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Epistemic Communities in Urban Self-organization: A Systematic Review and Assessment

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Abstract

The application of the concept of self-organization has grown over time in the field of urban planning, but with various interpretations. This article presents a systematic review that aims to uncover whether different uses of self-organization are tied to epistemic communities. Through coding and bibliographical analysis, it became apparent that there are two epistemic communities that emphasize different conceptualizations of self-organization. They investigate different issues, use different methods, and find different results. At the one hand, authors use self-organization in modeling approaches, particularly revolving around topics such as economic geography and urban growth. At the other hand, authors use self-organization as surrogate for self-governance, often studied with qualitative methods.

Keywords

governance, self-organization, spatial analysis and models, epistemic communities, systematic review

Introduction and Motive

The concept of self-organization is gaining considerable traction in scientific work about urban and regional planning (see Figure 1). Outside of mere numerical proof, which is possible confounded by an overall increase in scientific output, the importance of self-organization in our discipline has been highlighted by other authors (Boonstra and Boelens 2011; Portugali 2011). There are roughly three reasons for this increased attention. First, it provides an explanans for the emergence of spatial patterns over long periods of time without any superimposed design or the emergence of spatial patterns that were not intended (Batty 2007; Moroni 2015). Second, it provides an attractive alternative planning approach for governments that—in this time and age—lack the resources to fulfill all societal wishes (Sørensen and Torfing 2016) or wish to foster participation (Jun 2007). Third, it ties in with established criticism against modernist planning methods with their focus on expert-driven, authority-based spatial plans as opposed to citizen-driven, bottom-up initiatives (De Roo 2012).

While there is both a strong normative, liberal undercurrent and a healthy dose of pragmatism in the current public debate about self-organization, there is also a genuine realization that self-organization in the broadest sense of the word is a crucial factor in understanding the evolution and resilience of the (built) environment (Boelens and de Roo 2016; Marchand 1984; Marshall and Marshall 2007).

On the basis of the current study, however, it is argued that urban self-organization is understood and used in many diverging, intersecting, complementary, and often contradicting ways in urban and regional planning. For a concept to have genuine value as explanans, to have true scientific values, at the very least, it needs to be conveyed in a somewhat unambiguous manner in order to let audiences get an understanding of the authors' understanding of source and target objects (Sayer 2010). Multiple interpretations used by different groups of scholars are likely to lead to the creation of so-called epistemic communities. Epistemic communities are networks of researchers that build on each other's expertise. Over time, these epistemic communities become more distinct as they emphasize their own conceptualization of self-organization while not being aware of the developments in adjacent communities that started with the same concept but have developed in different directions.

Next of the fact that other authors are working diverse and contradictory uses of self-organization (e.g., Rauws 2016), little persistent empirical evidence has thus far been generated to prove the many claims that are made about self-organization in urban and regional social and spatial systems. The goal of this article is therefore to map and explain the confusion of tongues

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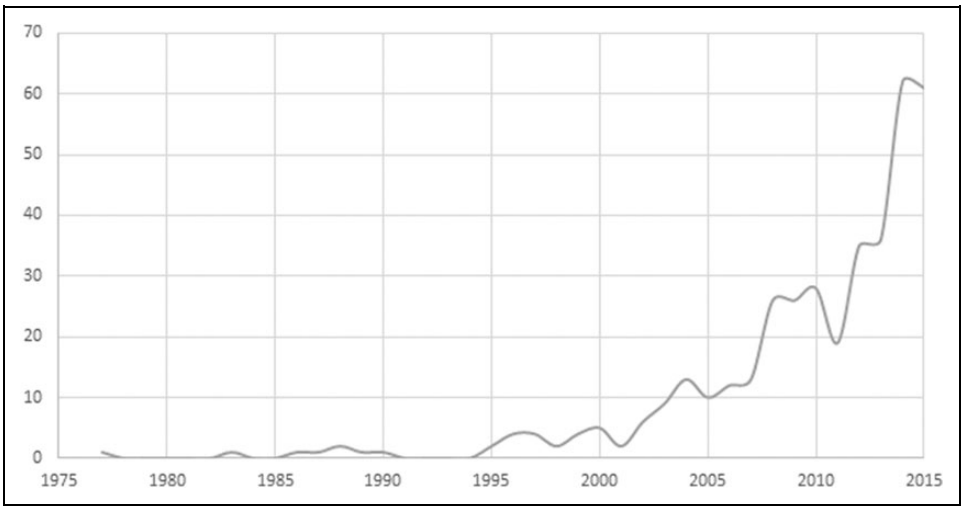

Figure 1. Published papers on self-organization in urban planning per year.

with regard to self-organization by means of both a bibliometric analysis and a content analysis in which different epistemic communities are identified. To this end, this article follows the procedure of a systematic review according to Moher et al. (2009). Systematic reviews of published scientific results are essential in gaining an overall understanding of a concept and its applications. The main research question is: how are the diverse conceptualizations and applications of self-organization in urban planning tied to epistemic communities? From this, follow four subquestions: (1) which epistemic can communities be identified? (2) How is self-organization conceptualized within those communities? (3) Which methods are used to study self-organization within those communities? (4) What outcomes are associated with self-organization within those communities? The answers to the subquestions should provide solid evidence about the linkages between conceptualizations and applications of self-organization on the one hand and specific epistemic communities on the other. This will allow us to explain the diverging uses of the concept.

A systematic review of scientific literature has, by definition, to be systematic, transparent, and reproducible. Therefore, the methodology and an overview of the sample will be reported in second section. The results will be discussed in third section and reflected upon in fourth section. The conclusions can be found in fifth section. As mentioned above, the presentation of our findings is structured according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses checklist (Moher et al. 2009). This checklist is included in Appendix A.

Method

Method and Sample

An important step for any review is to define the main criteria for selecting data sources. Because self-organization is not exclusively tied to one approach or method, both empirical and theoretical studies were included, as well as quantitative and qualitative studies. The sample was restricted to peer-reviewed journal articles that were cited more than ten times. The time span covered in each search was 1972–2015, the starting point being given by the earliest online records. Journal articles were collected from Web of Knowledge, Scopus, and Google Scholar. The data selection was limited to studies published in English since that is the lingua franca for reporting scientific results to a broad academic audience.

Citations are regarded as a proxy for the quality of the study, which is why we selected articles that were cited more than ten times. This approach somewhat favors older publications over recent ones but that is inevitable when looking at impact: very recent papers have simply not been able to reach a wider audience. However, the sample shows no inclination in frequency toward older articles. The sample excludes books on self-organization (e.g., Allen 1997; Portugali 2012), but this is inevitable since many books are not available digitally or in libraries and therefore difficult to trace and code (see Coding section for the technique used). Last but not least, an argument can be made that books are rarely peer reviewed and have been under less scrutiny than journal articles, which is an additional motive for our selection.

Search Queries and Sample Size

For Web of Knowledge, the following search query was used: (“self-org*” OR “self org*”) AND (“*urban” OR “*city” OR “town” OR “metrop*” OR “municipal*”). By using wildcards (*), differences in spelling have been accounted for. This query resulted in 6,656 entries. After limiting the domain to social sciences only (excluding “science & technology” and “arts & humanities”) and to publications in English, this number was reduced to 480. To further reduce this amount of publications, several research areas that did not fall within the scope of our research were excluded, such as life sciences, neurosciences,

and zoology. This left us with 243 publications, 91 of which were cited ten times or more.

For Scopus, the same search query was used as with Web of Knowledge. The search was limited to articles within the social sciences subject area, as defined by Scopus. This netted 368 articles, of which 100 had more than ten citations.

Since Google Scholar does not allow the use of the asterisk, the query was altered slightly to accommodate for this. The first ninety entries that had more than ten citations were included in the sample. This way the total amount of article extracted from Scholar matches the results from Web of Knowledge. Since Google Scholar ranks results based on a relevance algorithm, consisting of various parameters, it favors mainstream ideas rather than fringe ideas or opposing views. Hence, the amount of articles from Google Scholar was chosen to be relatively equal to the other data sources.

Sorting of Sample

The search above resulted in 281 titles, of which 53 concerned duplicates. Of these remaining 228 articles, 54 were excluded based on relevance, language, and not being peer-reviewed or being inaccessible. Seven items in the sample concerned books or book chapters and were excluded on the basis of the arguments mentioned in Method and Sample section. This resulted 167 articles that were fully read by both authors.

The sample was iteratively tidied up on the basis of the following considerations. The first consideration was whether an article was about urban planning and mentioned self-organization in text. Some articles would mention urban planning (as such appearing in the search) but didn't really address it. Twenty-seven such articles were taken out of the sample. Additionally, Google Scholar sometimes included publications where the term self-organization only appeared in the references but not in the main text. These were also left out (twenty-eight articles total).

