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Modelling trajectories of urban shrinkage – involvement and role of local stakeholders

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Abstract: Shrinkage is understood as the process of population decline in an area which is the result of different processes such as deindustrialisation or demographic change. Local stakeholders in shrinking cities are faced with a contradictory task: they have to ensure a good living quality under conditions of shrinkage with fewer funds for this purpose and become increasingly dependent on external sources. Set against this background, the paper analyses different ways of how local stakeholders are involved in developing empirically founded rules to model local trajectories and decision-making heuristics of urban shrinkage. After the introduction of research objectives (1.1), the paper provides an insight into the challenge of urban shrinkage from the perspective of local stakeholders (1.2). Next materials and methods for modelling local pathways of urban shrinkage by involving local stakeholders are presented (2.). A third part introduces different research projects/ approaches working with stakeholder involvement and modelling techniques (3.). By means of these case studies, we show how stakeholders are enabled to participate in knowledge creation. The last part of the paper discusses what the impact of local stakeholders in the presented cases really is. (4.) Thus, we argue that stakeholder processes have generated new knowledge and valuable insights into drivers and relationships of the shrinkage process, and have also supported the generation of more comprehensive future development trajectories.

Keywords: Urban modelling, urban shrinkage, local stakeholder knowledge, scenario games

1. Introduction

1.1. Research objectives

Urban shrinkage represents a major challenge for many cities across Europe: is understood as the process of population decline in an area which is the result of different processes such as deindustrialisation, demographic change or natural hazards. Shrinking cities have to adapt to decreasing population numbers, densities and demands for housing, infrastructure and amenities and lower tax revenues or municipal income. At the same time, the municipalities have to ensure the liveability of the city and its attractiveness for investment. In sharp contrast to growth contexts, which up to now predominate the thinking of urban planners around the world, local stakeholders in shrinking cities are faced with a contradictory task: they have to ensure a good living quality under conditions of shrinkage with fewer funds for this purpose and become increasingly dependent on external sources. Despite the lack of expertise mentioned above, urban research has recently become increasingly engaged in the explanation of the causes and consequences of urban shrinkage (Haase et al., submitted). This also applies to the modelling of local trajectories of urban shrinkage and its consequences. Here, the knowledge by local stakeholders is indispensable: firstly, to build comprehensive causal relationships that describe shrinkage and secondly, to formulate rules for spatially explicit land use, system models and scenario games. Only thus is it possible to create surplus knowledge through the modelling of results and the participatory process that help local stakeholders to get along better with the challenges of urban shrinkage in their daily business (Haase et al., submitted).

Set against this background, this paper analyses how local stakeholders are involved in developing empirically founded rules to model local trajectories and decision-making heuristics of/under urban shrinkage in different urban regions across Europe. We show how stakeholders are enabled to participate in knowledge creation, what their impact really is and how they evaluate the outcomes of the models. We use empirical evidence from different European research projects. Although our focus will be on Europe, we emphasise that we understand urban shrinkage as a global challenge and treat our conceptual and modelling approaches as also being transferable outside the European realm.

1.2. The challenge of urban shrinkage from the perspective of local stakeholders

Urban shrinkage has been conceptualised in different ways. Some scholars interpret the term as a decreasing population in the urban core as part of wider shifts in the spatial organisation of urban regions (for example, between the urban core and the hinterland) in the course of which existing built environments are devalorised and made obsolete (Berg et al., 1982; Lever, 1993; Garreau, 1991). Others discuss urban shrinkage as an inevitable result of uneven economic development, emerging as something rather natural that is deeply rooted in the nature of capitalist economies (Harvey, 2006) and the underlying dynamics of the territorial division of labour (Amin and Thrift, 1994; Storper, 1995). Still another explanatory approach discusses urban shrinkage in the light of demographic change and relates it to declining birth rates, changes in household formation and migration impact (Haase et al., submitted).

In this paper, we present urban shrinkage as an event resulting from the specific interplay of different macro-processes at the local scale (Rink et al. 2009; Großmann, 2008a). Macro-processes may be related to the economic, demographic or settlement system development as well as to environmental issues or changes in the political or administrative system. Urban shrinkage occurs when the specific interplay of the mentioned macro-processes leads to population decline (cf. studies by Oswalt and Rieniets, 2006; Turok and Mykhnenko, 2007). Population decline is due to both natural decline (death surpluses) and losses by out-migration (suburbanisation, intra-regional migration, emigration). Moreover, changes in household formation – more related to demographic change than to shrinkage – lead in addition to altered decision-making heuristics of this declining population (Haase et al., 2010).

