



Analyzing the political impact of Real-world laboratories for urban transformation in eight German ‘Cities of the Future’

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ABSTRACT

Real-world laboratories (RwLs) provide research settings to develop and test sustainability solution options and have gained considerable attention in the field of sustainability research since the early 2010s. RwLs, especially those in which urban municipalities are involved as partners, have been linked to promises for fostering sustainable urban development, but they are also critically discussed, e.g., for being used as proof for already doing ‘enough’ in terms of sustainability and citizen participation. However, these assumptions are rarely empirically investigated. This paper applies a traceable methodological approach. We focus on long-term RwL processes in eight German cities, that were all part of the Cities of the Future funding program (2015–2022/23). Based on policy documents provided in city council information systems, we conducted a qualitative content analysis. By applying deductively and inductively developed codes, we capture the ways in which the RwL processes were a) linked to changes in urban polity, politics and policy, and b) strategically used by city officials. Our findings suggest that most of the RwLs had political impacts in several ways. Further, attempts of strategic use were particularly visible for politically highly impactful RwLs.

1. Introduction

Experimental approaches are considered promising for contributing to urban transformations towards sustainability (Scholl and de Kraker, 2021; Torrens et al., 2019). One specific format in this field that has gained considerable prominence since the last 10 years are real-world laboratories (RwLs) (Schäpke et al., 2017; McCrory et al., 2020). RwLs have been established as settings for transdisciplinary research and joint experimentation towards sustainability (Schneidewind et al., 2018; Bergmann et al., 2021). While many approaches exist for capturing change towards sustainability on the local and national level (Geels et al., 2016; Oates, 2021), the effects of RwLs on cities as political systems have not yet been empirically studied (Kern and Haupt, 2021). Effects resulting from RwL approaches have been addressed on individual levels (Singer-Brodowski et al., 2018; Franke et al., 2022; Albiez et al., 2016). Impacts that go beyond micro levels were introduced conceptually (Augenstein et al., 2022), but have not been captured in the political sphere of urban transformation.

RwLs hold the potential to drive changes on meso and macro levels (Marg et al., 2019), and to create political-institutional transformations towards more sustainability (Schneidewind and Rehm, 2019). There is a

need to investigate if, and in which ways, those changes occur in practice (Parodi et al., 2021; Wanner et al., 2023). Therefore, in this paper, we empirically analyze the political impacts of eight RwLs. We analyze political decisions made by public authorities that were justified through RwLs. In doing so, we (i) address the often-articulated need to assess the societal impacts of transformative research formats in practice (Stelzer et al., 2018; Turnheim et al., 2018); (ii) stress the importance of political action for achieving change towards sustainability with less pressure on individual decisions (Grunwald, 2012; Neckel, 2021), and (iii) consider calls for a stronger connection between (neo-) institutional theory and sustainability transitions (Fünfschilling, 2019; Parris et al., 2022). Additionally, we consider arguments that critically reflect on those experimental sustainability formats (e.g., Torrens and von Wirth, 2021; Lawrence et al., 2022). We investigate how RwL processes have been strategically used through underlying statements that claim they demonstrate cities’ improved sustainability efforts. In this way, we follow the view that while RwL projects can have demonstrable impacts, they can also be utilized by city officials to strengthen an argument.

In this study, we analyzed policy documents provided by city council information systems such as resolutions, budget plans and minutes, in which RwLs were linked to altered policy, polity and politics in eight

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municipalities. These municipalities were part of a seven-year ‘Cities of the Future’ programme (2015–2022/23) to establish and conduct urban RwLs in Germany, funded by the Federal Ministry of Education and Research (BMBF). With the ending of this funding programme, we see an opportunity to investigate how far these eight RwLs were drivers for change towards more sustainability in the respective urban governance contexts. We aimed to capture effects of the RwL processes at the administrative-political level. We selected suitable documents and conducted a qualitative content analysis by applying and developing deductive and inductive codes. We thus followed an empirical, traceable approach to capturing effects linked to urban policy, polity and politics resulting from RwL processes.

The paper is structured as follows. In the next chapter, we discuss literature that suggests effects of transdisciplinary research formats on the political-institutional level, from which we later formed our deductive codes for the qualitative content analysis. In the third chapter, we give a structured overview on the eight German cities and their respective RwL processes. Chapter 4 introduces our methodical approach. We present how the policy documents were selected and provide an overview of them. This is followed by the presentation of our coding process, where we also introduce the inductively developed codes. In chapter 5, our results are presented, which are critically approached and linked to recommendations and further research in the discussion.

2. Theoretical background

One core characteristic of RwLs is their aim to contribute to societal transformations (Schäpke et al., 2018). Ways to evaluate this kind of contribution need to be further explored (Wanner et al., 2023; Augenstein et al., 2022; GAIA, 2023). One approach in this endeavor could be to distinguish between different spheres of transformation and to further address the impacts of RwLs in each domain of transformation. O’Brien and Sygna (2013) discuss three (interdependent) spheres of transformation. These include the personal, political, and practical sphere of transformation, approaching changes in personal views and values, political shifts towards sustainability as well as actions and practices towards sustainability. This article uncovers impacts from RwLs in the political sphere of transformation. To be more precise, the study focusses on impacts of RwLs in the political sphere of urban transformation. Several works that study effects from transdisciplinary research projects in general, as well as from urban sustainability experiments in particular, serve as a useful basis for deriving categories of impacts that are observable on the urban governance level. Thereby, we follow approaches that understand RwLs as one format of transdisciplinary research (Bergmann et al., 2021), as well as perspectives that consider experiments as central components of RwLs (Schneidewind et al., 2018). We draw on literature that uses the terms *effects* or *impacts*, and we use the terms synonymously in this article. To analyze the successes and shortcomings of the RwLs on urban governance, we take up the proposal discussed by Kivimaa et al. (2017). They suggest drawing on articulations of urban policy, polity, and politics to approach successes and shortcomings of experimentation. Accordingly, we use the

differentiation between policy, polity, and politics (Fig. 1) for structuring the effects RwLs (might) have on cities.

