence, or social relatedness. Based on this analysis, recommendations can be derived for strengthening player motivation through targeted adjustments to game elements and addressing misfits.

Accordingly, the RADLÄR Game was designed to motivate participants to share individual insights and to foster dialogue across stakeholder groups. EMPAMOS thus served as a complementary method to refine preliminary design considerations, highlight potential motivational misfits, and guide the selection of suitable game elements. In a subsequent step, we used the EMPAMOS AI tool to enrich these findings by suggesting additional correlating elements observed in other games, which were then considered for integration into the SG (Bröker et al., 2023).

***5. Hackathon on Prototype Development***

The next stage of SG development focused on moving from abstract ideas to a concrete prototype. To achieve this, the project team organised a full-day hackathon with all partners, designed to foster creativity and rapid prototyping. Participants were divided into two groups, each tasked with designing a game concept around a distinct thematic focus: one group addressed potentials of cycle logistics, the other explored barriers.

The two groups produced functional prototypes (see Figure 2). The "Hurdles Game" was based on a regional map where participants revealed question cards linked to different locations. Closed questions (e.g., "How strongly is your region affected by demographic change?") were discussed and answered collectively, while open questions (e.g., "How could cargo bikes be used at a local shipyard?") encouraged reflection and ideation among the participants. Identified barriers were subsequently introduced into later rounds, requiring participants to resolve them with previously discovered potentials. In contrast, the "Potentials Game" followed a mission-based structure. Participants first mapped relevant sites and routes within their region, then assigned transport volumes to these routes. Each player then received a mission consisting of four elements: a cargo bike type, a technology, a business model, and a societal trend and attempted to integrate these into the mapped logistics system. By playing through such missions, participants experimented with realistic scenarios and identified opportunities for integrating cycle logistics.

Following the hackathon, the project team concluded that a synthesis of both prototypes would be most effective. Combining the two approaches enabled the documentation of both barriers and potentials while maintaining a strong

motivational component. The final design combined role-play, mapping, and mission-based tasks, enabling participants to contribute regional expertise while learning about cargo bike applications and broader (societal) trends.

The final prototype was built around a large-format map of the respective municipality or region (DIN A0), which acted as a shared reference point. The game unfolded in two main phases. In Phase 1, participants located key sites, marked them on the map, and responded to structured questions across five categories (economy, environment, population, law, and infrastructure). This process anchored local challenges and opportunities spatially, creating a "logistics atlas" of the region. In Phase 2, participants drew missions composed of a cargo bike, technology, business model, and societal trend, and used them to design transport solutions for goods flows mapped in Phase 1. Previously identified barriers and potentials were reintroduced as constraints and incentives, ensuring that solutions were realistic and context-sensitive.

Throughout both phases, the SG fostered collaborative problem-solving, with participants co-creating scenarios that reflected both local realities and broader potentials of sustainable logistics innovation. For participants, the game provided an accessible, engaging entry point into the complex issue of rural (cycle) logistics. For the research team, it generated valuable qualitative data on perceptions, barriers, and opportunities, which could then be triangulated with simulation results to derive transferable recommendations.


**a** **b**

**Figure 2.** Outcome of SG Group „Hurdles Game" (a) & SG Group and „Potentials Game" (b)

### *5. Serious Game Production: Material*

The RADLÄR Serious Game was supported by a coherent set of materials designed to motivate participants through an engaging, structured process while also providing researchers with comparable, well-documented qualitative data across regional contexts.

Central to the package was a facilitator's guide, which described the flow of the game in detail and provided instructions for the moderator (see Game Material – radlaer-spiel). While intended primarily as a preparation tool, the guide also served as a point of reference during workshops. To complement this, a concise set of player rules was developed, offering participants a clear overview of the gameplay and ensuring that instructions were transparent and accessible to all players during the game.

The game relied on two distinct sets of cards, corresponding to the two phases of gameplay. In Phase 1, participants engaged with question cards that contained both closed and open questions (see Figure 3). The cards encouraged structured reflection on local conditions, such as infrastructure, demographics, or environmental considerations, and enabled participants to document their shared answers directly. This feature proved essential for capturing locally grounded insights in a way that was both systematic and visible to the group. In Phase 2, a second set of cards introduced the thematic building blocks of the game, including different types of cargo bikes, technologies, business models, and societal trends (see Figure 4). Unlike the Phase 1 cards, these were not intended for annotation but functioned as reusable elements that could be combined to form missions and stimulate scenario-based discussions.