Eight more articles were removed because they were not peer reviewed or had less than ten citations in Scopus. This "contamination" was a result of including articles from Google Scholar. Cross-checking with Scopus revealed the low number of citations. Some articles could not be cross-checked but received the benefit of the doubt and were left in the sample. The final sample then consists of 103 credible publications. The final list of publications can be found in Appendix B.

Coding

Texts in the sample were coded using ATLAS.ti. The codes used were grouped in various code families as follows: (1) type of study, (2) conceptualization of self-organization, (3) the issue(s) or topic(s) the concept of self-organization is applied to, (4) the method(s) deployed to research self-organization, (5) and the results of the process of self-organization. Each family consists of various subcategories. Code families (1), (2), and (4) feature a limited set of subcategories predefined before the first coding cycle. Code families (3) and (5) were open.

The initial coding cycle covered the full sample, but each author coded a batch in order to distribute the workload. This first cycle resulted in 501 active codes. Subsequently, the entire codebook was cross-checked, that is, each code in each family was reassessed against the original text by the coder who had not formulated and assigned this code originally, in order to ensure a degree of intercoder reliability. This measure was also instituted to prevent confirmation bias. Subsequently, fifty-seven codes were removed from the codebook, forty-four codes were merged, and twenty-four new codes were introduced. Codes were removed if they were considered too unspecified, too vague, tautological, or when attached to a text that was going to be removed from the sample. Codes were merged if both coders had used (slightly) different codes to denote the same thing. New codes were introduced mainly as a result of a more precise rephrasing of other codes. Consequently, and together with texts that were removed after reconsideration, the codebook was reduced to 411 active codes. The second round of code merging reduced the amount of result codes to 314 unique codes. The final version of the codebook can be found in Appendix D.

Results: A First Glance

This section will start with some general metrics of the sample. Figure 2 shows the distribution of the publications by time. When compared to Figure 1, the sample shows correspondence to the overall output. The sample skewers somewhat toward older publications because of the requirement of >10 citations, but this bias is limited because recent publications within the sample are usually cited more frequently than older ones.

The publications were divided into the two principal and discrete categories: "empirical" and "theoretical" studies. Empirical studies include modeling and both quantitative and qualitative approaches toward collecting and analyzing empirical data. Theoretical studies in this article are defined as those studies for which no primary empirical data have been collected (Ragin and Amoroso 2010). Examples of theoretical studies include theorizing or reviews without an explanation of how the data underlying the review were collected. Articles that used interviews for a quantitative purpose (i.e., Andersson and Ostrom 2008) were coded as quantitative. Articles that present overviews of modeling approaches without original work were considered theoretical. The distribution (sixty-nine empirical and thirty-four theoretical) shows that empirical studies about self-organization are prevalent. Of those empirical articles, thirty-two were based on modeling (e.g., White and Engelen 1993), while eleven studies deployed other quantitative methods such as regression analysis (e.g., Kühnert, Helbing, and West 2006). Twelve articles were based on qualitative approaches (e.g., Walker 2006), of which five articles lacked specific information about the used methods (e.g., Olsson, Folke, and Berkes 2004).

Reading, sorting, and coding of the articles led to the tentative identification of two main epistemic communities: one around modeling approaches to urban and regional spatial patterns (C1) and one around case-based approaches of

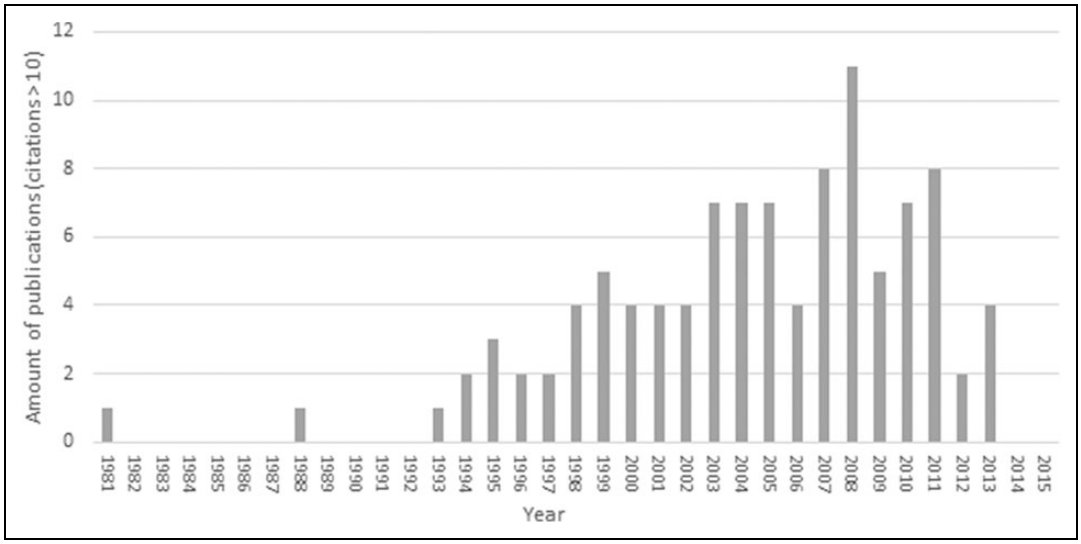

Figure 2. Publications in the sample with more than ten citations, per year.

understanding self-organization through human agency (C2). To increase the robustness of this first impression and to answer subquestion 1, document characteristics such as authors and title alongside the references of articles in our sample were obtained from Scopus alongside eight manually added texts that were not present in the Scopus database. All references were cleaned to accommodate for any erroneous references or misspellings. Two approaches were used to clean up the references. First, an algorithm, on the basis of the Levenshtein coefficient was used. This checks if two strings of words are similar. Second, a manual check was performed after this step to fix any remaining errors.

Based on the references per article, two bibliographical analyses were conducted: bibliographical coupling and co-citation. Bibliographical coupling is a measure used to determine similarity between documents by comparing the degree to which they refer to similar other documents. Co-citation is a measure for similarity between references and is determined by checking whether two references occur in one document. The results for bibliographical coupling and co-citation can be found in Figures 3 and 4, respectively, in which both measures are visualized using Gephi. For purposes of readability, all documents or references have been numbered. The associated documents or references can be found in Appendices B and C.

Figure 3 shows the similarity between *articles* in our sample by comparing the references within these articles. The width of the arrows expresses the similarity between two texts. The place of each node in the graph is determined by similarity, resulting in a clustering of similar texts. Five articles are absent from this image because they showed no overlap at all. A visual inspection shows that the two separate communities can be identified: a tightly knit community at the bottom of the graphic (C1) and a more loosely tied community at the top (C2). Furthermore, it shows that some articles fall somewhat within two branches or fall mostly outside the communities. To the left of C1 is a smaller set of articles that use a specific method (self-organizing maps [SOM]). However, this is no distinctive community, as other articles that make use of the same method fall within C1. Given the degree of overall overlap, it is clear that the communities are largely closed and that few authors use material from both communities.

In total, the sample of 103 publications contained references to 4,117 different documents. Figure 4 shows the similarity between *references* in our sample, that is, co-citation, for citations that co-occurred in at least three articles. When the occurrence count is lowered to two, the segregation between the communities is somewhat lowered, but other less relevant groups of co-occurring citations appear because some articles in the sample were written by the same author and share citations. The size of the circle represents the frequency of appearance. Two separate groups of references are marked in Figure 4. Group A is by far the largest batch of references in the figure and contains a host of articles from the complexity sciences and/or modeling approaches such as agent-based modeling. Also included in group A are modeling papers on economic geography. Group B involves articles relevant to theories on social capital or social ties and institution building (e.g., Ostrom 2015; Putnam 1995). The origin of references in group B is articles in C2, whereas group A are typical of C1. Coupling the information from both graphs leads to two important insights.

First, the co-citation measure reaffirms what the bibliographical coupling showed, namely, that there are two distinct communities, such as group A and group B, that match the clusters recognized in Figure 3. Secondly, the sheer difference in size between group A and group B in Figure 4 shows that C1 is more internally consistent. That is, articles in our sample that fall within C1 often refer to the same sources, whereas the same statement cannot be made for articles from C2.

