Risk Systemicity: promoting interdisciplinary working in Cities

Abstract

As cities continue to play an increasingly important role in the global economy, managing them is becoming more complex and interdisciplinary. With a rising number of new risks and high demands on critical infrastructures such as transport and healthcare, cities are affected by resource constraints. At the same time, the complexity of growing cities has led to increasing silo working, which makes it more difficult to orchestrate appropriate risk assessment. The challenge that is faced is that cities are subject to more complex networks of interacting risks which link across different risk areas. Effective interdisciplinary working is therefore necessary. However, although the importance of talking across silos has been a consistent plea, its operationalization, especially in the context of risk assessment in cities, remains a challenge. We argue that taking a perspective of risk systemicity, where risks are seen as forming complex networks of interacting, interdisciplinary risks, can contribute to the existing research and practice of risk assessment in public management. In order to support cities in talking about risk systemicity across 'traditional' silos, we introduce a systemic risk evaluation tool which serves as an interactive boundary object in facilitated interdisciplinary group meetings.

Keywords: risk systemicity, risk assessment, boundary objects, public management

1. Introduction

Cities around the globe are enjoying steady growth as global commercial hubs continue to attract skilled workers, and so rural residents in developing countries leave their homes for cities in search of improved life opportunities (The Economist Intelligence Unit, 2017). According to the 'World Urbanization Prospect' report commissioned by the United Nations, it is expected that by year 2030 there will be 41 mega cities in the world, that is cities which have more than 10 million inhabitants, which is up from 5 mega cities in 1975 and 10 estimated mega cities in year 2015 (The Economist, 2015; United Nations Department of Economic and Social Affairs/Population Division, 2014). In other words, cities are becoming bigger, and they are playing an increasingly dominating role in the generation of economic activity.

However, as previously observed in business organizations, cities appear to be subject to the so-called *Icarus Paradox* (Miller, 1992) which means that many of the reasons for their success turn out to be sources of their greatest vulnerabilities. The growing size of cities places new demands on critical infrastructures such as healthcare, housing supply, or transportation as well as on their social fabric. Cities are becoming increasingly complex as their systems and infrastructures become more interconnected (The Economist Intelligence Unit, 2017). As a result, the vulnerabilities, or risks, that are faced by cities can no longer be assumed to be relatively independent from one another, if they ever could. Instead, it is important to understand how, and why, different types of risks interact with one another as a complex system. The importance of understanding the impact that one risk can have on another risk has previously been highlighted in large complex industrial projects where it is recognized that it is the interaction between risks that can have the greatest impact on the outturn of a project (Ackermann, Eden, Williams, & Howick, 2007; Ackermann, Howick, Quigley, Walls, & Houghton, 2014).

In this paper we show that adopting such a systemic approach to risk assessment in cities necessarily requires different parts of a city to work together. The increasing complexity in cities has led to even greater silo working in city administrations – an observation made consistently by the European cities who have been a part of the project reported in this paper: for example for one large city noted – "the silo base nature of several territorial organisations […] is by far the most relevant governance issue of the city". Working in silos within a city is detrimental to effective communication, and so to effective risk assessment and mitigation.

By taking a 'knowing-in-practice' perspective (Gherardi, 2000; Nicolini, 2013; Orlikowski, 2002) on the matter of working in silos, it is evident that 'breaking the silos' is not a straightforward endeavour. The 'silos' which city participants refer to can be understood as epistemic boundaries of local communities which work in cities (Barrett, Oborn, Orlikowski, & Yates, 2012; Carlile, 2004; Wenger & Snyder, 2000). Those epistemic boundaries represent the knowledge which anyone would need to develop for themselves in order to be able to participate in those practices as a recognized member. In this way the epistemic boundaries do not need to have negative connotations, as they are a sign that 'serious learning is taking place' (Wenger, 1998). The epistemic boundaries, and so the silos, cannot be simply 'dissolved' without disrupting and possibly irrevocably damaging the texture of local practices (Patriotta, 2003; Thompson, 2005; Waring & Currie, 2009), and so the knowledge capabilities which they bring. If we are to encourage cities to consider the interaction between risks it therefore becomes important to support cities in engaging in focussed, interdisciplinary conversations about the risk landscape which they face.

The aim of this paper is to report on attempts to address the challenge of developing the *theory and practice of risk assessment in cities* by adopting a perspective of *risk systemicity*. We discuss the development and use of a systemic risk evaluation tool that has been developed with, and used by, European cities to promote interdisciplinary discussions regarding risks that

a city faces. Use of the tool involves bringing interdisciplinary groups of stakeholders from around the city together in a focussed conversation about a range of risk *scenarios* that are created by the interaction of a series of risks. The groups of stakeholders assess and prioritize the risk scenarios, and consider mitigation actions across their city, and thereby across silos. Silo working can mean that different parts of the city administration may not consider how a risk in one silo may impact upon a risk in another silo and how mitigating risks in their own areas may create risks in other parts of the city. The systemic risk evaluation tool reported in this paper seeks to tackle these particular aspects of silo working through i) encouraging talking across silos, and ii) developing an interdisciplinary perspective on risk assessment which accounts for risk systemicity.

The structure of this paper is as follows. We begin our discussion by describing the systemic risk evaluation which was developed as part of the reported research. While doing so, we explain that in this research risk systemicity was explored with the use of a causal mapping technique which helped to attend to networks of risk ramifications, risk interdependencies, and the role of vicious cycles as a generative risk. Building on this perspective, we note that complex networks of risk outcomes are not constrained by one discipline, and so they require interdisciplinary talk. We discuss how the systemic risk evaluation tool has been designed to promote interdisciplinary talk about risk assessment in cities by focussing on the appreciation of systemic risk scenarios. We also report on the operationalization of the systemic risk evaluation tool and we discuss how this tool, as a 'boundary object', supported cities in gaining value from talking across traditional silos. The findings are related to the 'knowing-in-practice' literature to sharpen an understanding of the role played by the tool in encouraging talk about risk systemicity in the context of public management. We conclude our discussion by reflecting on how the design and operationalization of the systemic risk evaluation tool progresses the

current research and practice of risk assessment in cities, and how future studies could advance further the role of risk systemicity in addressing the complex, interacting risks faced by cities.

