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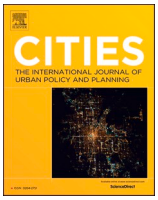

Tracing complex urban transformations in Germany, Switzerland and Austria using trajectory-based qualitative comparative analysis (TJ-QCA)

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ABSTRACT

The re-development of abandoned industrial areas and city cores characterizes the transition from industrial to post-industrial societies in Western Europe. Shorter-term and project-based urban programs, like the re-developments of waterfronts and station areas, emerged as more sui in response to the consequences of economic, demographic, political and cultural change than long-term, top-down spatial planning. Notably, processes and outcomes of strategic spatial planning vary across European cities and may display unique characteristics. This study compares eleven urban transformations in Germany, Austria, and Switzerland to shed light on the degree to which these programmatic urban transformations have been successful in shifting the urban fabric from an industrial to a post-industrial state. We examine the combinations of factors that, over time, have contributed to a qualitative urban change. Using primary and secondary sources, we perform a Trajectory-Based Qualitative Comparative Analysis (TJ-QCA) to identify recipes for successful urban transitions. Results show that there are two main planning recipes associated with successful urban transformations: either a combination of a high strategic character of the project with a leading role of public actors, or a combination of a high strategic character with brownfield redevelopment.

1. Introduction

Since the 1980s, post-industrialisation has become a global phenomenon at the same time when the world was increasingly becoming urban. In a nutshell, post-industrialisation refers to the transition from a manufacturing-based to a service-based economy, and is intimately tied to globalisation. Post-industrialisation is a transformation that can take decades to complete, and its magnitude greatly varies across countries (Byrne, 2001).

Post-industrialisation is driven by a multiplicity of factors and has overarching political, social and cultural consequences (ibid.). In Europe, the progressive decrease in the number of employees in the manufacturing sector and the increase of employed people in service activities have brought about the crisis of the welfare state and of the Keynesian model. Post-industrialisation in Europe has been amplified by changes in the social and cultural composition of urban dwellers, as a consequence of deindustrialisation and migration, the end of clear-cut political ideologies that characterised the post-war period, as well as the collapse of dictatorial regimes in Southern Europe (mid-1970s) and Central and Eastern Europe (1990s) (Byrne, 2001; Kazepov, 2005).

The transition towards post-industrialisation has distinctively materialised in the urban fabric of Western European cities. Policy-makers and planners at different governance levels were confronted with unprecedented challenges, as they were called to manage decline instead of growth. Abandoned industrial areas had to be redeveloped, and city cores renewed and re-populated. Gradually, a new type of strategic, project-based spatial planning appeared to be more suitable to respond to the consequences of economic, demographic, political and cultural change characterising the transition to post-industrial societies (Albrechts, 2006; Albrechts et al., 2003; Albrechts et al., 2017; Albrechts & Balducci, 2013; Hersperger et al., 2018, 2019).

In contrast to the conventional long-term, top-down spatial planning characterising the post-war period, strategic spatial planning was not only characterised by different scope and aims, but also by the complexity of the increasingly diverse range of actors involved in the process. Planned urban transformations targeted delimited areas in the city and were project-based, often framed around flagship projects or infrastructure (Hersperger et al., 2019; Salet & Gualini, 2007). Urban

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renewal schemes were given the broader aim to become flywheels of further (economic) development, and private economic actors – in particular, investors – played key role in partnering up with (and at times leading) public actors in stimulating urban change (Fainstein, 2001; Moulaert et al., 2005; Oliveira & Hersperger, 2018). Western European cities have become laboratories of profound urban change, where neoliberal agendas have fostered the emergence of an 'entrepreneurial' urban policy agenda through the commodification of the urban space (Harvey, 1989; Swyngedouw et al., 2002). For instance, waterfront redevelopments in European cities such as Bilbao (Rodriguez & Martinez, 2005) or Barcelona have been influential 'models' for the strategic re-development of derelict neighbourhoods or former industrial areas. At the same time, strategic spatial planning accommodated demands from civil society to partake in the planning and decision-making concerning these transformations (Healey, 2009; Healey et al., 1997).

Since the mid-1980s, large-scale, strategic urban transformations have been widely used worldwide as an object of research. In Europe, these strategic, project-based programs have been inscribed within the same macro-trend of the transition to post-industrial societies and within the shift from functionalist to strategic spatial planning. However, these urban transformations in individual cities and neighbourhoods have also unique characteristics, as processes and practices of strategic spatial planning in Europe have been affected in their planning and implementation by contextual differences related to economic, political, social, and cultural specificities. For this reason, most studies on strategic spatial planning and practices have consisted in qualitative, case-based empirical research juxtaposing different experiences across Europe (Albrechts, 2006; Albrechts et al., 2003; Albrechts & Balducci, 2017; Healey, 2007; Salet & Gualini, 2007); for a multi-method approach, see (Hersperger et al., 2019, 2018; Palka et al., 2020).

However, strategic urban transformations are not just unique. They can also be considered comparable to a certain degree. Scholars have identified several factors as relevant to evaluate both the process and outcome of different strategic urban transformations: the role of public and private actors, the involvement of civil society, the strategic character of the project, and its location (ib.). All these can substantially affect the successful completion of the planned urban change. 'Completion' here means that the urban transformation has achieved a *qualitative* change in the urban fabric from an industrial to a post-industrial state as compared to the previous state of the targeted area. In other words, a substantially different urban area is produced. This urban change can be partial or full, for instance when the transition of an urban area from a derelict industrial area to a new residential development is completed in full or only partially.

(Strategic) spatial planning is hence inherently programmatic. It requires many years to transition from plan formulation to plan implementation. The *time dimension* therefore becomes conceptually important for the analysis of project-based processes of strategic planning (Gerrits et al., 2022). Over time, many factors can affect these projects, such as changes in political scenarios and public-private governance arrangements, lack of funding, and citizens' protests (Oliveira & Hersperger, 2018). Consequently, there is a need to trace and compare different transformations over a prolonged period, while accounting for the complex combinations of factors that may contribute to the transformation as their outcome.

In addressing this research gap, in this study we account for both the similarities and differences characterising the process and outcome of a sample of urban transformations in Europe. The research question is the following: under which combinations of conditions have urban transformations successfully achieved a qualitative change in the urban fabric from an industrial to a post-industrial state?

In the effort to provide a possible answer to this question, we use trajectory-based Qualitative Comparative Analysis or TJ-QCA (Gerrits & Pagliarin, 2020; Pagliarin & Gerrits, 2020) to compare 11 urban trajectories in German, Swiss and Austrian cities. The urban transformations are subdivided into multiple consecutive development stages to account for *within-case* variation. Next, the development stages of these trajectories are compared - thus accounting for *cross-case* variation - to identify similarities and dissimilarities regarding the extent and type of transformation that has taken place. We expect to identify multiple patterns across cases, and that these can serve as alternative planning and policy recipes or 'pathways' towards the outcome, namely successfully achieving a qualitative change from an industrial to a post-industrial urban area.