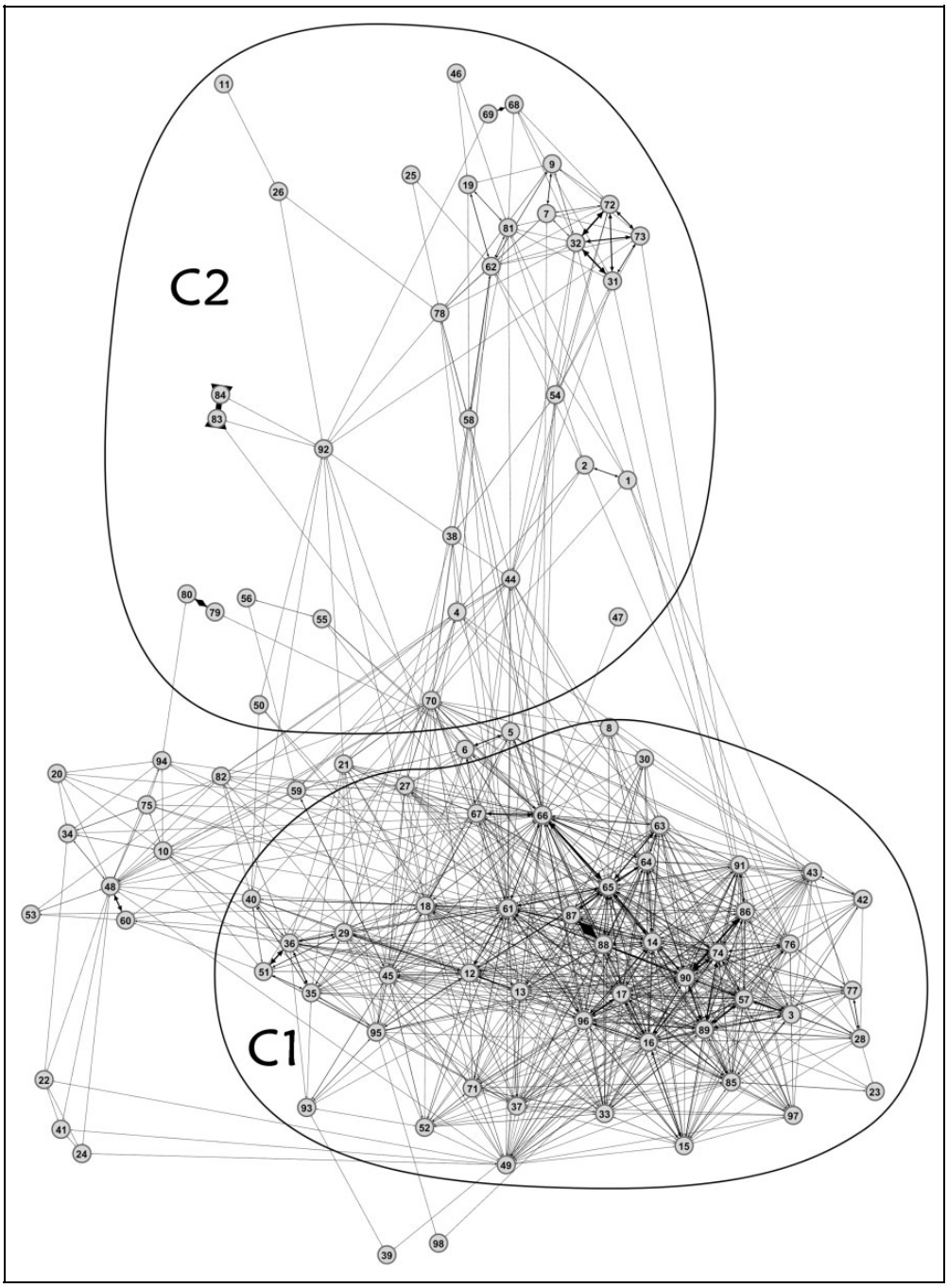

Figure 3. Bibliometric coupling analysis of articles in the review sample.

Results: In-depth

Conceptualization. The discussion in the following section is structured around the remaining subquestions. The second subquestion is: how is self-organization conceptualized? It turned out to be very difficult to give one unambiguous answer to this question because more than just a few authors don't conceptualize self-organization explicitly. Oftentimes, self-organization was used implicitly to denote self-governance or as a property of complex systems. In total, we found five discrete conceptualizations (see Table 1). Some articles contain multiple of these conceptualizations, which is why the total does not add up to 103.

Self-organization under conceptualization #1 here is often based on a long history, starting at Ashby in 1947 (de Wolf and Holvoet 2004) and also popularized in thermodynamics (Prigogine and Stengers 1984). Put concisely, self-organization is the property of complex systems that is the resultant of internal changes and external influences. There is no central control that mandates the emerging macrostructure. In return, the macrolevel influences the microlevel. Self-organization in the

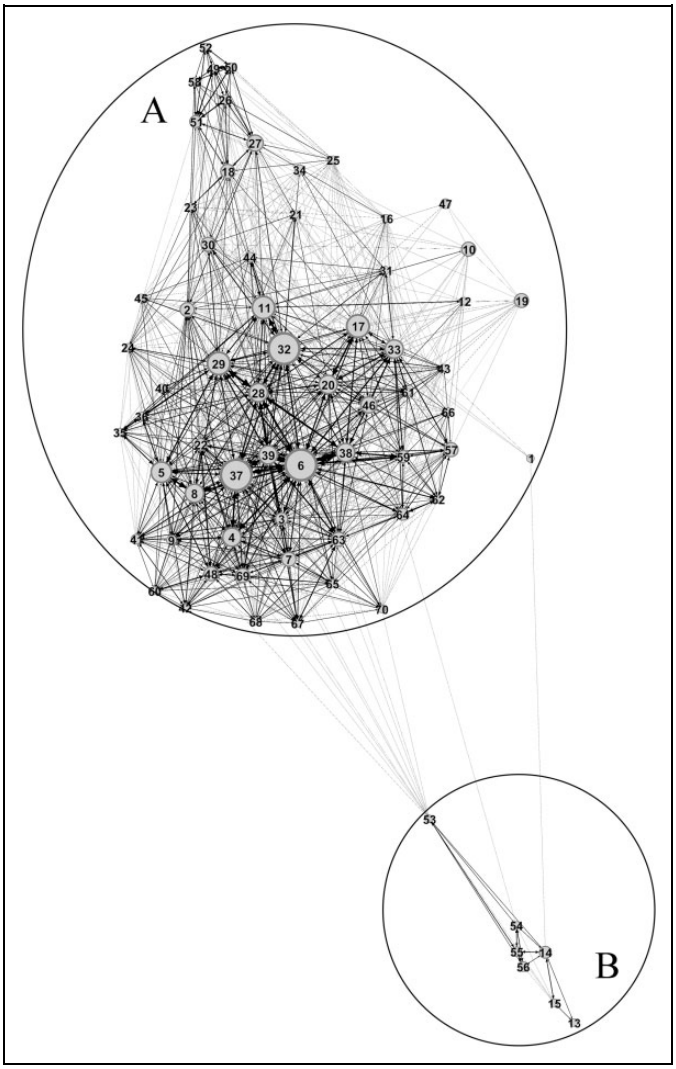

Figure 4. Co-citation analysis of articles in the review sample.

Table 1. Different Conceptualization of Self-organization.

No.	Conceptualization	Frequency	Example
1	As a property of complex systems	48	Portugalli (2008)
2	Local interaction leads to macro patterns	28	Helbing et al. (2005)
3	Self-governance	25	Davies (2005)
4	Power laws	10	Batty (1998)
5	SOM	11	Bloom (2005)

SOM = self-organizing maps.

glossary of complex systems has some leeway in terms of meaning and application. A discussion and elaboration on this is too extensive for the purposes of this article and can be found elsewhere (e.g., de Wolf and Holvoet 2004).

Conceptualization #2 deals with the emergence of macro patterns through local interactions in a very concrete fashion. It is applied in various ways, ranging from the emergence of interaction structures between governments, the emergence of transport networks, to the movements of individuals (cf. Helbing et al. 2005; Shresta and Feiock 2009; Xie and Levison 2009). The major differentiator between conceptualizations #1 and #2 is that #1 refers to the nomenclature of complexity theory (e.g., emergence, nonlinearity, dissipative structures, entropy, order, and chaos), while #2 refers to the type of mechanism identified by Schelling (2006).

Conceptualization #3 sees self-organization as self-governance. It refers to autonomy, independence from the state of a group of individuals, or cooperation between (groups of) individuals in the context of civil society. The central concept was not always defined precisely so self-organization has a rather broad meaning here, generally referring to people engaging in activities without being ordered to do so. Furthermore, self-organization isn't always positioned as the main concept of the article but for example as part of a definition for what constitutes urban (self-) governance (Davies 2005).

Conceptualization #4 refers to power laws and self-organized critically. Here, self-organization means that systems maintain themselves at a critical threshold (Bak 1990; Batty 1998). The typical example of self-organized criticality is a pile of sand on which particles of sand are dropped. When the slope of the pile of sand becomes too steep, it pushes the system too far from equilibrium, and an avalanche occurs from which a new (barely) stable system state emerges. In such a system, smaller avalanches occur more frequently than large avalanches (Bak, Tang, and Wiesenfeld 1988).

Conceptualization #5 is tied to the use of a specific form of neural network models that learn without superimposed instructions, called SOM. In articles using SOM (e.g., Bloom 2005), an explicit conceptualization is often missing because the concept is the method here.

Overall, conceptualization #3 differs the most from other conceptualizations as it relates to governance and civil society, whereas the other conceptualizations involve structure and (distributive) dynamics of (complex) systems without being very explicit about the relationship between state and society. The conceptualizations need not necessarily to be exclusive. For example, the emergence of cooperation between individuals (conceptualization #3) is also a matter of emerging structure (conceptualization #2). Within the different communities depicted in Figures 3 and 4, conceptualization #3 is tightly linked to C2.