2. Creating a tool to support assessment of risk systemicity in cities

In this section we characterize the notion of risk systemicity in the context of risk assessment, and we describe the construction of the systemic risk evaluation tool[1]. As risk systemicity entails a view on how different types of risks interact with one another, we argue that a qualitative causal mapping method is an effective way of capturing risk systemicity in cities. We then describe how causal mapping was employed in a series of workshops to develop risk scenarios with city participants. The overall complex causal map of risks subsequently served as the main resource in the identification of crucial risk scenarios and so the construction of the systemic risk evaluation tool. The development of this tool, described in section 4, subsequently serves as the main focus of our following discussion.

Risk systemicity and recognizing multiple perspectives on risks

When considering risks from a systemic perspective, attention is paid to complex networks of risk consequences, consequences that can be seen as risks in their own right. Risk systemicity has been operationalized in the commercial sector and the process of doing so was expected to provide a valuable contribution to risk assessment in cities (Ackermann et al., 2007; Ackermann et al., 2014).

In contrast to systemic risk assessment, traditional risk assessment methods such as a risk register focus on assessing a list of risks in terms of their probability and impact, with individual risks being considered separately. A risk register is also usually completed by a narrow set of

1 The systemic risk evaluation tool discussed in this article is publicly available and can be downloaded from this page: http://smr-project.eu/tools/risk-systemicity-questionnaire/

people (Chapman & Ward, 1997; Hull, 1990; Mace, Hails, Cryle, Harlow, & Clarke, 2015; Patterson & Neailey, 2002) and it is rarely used to capture multiple perspectives derived from multiple expertise and experience (Ackermann et al., 2007; Ackermann et al., 2014). Although the European Commission recommends the use of risk scenarios as part of quantitative risk assessment, the focus is not placed on either (i) the communication about the interactions between different categories of risks that interact across silos, or (ii) the interaction between scenarios (European Commission, 2010).

Meanwhile, considering that "individuals only ever have a partial view of risk" (Hardy & Maguire, 2016: 92), the very nature of taking a systemic view of risk entails taking account of multiple perspectives. As a result, suitable methods are required to capture the systemic view of risk which go beyond the traditional approaches to risk assessment (Taroun, 2014). In the reported research a qualitative causal mapping technique was employed to identify, explore, and demonstrate causal networks and vicious cycles which encompass multiple perspectives. Causal mapping is a research method which aims to represent participants' understanding of the consequential risks using directed graphs (a network of nodes – events, linked through assumed causality) (Huff, 1990; Jenkins, 2002; Paroutis, Franco, & Papadopoulos, 2015). The constructed graphs, causal maps, consist of brief statements (typically 8-10 words reflecting a single risk) linked with unidirectional arrows signifying 'may lead to' relationships. Causal mapping is underpinned by a set of established formalisms (Bryson, Ackermann, & Eden, 2014; Bryson, Ackermann, Eden, & Finn, 2004) which make the resulting maps amenable to analysis, and which are therefore different than simply 'word and arrow' diagrams.

Mapping risk systemicity: causal networks, vicious cycles, and interdisciplinary work

With respect to risk systemicity, causal mapping is designed to capture how risks affect one another. For example, increasing air pollution may be argued to lead to a higher number of

respiratory illnesses in the city, which then can then lead to an increasing pressure on healthcare, which in turn may lead to a worsening quality of healthcare delivery to citizens. It is therefore worth noting that, from the city's perspective, there can be experienced risk interactions between different categories of risks, such as when human activity affects the environment, which then affects social issues and populations' health. Furthermore, various risks may occur concurrently rather than sequentially, and so they can form portfolios of risks where the combined impact of risks is greater than the sum of them all (see also Ackermann et al. 2007). The process of capturing causal maps in group workshops with city participants follows the established approach developed by Ackermann and Eden (2011a; 1998) and is explained in more detail in the following sub-section where we discuss the construction of risk systemicity scenarios. In this part of our discussion it is important to note a number of implications of mapping risk systemicity, an example of which is shown in Figure 1 below.

Insert Figure 1 about here

The first implication of mapping risk systemicity is that, when viewed as a complex network, risks can be seen as consequential outcomes of 'trigger' events. In Figure 1 , the trigger event is statement 347 'climate change happening beyond modelled projections' because it leads to chains of other risks depicted in the segment of the map. This way a hierarchy of risk outcomes is formed, where some risks are outcomes which need to be mitigated, while other risks are potent triggers that cause numerous branches of ramifications. Secondly, mapping of risk systemicity promotes understanding that risk networks are not constrained by a single discipline. For example, in Figure 1 interdependent risks can be seen that link together different disciplines such as climate change ("melting of ice sheets and glacial retreat"), health ("more diseases related to contact with sewage water"), critical infrastructure ("urban coastal areas

damaged"), or flooding ("city overwhelmed by flooding"). Therefore, effective mitigation of risk networks may require interdisciplinary working across the silos in the city in order to pool together different types of expertise. And thirdly, causal networks of risks can form vicious cycles where risks feed off themselves to escalate the impact of a scenario over time. These vicious cycles are of particular importance because they are notoriously misperceived (Diehl & Sterman, 1995; Sterman, 1989) and very difficult to manage. An example of a vicious cycle is shown in Figure 2: unhealthy air in the city means that fewer people use bicycles in the city, leading to growth in the use of cars and increases in pollution emissions, and so increases in unacceptable levels of air pollution, which reinforces unhealthy air in the city. The challenge is therefore that not only these kinds of vicious cycles can be difficult to identify, but their various elements need to be tackled with appropriate *portfolios* of mitigating actions (Weil & Dalton, 1992).