2.1. Articulations of policy: content-wise changes

Schäfer et al. (2021) proposed a model for systematizing societal effects of transdisciplinary sustainability research. One category identified is the influence those projects can have on laws and regulations. For the field of sustainability experiments, Karvonen (2018) emphasized the possibilities of informing long-term policies. Schreiber et al. (2023) connected urban experiments to changed urban planning policies. All these works have in common that the effects of transformative research projects target the content of urban policy. Building on this, our analysis includes capturing text passages in which decisions regarding policies are linked to experiences from RwL processes.

2.2. Articulations of polity: institutional change within city administration

Another effect identified by Schäfer et al. (2021) is structural effects created by transdisciplinary research projects, such as the establishment of novel staff positions. The call to investigate the effects of experiments on institutional refiguration is quite broad. It encompasses not only formal institutions such as city administrations and their respective departments, but also values, norms, and social configurations in the sense of networks (Fünfschilling et al., 2019). We decided to adapt a narrow institutional view in our analysis, and to concentrate on altered structures within the city administration as an institution. Following the understandings of Kivimaa et al. (2017) and Bulkeley et al. (2015), we concentrate on changes in the system of the urban municipality. Our analysis encompasses capturing discursive links and effects of RwLs on existing organizational structures within the public administration, as well as changes in city administration as an organization.

2.3. Articulations of politics: citizen participation & inter-institutional collaboration

Using the notion of participatory governance, Marg et al. (2019) discussed possible changes occurring from transdisciplinary research formats, such as novel or improved participation opportunities for citizens offered by municipalities. RwL processes, in which civil-society actors were active partners, could lead to a higher appreciation of citizen participation on the city level. As suggested by Marg et al. (2019), as well as Borner and Kraft (2018), this experience could be implemented by public administrations in developing and offering new and improved formats for citizen participation. At the same time, there is a growing body of literature which stresses the function of urban experiments for fostering networks between city administrations and non-state actors (Hildén et al., 2017; Ehnert, 2023). Following transdisciplinary principles, RwLs are shaped by the collaboration between scientific actors and actors from other societal sectors (Parodi et al., 2016). The potentially strong partnership that emerges in these RwL settings between science and municipality has been subject to previous research (Marquardt, 2019). In the eight RwL cases presented here, the urban municipality

| Policy | Polity | Politics |
|--|------------------------------------|---|
| Emphasis on Content | Emphasis on Structure | Emphasis on Processes & Actors |
| Goals, strategies, measures, instruments | Institutions, organizations, norms | Decision-making, coalition building, negotiations |

Fig. 1. Overview of the political dimensions of policy, polity and politics, based on Bernauer et al. (2022), modified.

was always one of the partners. Accordingly, in our analysis we draw on suggested impacts of transdisciplinary research regarding network effects (Marg et al., 2019) and university-city partnerships (Withycombe Keeler et al., 2019). We analyze, a) how citizen participation was improved and strengthened, and b) how collaborations between urban municipalities and research bodies such as universities were stressed as results of the RwL experience.

2.4. Utilization of RwLs

While RwLs have been recognized for their significant potential in achieving sustainability, there is also a growing awareness of the complexities involved in transdisciplinary research projects (Lawrence et al., 2022; Parodi and Seebacher, 2023) and sustainability experiments (Beukers and Bertolini, 2023; Coenen and Morgan, 2020; Von Wirth and Levin-Keitel, 2020). One aspect highlighted by Lawrence et al. (2022) is that transdisciplinary research projects can sometimes be used 'to serve particular interests, such as dominating the political discourse or gaining support from a membership or voter basis' (ibid, 50). Emphasizing individual sustainability projects to present cities as sustainable per se fits into green city marketing strategies (Chicca et al., 2022). There is a risk of *greenwashing*, for being approached as a sustainable, green city (Andersson and James, 2018). We aimed to include these considerations in our analysis to capture instances where RwL processes are strategically utilized.

3. RwLs for future cities

With the 'Cities of the Future' competition launched in 2015, the German Federal Ministry of Education and Research (BMBF) supported teams consisting of local politics and administration, research institutes, citizens and industry to transform their cities and municipalities into more livable and sustainable environments through three phases (BMBF, 2015). In the first phase, visions for the year 2030 (and beyond) were created collaboratively among different city actor groups accompanied by research partners (2015–2016), then solution approaches for achieving such visions were developed in phase 2 (2017–2018). The third phase consisted of the implementation of the developed measures in the form of real-world labs (2019–2022/23), with the municipalities being the main partners. While the first phase started with 51 cities and municipalities, only eight municipalities received funding in the third phase (FONA, 2023). These eight cities' respective municipalities were Bocholt, Dresden, Friedrichstadt, Gelsenkirchen, Lüneburg, Norderstedt, Ulm and Peenetal/Loitz. The RwLs (and similar settings) implemented in the cities/municipalities concentrated on different aspects of sustainable urban development (BMBF, 2023).

Table 1 provides an overview of the cities and their respective RwL projects in phase 3. We introduce classifications for each category that help to identify similarities and differences between the cities and their projects. These classifications are used to interpret and discuss the results in chapter 6.