The overall picture shows that the conceptualizations are broad and sometimes ambiguous. A likely cause for this is that the more precise a conceptualization is, the less likely it will be to be used again by others because of the specific situations it is applied to. Conversely, generic conceptualizations fit easily with many types of research but are not very informative.

Methods. The third subquestion concerns the question the methods used to study self-organization. Within the sample, we can see a clear preference for emergence-type modeling approaches such as agent-based modeling and cellular automata. Naturally, this is the exclusive domain of C1. One of the

strengths of modeling is that it forces the researcher to be very precise about the conceptualization and properties of self-organization (Klein 2015). It is therefore no surprise that explicit conceptualizations and operationalization are usually found in modeling attempts.

The qualitative studies prevalent in C2 seem to favor case-based approaches to researching self-organization. The techniques deployed vary between interviews, field observations, and writing down personal experiences obtained in projects. Generally speaking, qualitative methods can be geared toward understanding certain causal relationships rather than mapping those relationships. As such, it is no surprise that conceptualizations are more intimately tied to the ways in which an author understands the phenomenon, an understanding that can be hard to communicate to a wider audience.

Naturally, the discussion about methods doesn't concern the theoretical studies. There are frameworks available to structure literature reviews—such as the one deployed in this article—thereby turning theoretical endeavors into methodologically transparent, structured empirical data analyses. However, none of the theoretical articles in the sample provided any clarity on the selection of sources and ideas.

Results of self-organization. The final subquestion is "What outcomes are associated with self-organization within those communities?" After a first round of merging codes, 118 different results from self-organization were identified, varying from concrete results such as grassroots groups and industrial clusters to abstract measures such as weak-tie relationships. More than half of these results only occurred once in our sample. Hence, the results will be discussed on a more aggregated level. The 118 codes were reduced to twenty-two aggregated results. These in turn were fit into broader categories of results regarding distribution, social processes, information, economic output, and institutional context.

Distributive results from self-organization refer to results from self-organizing processes that move objects over space. This can involve the distribution of economic entities over a land mass or within cities, the distribution of demographics within cities or countries, the distribution of traffic flows in areas, or the distribution of built space within city contexts (e.g., Allen and Sanglier 1981; Batten 2001; Dymski 1996; Yerra and Levinson 2005). In most cases, distributive results can be found within articles from C1, as modeling approaches are typically distributive in nature and ask how certain structures emerge as a result of push- or pull-factors. Very often, this involves a form of homophily, such as the notion that similar people will live in similar areas or that an economic benefit can be obtained by having similar companies next to each other.

Results regarding social processes occur in cases where self-organizing processes lead to cohesion, robust networks capable of dealing with change, or reciprocal relations among humans. Alternatively, some studies into self-organization investigate how certain (types of) networks emerge (e.g., Feiock et al. 2010). The results are then discussed in terms of types of network structures. These structural properties of networks were also placed within the category of results regarding social processes.

Information results are those results that deal with the following three subcategories: (1) reframing, producing, and sharing ideas or information (Feiock et al. 2010; Portugali 1997, 2006); (2) innovating upon existing ideas or information (e.g., Olsson, Folke, and Berkes 2004); or (3) reaching (dis)agreement on information or ideas (e.g., Lemanski 2008). This category was set up broadly to incorporate results in the area of innovation (subcategory 2) as well as results regarding reached consensus within policy processes (subcategory 3).

Economic output refers to results in terms of increased profit margins, reduced transaction costs, or robust economic networks. These most often return in modeling studies, although reduced transaction costs also return in studies into governance networks (e.g., Shrestha and Feiock 2009, 2011).

Institutional results are results that deal with settings in which decision-making or collaboration occurs. Two somewhat opposing results can be found here. One strand of literature that deals with institutional results investigates how self-organization leads to collaborative capacity, whereas another series of articles detail how power structures emerge. The second result may hamper collaboration, empowered actors enforce their own agenda at the expense of other stakeholders (e.g., Boonstra and Boelens 2011; Lemanski 2008).

Besides collaborations among public entities are collaborations in which citizens are coproducing services together with or alongside governments. To distinguish between them, the second type of collaboration is dubbed "civic participation." The emergence of rules and their enforcement is a final result that may occur due to self-organization. Self-organization that has institutional results is often conceptualized as self-governance.

Although the above discussion of the results is largely concise, we don't intend to disguise the large range of results underlying these categories. In itself, a large variety of results is not an issue. However, the large amount of results that can be present in one research highlights the issue of causality. Most studies acknowledge that various factors appear in combination with others—there were very few instances where monocausality was suggested—and that these combined lead to certain outcomes. Overall, little attention was paid to such equifinality, however. Equifinality refers to the notion that there is more than one way to achieve a certain result. If there are more than one ways to achieve a specific result, then some caution regarding the results of these studies is warranted. For example, the fact that self-organizing processes may lead to collaboration or to power balances that hamper self-organization points to similar processes that may lead to conflicting or contradictory results.

Furthermore, by their very nature, the modeling studies prevalent in C1 predefine a set of factors from which the self-organizing pattern will emerge, so that inevitably will lead to the conclusion that such factors lead to self-organization—it is in the design of the method to see it that way. The method narrows down the scope of outcomes of self-organization to

spatial patterns. Core factors are often derived from other, earlier sources, leading to considerable repetition of the same factors within the modeling community.

Explaining Differences

If anything, the findings reported in the previous sections show that there is considerable diversity in the ways in which self-organization is understood and utilized and the conclusions that are drawn from it. Indeed, it is practically impossible to list all the types of outcomes here without aggregating them into categories. This is even more of a problem when it comes to listing all the causal chains that researchers have looked at: a bewildering amount of factors have been reported. This is considerably more prevalent in C2 than it is in C1. At the other end of the scale, we find research that is completely lacking in this area. Again, this happens more in C2 than in C1, presumably because modeling simply forces the researcher to become clear about the factors considered in the model.

At first glance, the current state of the topic seems to suggest that there is very little knowledge accumulation when it comes to self-organization in urban and regional planning studies. There is little cross-fertilization across the communities; the few sources used in both communities often concern cursory references. This could be a sobering observation.

The first impression, however, requires a more in-depth understanding of the findings. First of all, one could argue that some knowledge accumulation may still be present within the two communities. The strong internal coherence—as expressed in the reference patterns—could be an indicator for that. The communities are relatively consistent in referring to similar sources within their epistemic community—C1 more than C2. The internal consistency is mostly achieved through the self-referential nature of the communities, again demonstrated by the reference patterns. Authors keep referring to the more common sources within that particular community, which reinforces the belief of yet other authors that those sources are the most important ones and therefore need to be referred to. The same holds true for conceptualization and factors: they are often echoed from previous sources within the community but not across the communities.

Secondly, it could be argued that the diverging uses of the concept simply prohibit overall knowledge accumulation because researchers are using it in different ways for looking at different research objects. This is where the issue of theory transfer comes to the fore (e.g., Mäki 2009). In the most basic sense of the word, self-organization can be seen as a term devoid of any specific application. In other words, it can't be understood as an abstract direct representation (Weisberg 2007) of all the social phenomena researched in the articles included in this study. Indeed, no concept can represent the real world accurately (Knuuttila 2011). The transfer then encompasses the modification that takes place between the source domain and target domain. Often, the differences between the two are so extensive that this modification is necessary. Consider, for example, Portugali's discussion of the balconies of Tel Aviv and how the same reference has been used in research about self-organizing capacity in governance arrangements. It is only natural that the differences in the target domain necessitate a modification of the concept and its use in the source domain. This modification can take place on either one or both of the following two levels: the syntactic structure and the semantic dimension. The properties of the target domain could, for example, allow for a transfer of the syntactic structure but not tolerate the transfer of the semantics. Or, conversely, would allow the semantics to stay the same while requiring a change of the syntactic structure (Weisberg 2007). Both instances have been observed. For example, some authors used self-organization as a verb that represents activities of local citizens, while others used it as a core mechanisms of their method (a mechanism encapsulated in algorithms), and yet others used it to refer to properties of complex systems.

There is always a danger that in a strict transformation and application of the model, the idealized model cannot accommodate certain features of the target domain, while in a rather free application, any two things can be considered as arbitrarily similar (Bolinska 2013, 220). In order to properly transfer and apply a concept to a new target domain, it should achieve articulated awareness of the nature of the objects and relations in that target domain (Woody 2004). As such, it is reasonable to expect that there are diverging uses and applications of the concept, over time resulting in distinct communities. Naturally, it is important that the authors map the meaning of the concept in both the source and the target domain and the changes occurring during the transfer (Bolinska 2013). This often doesn't happen. On the surface, the use of the term seems coherent because it concerns related phenomena, but authors may point to entirely different concepts, within different research traditions and histories of the use of certain variables and causal mechanisms because of the theory transfer that took place.