Urban shrinkage affects both the physical space and the society of a city whose mutual fit is diminishing; this leads in turn to phenomena such as mismatches of supply and demand in various respects. We also differentiate between urban shrinkage as a process and its results, which are reconfigured or reshaped urban structure or patterns. We are mainly interested in its causal relationships and underlying dynamics, as well as the impact it has on different fields of urban development. Urban shrinkage represents a particular challenge for local urban planning and policy-making since the overwhelming majority of planning and policy strategies and instruments are based on the growth paradigm, that is, the implicit assumption that successful urban development is linked to growth, e.g. increasing population numbers, improving economic performance and enlarging the area of influence of a given city. The task of urban planning and policy, in this context, is to streamline and steer growth processes, and to provide solutions for markets of demand surplus – in terms of housing, employment, allocation of new businesses etc.

Local stakeholders in shrinking cities are faced with a contradictory task: they have to ensure a good living quality and social equity under conditions of decreasing population numbers and – in most cases – complicated economic and employment conditions such as an exodus of capital, lack of attractiveness of the given city for new investment and high rates of unemployment and under-employment. They are faced with an underuse of urban land and infrastructure as well as a perforating urban body as a consequence of abandonment, housing and commercial vacancies and derelict areas. Urban shrinkage means higher costs for the maintenance of urban infrastructures and amenities that are either used by fewer inhabitants or are used by people who do not live in the city but still work there (Naumann and Bernt, 2009). Subsequently, municipal administrations in shrinking cities are faced with higher costs and, at the same time, have fewer funds and become increasingly dependent on external sources. In relation to questions such as natural decrease and rapid ageing the most striking challenges for planning are thus an excess of out-migration, impoverishment, the re-definition of values of density and correct-sizing of infrastructures disposing at deficit budgets. Other challenges include new forms of dealing

with underuse, supply surplus and decreasing demands, the restoration of brownfields as well as issues of ecological mitigation of post-industrial areas (Blanco et al. 2009; Rink and Kabisch 2009).

2. Materials and methods for modelling local pathways of urban shrinkage by involving local stakeholders

For this paper, we use the empirical evidence of several European research projects – PLUREL (Peri-urban Land Use RELationships; contract no. 036921; 2007-2010), SHRINK SMART (full title: Governance of shrinkage within a European context; contract no. 225193; duration: 2009-2012) and the project “Town houses in a shrinking city”. In these projects, one task was to integrate the knowledge of local stakeholders into a scientific study on urban shrinkage. While in SHRINK SMART local trajectories of shrinkage are developed in cooperation with stakeholders (in the form of workshops), the task in PLUREL is to develop tools to assess the sustainability impact of urban and peri-urban land use changes under different future scenarios, e.g. shrinkage. In the third project, the decision-making heuristics of local residents (as stakeholders) concerning moving to new town houses built on former brownfields was of interest (both for modellers and for the urban administration).

In all cases, the involvement of local stakeholders is indispensable for the attainment of high quality results in research. Moreover, research results of all projects should also serve as knowledge for action in the form of decision support as well as guidelines for strategies and tool development. For the purpose of this paper, we compare the “who”, “when”, “how” and “why” referring to stakeholder involvement in modelling knowledge on urban shrinkage of the three projects.

Different methods exist to incorporate stakeholder knowledge and decision-making in urban (land use) modelling. They depend on the manner of participation of both stakeholders and researchers, which is described in the following list showing the type of cooperation as well as the varying amount of time and personal involvement:

- a) interviews and questionnaire surveys: using knowledge of stakeholders that has been gained from classical social science methods such as interviews or questionnaire surveys. Output is the qualitative and quantitative data and information of a representative group of stakeholders on specific questions/issues;
- b) qualitative models: mental models or mind maps are developed together with stakeholders using pen and paper or a visualisation software. The process might end up in a consensual group model (out of round tables and focus groups). Output is the graphical representation of stakeholder knowledge;
- c) planning or role games with stakeholders: the outputs are maps or narratives, both by the stakeholders, which can be used by the modeller to enhance and improve a model;
- d) scenario workshops: running scenario games together with the stakeholder whilst both sitting in front of a computer. The stakeholder can modify/alter the input data, parameter weights or suitability. The output is a stakeholder-generated data set;
- e) participatory methods such as Knowledge Elicitation Tools (KnETs): KnETs represent a new and reproducible way to formalise specific knowledge using computational techniques and, what is more, to implement scenario techniques within stakeholder interviews. The output is either a set of decision rules or individual/collective decision trees.