Table 1
Overview of the eight Cities of the Future and their real-world lab projects.

| City | Population and city classification (according to BBSR, 2023) | Content and thematic breadth of the real-world lab project | Scientific partners and spatial proximity to them | Funding (according to FONA, 2021) |
|----------------|--|---|---|-----------------------------------|
| Bocholt | 71.000 medium-sized town | A project called 'Breathing, moving Bocholt 2030+', with several real-world labs in the areas of education, health, quality of life, mobility and internationalization linked to urban development measures. broad thematic variety | University of Wuppertal, German Institute of Urban Affairs (Berlin) medium spatial proximity | 1,7 million € ≥ 1 million € |
| Dresden | 554.000 major-sized town | A citizen lab with 19 citizen projects, also called transformative experiments, covering the areas education, civil knowledge and participation, energy, culture, mobility, neighborhood, urban space, and economy. broad thematic variety | Leibniz Institute of Ecological Urban and Regional Development (Dresden) TU Dresden close spatial proximity | 2 million € ≥ 1 million € |
| Friedrichstadt | 2500 small town | A project with five 'fields of action': economy, tourism and culture, participation, housing, and the provision of an urban infrastructure for the surrounding area. medium thematic variety | HafenCity University of Hamburg medium spatial proximity | 0,6 million € < 1 million € |
| Gelsenkirchen | 263.000 major-sized town | A project called 'Learning City! Education and participation as strategies of socio-spatial development', with four real-world labs: 'places of learning and learning laboratories', 'participation in the neighborhood', 'digital city', and 'city and science', conducted in 16 modules in total. Medium thematic variety | University of Applied Sciences and Arts Dortmund, Freie Universität Berlin medium spatial proximity | 1,6 million € ≥ 1 million € |
| Lüneburg | 76.000 medium-sized town | One real-world lab with 15 experiments in four thematic areas: green city, living and working, promoting volunteerism and participation; and economy and urban development. Broad thematic variety | Leuphana University Lüneburg close spatial proximity | 1,4 million € ≥ 1 million € |
| Norderstedt | 83.000 medium-sized town | A project that focused on sustainable housing. narrow thematic variety | Advanced Sustainability Studies (IASS) in Potsdam little spatial proximity | 0,8 million € <1 million € |
| Ulm | 129.000 major-sized town | A real-world lab with the guiding principle, 'Internet of Things for ALL!'. The real-world lab is applied through four fields of application: mobility, education, administration, and demography. medium thematic variety | Zeppelin University (Friedrichshafen), Neu-Ulm University of Applied Sciences, Ulm University of Applied Sciences, Fraunhofer Institute for Industrial Engineering and Ulm University close spatial proximity | 1 million € ≥ 1 million € |
| Peenetal/Loitz | 6000 small town | Implemented as four 'real world labs' in order to tackle the increasing shrinkage of the region: 1) the participation lab, 2) the generation quarter, 3) the real-world lab 'build your house' and 4) the real-world lab 'creative strength' small thematic variety | University of Applied Sciences in Neubrandenburg medium spatial proximity | 0,9 million € <1 million € |

4. Data and methods

To capture direct links between RwLs and citywide changes adopted by public authorities, we make use of increased transparency regulations for political decisions and discussions (Fischer and Kraus, 2020; Wagner, 2023; Manoharan et al., 2021), which lead to more documents being available to the public. Transparency regulations concern different political levels, including the municipal level. In the following, we will first present the council information systems that we used to derive data. We will then explain the search strategy used to identify suitable documents.

4.1. Council information systems as a data source

A promising way to obtain transparent information on the objectives and work of urban municipalities is the use of council information systems. Cities' council information systems are used as a medium for providing access to all public documents (Piesold, 2021). An increasing number of German municipalities offer these kinds of systems to make a variety of documents and information concerning the council's work accessible to the public. The documents presented in council information systems encompass not only official resolutions with binding character (Birghan et al., 2019). The systems also provide access to preparatory documents for meetings of city council and committees as well as associated minutes. Further, they encompass requests and responses as well as documentation on budgeting.

By using the broad array of data found in such council information platforms, we widen the view on policy documents. In doing so, we acknowledge not only cities' official outcomes (such as resolutions), but also focus on the process that led to those outcomes (Barnickel and Klessmann, 2012). We also consider that the funding of the eight Cities of the Future projects has expired recently. Final policy papers may still be under discussion, and not yet adopted. But such discussions - if documented in the minutes - are accessible by focusing on the documents provided in council information systems.

While bigger cities usually offer digital formats of council information systems, smaller municipalities often do not provide such systems (Laxa, 2023). Documents such as minutes of meetings are then published in analog ways, such as notices in the town hall, or in municipal gazettes. Two of the eight Cities of the Future, Peenetal/Loitz and Friedrichstadt (the smallest of the eight cities), do not provide digital council information systems. Friedrichstadt provides access only to minutes from city council and committees meetings online. Peenetal/Loitz publishes a monthly municipal gazette, both analog and digital. Table 2 provides an overview from where we derived our data.

To avoid bias and unbalanced interpretation, we only included data derived from the websites displayed in the table and excluded background knowledge that we possessed due to our involvement as researchers in one of the RwL processes.

