

BRG REPORT

Preparing for Disasters in Global Cities: An International Comparison

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ABSTRACT

Today, the majority of the globe's inhabitants live in urban areas. According to all forecasts cities will continue to grow in the coming decades. At the same time, cities have become increasingly connected as a result of economic, political and cultural globalization. In the context of urban security, the growing complexity these connections bring may present a double-edged sword: cities can be both the most secure, or most dangerous places when disaster strikes. The very characteristics of urban life – such as population concentrations, compact architectural structures, diverse socio-demographics, as well as complex, interconnected infrastructure systems – present both challenges and opportunities in terms of managing disasters in cities.

This research report aims to illustrate current trends in research and practice concerning the management of disasters in cities around the world. In the first part of the study, we discuss conceptual trends in disaster research and related disciplines, based on a desktop analysis. Thereafter, in the empirical part of the study, we examine how the practices of disaster management are organized in different cities. For the empirical analysis, semi-structured interviews with city disaster management officials from eight global cities were conducted. City officials from Los Angeles, London, Sydney, Rotterdam, Vienna, Frankfurt, Hamburg and Singapore were willing to detail how risk assessments are conducted in their cities, how countermeasures are organized and in what ways they collaborate with other actors. Moreover, interviewees gave revealing insights into what changes have taken place in disaster management in recent years, including where they see the top priorities for safeguarding urban security in the future.

The research highlighted several notable trends. Above all, modern disaster planning is increasingly characterized by the need to adapt to uncertainty and unpredictability. As it is generally acknowledged that complex crises can never be prevented completely, social resilience becomes a major concern in urban disaster management. As a consequence, flexible strategies to cope with unpredicted disasters are gaining ground in many cities. In this context, government actors are taking on new roles in the planning and management of disasters in cities. Coordinating the myriad of actors involved in urban security becomes a key task for city disaster management officials. Moreover, cities are exploring the opportunities presented by new disaster communication technologies, and are specifically developing ways to target disaster preparedness information at vulnerable sub-populations within their cities. Finally, in order to address risk from complex crises, disaster management agencies and institutions are increasingly thinking beyond traditional jurisdictions or borders. At the same time our findings show that urban security practice, risk management processes and policies typically reflect the geographical, political and social contexts of each city, as well as the past experiences of the cities' risk management agencies. Based on these trends, we discuss implications for disaster management in Swiss cities.

ZUSAMMENFASSUNG UND SCHLUSSFOLGERUNGEN

Die Mehrheit der Weltbevölkerung lebt bereits heute in Städten. Alle Prognosen deuten darauf hin, dass urbane Siedlungen in den nächsten Jahrzehnten weiterwachsen werden. Gleichzeitig führt die Globalisierung von Wirtschaft, Politik und Kultur zu einer immer engeren Vernetzung urbaner Systeme. Für die Sicherheit von urbanen Räumen stellt die aus dieser Vernetzung resultierende Komplexität ein zweiseitiges Schwert dar. Zwar bieten Städte in vielen Fällen ein ausserordentliches Schutzniveau für die dort lebenden Menschen. Städte können bei Katastrophenereignissen aber auch besonders verletzlich sein. Alle zentralen Merkmale urbanen Lebens – angefangen von der hohen Einwohnerdichte und der spezifischen städtischen Architektur, über die häufig heterogene sozio-demographische Zusammensetzung, bis hin zu den komplexen Infrastruktursystemen moderner Städte – stellen zugleich Risiken und Chancen für den Umgang mit Katastrophenereignissen im urbanen Umfeld dar.