Conclusion and Discussion

We have identified and mapped two distinct and relatively self-referential communities with regard to self-organization in urban and regional planning research. The communities are primarily defined by method and conceptualization, but we noted that they are also fairly consistent when it comes to the results of self-organization. Yet, we can also observe considerable variety with regard to these factors. This variety is more prevalent in C2, which can be explained by the contextual nature of the qualitative (single) case studies popular within this community. We do see some signs of authors combining insights between the two epistemic communities but not to the extent that we speak of convergence between the communities. While this issue requires ongoing attention in this burgeoning niche, it doesn't mean that the situation is helpless. On the contrary, conceptual purity, scientific progress, and falsification in the fashion of Popper do not reflect the state and operations of the social sciences. It is part of the scientific endeavor

that we poke in different directions, try out things, and see what sticks in the long run. Inevitably, those attempts are not always consistent or even coherent. Scientific progress is very much about the question which representation can accurately describe the world (Knuuttila 2011) and attempts at answering that question constitutes a noncumulative process where fragmentation is inevitable, and essential, in trying out different answers.

Appendix A

Table A1. PRISMA Checklist.

Section/Topic	No.	Checklist Item	Reported on Page No.
Title			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
Abstract			
Structured summary	2	Provide a structured summary including, as applicable, background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	1–2
Introduction			
Rationale	3	Describe the rationale for the review in the context of what is already known	3–5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)	5
Methods			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number	N/A
Eligibility criteria	6	Specify study characteristics (e.g., PICOS and length of follow-up) and report characteristics (e.g., years considered, language, and publication status) used as criteria for eligibility, giving rationale	6–7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage and contact with study authors to identify additional studies) in the search and date last searched	6–7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	7–8
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	8–9
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	10–11
Data items	11	List and define all variables for which data were sought (e.g., PICOS and funding sources) and any assumptions and simplifications made	10
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis	N/A
Summary measures	13	State the principal summary measures (e.g., risk ratio and difference in means)	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis	N/A
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias and selective reporting within studies)	10–11
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses and meta-regression), if done, indicating which were pre-specified	N/A
Results			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	9
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, and follow-up period) and provide the citations	N/A
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12)	N/A
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency	11–25
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15)	N/A

(continued)

Table A1. (continued)

Section/Topic	No.	Checklist Item	Reported on Page No.
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses and meta-regression [see item 16])	N/A
Discussion			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health-care providers, users, and policy makers)	24–27
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research and reporting bias)	N/A
Conclusions	26	Provide a general interpretation of the results in the context of other evidence and implications for future research	27–28
Funding			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review	23

Source: From Moher D., A. Liberati, J. Tetzlaff, D.G. Altman, and the PRISMA Group. 2009. "Preferred Reporting Items for Systematic Reviews and Meta-analyses: The PRISMA Statement." *PLoS Medicine* 6 (6): e1000097. doi: 10.1371/journal.pmed1000097.

Appendix B

Table B1. List of Publications Included in the Final Sample and Legend for Figure 3.

Number in Figure 3	Title
1	Ahern, J. 2011. "From Fail-safe to Safe-to-fail: Sustainability and Resilience in the New Urban World." *Landscape and Urban Planning* 100 (4): 341–43
2	Ahern, J. 2013. "Urban Landscape Sustainability and Resilience: The Promise and Challenges of Integrating Ecology with Urban Planning and Design." *Landscape Ecology* 28 (6): 1203–212
3	Alberti, M., J. M. Marzluff, E. Shulenberger, G. Bradley, C. Ryan, and C. Zumbrunnen. 2003. "Integrating Humans into Ecology: Opportunities and Challenges for Studying Urban Ecosystems." *Bioscience* 53 (12): 1169–179
4	Alberti, M., and P. Waddell. 2000. "An Integrated Urban Development and Ecological Simulation Model." *Integrated Assessment* 1 (3): 215–27
5	Alfasi, N., and J. Portugali. 2004. "Planning Just-in-time versus Planning Just-in-case." *Cities* 21 (1): 29–39. doi: 10.1016/j.cities.2003.10.007
6	Alfasi, N., and J. Portugali. 2007. "Planning Rules for a Self-planned City." *Planning Theory* 6 (2): 164–82. doi: 10.1177/1473095207077587
7	Aligica, P. D., and V. Tarko. 2012. "Polycentricity: From Polanyi to Ostrom, and Beyond." *Governance—An International Journal of Policy Administration and Institutions* 25 (2): 237–62. doi: 10.1111/j.1468-0491.2011.01550.x
8	Allen, P. M., and M. Sanglier. 1981. "Urban Evolution, Self-organization, and Decision-making." *Environment and Planning A* 13 (2): 167–83. doi: 10.1068/a130167
9	Andersson, K. P., and E. Ostrom. 2008. "Analyzing Decentralized Resource Regimes From a Polycentric Perspective." *Policy Sciences* 41 (1): 71–93. doi: 10.1007/s11077-007-9055-6
10	Arribas-Bel, D., P. Nijkamp, and H. Scholten. 2011. "Multidimensional Urban Sprawl in Europe: A Self-organizing Map Approach." *Computers Environment and Urban Systems* 35 (4): 263–75. doi: 10.1016/j.compenvurbsys.2010.10.002
11	Baiocchi, G., P. Heller, and M. K. Silva. 2008. "Making Space for Civil Society: Institutional Reforms and Local Democracy in Brazil." *Social Forces* 86 (3): 911–36.
12	Batten, D. F. 2001. "Complex Landscapes of Spatial Interaction." *Annals of Regional Science* 35 (1): 81–111. doi: 10.1007/s001680000032
13	Batty, M. 1998. "Urban Evolution on the Desktop: Simulation with the Use of Extended Cellular Automata." *Environment and Planning A* 30 (11): 1943–967. doi: 10.1068/a301943
14	Benenson, I. 1999. "Modeling Population Dynamics in the City: From a Regional to a Multi-agent Approach." *Discrete Dynamics in Nature and Society* 3 (2–3): 149–70.
15	Benenson, I., I. Omer, and E. Hatna. 2002. "Entity-based Modeling of Urban Residential Dynamics: The Case of Yaffo, Tel Aviv." *Environment and Planning B* 29 (4): 491–512.
16	Benenson, I., and P. M. Torrens. 2004. *Geosimulation: Automata-based Modeling of Urban Phenomena*. John Wiley.
17	Benenson, I., S. Aronovich, and S. Noam. 2005. "Let's Talk Objects: Generic Methodology for Urban High-resolution Simulation." *Computers, Environment and Urban Systems* 29 (4): 425–53. doi: 10.1016/j.compenvurbsys.2003.11.008

(continued)

Table B1. (continued)