Table 2
The eight cities and their respective websites for accessing policy documents.

| City | Website | Limitations |
|----------------|---|---------------------------|
| Bocholt | https://bocholt.ratsinfomanagement.net/ | - |
| Dresden | https://ratsinfo.dresden.de/info.asp | - |
| Friedrichstadt | https://rathaus-friedrichstadt.de/pr-otokolle/ | Only minutes are provided |
| Gelsenkirchen | https://ratsinfo.gelsenkirchen.de/ratsinfo/ | - |
| Lüneburg | https://ratsinfo.stadt.lueneburg.de/bi-yw020.asp | - |
| Norderstedt | https://buergerinfo.norderstedt.de/ratsinfo/sessionnet/buergerinfo/info.php | - |
| Ulm | https://buergerinfo.ulm.de/suchen01.php | - |
| Peenetal/Loitz | https://www.loitz.de/buergerservice/loitzer-bote/ | Municipal gazettes |

4.2. Search strategy

Based on the official web pages of each City of the Future project, we derived the project designations. All of them used the term City of the Future ('Zukunftsstadt') in combination with the respective name of the city. Some used additional names (Bocholt, Gelsenkirchen, Ulm, Peenetal/Loitz, Lüneburg). We then searched in each city council system or other website (as presented in Table 2) for those terms between 1/1/2014 and 16/05/2023. In Table 3, we provide an overview of how many results were found before the subsequent selection process.

As presented in Table 3, there are remarkable differences regarding the number of results between the cities. The seemingly simplest explanation would be that in some cities, the RwL process was discussed more frequently. But it should also be considered that the cities are subject to different requirements regarding what they (must) publish (Fischer and Kraus, 2020). Often, the cities' activities are influenced by laws on the federal state level (Bocholt, Friedrichstadt, Gelsenkirchen, Norderstedt, Ulm, Peenetal/Loitz), which differ significantly according to the requirement for transparency (Vos, 2022). In some cases, transparency laws on the federal state level do not exist (Lüneburg) or the federal state laws explicitly do not apply to municipalities (Magoley, 2022), while some municipalities actively implement their own laws about transparency of documents (Dresden, 2012). In the case of Dresden, this results in an increased transparency. Accordingly, more documents become available.

4.3. Selection process

Before conducting the qualitative content analysis, we determined the entirety of articles eligible for further analysis (Pickel and Pickel, 2018). Based on our aims to identify, 1) effects of the RwL processes, and 2) how those processes were used as form of proof, we formulated the following inclusion criteria.

Documents are included in which:

- the RwL project is linked to any kind of decision made by public bodies, such as the city council or thematic political committees.
- the RwL project is linked to statements regarding cooperation with other institutions and citizens.
- the RwL project is used to strengthen arguments.

While most of the documents were selected based on the inclusion criteria by one reviewer alone, the beginning of the selection process (nearly 10 % of the documents) was conducted by two reviewers for quality reasons. A total of 85 documents were identified for analysis (table4).

Overall, we excluded a considerable group of documents in which (single) activities of the Cities of the Future projects were merely described. We also excluded documents in which procedures and day-to-day activities were discussed, and documents which were not duplicates in a narrow sense (e.g., they were different document types), but

Table 3
Number of results for the eight cities (before selection process).

| City/Municipality | Number of results |
|--|-------------------|
| Dresden | 368 |
| Bocholt (additional name: breathing Bocholt) | 177 |
| Lüneburg (additional name: LG2030+) | 74 |
| Gelsenkirchen (additional name: learning Gelsenkirchen; learning city) | 57 |
| Norderstedt | 56 |
| Peenetal/Loitz (additional name: small town awakening) | 54 |
| Ulm (additional name: digital city) | 46 |
| Friedrichstadt | 38 |
| Total | 870 |

encompassed repetition.

While seven of the eight cities provided only documents resulting from processes within the city administration, Peenetal/Loitz published official documents from public administration in municipal gazettes, which also consist of other article types. Accordingly, for Peenetal/Loitz we also excluded documents that were not produced by the municipality. [Table 4](#)

4.4. Short overview of the selected documents

The results vary between years ([Fig. 2](#)). The highest number of results was identified for 2022.

The 85 selected documents can be assigned to different types, and include meeting minutes from committees and city councils, resolutions, and resolution controls (usually issued through the mayor), budget plans and associated speeches, requests and replies, as well as internal notifications ([Fig. 3](#)).

4.5. Coding process

We used both deductive and inductive codes to extract relevant sections to answer questions about the effects of RWLs on the urban governance level, as well as about strategic use. This procedure is based on the work of [Gläser and Laudel \(2010\)](#), who suggest first formulating categories based on theoretical considerations. Passages of the documents that fit into those categories will be extracted. At the same time, the entirety of codes is open to modification during the extraction process if information emerges in the documents that is essential to answer the research question, but is not captured by the deductively established codes (*ibid.*).

The deductive codes were developed from the theoretical background in chapter two. In this chapter, we linked literature discussing effects and impacts for transdisciplinary research, RWLs and experiments in the political sphere of transformation to the articulations of polity, politics and policy. Accordingly, originating from the theoretical background in chapter two, we formed the five codes changes in policies (content wise), structural changes, strengthened inter-institutional collaboration, strengthened civil participation options as well as arguments of proofs. The 85 documents identified contain passages that point to further political effects and forms of strategic use of the RWLs beyond the deductive categories. Consequently, we introduce three inductive codes, which have been developed based on our text material. These are physical changes in the cityscape, drawing on real-world lab expertise and favorable positioning as a city. [Fig. 4](#) provides an overview of how the selection and coding process are linked.

In this way, our analysis was led by two areas of interest (effects of RWL processes and attempts of strategic use of the RWL processes) and their respective codes ([Table 5](#)).