Ziel der vorliegenden Studie ist es, einen Überblick über gegenwärtige Trends zu Fragen urbaner Sicherheit (sowohl in der Forschung) als auch in der Praxis des städtischen Katastrophenmanagements zu bieten. Im ersten Teil der Untersuchung werden zunächst auf Grundlage einer Sekundäranalyse konzeptionelle Entwicklungen in der Katastrophenforschung und angrenzenden Disziplinen dargestellt. Anschliessend wird im empirischen Teil der Studie betrachtet, wie Katastrophenmanagement in verschiedenen Städten gegenwärtig praktisch umgesetzt wird. Für die empirische Untersuchung wurden semi-strukturierte Interviews mit Verantwortlichen im Katastrophenschutz aus acht unterschiedlichen Städten durchgeführt. Behördenvertreter aus Los Angeles, London, Sydney, Rotterdam, Wien, Frankfurt am Main, Hamburg und Singapur gaben Auskunft

darüber, wie in ihren Städten Risikobewertungen vorgenommen und Gegenmassnahmen organisiert werden; welche Veränderungen es in den letzten Jahren gegeben hat; und in welchen Bereichen für sie die künftigen Schwerpunkte zur Wahrung der urbanen Sicherheit liegen.

Die Ergebnisse der Untersuchung lassen einige zentrale Entwicklungen erkennen: Zunächst lässt sich beobachten, dass die Katastrophenschutzplanung in den untersuchten Städten zunehmend von der Notwendigkeit gekennzeichnet ist, sich an unsichere und unvorhersehbare Kontexte anzupassen. Folglich gewinnen flexible Strategien zum Umgang mit unvorhergesehenen Katastrophen und zur Steigerung gesellschaftlicher Resilienz an Bedeutung. Im Zuge dieser Entwicklungen wandelt sich zusehends die Rolle von staatlichen Akteuren im Umgang mit Katastrophenereignissen. Immer größere Bedeutung im städtischen Katastrophenmanagement bekommt die Koordination der unterschiedlichen staatlichen, privaten und gesellschaftlichen Akteure. Zudem erschliessen viele Behörden die Möglichkeiten, die sich durch den Einsatz neuer Kommunikationstechnologien ergeben, unter anderem um Informationen zur Katastrophenprävention und –vorsorge an besonders gefährdete Bevölkerungsgruppen zu vermitteln. Um urbane Risiken frühzeitig zu begegnen, werden in der Praxis des urbanen Katastrophenschutzes Fach- und Landesgrenzen immer stärker überschritten. Gleichzeitig zeigen die Ergebnisse aber auch, dass die Praxis des urbanen Katastrophenschutzes in erster Linie die jeweiligen geografischen, politischen und sozialen Kontexte der einzelnen Städte widerspiegelt. Strategien zum Umgang mit urbanen Risiken entwickeln sich jeweils spezifisch auf der Grundlage von historischen Erfahrungen mit Katastrophenereignissen.

Ausgehend von dieser Analyse werden Implikationen für den Katastrophenschutz in der Schweiz diskutiert. Nicht nur weil der Grossteil der Landesbevölkerung in urbanen Räumen lebt, ist das Thema urbane Sicherheit von zunehmend zentraler Bedeutung für den Katastrophenschutz in der Schweiz. Auch hat die Komplexität schweizer Städte mit der wachsenden lokalen, nationalen und internationalen Vernetzung von Wirtschaftsunternehmen, Infrastrukturen und Kommunikationskanälen in den letzten Jahren stark zugenommen. Um der wachsenden Komplexität urbanen Lebens im Katastrophenschutz Rechnung zu tragen und etwaige Vervundbarkeiten zu reduzieren, gilt es, alle Elemente des städtischen Katastrophenschutzes in der Schweiz, von der Risikobewertung bis zur Katastrophenbewältigung, zu überprüfen und gegebenenfalls an den sich wandelnden Handlungskontext anzupassen. Aufbauend auf der Analyse aktueller Forschungstrends sowie der Katastrophenschutz-Praxis in unterschiedlichen Weltregionen lassen sich fünf zentrale Handlungsfelder für den urbanen Katastrophenschutz in der Schweiz identifizieren:

1. Eine zentrale Herausforderung für den Bevölkerungsschutz in der Schweiz besteht darin, trotz der Seltenheit großer Schadensereignisse in der jüngeren Vergangenheit, mögliche Gefahrenlagen für Schweizer Städte zu erkennen und Vorkehrungen zu treffen. Insbesondere komplexe Krisensituationen, in denen mehrere Schadensereignisse zusammenfallen oder einander auslösen, und dann sektoren- und gebietsübergreifend wirken, lassen sich mit herkömmlichen Risikobewertungsmechanismen kaum erkennen. Daher erscheint es als richtig, die bereits stattfindende **Integration von Risikoerkennungs- und Bewertungsmechanismen** im Schweizer Bevölkerungsschutz fortzusetzen und dabei urbanen Risiken besondere Aufmerksamkeit zu schenken.