Insert Figure 2 about here

Developing risk scenarios in group workshops with cities

So far we have presented risk systemicity as a relevant approach to risk assessment in cities which involves exploiting multiple perspectives as well as learning about how risks interact with one another. We have also argued that casual mapping is a suitable method for exploring risk systemicity, and in this way risk can be viewed as i) complex hierarchies of ramifications, ii) requiring working across silos in order to be mitigated effectively, and iii) often forming self-reinforcing vicious cycles. We now introduce a systemic risk evaluation tool developed as part of the reported research. The purpose of the tool is to operationalize risk systemicity and facilitate discussion about risk systemicity in cities across professional silos. More specifically, the tool supports experts and generalists from different risk areas, who may not be working

together on a day-to-day basis, in risk assessment and negotiating an agreement on priorities about how to address the risk scenarios faced by a city.

The systemic risk evaluation tool was constructed over a period of two years, from close collaboration of the researchers working with representatives of seven European cities[2] who specialize in different risk areas. The three broad risk areas of particular interest to this research were social dynamics, climate change, and critical infrastructure. The initial empirical material to inform the construction of the tool was gathered during 3 one-day workshops with participants representing each of the involved cities (typically about 20 participants). The collected material was subsequently refined in the additional 2 workshops as the emerging scenarios were elaborated and checked, and 'tried and tested' mitigation strategies collected. The tool was then implemented, and further enhanced, in cities in a series of 11 engagement events.

The collection of empirical material in the workshops was conducted with the help of *Group Explorer*[3], a Group Support System equipped with a 'causal mapping' facility. The reason for selecting *Group Explorer* for conducting the workshops is that it has been used extensively and successfully, with a variety of organisations and distinct settings, to facilitate productive meetings when working with groups of practitioners (Ackermann & Eden, 2011a, 2011b; Paroutis et al., 2015). During the course of a workshop the facilitator encourages users to consider a number of questions with respect to the risks that cities face and how they interact with one another. Participants use individual laptops to communicate independently with a

[2] Participating cities involved: Rome, Italy; San Sebastian, Spain; Vejle, Denmark; Kristiansand, Norway; Glasgow and Bristol, UK; and Riga, Latvia.

[3] *Group Explorer* is a Group Support System (GSS): specially developed software and a networked computer system that facilitates high productivity in collecting multiple perspectives as a group perspective represented as a causal map. The system permits establishing the degree of consensus about view, identifying causal loops, and a variety of other supporting analyses. The software is in the public domain and is open source.

growing causal map projected on a screen seen by all participants. Participants enter their contributions in the form of short statements and/or causal links which connect previously added statements on the shared map. *Group Explorer* enabled participants to express their preference with respect to, for example, the significance of statements, and of scenarios, on the shared causal map by engaging in an electronic 'voting' exercise. This way participants could evaluate the 'risk significance', which refers to the intuitive perception of the risk by the experts (Han, Kim, Kim, & Jang, 2008).

The outcome of the workshops was a co-created and shared causal risk map which were subsequently 'tidied' (including validating some of the risk scenarios through published literature) and analysed by the researchers. The analytical functions of the mapping software were applied to identify key themes and patterns in the data, which included feedback loop analysis (identification of self-sustaining vicious cycles), cluster analysis (the software partitions the data into segments based on the density of causal links between statements), and analysis of centrality (identification of those statements which exercise the strongest influence in the map based on their causal links with the rest of the map). The analysis of the risk maps, involving identifying key risk scenarios that emerged from the interaction between risks contributed by the cities, and those risk scenarios encompassing numerous social issues in the city, such as health, critical infrastructure, or social alienation. The resulting risk scenarios, in turn, informed the construction of the systemic risk evaluation tool.

The systemic risk evaluation tool

The systemic risk evaluation tool was programmed in Excel, and it comprises of 10 risk topics[4]. Each topic is represented as a separate Excel tab and it comprises between 8 to 14 risk

[4] The 10 risk topics include: elderly population, social cohesion, social alienation, social inequalities, climate change – flooding, climate change – air pollution, health, community integration, public unrest, and critical infrastructure.

systemicity scenarios that describe a chain of events, some of which can form a vicious cycle. These scenarios were firstly selected by attention to vicious cycles, because these are least often perceived by managers, and secondly by attention to those regarded as of most importance to the cities participating in the project.

When using the tool, a group is asked to consider the likelihood of each scenario happening in their city by selecting from one of five responses: 'highly probable (to occur) >60%', 'probable/possible between 20-60%', 'improbable <20%', 'we don't know', or 'I don't know but someone else (e.g. in my organisation or project team) knows'. The 'don't know' answers recognize that there is an inherent risk in not knowing about the probability of a risk scenario occurring (Ward & Chapman, 2003). Thus, not only can the users express their judgment with regards to the probability of the scenario affecting their city, but they can also flag their lack of knowledge to assess the probability of the scenario occurring as a risk in itself.

Accounting for risk systemicity using sub-systems of connected risks means that the scenarios interact with one another, as well as some scenarios appearing in more than one topic. For example the risk scenario, titled 'healthcare under pressure' (shown in Figure 3) belongs to two topics: 'health' and 'elderly population'. However, upon assessing the scenario through one of the topics, all other instances of that same scenario will be completed automatically, and so recognizing interactions between the different topics. Some parts of scenarios are encompassed in different scenarios. The group can also disable all scenarios in a given topic, through an initial general question about the topic, which would mark all of the interacting scenarios within that topic as being improbable to occur. However, in order to ensure a thoughtful response to the general question about a topic, when a group chooses to disable a topic, the tool responds with further detail about the content of the topic to ensure that the user group are confident about their response.

As we suggested above, an important way of representing risk systemicity is to present scenarios in the form of vicious cycles. The scenario in Figure 3 presents a narrative in which the increase of aged peoples' health problems creates a city with a growing demand for social care and healthcare, which leads to healthcare services being under pressure, and so the quality of healthcare is reduced, which reinforces the initial trigger about the aged peoples' health problems. This scenario is presented, both in narrative form and as a diagram, as a self-reinforcing vicious cycle, where it can become more evident when displayed in the form of a picture (as shown in Figure 4).