**a** **b**

Figure 3. Examples of Question Cards (Phase 1) - closed question (a) & open question (b)

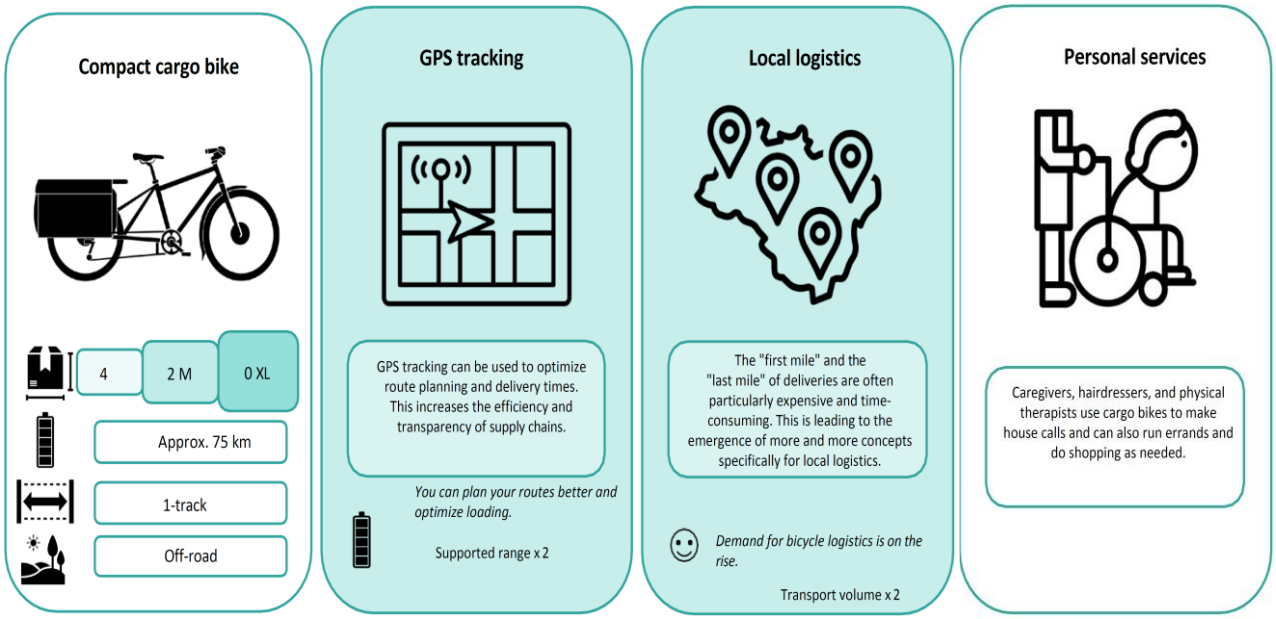


**Figure 2.** Examples of Mission-Cards (Phase 2)

A reference brochure with fact sheets on technologies, use cases, and societal trends (see Game Material – radlaer-spiel) ensured that discussions were informed by accurate, up-to-date information. These fact sheets provided a knowledge base for participants, ensuring that discussions were informed by accurate and up-to-date information rather than preconceived assumptions. In practice, the brochure not only contributed to equalised the level of knowledge among diverse stakeholder groups but may inspire participants to consider perspectives and options they might not have encountered in their daily lives.

Finally, the spatial dimension of the game was anchored in a large-format regional map (see Figure 5*)*. This map served as a common reference point throughout the workshop, allowing participants to situate barriers, potentials, and logistics flows in concrete geographical contexts. Its interactive character helped to link abstract discussions to tangible regional realities.

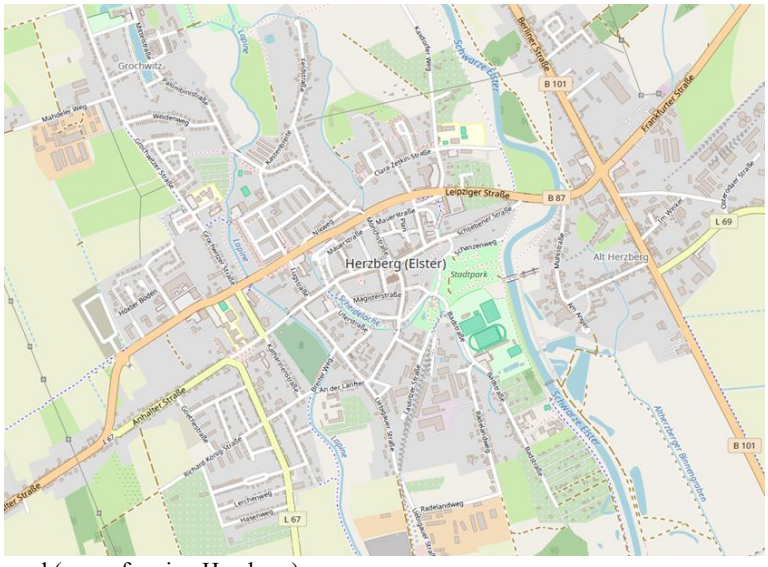


**Figure 5.** Example of the board (map of region Herzberg)

Together, the materials combined textual guidance, visual aids, and interactive components. Designed to be straightforward yet flexible, they allowed easy reproduction across regions while accommodating diverse local conditions. For participants, they created an engaging environment fostering creativity and collaboration; for researchers, they ensured structured qualitative data for later synthesis with simulation results.

## RESULTS AND DISCUSSION

The developed Serious Game was tested in six workshops conducted between March and July 2025 in rural areas across Germany. The workshops were organised in collaboration with the associated partners of the RADLÄR project, which in four cases were municipal administrations and in two cases county administrations. Municipalities were usually represented at the mayoral level, while the counties engaged staff from the relevant administrative departments. Table 1 provides an overview of the workshop locations and their population sizes.