2. Gleichzeitig lassen sich auch bei einer weiteren Verbesserung der Gefahrenfrüherkennung Katastrophenereignisse, die Schweizer Städte treffen können, auch zukünftig nicht vollständig vorhersagen, geschweige denn verhindern. Im Gegenteil muss davon ausgegangen werden, dass trotz der Verbesserung der Prognoseprozesse die Vorhersagbarkeit zukünftiger Katastrophen in Schweizer Städten eher abnehmen wird. Auf der anderen Seite ist eine Aufwertung der (bereits sehr gut ausgebauten) Kapazitäten in der Katastrophenbewältigung in der Schweiz nur mit sehr grossem Aufwand und abnehmendem Mehrwert möglich. Eine interessante Alternative bildet hier eine **Schwerpunktlegung des Krisenmanagements auf die Wiederherstellungsphase** nach Grossschadensereignissen, wie sie häufig in der Literatur zu systemischer Resilienz nahegelegt wird. Eine Verstärkung der Massnahmen in diesem Feld kann im Ereignisfall die Auswirkungen einer Krise auf Schweizer Städte lindern und die Rückkehr zur Normalität beschleunigen

3. Wie in vielen anderen Ländern sind auch in der Schweiz eine Vielzahl politischer Akteure auf unterschiedlichen administrativen Ebenen in der Katastrophenschutzplanung und Katastrophenbewältigung für urbane Räume involviert. Mit der Strategie Bevölkerungsschutz und Zivilschutz 2015+ besteht bereits ein tragfähiger Rahmen, um eine effektive Zusammenarbeit der unterschiedlichen Beteiligten zu ermöglichen. Entscheidend für die Sicherheit urbaner Räume in der Schweiz ist es nun, diesen Rahmen durch **themenspezifische Kooperationen** auszufüllen.

4. Zahlreiche der von uns untersuchten Städte haben die Möglichkeiten erkannt, die die Einbindung neuer Informations- und Kommunikationstechnologien für das urbane Katastrophenmanagement bieten. Anwendungsfelder sind u.a. die öffentliche Behördenkommunikation im Krisenfall, die behördliche Lagebeurteilung sowie die langfristige, dialogische

Kommunikation zwischen Behörden und der städtischen Bevölkerung. Aufbauend auf diesen überwiegend positiven Erfahrungen ist zu erwarten, dass eine verstärkte Nutzung technologischer Innovationen einen positiven Beitrag zur urbanen Sicherheit in der Schweiz leisten kann.

5. Wie die Praxis des städtischen Katastrophenschutzes immer wieder vor Augen führt, lassen sich Zeitpunkt, Ausmass und Ausgestalt von Katastropheneignissen nie vollständig vorhersagen. Gleichzeitig zeigt die Erfahrung aber auch, dass Schadensereignisse häufig einzelne, oft deprivilegierte Subpopulationen (bspw. Immigranten, alte Menschen) übermässig stark treffen. Aus diesem Grund bildet langfristig die **Reduzierung der Verletzlichkeit urbaner Subpopulationen** einen erfolgsversprechenden Ansatz, um die Konsequenzen von Schadensereignissen auf urbane Systeme zu mildern. Zentral ist hierbei, dass solche zielgruppenorientierten Massnahmen die Bedürfnisse, Ängste und Wünsche der Betroffenen einbeziehen und ihnen Möglichkeiten zur Selbsthilfe eröffnen. Vor diesem Hintergrund wäre ein verstärkter Dialog mit unterschiedlichen gesellschaftlichen Gruppen in Schweizer Städten zu Themen sozialer und individueller Sicherheit begrüssenswert.