5. Results

The presentation of results is structured along the areas of interest, a) effects, and b) strategic use of RWL processes. According to the

Table 4
Number of documents included in the content analysis.

| City/Municipality | Number of Documents included |
|-------------------|------------------------------|
| Dresden | 34 |
| Bocholt | 20 |
| Lüneburg | 14 |
| Gelsenkirchen | 7 |
| Ulm | 5 |
| Friedrichstadt | 2 |
| Norderstedt | 2 |
| Peenetal/Loitz | 1 |
| Total | 85 |

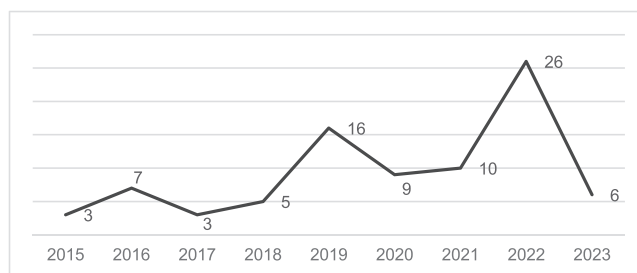


Fig. 2. Number of included documents per year.

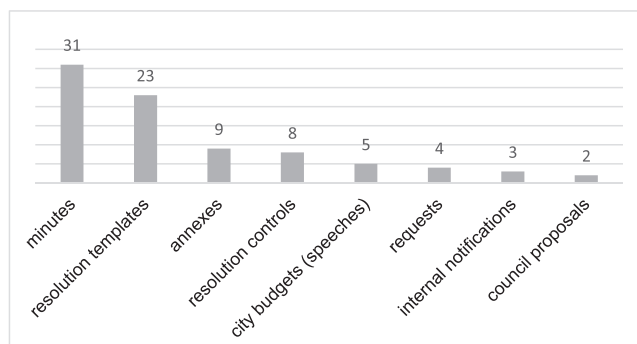


Fig. 3. Number of included document types.

documents we analyzed, none of the RWL processes had all kinds of effects at once. For seven out of the eight cities, we derived indications that the RWL processes conducted had some kind of documented effect on urban policy, politics and/or polity. Similarly, forms of strategic use were discovered in the documents of all cities except for one (Friedrichstadt).

5.1. Effects of the RWL processes

Following work that discusses a modular RWL structure that consists of the components lab context, real-world experiments, and interventions ([Schneidewind et al., 2018](#); [Kampfmann et al., 2022](#)), [Table 6](#) provides information on whether the political decisions and statements in the selected documents were more frequently justified by a link to individual experiments or to the entire RWL. In the following presentation of our findings, we will move from the political effects of RWLs that have been identified for the most cities to those that have been identified for the fewest cities.

Effect 1: structural changes in the city administration

Changes on urban polity were the type of reported effects that were visible for the largest group of cities. In five cities, the RWLs induced structural changes in the city administration.

In Bocholt, the mayor's department was structurally changed to improve the possibilities for project-based working after the funding for the RWL process had ended ([Bocholt 2022a](#)). In Ulm, the 'creative space' for employees of the city administration tried in the RWL continued to exist in the administration's structure so that creative aspects of the concept of new work could be further implemented ([Ulm 2022a](#)). In Lüneburg, novel staff positions were planned to sustain employees and their respective expertise from the RWL ([Lüneburg 2022a](#)). Dresden planned to implement the RWL approach in the areas of citizen concerns and participation in one specific department ([Dresden, 2023](#)). In Norderstedt, two positions were planned to be established based on the city's budget, one for the coordination of the Cities of the Future process between its different phases, and another for the promotion of urban biodiversity ([Norderstedt 2016a](#)).

Effect 2: strengthened inter-institutional collaboration

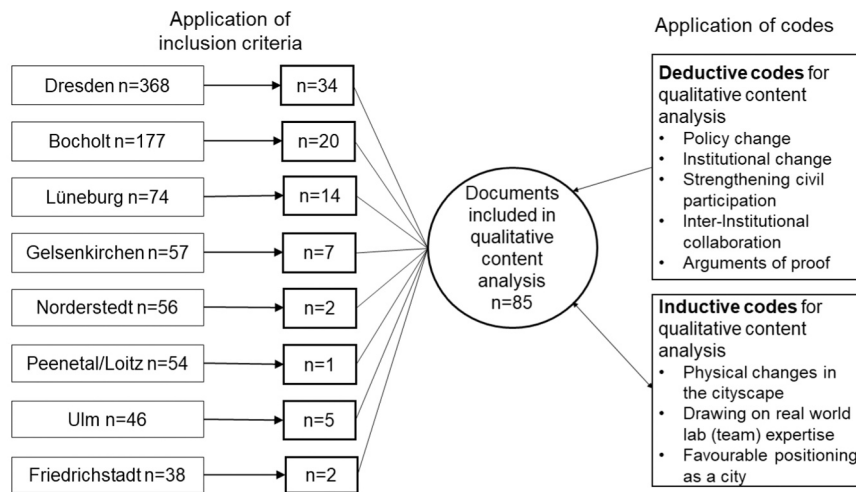


Fig. 4. Presentation of the selection and coding process within the qualitative content analysis.

Table 5
Categories for content analysis according to areas of interest.

| Areas of interest | Deductive Codes | Inductive Codes |
|---------------------------------------|---|--|
| Effects of Rwl processes | Changes in policy | Physical changes in the cityscape |
| | Structural changes in the institution city administration | Drawing on Rwl (team) expertise for other ventures |
| | Inter-institutional collaboration | |
| | Strengthening civil participation options | |
| Strategic use of Rwl processes | Use of the Rwl process as proof | Favorable positioning as city |

Table 6
Overview of the (frequency of) effects and their linkages to Rwl components experiment & lab (total number of linkages can be higher than number of Rwl as some labs had several variations of the effects).

| Type of effects | Number of Rwls showing the effects | Linked to Rwl components | |
|--|------------------------------------|--------------------------|------|
| | | Experiments | Labs |
| Structural changes in city administration | 5 | 1 | 5 |
| Strengthened inter-institutional collaboration | 4 | | 4 |
| Strengthened civil society participation | 4 | | 8 |
| Physical changes in the city scape | 4 | 5 | 3 |
| Drawing on Rwl team expertise | 4 | | 4 |
| Changes in policies | 3 | 4 | 4 |

Effects on urban politics were identifiable for half of the cities for each of our codes. Based on our material, indicators for strengthened inter-institutional collaboration could be identified for Ulm, Lüneburg, Gelsenkirchen and Bocholt.