Below, we first present the theoretical framework from which the explanatory conditions for urban transformation are selected. Next, we present the method and sampling, followed by the analysis and a discussion of the results.

2. Strategic spatial planning and urban trajectories in post-industrial societies

Conventional long-term, predictive planning strived to anticipate the demands of urban growth and predict change by separating urban functions. Offices and services were located in city cores and housing functions were allocated to new (suburban) towns or dormitory neighbourhoods in the outskirts (Albrechts, 2004; Salet & Gualini, 2007). Since the mid-1980s, scholars in Europe have highlighted the progressive abandonment of this functionalist, suburban, car-dominated spatial planning characterising the 1950s and 1970s, in favour of urban renewal programs. Urban renewal programs targeted specific areas and invested in the role of few strategic projects as flywheels to stimulate area-wide urban change (Albrechts et al., 2003; Albrechts, 2006; Albrechts & Balducci, 2013; Albrechts et al., 2017; Hersperger et al., 2018, 2019; Healey, 2007).

In Western European countries, this change in spatial planning practice 'from plans to projects' (Albrechts, 2006) has been related to the transition from industrial to post-industrial societies. Key factors producing the emergence of post-industrialisation have been the decrease of the employment share of workers in the manufacturing sector, and the related crisis of the welfare state; the increase of employees in service and commercial activities (economic restructuring); national and international political changes - in particular, the transition of socialist countries to post-socialist countries -; and changes in the social and cultural composition of urban dwellers (Albrechts et al., 2017; Byrne, 2001; Kazepov, 2005).

The consequences of post-industrialisation clearly materialised in cities: the functions of abandoned (light) industrial areas had to be converted (i.e., brownfield redevelopment), deprived neighbourhoods redeveloped, and city centres re-populated. These tasks (re)presented unprecedented challenges for policy-makers and urban planners, as they were called to manage decline instead of growth, as well as the social consequences of the transition from industrial to post-industrial societies. Strategic, project-based planning in targeted areas appeared to be suitable for managing the consequences of economic change and decline (Albrechts, 2006; Albrechts & Balducci, 2013).

In contrast to traditional top-down approaches of spatial planning, strategic spatial planning involves a variety of actors ('stakeholders') besides public authorities to define an overall 'vision' or 'strategy' for the city and its urban region. Citizens and their associations became key actors in urban development processes by means of public consultation, participation and civic engagement (including protests), consolidating the increasing demands for civic participation in collective decision-making that had matured during the 1960s and 1970s (Jacobs & Appleyard, 1987).

Area-wide strategies for city development are typically implemented through 'flagship' projects at specific sites with the aim to stimulate urban (economic) development (Hersperger et al., 2019). The cores of European cities have been gradually 'rediscovered,' not only because they maintained a central function for political and cultural life, but also because they became attractive for real-estate private investors. Well-

known projects include the Bilbao (Rodriguez & Martinez, 2005) and Barcelona (Marshall, 1996) waterfront redevelopments or the new Amsterdam Zuid financial district (Majoor, 2007). Several scholars have grown particularly critical towards these strategic, project-based urban developments and highlighted the neoliberal-tun in urban policies where private actors, in tight cooperation with public actors as enablers of land-rent extraction, could valorise the material assets of formerly run-down areas into high-end scenarios of post-industrial contemporary societies (Fainstein, 2001; Harvey, 1989; Healey, 2007; Moulaert et al., 2005; Swyngedouw et al., 2002).

In summary, (1) the strategic character of the project, (2) the nature and composition of the public and private actors involved, (3) the degree of involvement of civil society, and (4) the type of planned redevelopment in targeted areas substantially characterise the development itinerary of urban transformations (*process*), and crucially affect the successful completion of urban change in post-industrial societies (*outcome*).

While large-scale, strategic urban transformations have been common interventions that have been planned and implemented in many cities worldwide, and in Europe in particular, these urban transformations might vary in the degree to which the planned urban change is completed successfully. That is, we need to empirically examine how, and assess to what degree, an urban transformation has achieved a qualitative change in the urban fabric.

In focussing on project-based, strategic urban transformations, the goal of this study is to trace the development of such urban changes over time by identifying the multiple phases composing their trajectories to identify under what conditions transformations may become successful. The development stages conventionally correspond to site-identification, plan-formulation, and implementation (Hersperger et al., 2019). At certain turning points (i.e., stages), multiple factors, e.g., changes in the public-private governance arrangements, political changes, lack of funding and citizens' protests, may accelerate or obstruct the process of urban change. Conceptually, this means that time is an inherent component of spatial planning and urban transformations: decades are needed to convert and complete the planned urban transformation in a new area, and its successful completion remains an uncertain, medium-term target across the different planning phases.

By starting from this time-sensitive conceptualisation of the planning and implementation of strategic spatial projects, and by building on prior work (Pagliarin & Gerrits, 2020), we hence assume that urban transformations can be analytically described by a set of development stages (each of them conceptualised as a case), that form sequences (i.e., a temporal series of stages). As these stages belong to the same urban transformation, they represent the project's 'within-case' time variation and capture the entire development process of the urban transformation, i.e., its trajectory.

This conceptualisation of the planning and implementation process of urban transformations in terms of stages is key to advance our capacity to analyse both the *process* and *outcome* of urban change. While this conceptual operation can be performed for different individual urban transformations, the second goal of our study is to compare the sequence of development stages across a set of projects (i.e., cross-case comparison). The comparative analysis of different urban transformations can identify common patterns across different transformations, thus more clearly differentiating what is common and unique to each trajectory. We believe that such a time-based, comparative approach can enhance our understanding of how urban transitions towards post-industrialisation developed in Western European cities, and under what conditions these transitions have successfully brought forth a qualitatively different urban space, or lack thereof.

2.1. Systematically handling of within- and cross-case variation

The framework outlined above and our study goals are compatible with the diversity-oriented research approach offered by Qualitative comparative analysis (QCA) (Ragin, 2008, 1987, 2000). At its core, QCA is a set-theoretical, outcome-focused research approach that highlights the various configurations (conjunctions, disjunctions) of conditions (or factors) that have a set-theoretical relationship with the outcome observed. Importantly, there is a diversity-oriented logic (Ragin, 2000) underneath QCA that captures the differences between cases without the assumptions of uniformity often implied in variable-oriented approaches (Byrne, 2005; Byrne & Ragin, 2009). In doing so, it strives to generate causal statements that do justice to the equifinal and multifinal nature of social reality. Earlier applications of QCA in this journal include Chang & Gerrits, 2022; Cortes et al., 2022; Ruhlandt et al., 2020.