EXECUTIVE SUMMARY

Globalization has connected cities like never before. Such connectivity yields benefits for the inhabitants of large urban areas, but also brings challenges for city officials to manage the delivery of critical services, which are increasingly distributed, and non-geographic in nature (internet, telecommunications, energy provision, *etc.*). In the context of urban security and disaster, globalization may present a double-edged sword for city managers and inhabitants alike. On the one hand, the characteristics of the modern city, like high population concentrations, places of assembly, compact architectural structures, and complex, interconnected infrastructure systems might increase the vulnerability of the city to disaster or security disruptions. On the other hand, most urban environments offer considerable strengths in terms of economic production and distribution, human resources, civil society and the availability of services, which can all be used to significantly reduce disaster risk and vulnerability.

The general trends in disaster management in cities around the world that were identified in this research project can be summarized in three points:

- ◆ Cities face many and varied risks, and risk management processes, practices and policies reflect the context and experience of the cities' risk management agencies. 'Command and control' attitudes to risk management are diminishing as risk managers face ever more complex, severe or frequent incidents that highlight their growing incapacity to deal with these situations on their own. An increased focus on resilience and community preparedness for potential risks that may negatively impact urban security largely reflects the realization that dealing with disasters is a shared responsibility between governments, the private sector and civil society. In addition, disaster response legislation is slowly changing to accommodate the current risk environment (characterized by disasters like terrorism, pandemics and cyber attacks, for example), the nature of which may have caused some of the existing legislative structure to have become obsolete.
- ◆ Disaster management agencies have changed in recent history, and disaster legislation has also changed. Disaster or risk management processes or components were historically separated between a range of disjointed organizations or institutions, with distinct responsibilities in the disaster management chain of command. However, a new trend in disaster management is towards extensive institutional collaboration between local, regional, national and even international disaster management players. Like the legislative changes, the move to greater horizontal and vertical integration of disaster management processes and institutions reflects both the growing complexity of the city system, and the changing nature of the risk environment in which the city exists (increased severity, frequency and complexity of disruptions or disasters).
- ◆ While disaster management practices still predominantly evolve on the basis of path dependency (experience and lessons learned), moves to become more proactive and systematic about the identification and management of risk are becoming increasingly obvious. To this end established quantitative risk assessment procedures are increasingly complemented with semi-qualitative methods like horizon scanning and scenario exercises to anticipate new risks and institute proactive mechanisms to deal with these risks

well before their potential threat might be realized in a disaster event. In many instances, risk assessment techniques are developed in a strategic manner at central or federal administrative levels of government, and then delivered regionally or locally. In addition, city officials are looking beyond national borders to explore how other countries deal with both known and emerging types of risks, and developing collaborative means to share knowledge and skills.

1 INTRODUCTION

Urban security is a growing issue in the world's cities, both because the global population is already predominantly located in cities, and because the continued growth of urban populations will increase the ultimate consequences of disasters that might affect cities in the future. The combination of population growth, the nature of technical systems in cities, and predictions of more frequent and severe disasters will have significant implications for the vulnerability of cities. Therefore, developing appropriate mechanisms to plan for and manage disasters and disruptive events in cities will, in the future, be a key aspect of urban security.

This research report aims to illustrate current trends in research and practice concerning the management of disasters in cities around the world. The report particularly focuses on understanding cities' contemporary approaches to risk management, exploring aspects of disaster preparedness and risk assessment, response and countermeasures, and the institutions and collaboration involved in current processes of disaster risk management. Beside this analysis of the status quo in cities in different world regions, we draw on a strong examination of the trends in disaster research to also explore how new approaches to risk management are developing or evolving and what cues are triggering change in practice at the city level. The report is explorative in nature and therefore does not aim to assess or compare the quality of the various practices in cities under study. Rather, it is drawing on the variety of strategies, techniques and structural arrangements observed to illustrate and highlight how practices can (and must) suit the context and circumstances in which they are deployed.