Insert Figure 3 about here

Insert Figure 4 about here

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3. '*Talking*' about risky futures: implementing the systemic risk evaluation tool in cities

In the previous section we have characterized the notion of risky systemicity, and have described the construction of the systemic risk evaluation tool. We now discuss the implementation of the systemic risk evaluation tool in European cities which participated in the reported research. While doing so, we focus on the potential of this tool in promoting interdisciplinary talk across traditional silos in cities.

Implementing a 'boundary object' to support 'talking about risky futures'

The systemic risk evaluation tool was designed as a tool for facilitating group talk across silos rather than as a quantitative diagnostic tool. As we stated earlier, public sector managers are accustomed to thinking about individual risks that belonged only to their own jurisdiction –

and this was highlighted by our project participants. Hence, during the gradual co-creation of the tool, the developed features for the tool were oriented towards facilitating team and group conversations, rather than focussing on an individual use of the tool.

Therefore, the emphasis of the tool is on promoting *talk* across silos. We adopt a specific meaning of *talking* in our discussion, one in line with the 'knowing-in-practice' literature (Gherardi, 2000; Gherardi & Nicolini, 2000). As in Orr's (1996) popular book 'Talking About Machines', talking, thinking, and doing are not considered as separate activities, instead these activities manifest themselves in practice as practitioners mutually engage with one another. In addition, from a practitioner's perspective, talking represents the discourses which are characteristic to their local practitioner communities (Wenger, 1998; Wenger & Snyder, 2000). This means that in the context of risk systemicity, talking is a social and precipitative activity, and practitioners representing different local communities, that is organisational 'silos', seek to develop consensus and shared understanding across silos.

The systemic risk evaluation tool then serves its users as a 'boundary object' for group completion – an object that is "… shared and shareable across different problem solving contexts" (Carlile, 2002: 451; 2004) that are separated by epistemic boundaries. Such a boundary object serves "as a means of representing, learning about, and transforming knowledge to resolve the consequences that exist at a given boundary." According to Carlile (2002: 451-452), an effective boundary object: i) "establishes a shared syntax or language for individuals to represent their knowledge", ii) "provides a concrete means for individuals to specify and learn about their differences and dependencies across a given boundary", and iii) "facilitates a process where individuals can jointly transform their knowledge".

The conditions of effective boundary objects are met by the systemic risk evaluation tool in a number of ways. It offers content, in the form of risk scenarios, which gives a common point

of focus for experts from different areas so that they can engage in focussed conversations. Risk scenarios are helpful in this regard because chains of risks often cross different risk areas, such as health or critical infrastructure, and at the same time they visually demonstrate how those risk areas are interconnected. Therefore, as part of facilitated meetings, participants are supported in both talking and listening, and so it is easier for them to establish an intersubjective position on the risks in question as they come to appreciate one another's individual understandings (Eden, Jones, Sims, & Smithin, 1981). On this basis experts can negotiate collectively the course of action regarding the risky futures of the city; the risky futures being risk scenarios falling under the areas of climate change, critical infrastructure, and social dynamics. Consequently, the tool can be seen as a promising approach, in the context of public management, for operationalizing risk systemicity in cities by focussing on promoting talk.

Promoting 'talk', recording 'talk', and encouraging agreement

Due to the focus of the systemic risk evaluation tool on promoting talk, the tool has been tailored to support a format of a designed *focussed* conversation. As part of these facilitated conversations, interdisciplinary city groups are invited to engage in conversations about the risk scenarios which encompass risk systemicity, and the format of these sessions is explained in more detail in the next sub-section. We now describe the additional features which, throughout the reported research, have been included in the tool to support convening facilitated conversations.

One feature which was essential to include in the tool was an ability to take account of the group's own city context and to share perspectives across silos, in order to meet the conditions of effective 'boundary objects'. As part of the facilitated conversations it is therefore expected that users may express their differences in perspective: they may disagree with some aspects of the risks scenarios and explain the basis for their views. These debates can be gathered 'on

the hoof' through a facility in the tool to record and edit commentary for each scenario. Such commentary can be displayed on the public screen so that the whole group can talk about it, and subsequently it can serve as a useful take-away/'minutes' from the meeting. Users can also edit the text in the risk scenarios as long as the suggested changes remain in the 'spirit' of the original meaning of the scenario. Keeping the original meaning of the scenario is important because the meaning reflects the position of the scenario in the causal network of risk systemicity which affects the suggested priority of the scenario. Nonetheless, by amending the wording of the scenario but without changing its overall meaning, users can still make the scenarios more relevant to their cities' local contexts.

Another key consideration in programming the systemic risk evaluation tool was that all cities are resource constrained and so any risk assessment must help groups decide on the priorities for risk mitigation. This means that users are encouraged to decide as a group which risk scenarios need to be tackled as a matter of highest priority. In suggesting an initial view of priorities it was important to ensure that the priorities account for the systemic nature of risks – a group would not be able to evaluate the overall systemic consequences of any one scenario within a highly complex system of risks. Thus, in the systemic risk evaluation tool, suggested priorities are related to the extent of the ramified consequences of a scenario, where the overall causal risk map identifies all of the consequences from a specific scenario. In other words, the weight (or impact) of any particular risk scenario depends on how the scenario impacts other scenarios through its ramifications. Thus those risk scenarios which exercise a stronger role in reinforcing other risks are considered as having a higher priority than more 'isolated' scenarios. Similarly, when scenarios include vicious cycles they take on a higher relative priority because of the difficulties in mitigating such cycles.

Priorities allocated to the risk scenarios which participants have considered can be accessed by the group at any time during the course of working with the tool. While priorities are informed

by the scenarios' weights that reflect their potential impact, they are also relative to each other, and they are modified by the response of the group regarding how probable the occurrence of the scenario is in their city. This means that priorities are subject to continuous change as the group extend their assessment of the range of scenarios. These priorities are only suggestions for discussion, as the analysis which is the basis of the priorities is based on the risk causal map that emerged from working with the seven European cities and thus is not specific to their own city. Suggested priorities are expected to serve as a point of reference that can help the group negotiate appropriate courses of actions to address the risky future of their city.