QCA is suitable for tracing complex causality (Byrne & Ragin, 2009). The identified cross-case patterns are equifinal pathways that not only make individual cases similar to a certain degree (Pagliarin & Gerrits, 2020) but that also reveal the attractor basin where the cases tend to concentrate beyond their diversity and uniqueness (Gerrits & Pagliarin, 2020). This means that, within a conceptually delimited property space of *k* conditions (or factors), the development stages of cases are assumed to cluster around specific 'locations' instead of distributing equally and/or symmetrically across the property space. These locations are the multiple, but numerically limited pathways that 'attract.' Furthermore, these pathways can be further analysed to derive empirically based policy recommendations that can sustain and orient planning research and practice (see Befani, 2013).

As this study aims at a structural comparison of trajectories in the shape of sequences of development stages to examine the conditions under which urban transformations achieve a *qualitative* change in the urban fabric from an industrial to a post-industrial state, we apply a time-sensitive variant of QCA called Trajectory-based Qualitative Comparative Analysis (TJ-QCA) (Pagliarin & Gerrits, 2020).

2.2. Conditions influencing the success of urban transformations

We derive four main conditions (or factors)[1] influencing the urban trajectories from the theories mentioned above. The first condition is the civic influence on the project (labelled as 'CIVIC') and concerns the degree of influence of the involvement and participation (and in case resistance) of citizens on the planned urban development. The second condition captures the mixed nature of the governance constellations of the leading public and private actors stimulating the selected urban transformations (PUBLIC). The third condition concerns the acknowledgement by actors of the strategic character of the project (for the site) beyond the mere physical transformation (STRATEG). The fourth condition concerns the type and location of the project (SITE). As urban transformations are often anchored to flagship projects at specific sites, some types of projects and sites could contribute more strongly to an acceleration of the transformation than others (e.g., Vermeulen et al., 2014).

We expect these conditions to produce the outcome in various combinations. The outcome is defined as an urban transformation that has achieved a qualitative change in the urban fabric from a previously industrial to a subsequent post-industrial state (URBTRANS). Urban

[1] Following the literature on large-scale projects, such as strategic urban transformations, factors external to the projects, such as global financial crises affecting the real estate market, have been recognised to play an important role in the urban transformations (Flyvbjerg, 2014; Flyvbjerg et al., 2003). However, it is challenging to identify which, and how, external influences matter across the different development stages of the same urban transformation or across urban transformations. Furthermore, our empirical analysis showed that external factors had a role mostly during the formulation and planning of the urban projects, i.e., as a starting point for a transformation, but not beyond it. In other words, external factors are theoretically relevant but hard to capture empirically, therefore we did not specifically consider them in the present study.

transitions may come in many shapes (e.g., Healey, 2006; Karvonen & van Heur, 2014). We focus on the degree of physical change and the urban quality characterising the process of urban transformation. Following the method, each case is calibrated for each of the four conditions and the outcome condition. We explain these steps in Section 3.

3. Methods

3.1. Selection of trajectories and data collection

We selected eleven, strategic and project-based urban transformations in Germany, Austria and Switzerland (see Table 1). The selection criteria were the following: first, they had to be key urban transformations at the urban and regional level; second, they had to be in a sufficiently advanced phase to analyse their development over time. For any type of QCA, it is important to select on the outcome condition, i.e., sampling is targeted instead of random. Following the conceptual framework, the development process of eligible urban transformations could span across several decades, and most of the selected projects were initiated in the 1990s. Third, we were specifically interested in urban transformations in Germany, Switzerland, and Austria, as a way to balance the heterogeneity of the eleven selected urban transformations with countries characterised by similar planning traditions (for a critical appraisal, see Nadin & Stead, 2013). The fourth criterion has been data availability. Short summaries of each selected projects are available in the Supplementary material (Table A10).

Data was collected from both primary sources (e.g., policy and planning reports) and secondary sources (i.e., academic and newspaper articles). The full list of sources is available online.[2] The sources were read, categorised, and systematised in tabular form by the third and fourth authors of the study, under the supervision of the first two authors. Next, each trajectory was subdivided into discrete development stages. The selected 11 urban transformations were subdivided into 33 development stages in total. Each stage forms a case, a sequence of stages (i.e., a series of cases) forms a trajectory, i.e., an urban transformation. The development stages and the data sources we used were structured in a table that is available online.[3]

Fig. 1 shows the location of the ten cities where the eleven selected urban transformations are situated.

3.2. Calibration rounds and dataset construction

The collected data were calibrated in six calibration rounds.[4] In QCA, calibration is the qualitative assessment of the membership of cases into the sets of conditions by means of set-membership values.

We calibrated the condition CIVIC through a 4-scale fuzzy-set (Ragin, 2008) by re-elaborating Arnstein's (1969) ladder of participation. First, we deemed the full 'citizen control' to be absent empirically. This makes 'strong co-decision/co-planning' as the strongest form of influence (fully in the set, 1.0). Second, we considered citizens' protests, claims and resistances as an indication of a lack of participation (more out than in the set, 0.33). In sum, CIVIC is calibrated as follows: non-participation (0.0), consultation or protests, claims and resistances (0.33), co-decision/co-planning (0.67) and strong co-decision/co-planning (1).

The condition PUBLIC was calibrated as follows: the project is predominantly or fully led by private actors (0.0); the project is predominantly private-led, but there is some cooperation with public actors, in particular in the form of enablers of urban development (0.33); the urban transformation is predominantly public-led with some cooperation with private actors (0.67); the project is predominantly or fully led by public actors (1). Although we acknowledge that complex urban transformations require the involvement of different actors in multi-level governance arrangements and networks, in this study we focussed on the role of leading (public) actors, regardless their level local, regional or (inter)national nature.

The condition STRATEG was calibrated as follows: actors do not assign nor recognise any strategic character of the urban transformation (0.0); actors acknowledge it partially (0.33); actors recognise a strategic character to the urban transformation (0.67); the strategic character of the urban transformation is the key attribute to start the development in the first place (1.0).

The condition SITE was calibrated as follows: urban renewal outside the city centre (0.00); urban renewal in the inner city (0.33); conversion of function outside the city centre (0.67); conversion of function in the inner city (1.00).

The outcome URBTRANS was calibrated as follows: no physical urban change takes place and urban quality is not altered (0.0); some (partial) physical change takes place and urban quality is partially altered or improved (0.33); the project mostly implemented, and the urban transformation has achieved a qualitative change in the urban fabric (0.67); urban transformation fully or almost fully completed, and the urban transformation has achieved a substantial qualitative change in the urban fabric (1.0). While the extent of implementation can be assessed more easily at any point in the process in the light of what was originally planned (including scope changes and other changes one might expect), the changes to the urban quality remain, ultimately, a qualitative assessment by the researchers. They may include additional urban functions such as residential development, mixed zones, and infrastructures such as roads or metro stations, but also improvement of quality of life by adding green zones. The assessment is highly contextual: while a small new park may not be a big improvement in one place, it can constitute a major change in another one.