This 'Preparing for Disasters in Global Cities' study complements research commissioned by the Association of Swiss Cities (*Schweizerischer Städteverband, SSV*) to examine future trends and scenarios relating to the urban security situation in Swiss cities to 2025. Entitled 'Safe Swiss Cities 2025', the SSV project seeks to inform Swiss urban municipality officials with an overview of changes, developments and challenges that are likely to influence urban safety in Switzerland in the next 10 to 20 years. By relying on a much broader examination of security and disaster preparedness in global cities, this CSS study complements the 'Safe Swiss Cities 2025' project with a global perspective. This wide geographical scope allows a consideration of developments that Switzerland has previously not experienced, but also of those that could materialize in the future. The reflection on global patterns in risk management and disaster preparedness may have fruitful implications for future Swiss urban security and disaster preparedness policy developments.

1.1 Context and Relevance

This study is commissioned by the Swiss Federal Office for Civil Protection (*Bundesamt für Bevölkerungsschutz*). While global in extent, the sample of the study is delimited to cities in high-developed countries. While much can be learned from developing country cities, some of which probably have more developed response mechanisms to disaster than some of the cities included in this study, these were considered too fundamentally different from cities in Switzerland to make any comparison justifiable or useful.

While Swiss cities are not comparable in size (population or area) to those included in this study, the

population density of Zürich (4'092 people/km²) and Geneva (12'076 people/km²) is comparable to many of the cities included (for example, Sydney: 2058/km²; London: 5206/km²; Los Angeles: 8092/km²; Hamburg: 2400/km²; Frankfurt: 2785/km²). Yet even so, size does not influence connectivity and interdependence, and based on the assumption that complexity is also a major challenge of future disaster management in Swiss cities, we argue that important lessons can be learned from examining other global cities, many of which are already instituting mechanisms to cope with extremely high levels of complexity. Moreover, many of the processes and practices that larger global cities deploy in order to prepare their systems and inhabitants for disaster are also applicable in smaller cities. Indeed, whether home to ~400,000 (Zürich) inhabitants or ~13 million (Los Angeles metro region), disaster response processes and practices remain similar (with appropriate up or down scaling). Ultimately, Swiss cities are connected to the world, and face many of the same risks and threats as are dealt with in other cities around the world. Learning from experience, whether your own or someone else's, remains a powerful developmental imperative.

Studies such as this provide important documentation of the dynamic nature of urban risk management that can assist professionals involved in disaster planning and response to adapt to this dynamism. Processes and practices change constantly in response to events, through experience and personnel change, and in response to changes in the risk environment. At the same time as the socio-technical complexity of urban spaces is increasing, the risks that these systems face are changing. Risk managers appreciate that the risk 'playing field' changes, and a proactive stance that permits managers to stay ahead of the risk ball-game is essential, even for a country like Switzerland where disaster is an uncommon concern for the general populace.

1.2 Aim

The report describes the recent trends in disaster research and practice in the context of global cities. We use interviews with city disaster management officials to illustrate the latest planning and coping strategies, and particularly those pertinent to Switzerland. Since our aim is to identify alternative approaches and practices towards urban security in the context of disaster, we do not provide an in-depth comparison between the different cities we examined. Instead, we use the empirical findings from the different cities in our sample to outline alternative ways to cope with potential disasters in urban space, connecting practices with particular risks or city circumstances and contexts.

1.3 Methodology

The study is divided into two main parts: 1) theoretical background to disaster management in cities and analysis of new trends; 2) empirical examination to explore current practices and process in city disaster risk management around the world. The first part was undertaken as an extensive review of academic as well policy-oriented literature to provide a comprehensive background to the empirical component. The literature review focused on exploring disaster management and urban security research and trends in global cities (defined in chapter 2).

The empirical part consisted of three steps. Firstly, in discussion with representatives from the Swiss Federal Office for Civil Protection (FOCP), were identified that are subject to a diverse range of risks, or were from similar sized countries as Switzerland. The cities included: Frankfurt, Hamburg, Rotterdam, Vienna, London, Singapore, Los Angeles, and Sydney. Secondly, for each city a detailed city profile was constructed using information from online sources, grey

and peer-reviewed literature. Thirdly, the city profiles (not included here for reasons of privacy) were used to develop a semi-structured interview schedule. This included information not covered by the city profile, and on issues that have been identified in the profiles, but were considered necessary to explore more deeply in an interview.