Number in Figure 3	Title
18	Benguigui, L., D. Czamanski, and M. Marinov. 2001. "City Growth as a Leap-frogging Process: An Application to the Tel-Aviv Metropolis." *Urban Studies* 38 (10): 1819–839.
19	Berkes, F., and H. Ross. 2013. "Community Resilience: Toward an Integrated Approach." *Society & Natural Resources* 26 (1): 5–20. doi: 10.1080/08941920.2012.736605
20	Bloom, J. Z. 2005. "Market Segmentation—A Neural Network Application." *Annals of Tourism Research* 32 (1): 93–111. doi: 10.1016/j.annals.2004.05.001
21	Boonstra, B., and L. Boelens. 2011. "Self-organization in Urban Development: Towards a New Perspective on Spatial Planning." *Urban Research and Practice* 4 (2): 99–122. doi: 10.1080/17535069.2011.579767
22	Carafa, R., L. Faggiano, M. Real, A. Munne, A. Ginebreda, H. Guasch, M. Flo, L. Tirapu, and P. C. von der Ohe. 2011. "Water Toxicity Assessment and Spatial Pollution Patterns Identification in a Mediterranean River Basin District. Tools for Water Management and Risk Analysis." *Science of the Total Environment* 409 (20): 4269–279. doi: 10.1016/j.scitotenv.2011.06.053
23	Cheng, J., and I. Masser. 2003. "Modelling Urban Growth Patterns: A Multiscale Perspective." *Environment and Planning* A 35 (4): 679–704. doi: 10.1068/a35118
24	Cheu, R. L., and S. G. Ritchie. 1995. "Automated Detection of Lane-blocking Freeway Incidents Using Artificial Neural Networks." *Transportation Research Part C* 3 (6): 371–88. doi: 10.1016/0968-090X(95)00016-C
25	Comfort, L. K. 2007. "Crisis Management in Hindsight: Cognition, Communication, Coordination, and Control." *Public Administration Review* 67 (Suppl. 1): 189–97. doi: 10.1111/j.1540-6210.2007.00827.x
26	Davies, J. S. 2005. "Local Governance and the Dialectics of Hierarchy, Market and Network." *Policy Studies* 26 (3–4): 311–35. doi: 10.1080/01442870500198379
27	Devisch, O. 2008. "Should Planners Start Playing Computer Games? Arguments From Simcity and Second Life." *Planning Theory and Practice* 9 (2): 209–26. doi: 10.1080/14649350802042231
28	Dietzel, C., and Clarke, K. C. 2007. "Toward Optimal Calibration of the SLEUTH Land Use Change Model." *Transactions in GIS* 11 (1): 29–45. doi: 10.1111/j.1467-9671.2007.01031.x
29	Dymski, G. A. 1996. "On Krugman's Model of Economic Geography." *Geoforum* 27 (4): 439–52. doi: 10.1016/S0016-7185(96)00029-2
30	Engelen, G. 1988. "The Theory of Self-organization and Modeling Complex Urban Systems." *European Journal of Operational Research* 37 (1): 42–57. doi: 10.1016/0377-2217(88)90279-2
31	Feiock, R. C. 2009. "Metropolitan Governance and Institutional Collective Action." *Urban Affairs Review* 44 (3): 356–77. doi: 10.1177/1078087408324000
32	Feiock, R. C., I. W. Lee, H. J. Park, and K. Lee. 2010. "Collaboration Networks among Local Elected Officials: Information, Commitment, and Risk Aversion." *Urban Affairs Review* 46 (2): 241–62. doi: 10.1177/1078087409360509
33	Feng, J., and Y. Chen. 2010. "Spatiotemporal Evolution of Urban Form and Land-use Structure in Hangzhou, China: Evidence from Fractals." *Environment and Planning B: Planning and Design* 37 (5): 838–56. doi: 10.1068/b35078
34	Fujita, M., and P. Krugman. 2004. "The New Economic Geography: Past, Present and the Future." *Papers in Regional Science* 83 (1): 139–64. doi: 10.1007/s10110-003-0180-0
35	Fujita, M., P. Krugman, and T. Mori. 1999. "On the Evolution of Hierarchical Urban Systems." *European Economic Review* 43 (2): 209–51. doi: 10.1016/S0014-2921(98)00066-X
36	Gabaix, X., and Y. M. Ioannides. 2004. "The Evolution of City Size Distributions." *Handbook of Regional and Urban Economics* 4: 2341–378
37	Garmestani, A. S., C. R. Allen, C. M. Gallagher, and J. D. Mittelstaedt. 2007. "Departures from Gibrat's Law, Discontinuities and City Size Distributions." *Urban Studies* 44 (10): 1997–2007. doi: 10.1080/00420980701471935
38	Heeg, S., B. Klagge, and J. Ossenbruügge. 2003. "Metropolitan Cooperation in Europe: Theoretical Issues and Perspectives for Urban Networking 1." *European Planning Studies* 11 (2): 139–53
39	Helbing, D., L. Buzna, A. Johansson, and T. Werner. 2005. "Self-organized Pedestrian Crowd Dynamics: Experiments, Simulations, and Design Solutions." *Transportation Science* 39 (1): 1–24. doi: 10.1287/trsc.1040.0108
40	Henderson, V., and R. Becker. 2000. "Political Economy of City Sizes and Formation." *Journal of Urban Economics* 48 (3): 453–84. doi: 10.1006/juec.2000.2176
41	Hsieh, K., and F. Tien. 2004. "Self-organizing Feature Maps for Solving Location-allocation Problems with Rectilinear Distances." *Computers and Operations Research* 31 (7): 1017–031. doi: 10.1016/S0305-0548(03)00049-2
42	Huang, S. 1998. "Ecological Energetics, Hierarchy, and Urban Form: A System Modelling Approach to the Evolution of Urban Zonation." *Environment and Planning B* 25: 391–410
43	Huang, S., W. Kao, and C. Lee. 2007. "Energetic Mechanisms and Development of an Urban Landscape System." *Ecological Modelling* 201 (3): 495–506
44	Innes, J. E., and D. E. Booher. 1999. "Metropolitan Development as a Complex System: A New Approach to Sustainability." *Economic Development Quarterly* 13 (2): 141–56. doi: 10.1177/089124249901300204
45	Jiang, B. 2009. "Street Hierarchies: A Minority of Streets Account for a Majority of Traffic Flow." *International Journal of Geographical Information Science* 23 (8): 1033–48. doi: 10.1080/13658810802004648

(continued)

Table B1. (continued)

Number in Figure 3	Title
46	Kalikoski, D. C., P. Quevedo Neto, and T. Almudi. 2010. "Building Adaptive Capacity to Climate Variability: The Case of Artisanal Fisheries in the Estuary of the Patos Lagoon, Brazil." *Marine Policy* 34 (4): 742–51. doi: 10.1016/j.marpol.2010.02.003
47	Kipfer, S. 2002. "Urbanization, Everyday Life and the Survival of Capitalism: Lefebvre, Gramsci and the Problematic of Hegemony." *Capitalism, Nature, Socialism* 13 (2): 117–49
48	Kourtit, K., P. Nijkamp, and D. Arribas. 2012. "Smart Cities in Perspective—A Comparative European Study by Means of Self-organizing Maps." *Innovation: The European Journal of Social Science Research* 25 (2): 229–46
49	Kropp, J. 1998. "A Neural Network Approach to the Analysis of City Systems." *Applied Geography* 18 (1): 83–96. doi: 10.1016/S0143-6228(97)00048-9
50	Krugman, P. 1995. "Innovation and Agglomeration: Two Parables Suggested by City-size Distributions." *Japan and the World Economy* 7 (4): 371–90
51	Krugman, P. 1999. "The Role of Geography in Development." *International Regional Science Review* 22 (2): 142–61. doi: 10.1177/016001799761012307
52	Kühnert, C., D. Helbing, and G. B. West. 2006. "Scaling Laws in Urban Supply Networks." *Physica A: Statistical Mechanics and Its Applications* 363 (1): 96–103
53	Lange, B., A. Kalandides, B. Stoeber, and H. A. Mieg. 2008. "Berlin's Creative Industries: Governing Creativity?" *Industry and Innovation* 15 (5): 531–48. doi: 10.1080/13662710802373981
54	Leitner, H., and E. Sheppard. 2002. ""The City Is Dead, Long Live the Net": Harnessing European Interurban Networks for a Neoliberal Agenda." *Antipode* 34 (3): 495–518. doi: 10.1111/1467-8330.00252
N/A	Lemanski, C. 2008. "Houses without Community: Problems of Community (In)capacity in Cape Town, South Africa." *Environment and Urbanization* 20 (2): 393–410. doi: 10.1177/09562478080961119
55	Lin, Y., B. de Meulder, and S. Wang. 2011. "Understanding the 'Village in the City' in Guangzhou: Economic Integration and Development Issue and Their Implications for the Urban Migrant." *Urban Studies* 48 (16): 3583–598. doi: 10.1177/0042098010396239
56	Liu, Y., S. He, F. Wu, and C. Webster. 2010. "Urban Villages under China's Rapid Urbanization: Unregulated Assets and Transitional Neighbourhoods." *Habitat International* 34 (2): 135–44. doi: 10.1016/j.habitatint.2009.08.003
57	Long, Y., Q. Mao, and A. Dang. 2009. "Beijing Urban Development Model: Urban Growth Analysis and Simulation." *Tsinghua Science & Technology* 14 (6): 782–94
58	Mahon, R., P. McConney, and R. N. Roy. 2008. "Governing Fisheries as Complex Adaptive Systems." *Marine Policy* 32 (1): 104–12. doi: 10.1016/j.marpol.2007.04.011
59	Mehaffy, M., S. Porta, Y. Rofè, and N. Salingaros. 2010. "Urban Nuclei and the Geometry of Streets: The 'Emergent Neighborhoods' Model." *Urban Design International* 15 (1): 22–46. doi: 10.1057/udi.2009.26
60	Nijkamp, P. 2008. "XXQ Factors for Sustainable Urban Development: A Systems Economics View." *Romanian Journal of Regional Science* 2 (1): 1–34
61	O'Sullivan, D. 2004. "Complexity Science and Human Geography." *Transactions of the Institute of British Geographers* 29 (3): 282–95. doi: 10.1111/j.0020-2754.2004.00321.x
62	Olsson, P., C. Folke, and F. Berkes. 2004. "Adaptive Comanagement for Building Resilience in Social-ecological Systems." *Environmental Management* 34 (1): 75–90. doi: 10.1007/s00267-003-0101-7
63	Portugali, J., I. Benenson, and I. Omer. 1994. "Sociospatial Residential Dynamics—Stability and Instability within A Self-organizing City." *Geographical Analysis* 26 (4): 321–40
64	Portugali, J., and I. Benenson. 1995. "Artificial Planning Experience by Means of a Heuristic Cell-space Model—Simulating International Migration in the Urban Process." *Environment and Planning A* 27 (10): 1647–665. doi: 10.1068/a271647
65	Portugali, J. 1997. "Self-organizing Cities." *Futures* 29 (4–5): 353–80. doi: 10.1016/S0016-3287(97)00022-0
66	Portugali, J. 2006. "Complexity Theory as a Link between Space and Place." *Environment and Planning A* 38 (4): 647–64. doi: 10.1068/a37260
67	Portugali, J. 2008. "Learning from Paradoxes about Prediction and Planning in Self-organizing Cities." *Planning Theory* 7 (3): 248–62. doi: 10.1177/1473095208094823
68	Read, B. L. 2003. "Democratizing the Neighbourhood? New Private Housing and Home-owner Self-organization in Urban China." *China Journal* 49: 31–59
69	Read, B. L. 2008. "Assessing Variation in Civil Society Organizations: China's Homeowner Associations in Comparative Perspective." *Comparative Political Studies* 41 (9): 1240–265. doi: 10.1177/0010414007302340
N/A	Roy, A. 2011. "Slumdog Cities: Rethinking Subaltern Urbanism." *International Journal of Urban and Regional Research* 35 (2): 223–38. doi: 10.1111/j.1468-2427.2011.01051.x
70	Ruth, M., and D. Coelho. 2007. "Understanding and Managing the Complexity of Urban Systems under Climate Change." *Climate Policy* 7 (4): 317–36
71	Schweitzer, F., and J. Steinbrink. 1998. "Estimation of Megacity Growth—Simple Rules versus Complex Phenomena." *Applied Geography* 18 (1): 69–81. doi: 10.1016/S0143-6228(97)00047-7
N/A	Seet, B., G. Liu, B. Lee, C. Foh, K. Wong, and K. Lee. 2004. "A-STAR: A Mobile Ad Hoc Routing Strategy for Metropolis Vehicular Communications." *Networking* 2004, 989–99