In order to further support risk mitigation, the tool also offers possible portfolios of mitigating actions which the users can consider. This feature invites users to consider how they can tackle the risk scenarios of high priority to them. The risk mitigating actions are suggestions proposed by the participating cities in the research and are based on what they regard as 'tried and tested' actions and strategies, and the users can edit those suggested actions by making use of the commentary facility which is embedded in the tool (the users can copy-paste and edit the risk mitigating actions in the comment box). In this way the group may collectively discuss the introduction of additional risk mitigating actions which can be of most relevance to their cities.

Operationalizing risk systemicity group meetings

As part of the reported research, not only was the systemic risk evaluation tool co-created with city participants, but also a series of test sessions were organized to pilot the tool. In our discussion we report on the outcomes and the feedback received from a series of test sessions undertaken in various European cities[5]. In these sessions participants talked about the risky

[5] The test sessions took place in: Rome, Italy; Kristiansand, Norway; Glasgow and Bristol, UK; San Sebastian, Spain; and Thessaloniki, Greece. All test sessions took place between the autumn of year 2016 and the autumn of year 2017.

futures for their cities, and the risk scenarios embedded in the tool served to support talking across silos: "[the tool] made the group think; we should sit more often and talk together, cooperate better across NGOs"; "For the first time we are talking across our silos"; "Accentuated the silo mentality we are stuck in – we must get more of us across silos together and the [tool] will help us do this".

All of the test sessions followed a similar process. The systemic risk evaluation tool was projected on a public screen, and an interdisciplinary group, comprising 5-12 city and/or stakeholder (NGO) representatives, was seated in front of the screen. Given time constraints (typically a half-day) the group selected the topics they wished to cover which were of particular interest to them. The completion of topics was organized into three separate phases.

In the first phase, for each topic, the headline to the scenario was read out (such as 'healthcare under pressure' in Figure 3), then the picture of the scenario shown and the narrative of the risk scenario read out. Group discussion followed prompted by the request to consider the probability of the risk scenario happening in their city. Typically, the group engaged in debates about the significance of the scenarios from their individual perspectives, and they sometimes agreed to edit the scenario elements to make it more specific to the city in question. On other occasions, some members of the group might have stated that some parts of the scenario, or the whole scenario, was not of relevance to their city. The group then negotiated an agreement regarding their collective assessment of the scenario. Also, with the aid of the comment feature, summaries of conversations were recorded. Thus, the aim of this first phase was expected to help develop consensus, raise consciousness, and flush out different perspectives on risk assessment and resilience.

In the second phase, the group investigated the suggested priority ranking for all of the completed scenarios across all topics. Participants then discussed the priority suggestions, and,

in case of a disagreement, they recorded their own negotiated priority rankings. And in the third phase, the group considered the available risk mitigating actions for the scenarios agreed as being of high priority.

4. The outcomes of operationalizing the systemic risk evaluation tool in cities

Towards overcoming the challenge of talking across silos

The test sessions of the systemic risk evaluation tool evidenced that the tool was particularly suitable for promoting talk about risk systemicity in cities. Perhaps most importantly, through clear presentation of the interdisciplinary nature of risk chains and vicious cycles, the tool helped experts to talk together in a *focussed* manner and *collaborate* on the basis of their perspectives rather than as contrary conclusions. In other words, experts were able to identify common ground, concretized in the form of different aspects of risk scenarios, which they could only tackle by talking and working together: "We managed to get good agreement about where the big risks were"; "We were able to unpick messy problems". Disagreement incentivized the group to develop more relevant, and accurate, scenarios to their local contexts. As a result, the tool supported participants in recognizing and working with the reality of complex cities where the efforts of different agents needed to be orchestrated to succeed in their preparations against interdependent risks: "the tool promotes a focused discussion that draws on the mixed experiences and expertise in a group".

Furthermore, there was a strong pattern in the received feedback that risk systemicity is a new perspective for cities and could be very important for effective risk assessment. Participants noted that risk systemicity was a complex concept, and its operationalization in the form of the tool made this perspective significantly easier for them to understand. They particularly noted how the tool uniquely forced them out of their 'silos'. When talking about risk systemicity, risk mitigating actions and priorities inevitably had to be discussed in relation to complex, dynamic

networks of risks, rather than be seen as being independent from one another. This helped participants to practically evaluate which parts of the networks of risks needed to be addressed by them as a matter of priority, and how appropriate risk mitigation can be achieved in the context of the systemic nature of risks.

And finally, talking about risk systemicity revealed that silo working in cities poses a very difficult challenge with respect to risk assessment and mitigation: "We've now met 3 times and the process is focusing discussion and revealing the silo based nature of our city organisation. The issue of the nature of our city governance has consistently been revealed." When different key departments and organizations work separately and do not communicate, they are unable to address the systemic nature of risks because their expertise is likely to be limited to dealing with only some areas of risk networks. At the same time, as evidenced in the literature (Contu, 2013; Mørk, Hoholm, Maaninen-Olsson, & Aanestad, 2012), it is typically not easy for experts from different knowledge domains to talk and work together. Thus the systemic risk evaluation tool, seen as a boundary object (Nicolini, Mengis, & Swan, 2012), was understood by participants as useful for supporting cities in talking across the traditional silos.

Addressing the practice view of silo working in the context of risk systemicity

One reason why the systemic risk evaluation tool was useful in addressing the problem of silo working in cities was because it made talking across silos seen as an 'everyday activity'. 'Talking' in this sense is considered as 'doing' because it entails addressing the future of the city, and cooperation of a number of silos in order to prioritize and mitigate the risks. Although it is recommended by the research and practice of public management to bring people across silos to work together (100 Resilient Cities, 2016), it is not easy to establish a specific task focus for the cross-silo groups as an everyday activity.