The interviewees were city officials knowledgeable of their city’s disaster and urban security management planning processes and practices. These officials were identified either by the research team (London, Sydney), or by representatives from the FOCP (Frankfurt, Hamburg, Los Angeles, Singapore, Vienna, Rotterdam). Each potential interviewee was contacted first by email with a detailed description of the project and how information they provided would be used in the study. Once each official agreed to be interviewed, they were sent the specific interview schedule for their city prior to their interview being conducted, and asked to nominate a suitable time for the research team to conduct the interview.

Interviews lasted between 45 minutes and two hours. Prior to commencing the interview, interviewees were asked if they agreed to the interview being recorded, and this was done when the response was affirmative. In all interviews detailed notes were taken, and then included in the city’s profile. Where a recording was available, it was used to add detail to the interviewers’ notes. All interviews were conducted by Tim Prior and Florian Roth. Once completed and transcribed, interviews were coded and analyzed qualitatively using Atlas.ti text analysis software.¹

1.4 Document Outline

The aim of this report is to give an extensive overview of contemporary disaster and risk management approaches in urban areas in different world regions from a theoretical and practical perspective. Based on this information, we provide recommendations for future developments in this field for Swiss cities.



Figure 1: Cities included in the sample of the study.

¹ Friese S. Qualitative Data Analysis with Atlas.ti. London: Sage; 2012.

Chapter 2 addresses concepts and trends in current academic urban security and disaster research, with a special focus on cities. Firstly, we place the challenges of contemporary disaster management in the context of the global city, describing how diversity, complexity and globalization relate to disaster in these geographical entities. Secondly, disaster is defined and definitions for core concepts in disaster studies are given, including: risk, hazard, vulnerability, resilience, and urban security. Given the theoretical and practical importance of concepts like vulnerability and resilience in discussions about disaster risk management, we draw on the disaster studies literature to explore vulnerability and resilience of cities in detail, and explore cases where these concepts are applied in the context of cities' responses to crises. Together resilience and vulnerability provide a useful, and general starting point for exploring disaster preparedness and planning in more detail in a selection of eight large global cities.

The results of the cross-city analysis of city disaster risk management are presented in Chapter 3. They are structured in three overarching areas: risk assessment, mitigation strategies, and institutions and collaboration. Within the area of risk assessment the following questions are addressed: Which risks do cities already plan for and what are major emerging risks in the eyes of city officials? What tools and methods are employed in urban risk assessment? How has the awareness for urban risks changed in recent years at the different levels of responsibility? Section two – mitigation strategies – examines how theoretical concepts such as disaster prevention, preparedness or resilience are understood and implemented in the various practices of urban disaster management, including inter alia urban planning, public communication and emergency management. Mitigation strategies discussed in this context include among others: evacuation planning, public alarm systems, strategies for self-protection, as well as post-event meas-

ures and programs for public risk education. The third section on institutions and collaboration explores how responsibilities for the different stages of urban disaster management are institutionally distributed in different city contexts. In this section we not only describe which agency is in charge of what, but also examine how collaboration among key actors is organized. We identify key factors that foster or impede inter-organizational collaboration and integration. Moreover, this section also looks at how key actors outside the traditional 'disaster management community' – in particular the private sector and civil stakeholders – can contribute to successful disaster management, and what measures can be undertaken to nurture the beneficial involvement of these actors. Finally, we describe ways to strengthen the links between cities and their neighboring regions as well as to improve inter-city collaboration and learning.

The results of the analysis are organized in themes rather than as individual city reports. We aim to highlight the latest trends in practices and processes across cities, therefore yielding a comprehensive account of diverging or converging approaches and developments in the field of urban risk management and preparedness. In each section, we additionally focus on current challenges and how cities plan to address them, as well as recent changes.