In reaching this final calibration of the four conditions and the outcome, each coder independently assigned set-membership values to all the selected trajectories until full agreement about set-membership values was found between the two coders.[5] Before calibrating the entire dataset, the analytical framework and the calibration strategy were also validated by a pilot calibration round on three trajectories (Hafencity Hamburg, Neu Oerlikon and Jena Stadtumbaugebiet Innenstadt) with which the coders had different levels of familiarity (in-depth case knowledge). Furthermore, QCA being an iterative process, this first calibrated dataset was analysed by performing several QCAs, with the result that both a refinement of the conceptualisation of conditions and outcome, and a re-calibration of certain cases were needed. For instance, at times it was difficult to assign a set-membership value to PUBLIC as the public sector can have 'private arm', although the process is predominantly public-led (e.g., as in Munich Riem, Freiburg Vauban).

Conditions and outcome were checked for skewness (Oana et al., 2021). Although some were skewed towards low (CIVIC)[6] or high (PUBLIC) membership, their set conceptualisation and calibration did not substantially change because we considered the skewness of these conditions to be a specific characteristic of the *kind* of cases under analysis (i.e., the selected urban transformations usually require a high involvement of public actors and a non-high involvement of civil society). However, one condition that we initially thought to be relevant (namely, the set of external events having a high impact on urban

[2] The list of documents used for the case-based analysis is available at https://figshare.com/s/83975b78638a08924b81.

[3] Please use the same link as in footnote 2.

[4] For the complete calibration rules, please see Table A1 in the Supplementary material.

[5] A first intercoder agreement resulted in a match of 60 % (i.e., the two coders gave the same set-membership score to the case), around 20 % matches in kind (i.e., below or above 0.5) and the remaining 20 % did not match.

[6] Skewness towards low membership in CIVIC might also be due to the difficulty of retrieving data on the nature of the actual civic participation in the considered projects, or to missing data, as discussed by de Block and Vis (2018).

Table 1
List of 33 cases in 11 trajectories, and the calibrated set-membership values, for each identified phase and time period.

Case	Cases	Citizen participation	Role of public actors	Strategicness	Site	Urban transitions (outcome)	Phase	Time
ID	Case label	CIVIC	PUBLIC	STRATEG	SITE	URBTRANS	PHASE	Period
1	hafencity1	0.00	0.33	0.33	0.67	0.00	Formulation and site identification	1992–1997
2	hafencity2	0.00	0.33	0.33	0.67	0.33	Planning	1997–2001
3	hafencity3	0.00	0.33	0.67	0.67	0.67	Implementation	2001–2011
4	hafencity4	0.33	0.33	1.00	0.67	0.67	Implementation	2011–2020
5	jena_stadtum1	0.67	1.00	0.67	0.33	0.00	Formulation and site identification	1990–1993
6	jena_stadtum2	0.67	0.67	1.00	0.33	0.67	Planning	1993–2003
7	jena_stadtum3	0.67	0.67	1.00	0.33	1.00	Implementation	2003–2020
8	neuoerlikon1	0.00	0.33	0.00	0.67	0.00	Formulation and site identification	1975–1988
9	neuoerlikon2	0.00	0.33	0.33	0.67	0.00	Planning	1988–1998
10	neuoerlikon3	0.33	0.33	0.33	0.67	0.33	Implementation	1998–2000
11	neuoerlikon4	0.33	0.67	0.33	0.67	0.33	Implementation	2000–2010
12	wien_aspern1	1.00	1.00	1.00	0.67	0.33	Formulation, site identification and Planning	1992–2010
13	wien_aspern2	0.33	1.00	1.00	0.67	1.00	Implementation	2010–2020
14	ulm_citybahnhof1	0.33	1.00	0.33	0.33	0.33	Formulation and site identification	2006–2013
15	ulm_citybahnhof2	0.33	0.67	0.33	0.33	0.33	Planning	2013–2017
16	ulm_citybahnhof3	0.00	1.00	0.33	0.33	0.33	Implementation	2017–2020
17	stuttgart_europa_1	0.00	1.00	0.33	1.00	0.00	Formulation and site identification	1985–1994
18	stuttgart_europa_2	0.67	0.33	0.33	1.00	0.33	Planning and implementation	1994–2012
19	hamburg_altona1	0.00	0.67	0.33	0.67	0.00	Formulation and site identification	1997–2010
20	hamburg_altona2	0.33	0.67	0.33	0.67	0.00	Planning	2010–2016
21	hamburg_altona3	0.33	0.67	0.33	0.67	0.33	Implementation	2016–2020
22	freiburg_vauban1	1.00	1.00	1.00	0.33	0.33	Planning	1989–1996
23	freiburg_vauban2	1.00	1.00	1.00	0.33	0.67	Implementation	1996–2000
24	freiburg_vauban3	0.33	1.00	1.00	0.33	0.67	Implementation	2000–2009
25	freiburg_vauban4	0.33	1.00	1.00	0.33	0.67	Implementation	2009–2014
26	munich_riem1	0.00	1.00	0.67	0.67	0.33	Planning	1987–1995
27	munich_riem2	0.00	0.67	0.67	0.67	0.67	Implementation	1995–2015
28	munich_riem3	0.00	0.67	0.67	0.67	0.67	Implementation	2015–2020
29	dessau_innenstadt1	0.00	1.00	0.00	0.33	0.67	Planning	1990–2003
30	dessau_innenstadt2	0.00	1.00	0.67	0.33	0.67	Implementation	2003–2011
31	dessau_innenstadt3	0	1	0.33	0.33	0.33	Implementation	2011–2020
32	eisenhüttenstadt1	0	0.67	0.67	0.33	0.67	Planning	1989–2002
33	eisenhüttenstadt2	0.33	1	0.67	0.33	0.67	Implementation	2002–2020

transformations) was very highly skewed towards low membership. We subsequently decided to exclude this aspect it from the analysis.[7]

Although all calibration rounds required some adjustments in the assignment of set-membership values following the re-conceptualisation of conditions and outcome, our efforts were devoted to solving the so-called 'true logical contradictions' (TLCs). In QCA, TLCs are cases that are members of a certain set of conditions related to the outcome, but that do not show membership in the outcome set (or vice versa) (see e.g., Schneider & Wagemann, 2012). In our study, true logically contradictory cases arose in connection to the initial phases of urban transformations, where (often decade-long) decision-making processes are needed for site identification and planning, although no material transformation takes place even though conditions associated with the outcome can be present. While most TLCs were solved, we had to acknowledge this aspect to be a distinctive characteristic of the selected 11 trajectories: as the outcome represents the degree of physical change and changes in the urban quality of an area, the outcome will always be absent (i.e., lower than 0.5 in terms of set membership values) in the early stages, as it is not yet materially implemented and an urban transition is not yet underway. This also means that, in our dataset, decay is less likely to be found: the outcome is very unlikely to shift from being present to being absent (i.e., from above to below 0.5).