In both 2016 and 2023, it was emphasized in Ulm that the City of the Future process had encouraged the city to deepen its collaborations with the university, as well as with business and civil society. After phase 1, a novel transdisciplinary project in which the city administration and university closely worked together was introduced (Ulm 2016a). With the ending of phase 3, it was stated that based on the experiences from the Rwl, the city of Ulm will continue to strengthen and consolidate its cooperation with local scientific institutions (Ulm 2022b). In Lüneburg, the inter-institutional collaboration established within the City of the Future process was transferred to a new project focusing on resilient city centers. Here, participants of associated workshops as well as possible steering group members were selected from the inter-institutional

advisory board of the City of the Future in phase 3 (Lüneburg, 2021). In Bocholt’s city budget plan for 2023, the City of the Future process and associated collaborations were linked to future negotiations on the city’s strategy and branding. Those negotiations should be undertaken collaboratively with actors from local businesses, sports, churches, and social life (Bocholt 2022a). Gelsenkirchen attempted to increase efforts for strengthening new contacts with actors outside the city administration as learning from phase 1 (Gelsenkirchen, 2015).

Effect 3: intensification of civil participation possibilities

Very closely linked to strengthened inter-institutional collaboration is the intensification of civil participation possibilities as another effect of the Rwl processes, linked to altered politics.

Dresden’s plan to host the national garden show in 2033 is, for instance, strongly shaped by citizen participation. This decision was discursively linked to experiences gained within the Rwl process (Dresden 2022a). Dresden also planned to apply for additional federal state funding to become a citizen municipality. This funding line supports restructuring city administrations to increase the possibilities for civil participation and joint decision-making. The mayor based this decision on the aim to transform the City of the Future Rwl approach into a broad, city-wide format that fosters civil-society participation (Dresden, 2023). In a city budget speech held by a council member in Bocholt, numerous proposals for more civil participation as an experience from the Rwl process were discussed (Bocholt 2022b), and partially addressed in the adopted city budget plan for 2023, where digital and analog participation formats are planned to be further implemented (Bocholt 2022a). In a meeting of the council committee for finances in Lüneburg in 2022, the mayor stated the importance and further strengthening of citizen participation in reference to the City of the Future process (Lüneburg 2022b). In Ulm, citizen participation will be further advanced through a newly-developed municipal online platform (Ulm 2022b).

Effect 4: physical changes in the city scape

Our material suggests that for four of the cities, the Rwl processes led to physical changes made in the cityscape. We captured this type of effect by introducing an additional inductive code. By applying this code, we extracted text passages that indicate how ideas developed within the Rwl processes concerning design and construction in cities were implemented through other funds. These Cities of the Future processes had impacts on the long-term physical shape of cities. The funding of all Cities of the Future projects did not encompass the funding for investment measures, meaning that long-term changes (e.g., for a more attractive city space) were not fundable through the project itself (BMBF, 2015). Rather, application sketches for phase 3 suggest that applicants were encouraged to connect Rwl proposals with the Urban

Development Support program (Leipzig, 2017); a federal program for ‘supporting municipalities in urban development adaptation processes alongside the federal states’ (BMWSB, 2020).

At least two cities decided to link future city processes to Urban Development Support programs (Bocholt 2019a; Gelsenkirchen, 2019). In Bocholt, public spaces and several street sections were redesigned based on citizens’ opinions and participation. These changes should improve walkability, bikeability and meeting opportunities between citizens (Bocholt 2019b). Further, demands expressed within the City of the Future project were implemented in other construction projects (Bocholt 2020a). In Lüneburg, a resolution was passed that the city administration will formulate three options to permanently redesign a public square based on citizens’ proposals developed throughout one of the real-world experiments (Lüneburg 2022c). In Friedrichstadt, measures on the cityscape were also linked to the RwL activities (Friedrichstadt, 2016).

Effect 5: drawing on real-world lab (team) expertise for other ventures

For four cities, we found indications in the selected documents that the project team’s (sustainability) expertise was used beyond the City of the Future projects. Accordingly, the code drawing on real-world lab expertise was introduced to identify text passages that describe how and where the expertise of the project team was used for ventures not directly linked to Cities of the Future project activities. In this way, the RwL process shaped other activities on the urban level.

In Bocholt, plans for renovation of the town hall should be modified after obtaining expertise from the team of the RwL on including more participative elements in the renovation process (Bocholt 2017a). In both Friedrichstadt and Lüneburg, decisions on topics related to housing and ecological sustainability were passed to the respective RwL teams (Friedrichstadt, 2020; Lüneburg 2019a). In Gelsenkirchen, the RwL team was actively included in events to develop a venue concept for the UEFA European Championship 2024. Here, the Gelsenkirchen City of the Future team accompanied workshops from the German Football Association (Gelsenkirchen, 2020) and were part of the group within the city administration that elaborated the concrete Host-City plan for the UEFA European cup (Gelsenkirchen, 2021).

Effect 6: new policies

New policies resulting from RwL processes could be identified for three cities. These can be differentiated into changes resulting from the overarching topic of the specific RwL, and those that go back to experiments trialed within RwLs.