The results of the analysis are condensed in Chapter 4, where we draw conclusions about the trends and challenges cities face in contemporary disaster planning and preparedness. We also discuss the opportunities that new approaches present for planning and preparedness. We explore how challenges are dealt with and learned from; how successes are shared and built upon; and how new trends are instituted into practice. Finally, by illustrating developments that may be pertinent in the context of Swiss cities in the coming decades, we draw important recommendations from this international analysis for Swiss cities in section 4.2.

2 DISASTERS AND URBAN SECURITY: RESEARCH TRENDS

Today the majority of the globe's inhabitants live in cities rather than in rural settings. Far from abating, this trend is predicted to continue, and the United Nations Population Fund (UNFPA) predicts the number of people living in cities will rise from 3.6 billion in 2011 to five billion in 2030.¹¹ In addition, the UNFPA estimates that almost all of the world's population growth from 2010 to 2030 will take place in urban areas, particularly in low- and middle-income nations. This increase is more than simple population growth, but is mostly a result of migration.

Wenzel and colleagues⁽²⁾ define 'mega-cities' as cities with more than eight million inhabitants suggest migration (rather than births) as the main driver of their growth. There is disagreement on this cut-off point, but Cross qualitatively suggests that mega-cities are generally regarded as the largest of metropolitan centers.⁽³⁾ In this study, we define 'global cities' as centers of business, or capital cities, which are highly connected to the world by communications, transport and markets. Global cities offer a variety of economic benefits, they present cultural and social connectivity to their inhabitants, centralize services and increase accessibility to these services. The rapid rate at which global cities are growing reflects their attractiveness. Cities are attractive places because they provide opportunities that would otherwise be unavailable.⁽⁴⁾ The attractiveness is a result of ongoing globalization, a process of not just economic, but also cultural, social and technical connection. This has increased the complexity of the city, permitting "multiple, interdependent flows of a greater variety of goods, services, people, capital, information and diseases".^(5, p. 32)

No matter their attractiveness, cities can be both the most dangerous or safest places to be when disasters strike. The very characteristics of urban life – such as population concentrations, places of assembly, compact architectural structures, the variety of economic opportunities as well as complex, interconnected infrastructure systems – present both challenges and opportunities in terms of mitigating the impact of disasters. Poorly built urban environments on hazard-prone land, with unregulated construction and inadequate infrastructure, as well as the low income of many urban communities, significantly increase the vulnerability to disasters. On the other hand, most urban environments offer considerable strengths in terms of economic production and distribution, human resources, civil society and the availability of services, which can all be used to significantly reduce disaster risk and vulnerability.

This section provides a basic overview of recent research on disasters in urban settings, focusing particularly on large cities from developed nations. Firstly, we place the work in the context of the global city, describing how diversity, complexity and globalization relate to disaster in these geographical entities. Secondly, disaster is defined and definitions for core concepts in disaster studies are given, including: risk, hazard, vulnerability, resilience and urban security. Given the theoretical and practical importance of concepts like vulnerability and resilience in discussions about disaster risk management and reduction, we finally draw on the disaster studies literature to explore vulnerability and resilience of cities in detail, and place this in the context of cities' responses to crises. Based on the review of these different streams of research, the subsequent chapter explores the practices of disaster preparedness and planning in more detail in a selection of eight large global cities.

¹¹ United Nations Population Fund, <http://www.unfpa.org/pds/urbanization.htm>, accessed 22.01.2013.

2.1 The Global City

Cities are multicultural, geographically distinct and dynamic places where both the poor and wealthy reside. They are structured and organized human systems, and their existence as focal ‘nodes’ in the delivery of services to the global society places them at the centre of discussion about disaster, disruption and the mechanisms for avoiding or mitigating the consequences.⁽⁶⁾ Yet, they are also places of both diversity and centralization, where cross-border economic, social, cultural and technical processes flourish.⁽⁷⁾ Information, communication, energy, transportation and trading systems for instance are based on a variety of transnational networks and infrastructures that revolve around the city.⁽⁴⁾