Another strategy to solve TLCs was re-casing. In particular, the 'Stuttgart 21 project' (S21), which is a highly complex urban programme composed of smaller size, semi-independent projects (Novy & Peters, 2012), was refocused to only one such subproject, namely 'Europa Viertel', which has already been completed. In the trajectory of Eisenhüttenstadt, we excluded from the dataset its development stages before the German Reunification (pre- 1990s) to ensure that it would cover a comparable timespan than the other trajectories (usually starting in the 1990s). This decision aligned with our theoretical approach on the transition to post-industrial societies and the role of strategic spatial planning, which has increasingly emerged since the mid-1980s. For the trajectory of 'Wien Aspern Seestadt', we merged stages 1 (the project's 'formulation and site identification') and 2 ('planning') into one and we labelled it as stage 1. However, this specific strategy to solve contradictions must be done with care. We could do this for Wien because the two phases are connected (the former being usually a preparatory stage for the latter) and were not in contradiction with each other (i.e., the merging must be sensible and done on a case-by-case basis).

Finally, we previously recommended merging development stages of the same trajectory if they belong to the same configuration in kind, as this would add redundant information (and hence 'inflated' consistency scores) because of the repetition of same configurations (Pagliarin & Gerrits, 2020). However, we considered this recommendation unnecessary as it implies losing relevant information about the stability of trajectories (i.e., cases showing the same configuration in kind).

The final dataset is shown in Table 1.

4. Analysis and interpretation

Following default QCA procedures, we first performed the analysis of necessity (see Table 2) on single conditions. The analysis of necessity aims at identifying those individual conditions that enable (i.e., 'are necessary for') the outcome to occur, although their mere presence does not guarantee that the outcome will be observed (see e.g., Schneider & Wagemann, 2012, chap. 3). In our study, we tested if the presence of

[7] See also footnote 1.

Fig. 1. Location of the 10 cities where the 11 urban transformations are situated. Authors' elaboration in QGIS by using GISCO - Eurostat (2022)'s shapefiles data on Countries (2020) and Local Administrative Units (LAUs, 2019).

Table 2
Analysis of necessity for the occurrence of the outcome.

	Cons.Nec	Cov.Nec	RoN
CIVIC	0.450	0.677	0.887
PUBLIC	0.928	0.534	0.433
STRATEG	0.952	0.702	0.713
SITE	0.734	0.582	0.675
~CIVIC	0.809	0.478	0.430
~PUBLIC	0.355	0.574	0.868
~STRATEG	0.425	0.424	0.702
~SITE	0.808	0.738	0.815

CIVIC; PUBLIC, STRATEG and SITE on their own could enable the achievement of a qualitatively different urban area, i.e., enabling the transition from an industrial to a post-industrial state.

In our findings, conditions PUBLIC and STRATEG were above the formal cut-off value for necessity (0.9). However, other considerations must be taken into account before declaring a condition necessary for the outcome (Schneider & Wagemann, 2012, chap. 9). Specifically, the condition PUBLIC is skewed towards high membership[8] and its Relevance of Necessity (RoN) value is low (0.433). Therefore, we deemed only condition STRATEG to be necessary: not only are its cut-off values for necessity (0.952) and RoN (0.713) high, but this finding is both conceptually valid and also in line with the literature on strategic spatial planning (Albrechts, 2006; Albrechts et al., 2003; Albrechts & Balducci, 2017; Healey, 2007; Hersperger et al., 2018; Salet & Gualini, 2007). Substantially, this means that a high degree of physical change and a substantial qualitative change in the urban fabric occurs when actors frame the urban transformation within a comprehensive spatial strategy attributing more value than a mere physical urban change.

Second, we performed the analysis of sufficiency, which aims at identifying the alternative, and non-mutually exclusive, combinations of conditions ('configurations') that can 'produce' the outcome. In QCA, the analysis of sufficiency is visualised through the so-called 'truth table,' that is a table that lists all the logically possible combinations of conditions (2^4) and which rows of the table are associated, or not, with the occurrence of the outcome (Schneider & Wagemann, 2012, chap. 3). For each truth table row, parameters of fit, i.e., consistency scores for sufficiency ('incl.') and proportional reduction of inconsistency (PRI), measure the strength of the set relationships between each combination of conditions and the outcome (see Schneider & Wagemann, 2012).

The resulting truth table in our study is shown in Table 3. We used a cut-off value of 0.78, which defines when the set relationship between each combination of conditions and the outcome can be considered 'strong enough' for each combination to 'produce' the outcome. The cut-off value of 0.78 is not only between the range of cut-off values for consistency (0.75–0.80) conventionally accepted in QCA, but there is also substantial difference between the consistency values of the truth table rows 8, above which the outcome is present, and 10, below which

[8] See Supplementary material for further information.

Table 3
Truth table for 33 cases. The cases in italic are the contradictory cases excluded from the analysis of sufficiency for the presence of the outcome.

Row	CIVIC	PUBLIC	STRATEG	SITE	OUT	n	incl	PRI	Cases
16	1	1	1	1	1	1	0.841	0.398	*wien_aspern1|0.33*
7	0	1	1	0	1	5	0.839	0.589	freiburg_vauban3|0.67,freiburg_vauban4|0.67,dessau_innenstadt2|0.67,eisenhüttenstadt1|0.67,eisenhüttenstadt2|0.67
15	1	1	1	0	1	5	0.817	0.556	*jena_stadtum1|0*,jena_stadtum2|0.67,jena_stadtum3|1,*freiburg_vauban1|0.33*,freiburg_vauban2|0.67
4	0	0	1	1	1	2	0.790	0.433	hafencity3|0.67,hafencity4|0.67
8	0	1	1	1	1	4	0.781	0.420	wien_aspern2|1,*munich_riem1|0.33*,munich_riem2|0.67,munich_riem3|0.67
10	1	0	0	1	0	1	0.711	0	stuttgart_europa_2|0.33
5	0	1	0	0	0	5	0.627	0.092	ulm_citybahnhof1|0.33,ulm_citybahnhof2|0.33,ulm_citybahnhof3|0.33,dessau_innenstadt1|0.67,dessau_innenstadt3|0.33
6	0	1	0	1	0	5	0.583	0	neuoerlikon4|0.33,stuttgart_europa_1|0,hamburg_altona1|0,hamburg_altona2|0,hamburg_altona3|0.33
2	0	0	0	1	0	5	0.496	0	hafencity1|0,hafencity2|0.33,neuoerlikon1|0,neuoerlikon2|0,neuoerlikon3|0.33
1	0	0	0	0	?	0	–	–	
3	0	0	1	0	?	0	–	–	
9	1	0	0	0	?	0	–	–	
11	1	0	1	0	?	0	–	–	
12	1	0	1	1	?	0	–	–	
13	1	1	0	0	?	0	–	–	
14	1	1	0	1	?	0	–	–	

the outcome is not present (Schneider & Wagemann, 2012, chap. 5). This means that the set of urban transformations fully or almost completed and characterised by a qualitatively different type of urban area, i.e., an area that has transitioned from an industrial to a post-industrial state, are consistently distinguishable from those which do not.