In 2020, the municipal council of Ulm passed a resolution for a data ethics concept which was elaborated during the RwL process (Ulm 2022a, 2022b). It ‘contains ethical guidelines for the design, programming and operation as well as for the use of data, applications and IT systems by the City of Ulm’ (Ulm 2022b), with emphasis on citizens’ access to data. In Bocholt, demands expressed in the City of the Future project were implemented in the Integrated Mobility Concept 2035 (Bocholt 2020b). Dresden applied for a funding line for the development of smart cities; here the officials repeatedly referenced their experience with the conduct of the RwL process (Dresden 2021a,b). Several examples of the consolidation of experiments, or single components of RwL, were found for Dresden and Ulm. A model apartment in a clinic, where elders and relatives can test and discuss innovative technologies, as well as a show garden for sensor-based solutions, were part of the RwL in Ulm, and are now being funded by the city (Ulm 2022b). In Dresden, promotions of several urban district funds were approved until 2024 (Dresden 2022b; Dresden, 2023), after they were trialed within the RwL. Individuals and civil society associations from the districts can apply for funds.

5.2. Forms of strategic use

In addition to the documented effects of the RwLs we addressed in our analysis, we also intended to capture the ways RwL processes were

strategically used by city officials. In nearly every city, we found indicators in the documents that at least one of the two forms of utilization of the projects had been used (the exception is Friedrichstadt).

In five cities, RwL processes and associated results were used to present the respective cities in favorable positions in comparison to other cities and regions. In Lüneburg, the RwL process was linked, for instance, to being a role model for other cities in terms of sustainability (Lüneburg, 2015). This was also stated for Gelsenkirchen (Gelsenkirchen, 2022). Further, RwL processes were described as flagship projects or attractive site factors characterizing the associated cities (Gelsenkirchen, 2016; 2019c). In Ulm, the RwL process was linked to an anticipated economic growth of the whole city (Ulm 2016b).

We found indicators for using the RwL processes as arguments of proof based on the documents of four cities. The code ‘favorable positioning as a city’ aims to capture text passages in which the RwL process is invoked with a positive portrayal of the city – often in distinction from other cities and regions. By applying this code, we extracted text passages in which the City of the Future project is used as evidence for an attractive, in some way positively connotated, site factor of the city. There were passages suggesting overall urban sustainability ‘is given’ through the RwL processes (Peenetal/Loitz, 2016; Lüneburg 2019b). On various occasions, the projects were used to prove the city’s efforts for environmental sustainability (Dresden, 2018; Lüneburg, 2020; Norderstedt 2016b). Finally, RwL processes were utilized on several occasions to demonstrate a strong local democracy and participation culture in the city of Dresden (Dresden, 2019; Dresden 2021b, 2022c).

6. Discussion

In the following, we first discuss the political impacts of RwLs and their differences before we address the possibilities of RwLs for transformative urban governance. We then touch upon critical appraisals of RwLs and critically reflect on the methodological approach of our study.

6.1. The political impacts of RwLs, and their differences

Throughout the empirical analysis, we found that in all eight cities, representatives and/or employees dealt with RwLs in ways that go beyond just discussing day-to-day activities. For seven out of the eight cities we found that the respective RwLs had some kind of impact on the political-institutional level. The RwLs had clear links to the adoption of novel policies, altered structures in the city administration, strengthened collaborations with other institutions, fostered civil participation options, and contributed to participatorily developed changes in physical spaces. Furthermore, the RwL project teams influenced other ventures of the city.

The codes developed on the basis of the literature, as well as those derived from the analyzed documents, provide entry points for further analysis in the field of RwL impact evaluation in the political sphere of transformation. The introduction of the inductive codes is not only based on the material analyzed but is also supported by literature. The use of the code physical changes in the cityscape is supported by work on urban living labs, which share strong similarities with RwLs (McCorry et al., 2020). Among others, the works of Von Wirth et al. (2019) suggest that the embeddedness in and altered physical structures to be one core principle of ULLs. Augenstein et al. (2022) also considered changes in the physical structure as one impact dimension of real-world experimentation in RwLs. Another recurring aspect of RwL impact is the use of the RwL process expertise for other ventures that cities foster. The findings can be linked to literature discussing the role of boundary objects in transdisciplinary research settings. Boundary objects are seen as shared space between diverse groups (Star, 2010; Mattor et al., 2014). Applied to the identified text passages, this means that the RwLs served as boundary object for city administration members that were not necessarily attached to the RwL. RwLs were used by them to handle emerging (sustainability) challenges by drawing on the RwL team’s

expertise. The code 'favorable positioning as a city' is linked to the code 'argument of proof' but is connected to the *external* performance of the city. The introduction of this code is supported by literature discussing that urban competitiveness is increasingly based on communicated sustainability successes of cities (Carrizo Moreira et al., 2023; Komasi et al., 2023).

Nonetheless, we also found notable differences between the RwLs in the sample. Based on the selected documents, three of the eight RwLs brought forward effects in all political dimensions (policy, politics, and polity). While we cannot draw general conclusions from this, our small sample showed that these projects have in common that they received funding starting at 1 million €, the RwLs dealt with at least a medium variety of topics, the cities worked with scientific partners in rather close proximity, and that the cities were not small sized.

While within the Cities of the Future funding line no differences between city sizes were made, more recent German funding schemes on RwLs are specifically designed to target the particularities of small-sized towns and villages (Kesselring et al., 2022; Schmidt, 2023), suggesting that funding schemes need to be adapted according to the geographical context, as well as responding to accusations of underrepresentation of small-sized towns in research policies (Porsche, 2019). Small-sized cities face specific challenges for realizing RwLs (Rhodius et al., 2016). They need more financial resources, possibly because system knowledge must first be created for many small-town contexts, as certain data sets are only available for bigger towns in Germany (Mitchell et al., 2022a). RwLs in small-sized cities have also been described as needing more staff resources, because their municipal staff cannot build on previous experiences in the field or do not yet have the resources to handle tasks that go beyond day-to-day operations (Mitchell et al., 2022b).