3. Empirical case studies

In this section, we describe the role of stakeholders, the process of stakeholder involvement and the process of integration of stakeholder knowledge into the modelling process based on applications in three different research projects (mentioned above).

3.1 PLUREL scenario workshop

In the EU-project PLUREL we develop scenarios for future land use development in European urban regions facing population growth or shrinkage (Haase et al., 2009). We combine the spatially explicit modelling work with a participatory approach to involve stakeholder knowledge on drivers and policy instruments to steer land use development. Our scenario technique aims at incorporating feedbacks from planning into land use modelling.

In the PLUREL-project stakeholders – which are mainly local and regional planners and land use managers – are involved in urban land use modelling through scenario workshops and interactive planning games (Haase et al., 2009). In a first phase of the project, a scenario framework, including possible trajectories of land use change according to population, economic development and planning impact for the PLUREL case studies, was designed. Accordingly, a respective scenario matrix and respective storylines were created by scientists using information from expert interviews. Afterwards, a first model was set up using the cellular automata model MOLAND (Figure 1 left side). The resulting maps series were presented at the regional scenario workshop as an introduction. Based on the land use classes and time/space constraints the model uses, a planning game was created in the form of three divergent storylines, which however include all preferred ideas by the stakeholders invited: extreme growth, managed growth and managed shrinkage of urban land use. The game itself had three phases: firstly, stakeholders had to create a land use map for their specific scenario for the future using pen and paper (“design studio”; Figure 1 right side). Secondly, they had to discuss the drivers and pressures behind their mental land use development map and explain the respective planning instruments they would use to steer this development (“expert panel”). Thirdly, a joint discussion of the results with the other two groups (“regional council”) uncovered the pros and cons of each scenario. The results of all three phases of the scenario workshop were recorded and summarised by the participating scientists. Finally, the new stakeholder-based knowledge was integrated into the MOLAND model (Monitoring land use changes; Barredo et al., 2003) for a second phase of simulations. In terms of shrinkage, it was particularly important for the recent experiences of the planners to be captured by the modellers: for example, that open governance processes are seen as being important to create visions about how to sustainably steer land use development under population decline, whereas making decisions is still based on prevailing classical planning instruments such as preparatory plans. The scientists further learned about the significance of interim use agreements at urban brownfield sites (Lorance and Haase, submitted). The participating stakeholders, on the other side, were introduced to a way of commonly visualising and discussing their ideas of regional land use development.

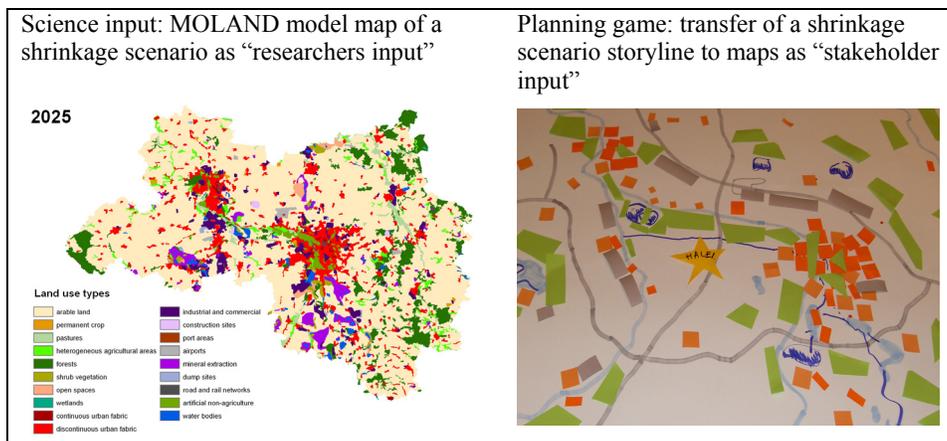


Figure 1. Modelling and mapping land use scenarios of shrinkage (Petrov et al., 2009)

3.2 Modelling trajectories of shrinkage: SHRINK SMART

The SHRINK SMART project uses qualitative social sciences’ methods, such as interviews and document analysis, to gather knowledge about local trajectories of urban shrinkage as a prerequisite to discuss the impacts of urban shrinkage on local governance arrangements and decision-making processes. It uses empirical evidence from seven case studies across Europe (Leipzig/Halle, Germany; Liverpool, UK; Genoa, Italy; Ostrava, Czech Republic; Sosnowiec/Bytom, Poland; Timisoara, Romania; Donetsk/Makiivka, Ukraine). Stakeholder workshops form part of the result-creating procedure; they take place at different stages of this process.