Furthermore, seven out of the 16 rows composing the truth table are logical remainders: these are logically possible combinations of conditions (2^4) but no empirical case shows a set membership above 0.5 to any of them. This is a common situation in QCA called 'limited diversity': although logically possible, not all configurations are empirically observed (Ragin, 2000). In a complexity-informed perspective, limited diversity is also an indication of configurations as attractors, where empirical evidence clusters in some configurations, or 'locations' of the property space (see Section 2, and Gerrits & Pagliarin, 2020).

We noticed one Deviant Case in Kind (DCK) in row 16, and three true logical contradictions in rows 8 and 15 of the truth table, which we highlighted in italic in Table 3. DCKs are cases that are members of a configuration that is sufficient for the outcome, but that do not show it (see Schneider & Wagemann, 2012), while TLCs correspond to cases that are members of configurations that are associated to the occurrence of the outcome, but that do not show it, and the other way around. Following standard procedures, deviant cases must be checked, and TLCs must be 'solved' before analysing the truth table,[9] otherwise inconsistent information (i.e., not 'sufficiently strong' information regarding set relationships) would be incorrectly included in the 'recipes' for the presence of the outcome. Following recommendations on how to deal with inconsistent and contradictory cases (Oana et al., 2021; see e.g. Rihoux & De Meur, 2009), we decided to delete the four cases highlighted in italic in Table 3 as they all belong to the first stages of urban transformations, where the outcome cannot be present as the site and plans for the urban transformation are still to be defined. Furthermore, the configurations in the truth table rows 8, 15, 16 that include contradictory information are, first, conceptually linked to the occurrence of the outcome, because the conditions expected to be associated to the outcome are mostly present (i.e., show '1'), and, second, because most of them contain empirical evidence that is associated with the occurrence of the outcome.

Having removed these contradictory cases, the results of the skewedness test and the analysis of necessity on the dataset with 29 cases were only slightly different from the previous analysis on the dataset with 33 cases. The new truth table with 29 cases is included as Table A4 in the Supplementary material.[10]

As time-sensitive information characterizes the cases, the truth table does not only provide an overview of the empirical evidence at hand, but also shows how some cases travel from one configuration to another. In dynamically interpreting the truth table in TJ-QCA, we envisage the cases moving between different positions of the property space, hence drawing their individual trajectory through that space.

Because of the limited space of the article, we cannot comment upon all the selected trajectories, therefore we will focus on few of them. The trajectory of Freiburg Vauban shifts from row 15 of the truth table (1110) in stages 1 and 2 (although this configuration is a TLCs), to row 7 (0110) in stages 3 and 4. What changes between the four stages describing the trajectory of Freiburg Vauban is the waning of civic participation and the rise of protests of residents (~CIVIC) in row 7 as compared to the initial stages (row 15) in the urban renewal of the city centre (~SITE),[11] while the leading role of public actors in the process (PUBLIC) and a high strategic character of the urban transformation (STRATEG) remain stable.

In the trajectory of Hafencity in Hamburg, the transformation of the site was primarily functional for the port expansion as clearly captured by row 2 (0001) in stages 1 and 2, where only the condition SITE is present, indicating that only the physical characteristics of the location were important. The configuration '0001' is, maybe unsurprisingly, not associated to the occurrence of the outcome. Later, Hafencity shifts to row 4 (0011) in stages 3 and 4, where the strategic character of the urban transformation is recognised by the actors (STRATEG) and where the outcome is present. In all the stages of its trajectory, the project Hafencity shows a low civic involvement (~CIVIC) in combination with public actors predominantly performing the role of enablers for private development.

For the urban transformations that do not show the outcome, a shift from one configuration to another can be observed, thus capturing change or, more precisely, a different type of urban transition. For

[9] In line with the iterative nature of QCA, the true logical contradictions we discussed in Section 3.2 were identified by performing several QCAs before the final one presented here.

[10] As compared to the truth table displayed in Table 3, the order of truth table rows slightly changes as the exclusion of contradictory cases improves both the consistency values and the values for PRI (Proportional Reduction of Inconsistency) and logical remainders row increase to 8, because row 16 is not populated anymore by the case 'wien_aspern1.'

[11] The '~' indicates absence of the condition.

instance, the trajectory of the Europa Viertel transformation in Stuttgart shows a movement from row 6 (0101), where civic participation is low (0, ~CIVIC) in combination with a leading role of public actors (1, PUBLIC), a low strategicness of the project (0, ~STRATEG) and the project is characterised by brownfield redevelopment (1, SITE), to row 10 (1001), where residents are more actively involved in its development (1, CIVIC), the public actors perform the role of enablers of private development as compared to the previous phase (0, ~PUBLIC) and in combination with the strategicness of the project that remains low (0, ~STRATEG) in the brownfield redevelopment (1, SITE).

In Section 3.2, we considered decay unlikely to occur in the selected urban transformations as kind of trajectories. However, we did observe it in the urban transformation of the city core of Dessau. This trajectory shows a shift in stage 1 from row 5 (0100; i.e., low involvement of civic society, leading role of public actors, low strategicness and urban renewal in the inner city), where the outcome is not present, to row 7, the same as Freiburg Vauban, in stage 2 (0110; i.e., low involvement of civic society, leading role of public actors, higher strategicness as compared to stage 1 and urban renewal in the inner city), where the outcome is present, and returns to row 5 in stage 3, where the outcome is not present. Although an urban transformation has taken place through demolitions, re-building and renovations, the urban reconstruction of the city centre has not yet been completed and will probably evolve towards a more common planning process in the next years.

These findings demonstrate the power of TJ-QCA in capturing within-case variation, while connecting the individual trajectory of a certain urban transformation to the other transformations in the sample by means of the truth table as an analytical device, and because the combinations of conditions (truth table rows) associated with the outcome (or not) can be compared across cases. Furthermore, the dynamic truth table allows to observe stability within trajectories. Despite shifting stages, some urban transformations remain in the same configuration, such as the trajectories of Munich Riem (row 8), Jena Innenstadt (row 15), Neu Oerlikon (row 2), City Bahnhof in Ulm (row 5), Hamburg Altona (row 6) and Eisenhüttenstadt (row 7).

TJ-QCA features the pair-wise comparison of the configurations associated to the outcome through a process called 'minimisation' (see Schneider & Wagemann, 2012). Here, we comment upon the so-called intermediate solution for the occurrence of the outcome (Table 4),[12] which is also graphically displayed in Fig. 2. The *xy*-plot should not be read as in conventional regression analysis, but it represents the set-membership values of each of the cases into the union (disjunction) of the two alternative pathways (x-axis) and into the outcome (y-axis).