**Table 1**. Workshop locations within the RADLÄR project

| Associated Partner | Type | Population |
|---|---|---|
| Hofstetten | Municipality | 1,791 |
| Havixbeck | Municipality | 12,357 |
| Emsland | County | 340,280 |
| Bad Soden-Salmünster | Municipality | 13,719 |
| Herzberg (Elster) | Municipality | 8,732 |
| Hochsauerlandkreis | County | 262,000 |

Each workshop brought together around ten participants, representing a cross-section of local administrations, political decision-makers, businesses, and citizens. The sessions began with an introductory presentation of the project and its objectives, followed by a concise overview of relevant technologies, use cases, and societal trends in cycle logistics. This educative component ensured that participants entered the game with a comparable level of background knowledge.

In the first phase, participants contributed their local knowledge to survey-based questions on the current state of transport in their municipality or county. This collaborative effort resulted in a "logistics atlas" that mapped out typical routing corridors and provided estimates of the types and volumes of goods regularly transported. In the second phase, participants explored concrete missions by matching specific cargo bike types with use cases and regional transport needs. During these discussions, both practical potentials and structural barriers became visible. These insights were documented systematically by the facilitators.

The workshops demonstrated that the value of the Serious Game lay not only in the documented outputs but also in the debates it stimulated. Discussions revealed differences in priorities between stakeholder groups, highlighted infrastructural and organisational bottlenecks, and at the same time inspired creative ideas for future applications. Following each workshop, the identified barriers and potentials were compared with secondary data such as infrastructure availability, business structures, and population distribution. This triangulation enabled the formulation of a shortlist of concrete use cases for each municipality or county.

Certain use cases proved straightforward and directly actionable, such as acquiring a cargo bike for collecting green cuttings, implementable with targeted funding and guidance on vehicle types. In contrast, other cases required infrastructural redesigns, which lay beyond the scope of RADLÄR and were therefore only documented. A further group of cases was more complex, involving systemic changes in local logistics networks; these will form the starting point for the subsequent project phase, where innovative processes will be co-developed and tested with local stakeholders.

Overall, the workshops confirmed the Serious Game's effectiveness in eliciting local knowledge, generating ideas, and facilitating cross-sectoral dialogue. They also yielded a structured dataset of regional potentials and barriers, suitable for comparison with previous studies on participatory planning and rural logistics. The implications of these findings will be further elaborated in the following section, where results are discussed in relation to broader debates on sustainable mobility and rural innovation.

## CONCLUSIONS

This paper has presented the development and application of a Serious Game designed to explore the potentials and barriers of cycle logistics in rural areas. Within the German national research project RADLÄR, the game was conceived as a participatory tool to connect diverse stakeholder groups—municipal administrations, businesses, and citizens. Through an iterative and collaborative process, the team created a format that integrates motivation, local knowledge, and structured debate.

The six workshops conducted across different German municipalities and counties demonstrated the game's ability to both elicit context-specific insights and stimulate dialogue between stakeholders who do not frequently engage in joint planning processes. The Serious Game produced tangible outputs such as participant-designed "logistics atlases" and concrete use cases, but its greater value lay in fostering debate and negotiation, thereby highlighting conflicting perspectives and enabling creative problem-solving. For participants, the game provided an accessible entry point into a complex domain. For researchers, it generated rich qualitative data that will be further triangulated with simulation studies and secondary data sources.

Three key conclusions emerge. First, Serious Games can act as an effective bridge between abstract sustainability goals and locally grounded realities, particularly in rural areas where planning capacities are often limited. Second, the iterative and feedback-driven development process proved essential in refining the game and ensuring its acceptance among diverse user groups. Third, embedding motivational analysis through tools such as EMPAMOS added value by highlighting potential demotivating structures and guiding the integration of elements that enhanced player engagement.

However, the study also revealed challenges. The workshops required significant moderation skills to balance open-ended discussions with the structured progression of the game. The relatively small number of participants in each setting restricted the diversity of perspectives, and further research is needed to assess scalability. Moreover, while the game generated valuable qualitative insights, translating these into policy recommendations or viable business models requires additional analysis and sustained collaboration with local stakeholders.

Future research should therefore focus on three directions. First, the transferability of the RADLÄR Game to other contexts should be systematically assessed, both within Germany and internationally. This includes adapting the game to mobility and logistics solutions beyond cycle logistics. Second, longitudinal studies could examine whether and how the insights generated through the game translate into concrete policy measures or business use cases. Third, methodological refinements may involve hybrid formats that combine analog board game elements with digital tools, thereby enhancing scalability, data capture, and interactivity.

In sum, the RADLÄR Game demonstrates the potential of participatory, game-based approaches to enrich rural planning and sustainability transitions. By combining structured knowledge dissemination with playful exploration and debate, the game not only generates data but also empowers local stakeholders to actively shape the future of logistics in their regions.

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