The project started with an analysis of local trajectories of urban shrinkage in different European cities by scientists together with stakeholders (brainstorming meetings, interviews, document analysis). A workshop and discussion of preliminary results of this

analysis together with local stakeholders helps to qualify them. The aim of the workshops is to bring in the knowledge and assessment of practitioners. The further elaboration of the material will take place in close cooperation with stakeholders and will finally lead to practice-validated policy recommendations, strategies and tools, among others conceptual models (Figure 2).

The challenge of the SHRINK SMART stakeholder-modelling-process is to get to a similar stage of knowledge, to understand the thinking and priorities of both participating scientists and stakeholders and to shape the discussion on an equal footing. The creation of a conceptual model, such as that shown in Figure 2, helps to integrate two (potentially different) points of view/approaches (analysis-led and practice-led) and to produce an added value for all persons involved: for stakeholders who best know the local situation and can help scientists/modellers to understand local specifics and logics, and for the scientists who use this local expertise and their theory- and method-driven expertise to create practice validated knowledge that later serves for policy recommendations, cross-cutting analyses and general conclusions.

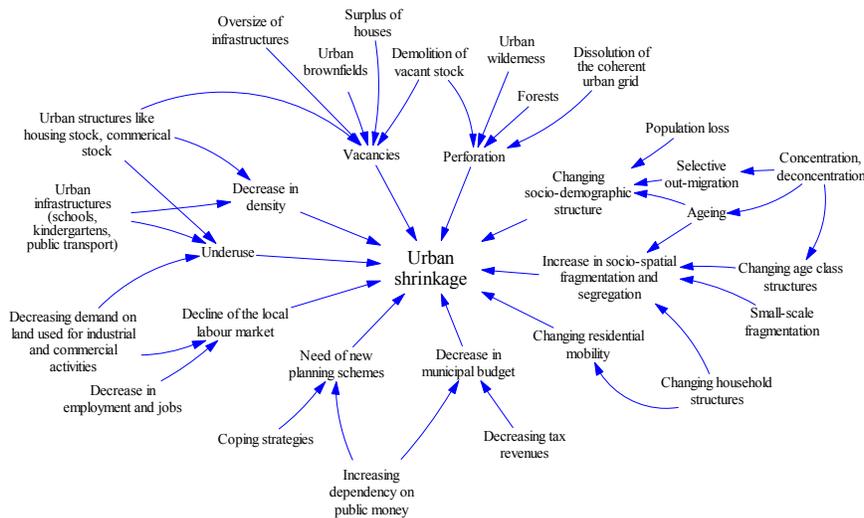


Figure 2. Conceptual model of stakeholder-driven collection of indicators about shrinkage, its drivers, processes and impacts

3.3 Knowledge elicitation analysing decision-making: applying KnETs

In the third project a participatory method named Knowledge Elicitation Tools (KnETs) was used to represent a new and reproducible way to formalise stakeholder knowledge by using computational techniques. The resulting decision trees shed light on what knowledge is used for decision-making by the respective group of stakeholders and how different criteria are weighted in these choices. It was applied to the programme of newly built town houses in the German city of Leipzig (Stadt Leipzig, 2003) which focuses on an enforced re-settlement on recycled former brownfield land within the inner city. KnETs aims to analyse the decision-making behaviour by urban dwellers (who are the stakeholders in this case) concerning the acceptance of town houses as infill-strategies of shrinking urban districts. KnETs can be understood as an amplified methodology of classical social science empirical tools such as interviews and questionnaire surveys combined with scenario games. In a first step, a question for stakeholder decision-making in the field of urban / town planning, which is also related to urban shrinkage, is elicited.