The solution formula is composed of two alternative (equifinal) pathways or 'recipes' (combinations of conditions): STRATEG * PUBLIC + STRATEGC * SITE) → URBTRANS. Equifinality, multifinality and conjunctural causation are key characteristics of QCA and express the capacity of QCA to deal with complex causality (Gerrits & Pagliarin, 2020; Ragin, 2000). The solution formula STRATEG * (PUBLIC + SITE) → URBTRANS means that successful urban transitions, that is, urban transformations whose urban change is fully or almost completed and that presents a substantial qualitative change in the urban fabric from an industrial to a post-industrial state, are produced *either* by the combination of a high strategic character of the project and a leading role of public actors, *or* by the combination of a high strategic character of the project and brownfield redevelopment (inside or outside the city centre). As the presence of the condition STRATEG has been considered necessary to enable a successful urban transition, it appears in each of the solution pathways. This means that, whenever an urban transformation is fully or almost completed and features a qualitative change in the urban fabric from an industrial to a post-industrial, it is also characterised by a strong strategic character, although other urban transformations with a high strategicness might not (yet) be full urban transitions.

As per Table 3, most cases (87.1 %) are covered by the first solution pathway,[13] where the leading role of public actors combines with a high strategicness of the urban transformation (PUBLIC * STRATEG). An excellent example for this pathway is Wien Aspern stage 2, whose development has been substantially led by the City of Vienna and where strategic aspects especially related to environmental sustainability have greatly characterised this project. The second pathway is exemplified in the cases of Hafencity in stages 3 and 4, as well as the projects of Munich Riem and Wien Aspern, as these urban transformations required a conversion of function outside the city centre (SITE; brownfield redevelopment; abandoned industries and warehouses in the case of Hafencity, an abandoned airport in the case of Munich Riem and Wien Aspern) in combination with a high strategic component (STRATEG) to steer the urban transition.

However, and although not in contradiction with the findings, the site identification and plan formulation (stage 1) of the urban transformation of Dessau Innenstadt is not a good instance of the relationships we found between the two pathways and the outcome, because this case is not a member of the overall causal recipe (Fig. 2). In turn, the development stages characterising Freiburg Vauban are inconsistent with our findings (deviant cases in degree), because their set membership to the pathways is lower than the membership to the outcome. This means that the recipes we found to be associated with a successful urban transition do not fully work in the specific instance of Freiburg Vauban. This is further indicated by the fact that the first stage of Freiburg Vauban was deleted from the analysis (see above), and suggests that this specific urban transformation is different (or 'deviant') from the rest of the cases and requires a further in-depth investigation to examine its individual trajectory towards a fully complete urban transitions with high urban quality (see Oana et al., 2021).

5. Discussion and conclusions

We started this paper with the observation that post-industrialisation and other major societal dynamics challenged policy-makers and planners to reconsider the ways in which the city could be revived. Strategic projects were conceived to combat the (threat of) urban decline. However, which combination(s) of conditions could lead to successful urban transformations remained unclear, as most studies on strategic spatial planning and practices have adopted a qualitative approach on individual case studies, at times structuring comparisons by simple juxtaposition of different experiences across Europe. While both commonalities and dissimilarities across projects were recognised, the acknowledgment of the uniqueness of individual projects hampered efforts to find common 'recipes' to the successful completion of the planned urban change, that is a qualitative change in the urban fabric from an industrial to a post-industrial state.

Following literature on strategic spatial planning processes, we identified four main conditions that may be associated with a successful urban transition: the influence of the involvement of civic society (CIVIC); the leading role of public actors (PUBLIC); the strategic character attributed to the urban transformation (STRATEG); and a conversion of functions (SITE). Furthermore, as strategic projects evolve over time, it was necessary to adopt a time-sensitive approach, which could also allow for comparison across different projects to identify common patterns.

We examined 29 development stages in eleven German, Austrian and Swiss transformations using Trajectory-based Qualitative Comparative Analysis (TJ-QCA) to answer the question under which combinations of conditions selected urban transformations have successfully achieved a

[12] See Supplementary material for the conservative and parsimonious solutions and for the analysis of the non-occurrence of the outcome.

[13] Except for the cases of Wien Aspern stage 2 and Munich Riem stages 2 and 3, all the other cases are uniquely covered by one of the solution paths.

Table 4
Intermediate solution for the occurrence of the outcome.

	Pathways	Consistency	PRI	covS	covU	Cases
1	PUBLIC * STRATEG	0.811	0.642	0.871	0.234	freiburg_vauban3|0.67,freiburg_vauban4|0.67,dessau_innenstadt2|0.67,eisenhüttenstadt1|0.67, eisenhüttenstadt2|0.67; wien_aspern2|1,munich_riem2|0.67,munich_riem3|0.67; jena_stadtum2|0.67, jena_stadtum3|1,freiburg_vauban2|0.67
2	STRATEG * SITE	0.844	0.589	0.689	0.052	hafencity3|0.67,hafencity4|0.67; wien_aspern2|1,munich_riem2|0.67,munich_riem3|0.67
	M1	0.820	0.672	0.923		