In this paper, we draw on the established 'knowing-in-practice' literature as a way of conceptualizing silo working when talking about risk assessment. Practice studies are widely recognized as having strong presence in management and organisation research (Corradi, Gherardi, & Verzelloni, 2010; Easterby-Smith, Crossan, & Nicolini, 2000). In principle, practice research aims to explore what practitioners *do* as part of their everyday work in organisations. Practice, in this sense, is essentially social, dependent on local context, and enacted historically through people's actions as part of which thinking and doing are not separate (Gherardi, 2000; Gherardi, Nicolini, & Odella, 1998).

Practice researchers tend to sensitize their attention to the subtle details of human work 'in practice', and they appreciate that everyday activities at work gradually lend themselves into broader social structures which become inevitably different than the sum of the activities that have originally enacted them (Brown & Duguid, 1991; Jarzabkowski, 2004; Nicolini, 2011). In other words, local practice is brought to life by practitioners, but practice starts to 'live its own life' in the social context which has its own history lived by its former and present members (Orr, 1996; Thompson, 2005). The implications of this view entails a more complex understanding of human work, where, for example, knowledge cannot be transferred between various contexts in a non-problematic way (Kuhn & Jackson, 2008; Pyrko, Dörfler, & Eden, 2017), the relationship between practices and organisations resembles more of a two-way road rather than a top-down 'command-and-control' pyramid (Tsoukas, 2017; Waring & Currie, 2009), and the artefacts (the tools, such as that presented in this paper) gain idiosyncratic meaning developed in practice and are not simply implemented in a detached manner (Nicolini et al., 2012; Orlikowski, 2000).

Because the tool addresses the systemicity of risk, the evaluation of the scenarios demanded that knowledge was transferred between different disciplines but within the context of a scenario. For example, as part of this research, in the facilitated session in one of the large

cities, there were 20 participants including experts in water, electricity, local protection services, social assistance, and healthcare. Meanwhile in a workshop in one of the small cities there was a mixed group of 11 participants from different organisations with a strong body of experience related to flooding and water supply, as well as a fire officer. In each of those workshops, participants stated that "much discussion was promoted that crossed silos". The interactivity of the tool, and the risk scenarios which spanned across different disciplines' boundaries, helped participants to 'think together' about the real-life problems (risks) which they all cared about (Pyrko et al., 2017). Thereby the systemic risk evaluation tool, as an interactive boundary object, supported practitioners in gradually sharing knowledge across silos through talk. In addition, the tool did not impose a linear path in its completion, and therefore it was the participants who were in control with respect to which scenarios to complete, what content to edit, and which risk mitigating actions to consider as a group. As a result, participants were empowered as part of the process, and they had an opportunity to engage with the matter of risk systemicity in a social and bottom-up manner. As commented by the participants in one city, "the tool helped to make the discussions about risk systemicity easy by promoting discussion about vicious cycles and risk interdependencies in an accessible way".

In addition, from the practice perspective there can be seen a tension with respect to the claims that risk assessment in cities should entail increased collaboration between the various stakeholders in order to dissolve epistemic boundaries which are formed by the silos (100 Resilient Cities, 2016). The reason for this tension is that participation and non-participation are two sides of the same coin (Wenger, 1998). Intensive, regular participation in practice inevitably leads to the formation, at least to some extent, of silos. From the practice perspective, it is not possible that everyone engages with everyone, because participation in practice is demanding in time, effort, and it also importantly entails an investment of identity on behalf of

an individual. In other words, participation in one practice means that practitioners will have to spend less time on engaging with other practices. This means that the problem of silos can be seen as a problem of targeting the right people with the right kinds of problems that are vital to the organisation. It is then essential to appropriately prioritise the problems (risks) so that practitioners can invest their energy, effort, resources, and emotions in problems that really matter to them and to the city.

The importance of the prioritization of experts' participation was reflected in use of the systemic risk evaluation tool. The tool enabled groups to prioritize risks in a way which accounts for the interdependencies between risks. Because of this, use of the tool can lead to a better understanding of those risk areas, possibly at the boundaries of different disciplines, where different local professional communities are recommended to invest their commitment into working together. From the long-term perspective it is unlikely that the original silos would cease to exist this way, but systemic risk assessment can give life to new forms of peoples' mutual engagement with respect to the areas within risk networks which are of highest priority for the city. Careful prioritization of experts' participation also means that the time and effort spent during the meetings dedicated to risk assessment in cities has to be productive.

According to participants from our test sessions, the proposed tool allowed them to focus as a group on real-life problems and achieve significant results in terms of improved shared understanding in a relative short amount of time. For example, participants appreciated the 'actionable' nature of the tool as it helped them to understand better what mitigating actions they can take in relation to the risk areas of high priority. Moreover, participants from one city commented: "At some stage we are hoping to engage city councillors in a workshop using the systemic risk evaluation tool as the basis for discussion and to get councillors aware of potential risk scenarios as well as their views about which we should be doing something about."

And finally, managers may be interested in attempting to 'build bridges' and facilitate interdisciplinary conversations across different communities so that those communities can learn from one another. Problems of interdisciplinary nature are likely to require the cultivation of good conversations between practitioners representing different domains of expertise (Hibbert, Siedlok, & Beech, 2016; Siedlok, Hibbert, & Sillince, 2015). This can include trying to help to increase the communities' awareness of other relevant communities from which organisational 'silos' could learn from valuable insights (McDermott & Archibald, 2010; Wenger, McDermott, & Snyder, 2002). However, similar interventions need to give voice to the practitioners and they cannot be mandated in a top-down manner as otherwise the self-governed communities can resist them (Addicott, McGivern, & Ferlie, 2006; Currie & Suhomlinova, 2006; Swan, Scarbrough, & Robertson, 2002; Waring & Currie, 2009). The systemic risk evaluation tool was specifically intended to allow the interdisciplinary city groups an opportunity to voice their concerns and opinions about good ways for a city to find its way through the networks of risks, and to address those risks appropriately.