(continued)

Table B1. (continued)

Number in Figure 3	Title
72	Shrestha, M. K., and R. C. Feiock. 2011. "Transaction Cost, Exchange Embeddedness, and Interlocal Cooperation in Local Public Goods Supply." *Political Research Quarterly* 64 (3): 573–87. doi: 10.1177/1065912910370683
73	Shrestha, M. K., and R. C. Feiock. 2009. "Governing US Metropolitan Areas Self-organizing and Multiplex Service Networks." *American Politics Research* 37 (5): 801–23. doi: 10.1177/1532673X09337466
74	Silva, E. A., and K. C. Clarke. 2005. "Complexity, Emergence and Cellular Urban Models: Lessons Learned from Applying SLEUTH to Two Portuguese Metropolitan Areas." *European Planning Studies* 13 (1): 93–115
75	Spielman, S. E., and J. Thill. 2008. "Social Area Analysis, Data Mining, and GIS." *Computers, Environment and Urban Systems* 32 (2): 110–22. doi: 10.1016/j.compenvurbsys.2007.11.004
76	Sui, D. Z., and H. Zeng. 2001. "Modeling the Dynamics of Landscape Structure in Asia's Emerging Desakota Regions: A Case Study in Shenzhen." *Landscape and Urban Planning* 53 (1): 37–52
N/A	Surazska, W., J. Bucek, L. Malikova, and P. Danek. 1997. "Towards Regional Government in Central Europe: Territorial Restructuring of Postcommunist Regimes." *Environment and Planning C: Government and Policy* 15 (4): 437–62
77	Syphard, A. D., K. C. Clarke, and J. Franklin. 2005. "Using a Cellular Automaton Model to Forecast the Effects of Urban Growth on Habitat Pattern in Southern California." *Ecological Complexity* 2 (2): 185–203
78	Teisman, G. R., and J. Edelenbos. 2011. "Towards a Perspective of System Synchronization in Water Governance: A Synthesis of Empirical Lessons and Complexity Theories." *International Review of Administrative Sciences* 77 (1): 101–18. doi: 10.1177/0020852310390121
79	Teodorovic, D. 2003. "Transport Modeling by Multi-agent Systems: A Swarm Intelligence Approach." *Transportation Planning and Technology* 26 (4): 289–312. doi: 10.1080/0308106032000154593
80	Teodorovic, D. 2008. "Swarm Intelligence Systems for Transportation Engineering: Principles and Applications." *Transportation Research Part C: Emerging Technologies* 16 (6): 651–67. doi: 10.1016/j.trc.2008.03.002
81	Tidball, K. G., M. E. Krasny, E. Svendsen, L. Campbell, and K. Helphand. 2010. "Stewardship, Learning, and Memory in Disaster Resilience." *Environmental Education Research* 16 (5–6): 591–609. doi: 10.1080/13504622.2010.505437
82	Tremblay, D., and T. Pilati. 2007. "Tohu and Artist-run Centres in Montreal: Contributions to the Creative City." *Canadian Journal of Regional Science* 30 (2): 337–58
83	Walker, R. C. 2006a. "Interweaving Aboriginal/Indigenous Rights with Urban Citizenship: A View from the Winnipeg Low-cost Housing Sector, Canada." *Citizenship Studies* 10 (4): 391–411. doi: 10.1080/13621020600858096
84	Walker, R. C. 2006b. "Searching for Aboriginal/Indigenous Self-determination: Urban Citizenship in the Winnipeg Low-cost-housing Sector, Canada." *Environment and Planning A* 38 (12): 2345–363. doi: 10.1068/a38136
85	Ward, D. P., A. T. Murray, and S. R. Phinn. 2000. "A Stochastically Constrained Cellular Model of Urban Growth." *Computers, Environment and Urban Systems* 24 (6): 539–58. doi: 10.1016/S0198-9715(00)00008-9
86	Webster, C., and F. L. Wu. 2001. "Coase, Spatial Pricing and Self-organising Cities." *Urban Studies* 38 (11): 2037–54. doi: 10.1080/00420980120080925
87	White, R., and G. Engelen. 1993. "Cellular Automata and Fractal Urban Form: A Cellular Modelling Approach to the Evolution of Urban Land-use Patterns." *Environment and Planning A* 25 (8): 1175–199
88	White, R., and G. Engelen. 1994. "Urban Systems Dynamics and Cellular Automata: Fractal Structures between Order and Chaos." *Chaos, Solitons & Fractals* 4 (4): 563–83
89	Wu, F. 1996. "A Linguistic Cellular Automata Simulation Approach for Sustainable Land Development in a Fast Growing Region." *Computers, Environment and Urban Systems* 20 (6): 367–87. doi: 10.1016/S0198-9715(97)00003-3
90	Wu, F., and D. Martin. 2002. "Urban Expansion Simulation of Southeast England Using Population Surface Modelling and Cellular Automata." *Environment and Planning A* 34 (10): 1855–876. doi: 10.1068/a3520
91	Wu, F., and C. J. Webster. 2000. "Simulating Artificial Cities in a GIS Environment: Urban Growth under Alternative Regulation Regimes." *International Journal of Geographical Information Science* 14 (7): 625–48
92	Walti, S., and D. Kubler. 2003. ""New Governance" and Associative Pluralism: The Case of Drug Policy in Swiss Cities." *Policy Studies Journal* 31 (4): 499–525. doi: 10.1111/1541-0072.00040
93	Xie, F., and D. Levinson. 2009. "Topological Evolution of Surface Transportation Networks." *Computers, Environment and Urban Systems* 33 (3): 211–23. doi: 10.1016/j.compenvurbsys.2008.09.009
94	Yao, X. 2007. "Where are Public Transit Needed—Examining Potential Demand for Public Transit for Commuting Trips." *Computers, Environment and Urban Systems* 31 (5): 535–50
95	Yerra, B. M., and D. M. Levinson. 2005. "The Emergence of Hierarchy in Transportation Networks." *The Annals of Regional Science* 39 (3): 541–53
96	Yizhaq, H., B. A. Portnov, and E. Meron, 2004. "A Mathematical Model of Segregation Patterns in Residential Neighbourhoods." *Environment and Planning A* 36 (1): 149–72
N/A	Young, I. M. 1999. "Residential Segregation and Differentiated Citizenship." *Citizenship Studies* 3 (2): 237–52
97	Yuan, F. 2010. "Urban Growth Monitoring and Projection Using Remote Sensing and Geographic Information Systems: A Case Study in the Twin Cities Metropolitan Area, Minnesota." *Geocarto International* 25 (3): 213–30
98	Zhang, L., T. M. Garoni, and J. de Gier. 2013. "A Comparative Study of Macroscopic Fundamental Diagrams of Arterial Road Networks Governed by Adaptive Traffic Signal Systems." *Transportation Research Part B: Methodological* 49: 1–23

Appendix C

Table C1. Legend for Figure 4.