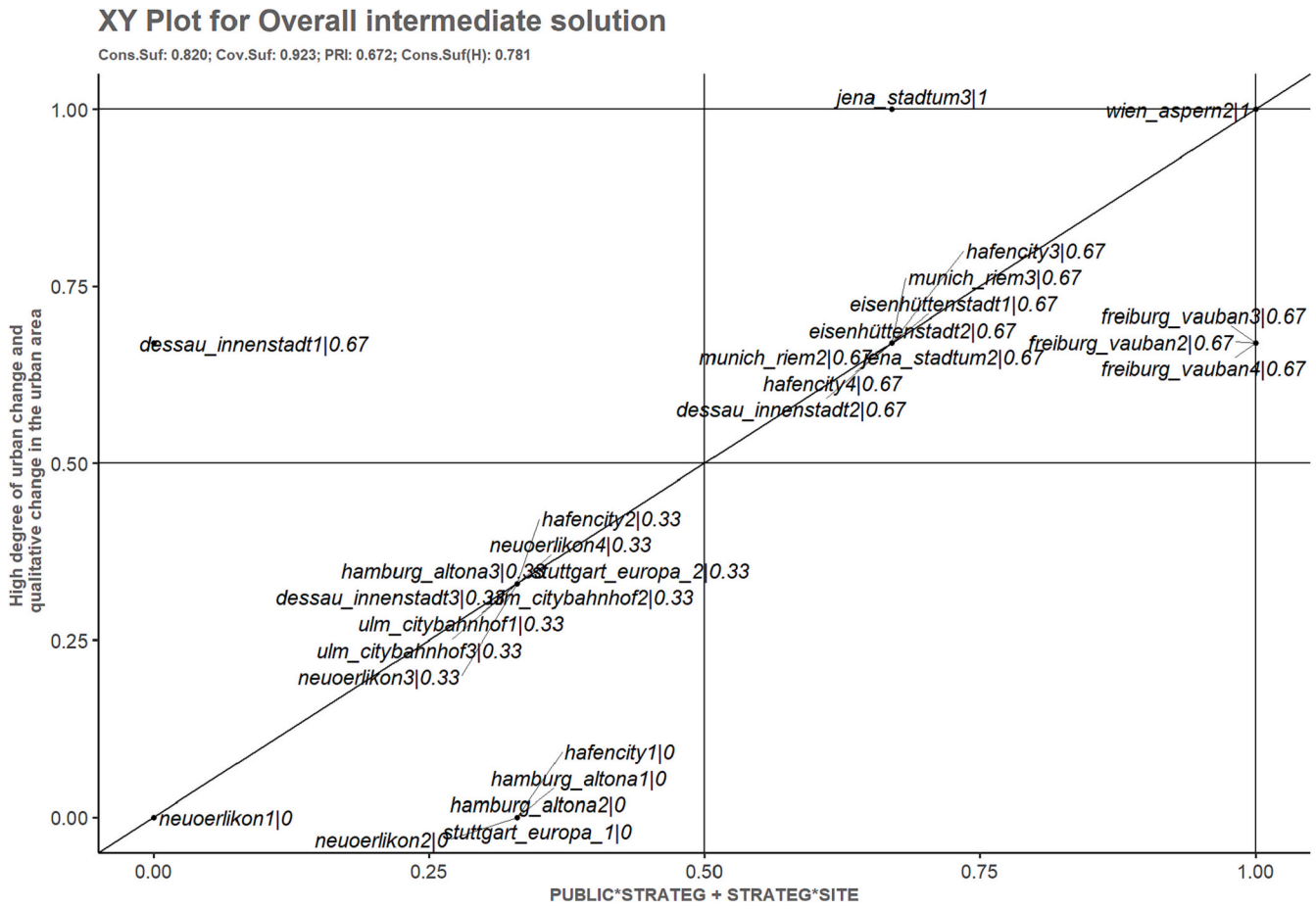

Fig. 2. XY Plot for the overall intermediate solution for the occurrence of the outcome.

qualitative change in the urban fabric from an industrial to a post-industrial state. Our findings show that there are two main pathways (combinations of conditions) that lead to the outcome. Urban transformations, whose urban change is fully or almost completed and that presents a substantial qualitative change in the urban fabric (outcome), are produced (processes) *either* by the combination of a strong strategic character of the project and a leading role of public actors (i.e., the solution STRATEG * PUBLIC), *or* by the combination of a strong strategic character of the project and brownfield redevelopment (i.e., the solution STRATEG * SITE).

We also found that the presence of the condition STRATEG is necessary. That is, it enables a successful urban transition. Our analysis of non-occurrence of the outcome (for details, see Supplementary material) shows that a relative absence of strategicness is sufficient to produce a low degree of physical change. In other words, if actors do not attribute a (strong) strategic character to the project, the transition of the area from an industrial to a post-industrial state is not achieved. This does not mean that these urban transformations are 'failures.' Rather, it means that their physical and qualitative transition are either still undergoing, as in the cases of Dessau city centre and the redevelopment of the Ulm central train station and surrounding neighbourhood, or not enough ambitious in terms of scope and goals, as in the cases of Hamburg Altona and Neu Oerlikon.

The findings suggest some planning or policy directions to steer the planned urban change towards a successful completion. First, our study demonstrates that strategic spatial planning (i.e., strategicness) is an important aspect to support actors in steering urban transformations towards a post-industrial state. However, *strategic spatial planning* must come in combination with other factors, specifically with a *leading role of public actors* in such transformation and with a *conversion of functions*, in *brownfield redevelopment*. We believe that the identified pathways can also be helpful guidelines when sustaining the efforts of governance actors to stimulate a meaningful urban change.

Second, our findings show that urban transformations require time to be completed. On average, urban transformations are composed of 3.3 development stages, each of which lasts for roughly 10 years. Transforming cities is hence a challenging endeavour that requires sustained efforts. Spatial planning research and practice needs to account for time

and use methods for empirical research that are time-sensitive. The description of the overall process of urban change (i.e., trajectory) through multiple development stages (or cases), and the association of each stage with a specific outcome, can be a powerful analytical tool for both planning theory and practice to systematise *and* compare how urban transformations unfolds.

Third, and connected to the previous point, the analysis demonstrates that systematic comparison across urban transformations is possible- and that findings from unique planning trajectories can be limitedly generalisable, provided a certain level of abstraction. Acknowledging that urban transformations are neither completely unique nor completely the same is a key take-home-message for planning practice. Institutional learning can take place and should be fostered, for instance through comparative analysis across networks of cities. However, we also recognise that our analysis and findings do not sufficiently account for important differences between planning cultures, or even within urban transformations located in different parts of each country (e.g., the differences between former West and East Germany). The relevance of spatial planning cultures should inform further research when comparing different experience of strategic spatial planning (Zimmermann et al., 2020).

The study comes with some limitations. First, the method requires researchers to examine within-case variations. Differentiating trajectories into stages (i.e., sequential cases) is not straightforward, and results in an amplification of the initial number of cases. In our study, eleven urban transformations were 'segmented' into development stages. Methodologically contradictory cases are expected to appear more often than in conventional Qualitative Comparative Analysis (QCA), hence posing further challenges for researchers applying TJ-QCA in empirical research.

Second, data collection was limited to written sources. Ideally, researchers should perform a more in-depth investigation of the histories of the cases, for instance through narrative interviews. However, the analytical step of assigning set-membership values to cases into the identified conditions and outcome remains a simplification in the attempt to find a balance between case idiosyncrasies and general patterns. Therefore, the analysis of complex processes, such as large-scale urban transformations as in our study, will inevitably be limited because the analytical pathways will never do full justice to the immense richness of social reality. Consequently, the generalisation of the findings is limited as our sample is composed of purposefully selected transformations. Future research should expand the pool of urban transformations and extend beyond the three countries we selected for our study.

Third, we selected only a limited set of conditions. This is in accordance with the employed method. Empirical research should reveal which other (combinations) of conditions matter in addition to the ones we tested.

These limitations notwithstanding, we hope that this study demonstrates the advantages of capturing, and systematically comparing, the multiple development stages through which urban transformations unfold over time and change our cities.

CRediT authorship contribution statement

Lasse Gerrits: conceptualization; methodology; formal analysis; investigation; resources; writing; editing; supervision; funding acquisition; Sofia Pagliarin: conceptualization; methodology; formal analysis; investigation; data management; resources; visualization; writing; editing; supervision; Kai Udo Klein, investigation; data curation; Fiona Knieling investigation; data curation.

Declaration of competing interest

There are no conflicts of interest to report. There is no financial/personal interest or belief that could affect our objectivity.

Data availability

All data sources have been uploaded to an online repository. The link is shared in the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cities.2023.104507.

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