Challenges and limitations in the implementation of the systemic risk evaluation tool

Based on the participants' feedback from the workshops, there was observed a number of limitations of the tool. As the tool was intended to be used with a variety of cities, one of the main challenges was in designing a 'generic tool' which was not designed focussing on any particular city. Consequently, the risk scenarios had to be relatively generic so that they apply to a wide range of cities. The achievement of a good balance between the 'generic' and the 'specific' character of risk scenarios was made through facilitated trials, which involved numerous iterations and changes to the wording of scenarios based on city representatives' advice. In addition, the comment box and the ability to edit the wording of the scenarios allows participants a degree of customization of the content of the tool to their cities' particular situations.

Another challenge was the validation of risk scenarios which was ensured in a number of ways. Firstly, many of the city participants in the initial data collection workshops were subject experts in the three broad risk areas of interest, that is climate change, social dynamics, and critical infrastructure, and therefore they validated the gathered material 'on the hoof' during the sessions. Secondly, the researchers validated the risk scenarios during the analysis of the gathered empirical by drawing on the academic literature and relevant government reports, and by 'tidying' the initial, messy causal maps. And thirdly, the risk scenarios included in the tool were validated during the numerous tool implementation sessions in European cities reported in this article, which gave city representatives to opportunity to provide feedback on the suitability of the scenarios. This way care was taken that the risk scenarios accounted both for the city experts' opinions and the secondary literature.

5. Conclusion

Contemporary cities face many risks of different kinds. What makes risk assessment even more demanding is that risks form complex networks of interdependencies which may not be easy to identify. At the same time, cities have finite resources and so that they cannot deal with all the risks that they face, which means that they need to be able to prioritize their risks within the broad networks of interacting risks. Hence, it has been argued in this article that risk systemicity, through its attention to the interactions between risks, is a suitable perspective for improving risk assessment in cities. Risk systemicity is also important when considering mitigation actions as mitigating against individual risks may mean transferring the issue elsewhere in the city. Decision makers need to understand the consequences of the risks and their mitigation actions across the city. They therefore need to understand other aspects of the city beyond those within their own experiences and thus need to appreciate, and discuss, the experience of others within other parts of the city.

However, as voiced by city participants in this research, risk systemicity, due to its complexity, is not easy for city managers to address. In addition to this, building on the 'knowing-in-practice' literature, talking across epistemic boundaries tends to be highly demanding for practitioners and knowledge cannot be transferred across silos in a non-problematic way. In order to address the challenge of talking about risk systemicity, in the reported research a systemic risk assessment tool, which serves as a 'boundary object', has been developed. This tool aims to support cities in inter-departmental collaboration by taking risk systemicity as the main point of reference. Considering the interdependence of a wide range of risks through consideration of multiple perspectives, increases inter-departmental collaboration, thus building bridges across silos, and cities can become better prepared to deal with risks which they are likely to be facing.

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Figures

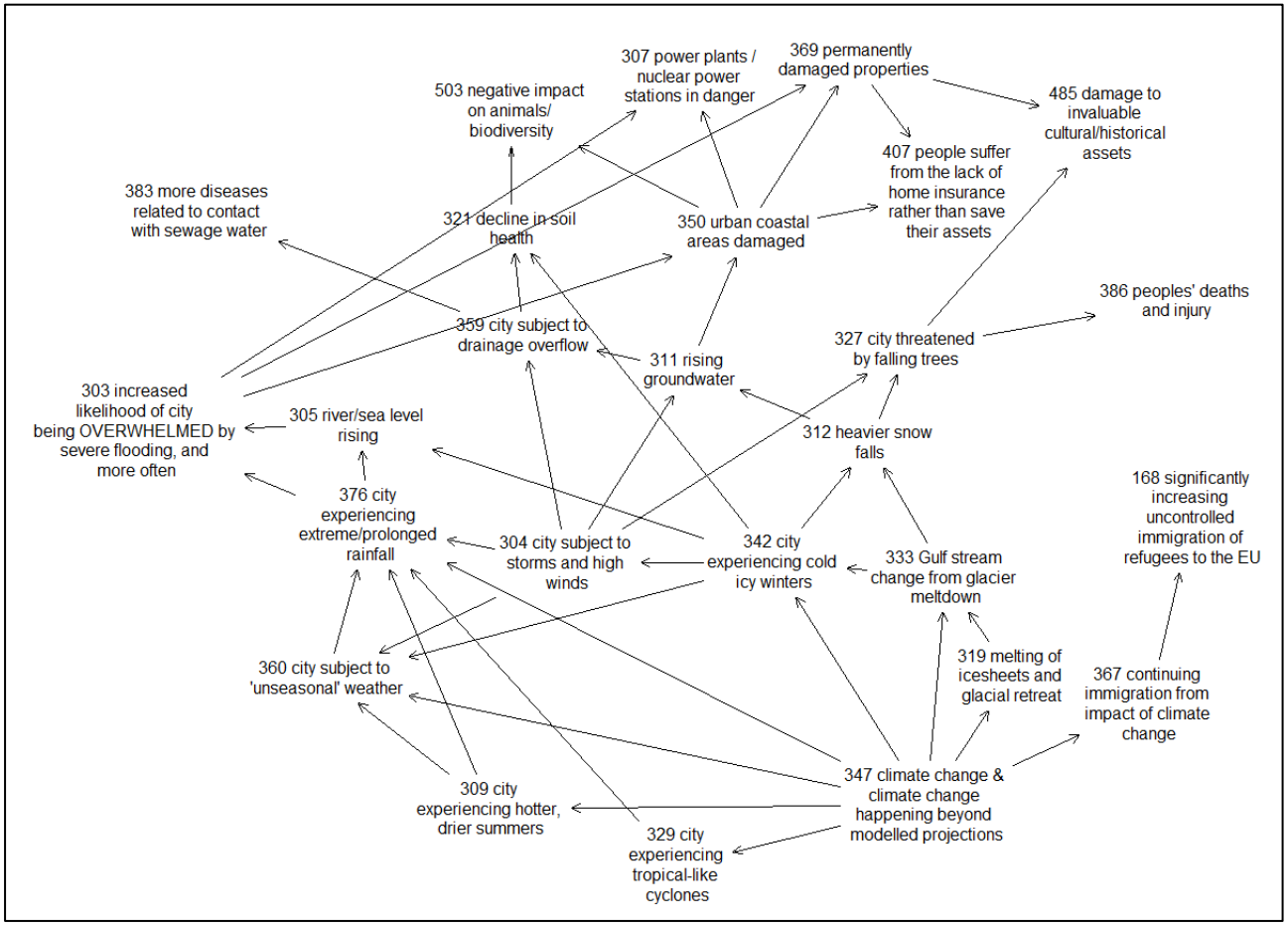

Figure 1: A segment of a causal map co-created by city participants

**Numbers before statements signify the order in which the statements were added on the map. Links signify 'may lead to' relationships.*