In a second step, interviews with experts of the respective stakeholder group, which usually makes the decision, elicited help to create a scenario computer game including major drivers, instruments, processes, constraints, potentials of the decision-making process including different decision options and respective reasons for them. In a fourth step, this game is run together with members of the same group of stakeholders. The machine learning based on about 50 games or more results in decision-making heuristics (rules). Respective decision-trees are created using pen and paper. The validation of the trees is done again together with stakeholders before the game is played once more in a verification phase with a “zero-group” of the same type of stakeholders. Their decisions are compared

with those made by the tree. The results of a KnETs game can either feed individual models (agent-based models) in order to test resident stakeholder decision-making in case the environment changes in the future. Most importantly, the resulting decision-trees help the creators of the town houses programme to improve adaptation of their ideas to what potential town house dwellers might expect. Thus, our results feed current decision-making processes to reduce uncertainties in the future.

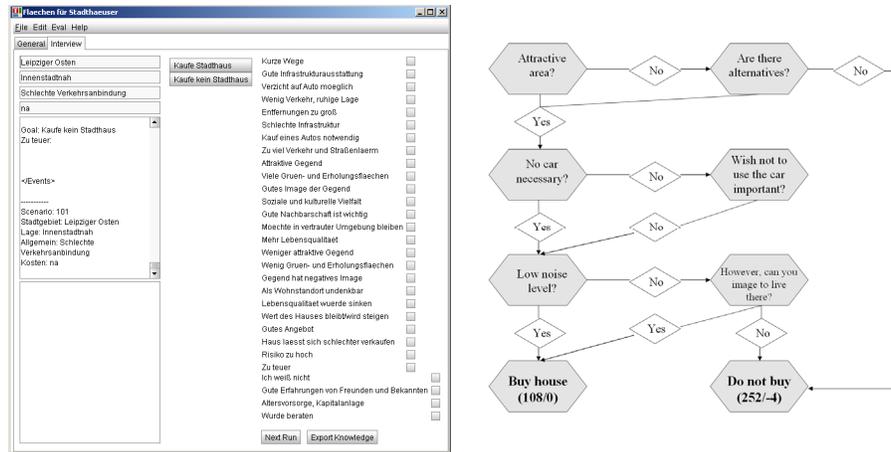


Figure 3. GUI and output decision-tree of the scenario game on decision-making heuristics of local households concerning buying a town house on a brownfield site

4. Preliminary conclusions concerning the stakeholders’ impact

The stakeholders’ impact on the modelling activities and the models themselves in the three projects can be summarised as follows:

- PLUREL project: improvements of the inputs into the cellular automata model arising from the stakeholder feedback after presentation of the model during the regional workshop. This helps to improve understanding of complex processes of simultaneous growth at the fringe and decline in the core city.
- SHRINK SMART project: creation of practice-validated knowledge on local trajectories of urban shrinkage, which serves as an input for the concept model. Joint definition of the relationships of the shrinkage process in cities, which finally lead to the building up of the conceptual model as presented in this paper. The concept model brings together both newly generated knowledge and new insights.
- KnETs project: design of the model and its scenarios itself only works when stakeholder input is given. Subsequently, a living KnETs model is directly linked to stakeholders’ input.

Table 1. Advantages and disadvantages of participatory modeling (PM) involving local or regional stakeholders (SH) (based on Sendzimir et al., 2009, adopted)

Possible problems of PM	Advantages to involve local SH	Disadvantages and challenges to involve local SH
SH might not be prepared to operate on a voluntary basis.	SH groups from different disciplines discuss together and inform each other.	Involving SH is very costly in terms of time and money.
SH might not be prepared to communicate with each other, or other disciplines. Might not be open for other opinions?	Newly generated knowledge through SH involvement qualify models and improve model output.	SH group might not be representative in the communities and might generate a biased set of solutions.
Problem might not require PM approach.	SH knowledge generates new insight into scientists’ analysis output and helps to improve understanding of complex processes. SH gain new knowledge and methods by using researchers’ approaches and results. Both SH and scientists improve their local database by using information from the	SH group might use PM to propagate their specific opinion.

other respectively.

The core part of our written paper describes different ways about how local stakeholders are involved in developing empirically founded rules to model local trajectories and decision-making heuristics with respect to urban shrinkage. In the oral paper, we show different ways of how stakeholders are enabled to participate in knowledge-creation in more detail and expand on how their knowledge is recorded and translated into different types of models or, in short, what the stakeholders' impact really is. Moreover, we will discuss advantages and disadvantages of participatory modelling (Table 1) and how the stakeholders evaluate the outcomes of the models.

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