The finding of fewer effects for the RwLs carried out in small cities should also be seen in the light of the fact that little data was available for these RwLs. These cities did not offer the same council information systems as the larger cities. From the standpoint of democratic theory, this can be critically discussed. It means that citizens in small cities do not have the same digital, remote access to documents in which political decisions are announced and discussed as citizens in larger cities. From a research perspective, this implies that the political impact of RwLs or other transdisciplinary research projects will be easier to identify for larger cities that have a digital council information system. This also could imply that larger cities have an advantage in terms of funding (Porsche, 2020), as the allocation of funds for transformative, transdisciplinary research projects is often linked to the measurable assessment of the resulting societal impacts (Krainer and Winiwarter, 2016).

6.2. Implications for sustainable urban governance through RwLs

While we demonstrated the limitations of this analysis for smaller cities, we argue that the approach used in this study can be an important contribution to the discussion on how to capture and how to differentiate the political effects of RwLs. We linked RwLs to the political sphere of transformation at the city level, strengthening the prospect that RwLs lead to societal transformations towards sustainability (Schäpke et al., 2018; Barbarino, 2021; Kok et al., 2023), drawing on the crucial role of local governments in achieving sustainability (Sassen, 2015; Neckel, 2021).

RwLs hold the potential to be used by politicians, employees of urban municipalities and other actors to support certain arguments. They can be utilized to put the city in a positive light and can be presented as an attractive site factor of the city. But these attempts of strategic use do not necessarily diminish the potential such RwLs hold for advancing tangible changes. We rather tend to argue that arguments brought forward in the context of 'marketing' a respective RwL could also support convincing city councils and municipalities to conduct ambitious RwLs and similar transdisciplinary projects. Based on the identified effects that RwLs have on the political level, we should rather expand our efforts in critically discussing and strengthening their democratic

legitimacy (Asenbaum and Hanusch, 2021; Jahn and Keil, 2016), as changes made within or as an outcome of RwLs affect the daily lives of many citizens, involving groups of citizens who were not involved in the implementation of the RwLs.

Based on our findings, we argue that RwLs can lead to transformative governance, especially those in which thematically heterogeneous experiments were conducted – implying an adequate funding volume. Further, our analysis suggests that impacts in all political fields were more likely to be generated by RwLs with scientific partners in close spatial proximity to the RwL. This hypothesis is supported by prior research on RwLs that highlights the importance of overcoming spatial distance between researchers and the other partners in RwLs (Kohler et al., 2021; Marquardt and Gerhard, 2021a), as RwLs deal with topics that are influenced by the spatial contexts and their specifics (Marquardt and Gerhard, 2021a). As many small-sized towns and villages cannot access scientific institutions in their direct geographical area, we thus support the implementation of novel funding lines that take such contextual conditions into account, as discussed above. Various arrangements could not only support obtaining knowledge of the local system, but also build the basis for relationship work on site (Mager and Wagner, 2022), such as the provision of more travel expenses for researchers, temporary offices for them in small-sized towns.

6.3. Methodological reflections

While studies that analyze council information system data do exist for other disciplines (Raschke, 2021; Neumann, 2020), to the best of our knowledge, the impacts of RwLs and other transdisciplinary research formats have not been linked to this data source before. The analysis presented in this paper seems to be beneficial for identifying the political impacts of RwLs empirically. The transparent selection of documents that are available for the public as well as the subsequent qualitative content analysis overcome the limitations that have often been associated with analyzing the societal effects of transdisciplinary research. In numerous studies, these were assessed through mechanisms of self-reporting, such as surveys and interviews. Accordingly, only the *perceived* effects of actors that were involved in transdisciplinary research settings were captured (De Jong et al., 2016; Fritz et al., 2019; Schäfer et al., 2021). By making use of council information systems, impacts with a temporal and thematic diversity that probably no single actor could have a complete overview of, become visible. A linkage between these approaches could lead to a comprehensive impact evaluation. Nevertheless, the amount of data provided by cities is neither uniform nor comprehensive, as discussed above. Beyond that, there may be many more impacts resulting from RwLs, that were, a) not made publicly available, b) were not political impacts. Further, we did not delve into the underlying political processes that led to the outcomes described, involving negotiations between different parties and other contextual conditions. Nor did we explore the aspect that local authorities applying for funding to develop and implement RwLs that address sustainability issues already appear to be quite ambitious in their sustainability efforts. It would be interesting to ascertain what kind of political changes toward sustainability would have been sought without RwLs. To describe the characteristics of the RwLs, we only considered the facts that were publicly available. In doing so, we did not capture process-related elements such as actor constellations and collaboration culture, which are described as being strongly intertwined with impacts (Lux et al., 2019; Pärli, 2023). To address political changes from RwLs in further research, it seems beneficial to also take process characteristics of the RwLs into account.

7. Conclusion

This article aimed to capture effects of real-world labs on urban policy, polity and politics while also addressing the ways in which they were strategically used by city officials. This study was the first attempt

at using city council information data for showing how real-world lab processes directly foster sustainable and collaborative urban development. Critical approaches were actively included in the analysis, demonstrating that real-world labs can both be presented as showcase projects while developing direct, easily traceable political impact.

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CRedit authorship contribution statement

Annika Weiser: Writing – review & editing, Writing – original draft, Funding acquisition. **Daniel J Lang:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Conceptualization. **Teresa Kampfmann:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All the policy documents analysed and cited are in the reference list.

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