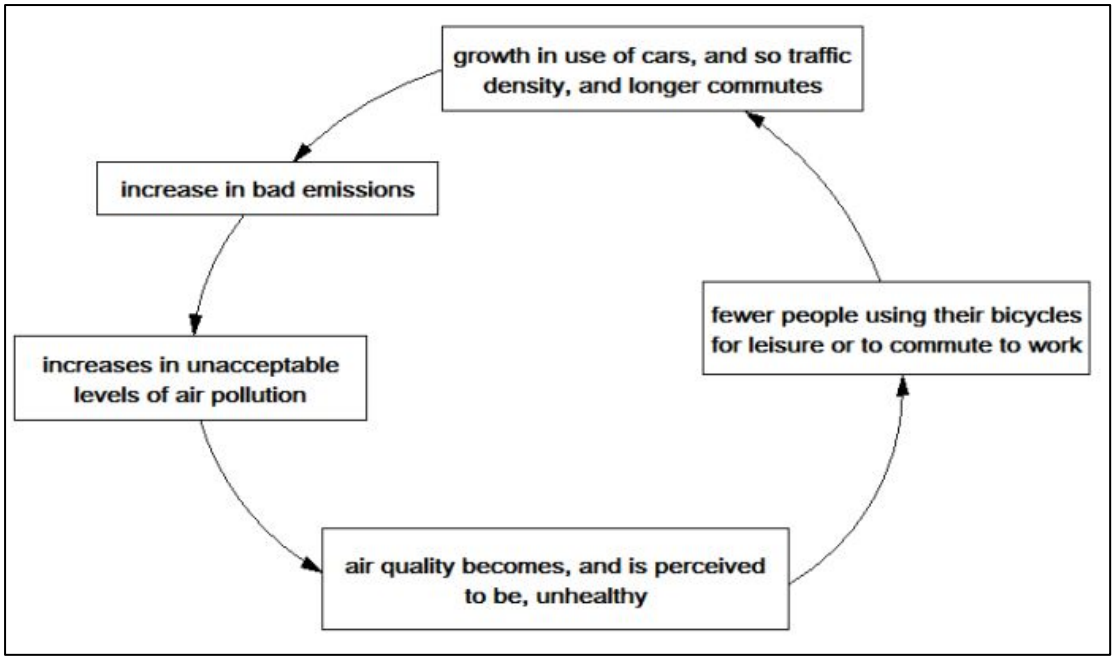

Figure 2: An example of a vicious cycle derived from mapping of risk systemicity in cities

Scenario 9: "HEALTHCARE UNDER PRESSURE" - vicious cycle				
overall increase of the aged peoples' health problems creates a city faced with a significantly growing demand for social care and healthcare and so healthcare services are under increasing pressure causing the quality of healthcare reduced which REINFORCES overall increase of the aged peoples' health problems			View as picture Comment Go to comments records	
HOW LIKELY DO YOU THINK THIS SCENARIO WILL DEVELOP IN YOUR CITY/REGION?				
Highly probable	**Probable/Possible**	**Improbable**	**We don't know**	**I don't know - someone else does**

Figure 3: A risk systemicity scenario in the text format

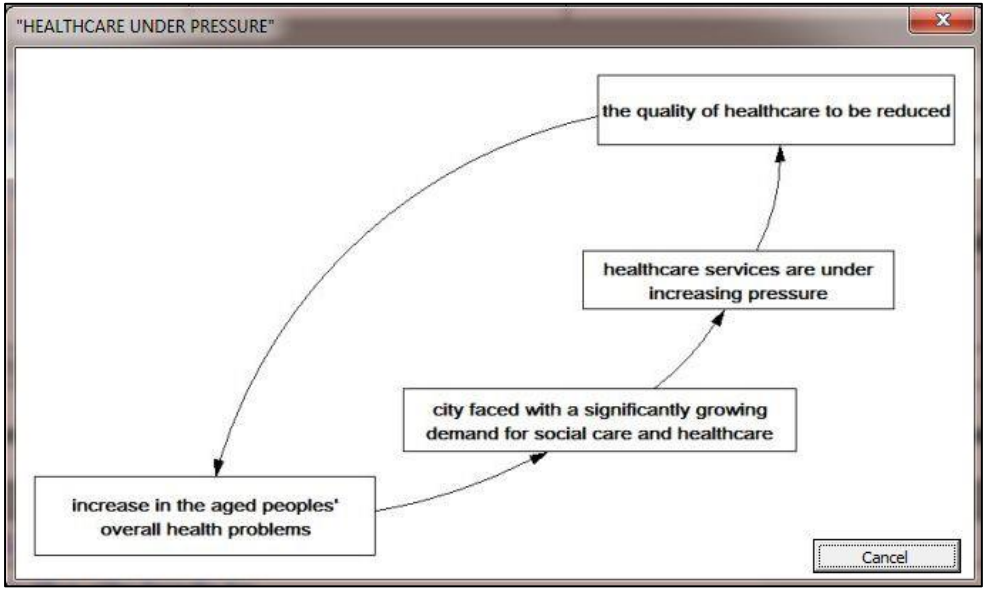

Figure 4: A risk systemicity scenario in the picture format