Number in Figure 4	Title
1	Holling, C. S. 1978. *Adaptive Environmental Assessment and Management*. John Wiley
2	Alonso, W. 1964. *Location and Land Use. Toward a General Theory of Land Rent. Location and Land Use. Toward a General Theory of Land Rent*
3	Batty, M. 1997. "Cellular Automata and Urban Form: A Primer." *Journal of the American Planning Association* 63 (2): 266–74
4	Batty, M., and Y. Xie. 1994. "From Cells to Cities." *Environment and Planning B: Planning and Design* 21 (7): S31–S48
5	Clarke, K. C., S. Hoppen, and L. Gaydos. 1997. "A Self-modifying Cellular Automaton Model of Historical Urbanization in the San Francisco Bay Area." *Environment and Planning B: Planning and Design* 24 (2): 247–61
6	Couclelis, H. 1985. "Cellular Worlds: A Framework for Modeling Micro–Macro Dynamics." *Environment and Planning A* 17 (5): 585–96
7	Couclelis, H. 1997. "From Cellular Automata to Urban Models: New Principles for Model Development and Implementation." *Environment and Planning B: Planning and Design* 24 (2): 165–74
8	White, R., G. Engelen, and I. Uljee. 1997. "The Use of Constrained Cellular Automata for High-resolution Modelling of Urban Land-use Dynamics." *Environment and Planning B: Planning and Design* 24 (3): 323–43
9	Wu, F., and C. J. Webster. 1998. "Simulation of Land Development through the Integration of Cellular Automata and Multicriteria Evaluation." *Environment and Planning B: Planning and Design* 25 (1): 103–26
10	Jacobs, J. 1961. *The Death and Life of Great American Cities*. New York: Vintage
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(continued)

Table C1. (continued)

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Appendix D

Table D1. Final Version of the Codebook.

Conceptualization:
Co_LocalInteractionLeadsToMacroPatterns
CO_PowerLaws
Co_PropertyOfComplexOpenSystems
Co_Self-Governance
Co_SOM

Factors enabling self-organization
F_AbsenceOfGovernment
F_AdaptationToLocalCircumstances
F_AdministrativeBoundaries
F_Age
F_AmountOfCustomers
F_AmountOfFirms
F_ArtCulture
F_Assymetry
F_Autonomy
F_AvailableInformation
F_AvoidingSpillOverCosts
F_CarOwnership
F_ChangingServiceDemand
F_Children
F_CitySize
F_CivicEngagement
F_CognitiveUnderstanding
F_Commodification
F_CommonInterest
F_Communication
F_Commuting
F_Competition
F_Complexity
F_Connectivity
F_Consumption
F_Cooperation
F_CoordinationMechanism
F_Corruption
F_Cost
F_Creativity
F_Credibility
F_CrisisAndThreats
F_CulturalActivity
F_CulturalIdentity
F_Culture
F_DemographicCharacteristicsOfInstitutionalUnits
F_DependenceOnIndividuals
F_DesireForSelforganization
F_Discourse
F_Distance
F_Diversity
F_DiversityOfGoods
F_EconomicActivities
F_EconomicStatus
F_EconomiesOfScale
F_Education
F_Employment
F_Energy
F_EnforcmentOfRules

(continued)

Table D1. (*Continued*)

F_Entrepeneurship
F_EstablishedCentres
F_Expenditure
F_Expertise
F_Exploitation
F_ExternalEffects
F_ExternalLinks
F_FinancialResources
F_FirstMoversAdvantage
F_FreedomOfChoice
F_FreedomOfEntryandExit
F_FrictionOfDistance
F_FriendshipTies
F_Gender
F_GenerationOfInformation
F_GettingThingsDone
F_Globalization
F_GovernmentalDominanceOfProcess
F_GovernmentDecisions
F_GovernmentInability
F_Governments
F_GovernmentSpending
F_HerdingBehavior
F_HeterogenousEnvironment
F_Hierarchy
F_HomeOrientedActivity
F_Homogenization
F_HouseholdIncome
F_HousingMarkets
F_HousingProperties
F_Identity
F_Ideology
F_ImmobilityOfResources
F_Impatience
F_Incentives
F_Inclusiveness
F_Income
F_IndustryDevelopment
F_Inequality
F_InformalRelations
F_Information
F_InformationCompression
F_InformationDispersion
F_InformationSharing
F_InformationValidation
F_Innovation
F_InstitutionalBarriers
F_InstitutionalCapacity
F_InstitutionalEvolution
F_InstitutionalIncentives
F_Instructions
F_Interaction
F_InternalBonds
F_InternalFeedback
F_Investment
F_Jobs

(continued)

Table D1. (*Continued*)

F_KnowledgeIncrease
F_KnowledgeSharing
F_LackOfGovernanceCapacity
F_Land Use
F_LandOwnershipRegime
F_LandUseNotAllowed
F_Layout
F_Leadership
F_Learning
F_Legislation
F_LessGovernmentInvolvement
F_Lifestyle
F_LimitedResources
F_LittleCivicInvolvement
F_LocalInteraction
F_Location
F_MaritalStatus
F_MarketCharacteristics
F_Marketing
F_Markets/EconomicIncentives
F_MarketSize
F_Memories
F_MergingWihNearbyClusters
F_Migration
F_MobilizationPeriod
F_MonitoringAndFeedback
F_Myopia
F_Negligence
F_Negotiation
F_Neighborhood
F_Networks
F_ObtainingVoice
F_Oppression
F_PathDependency
F_PedestrianBehavior
F_PedestrianSheds
F_PlatformsForDelliberation
F_Policy
F_PolicyGoals
F_PolicyWindow
F_PoliticalConditions
F_PoliticalHistory
F_PoliticalIDeals
F_PoliticalMotivations
F_PoliticalPressure
F_PoliticalStructure
F_Population
F_PopulationDensity
F_PopulationGrowth
F_PopulationSaturation
F_Poverty
F_Power
F_Preference
F_Proceduralism
F_production
F_PropertyRights
F_PublicAnger
F_QualityOfLife

(continued)

Table D1. (*Continued*)

F_Racial/SocialDiversity
F_Recreation
F_RedefiningRules
F_ReducedAccountability
F_ReducedVarietyOfServices
F_RelocationOfFirms
F_Rent
F_ResidentialSuccession
F_ResistanceToLosingAuthority
F_ResourceAccessibility
F_RestructurationOfNationState
F_Revenues
F_RiskAversity
F_Risks
F_SenseMaking
F_Slope
F_Slums
F_SocialActivites
F_SocialConnectivity
F_SocialExpanditure
F_SpatialAssimilation
F_SpatialCharacteristicsOfInstitutionalUnits
F_SpatialQuality
F_Spinoffs
F_SportActivity
F_SpreadingMotivation
F_Tax
F_Technology
F_Time
F_Tolerance
F_Tourism
F_Tradition
F_TrafficFlows
F_TransactionCosts
F_TransformationOfGoodsOrCapital
F_Transparancy, Truthfulness & Respect
F_TransportationNetwork
F_TransportCosts
F_TravelDemand
F_Trust
F_Turnover
F_TypeOfConflict
F_Unemployment
F_Uproar
F_UrbanGrid
F_Urbanization
F_Variation
F_VarietyOfProducts
F_Violence
F_WorkLocation
F_WorkOrientedActivity

Issues or topics that self-organization is applied to:
I_CivilSociety / Civic Participation
I_CollectiveProblems
I_CommunicationSystems
I_CompetitiveCities
I_CulturalClusters
I_DistributionWithinCities

(continued)

Table D1. (*Continued*)

I_EconomicDevelopment
I_EconomicGeography
I_EnvironmentalGovernance
I_FishingCommunities
I_Geography
I_GoverningDrugUse
I_InformationDispersion
I_LocalGovernment
I_Marxism
I_NaturalResourceGovernance
I_Networks
I_OrganizationOfGovernment
I_PedestrianStampede
I_Polycentricity
I_ProductionProcesses
I_PublicTransport
I_RacialSeggregation
I_ResidentalChoice
I_Resilience
I_ServiceProvision
I_SizeDistributionofCities
I_SocialSimilarityAndGeographicalProximity
I_SpatialPlanning
I_Tourism
I_traffic
I_UrbanDevelopment
I_UrbanGrowth
I_UrbanPlanning
I_UrbanSprawl
I_UrbanSustainability
I_VillagesInCities
I_WaterQuality

Type of Paper:
P_Empirical_Modeling/Simulation
P_Empirical_None
P_Empirical_Qualitative
P_Empirical_Quantitative
P_Empirical_SOM
P_Theoretical

Results or effects of self-organization:
R_Distribution_Cities
R_Distribution_Demographic
R_Distribution_Economic
R_Distribution_Logistical behavior
R_Economic_Profit
R_Economic_Resilience
R_Economic_Transaction Costs
R_Information_Consensus
R_Information_Dispersion/Generation
R_Information_Framing
R_Information_Policy Support
R_Information_Uncertainty Reduction
R_Institutional_Civic Participation
R_Institutional_Collaborative Capacity
R_Institutional_Power Structure
R_Institutional_Rule enforcement
R_Social_Cohesion
R_Social_Freeriding/Hit-and-run/Conflict
R_Social_Network Structure
R_Social_Trust/reciprocity

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