The ‘global’ city represents the reality of accelerated globalization, which has degraded national boundaries and facilitated the interconnectedness of urban centers and nations in the global economy.^(7–10) Firstly, it was the globalization of economics that largely resulted from the “privatization, deregulation, the opening up of national economies to foreign firms and the growing participation of national economic actors in global markets” that drove forward the international exchange of goods, information and labor among cities.^(7, p. 13) At the same time, it was also the globalization of communication and information itself, fostered by new ICT technologies, which propelled the interconnection of urban spaces around the globe. The processes that globalization has entailed increase complexity because they create interrelationships and interdependencies within cities, between cities and regions, nationally and internationally. This is particularly the case in the provision of services, like telecommunications, which were historically provided by governments, but are increasingly delivered and managed by the private sector.⁽⁷⁾

In the context of hazard, disruption and disaster (natural, social or technological), there are two schools of thought regarding the increasing complexity of the global city, and the services they provide. On the one hand, complexity increases the robustness of service systems (particularly critical infrastructures) because increased connectivity creates redundancy, thereby overcoming issues associated with random faults and disruptions or targeted attacks.⁽¹¹⁾ On the other hand, complexity may be a problem for the city and its services if those services rely on all the supporting connections remaining constantly viable, which may not be the case in times of disruption or given the dynamic nature of the global city.⁽¹²⁾

Importantly, with globalization has come an increase in the consequences of disaster in cities,^(13–15) and although there are arguments for robustness, complexity has heightened the vulnerability of the city system to change or disruption caused by hazards. Most scholars perceive the global city no longer as a closed and self-sustaining system that can withstand disruption independently, but rather as an open system that is increasingly characterized by its external connections and interdependencies.⁽¹²⁾ This open and dynamic nature is increasingly acknowledged in pre- and post-disaster planning and management, but likely requires a different approach to disaster management from the traditional top-down, ‘command and control’ model.^(16, 17)

For example, as different studies suggest,^(2, 18) the distributed nature of services in global cities, with cross-border interdependencies, calls for distributed and dynamic risk management and planning processes. Consequently, one of the main challenges is to identify governance mechanisms that account for differences in legal structures, data availability and compatibility and institutional path-dependencies.^(2, 18) In addition, given that in many cities important infrastructures and services are privatized, but that State or Muni-

pal governments coordinate city disaster preparedness and response processes, research indicates that navigating the connections between private and public sector stakeholders has become very important.⁽¹⁹⁾ In the context of disaster planning and preparedness, the increasing complexity of the city, and the distributed nature of services raises the question of where disaster planning should stop? What is the new city ‘boundary’, and how can (or should) disaster planners and managers delineate their own planning and approaches to disaster risk reduction from other cities that they are inextricably connected to?

The traditional focus in disaster management has been on physical systems and technical risk reduction measures. Hazard mitigation programs typically focused on making physical systems resistant to disasters.⁽²⁰⁾ Such an approach is based on the idea that people can use technology to control disasters and ensure their safety. The underlying (traditional) planning model has been criticized for implying a static concept of disasters and sees mitigation as a linear problem that can be solved in isolation.⁽²¹⁾ As implied above, however, research in different domains suggests that the complexity of human systems, and cities in particular, calls for a more sustainable and inclusive conception of ‘disaster mitigation’ that links technical risk reduction with social resilience and places disaster mitigation in a much larger context. Improving the resistance of technical systems to disasters is certainly essential as their failure may result in damage and injury, but the focus of disaster management research in recent years has increasingly shifted towards the role of social communities in reducing hazard risks and responding effectively to disasters.

The underlying concept used by many contemporary researchers and practitioners to capture this ‘new’ direction – also, and especially in the city context – is *Resilience*. The concept of resilience, originally coming from the domain of physics, has been used in ecol-

ogy and psychology since the 1970’s to describe how complex systems adapt to external shocks. More recently, it has also been applied to the study of disaster management. Despite its theoretical fruitfulness, a problem with the concept of resilience – as with more established concepts in disaster studies such as risk or vulnerability – is that it is being used in very different ways, often with significantly different implied meanings. In order to avoid such conceptual fuzziness, we provide definitions for the most relevant theoretical concepts to this report in the subsequent section.

2.2 Core Concepts and Definitions

Several concepts are used consistently throughout city-scale discussions of disaster, emergency and disruptions. Important disaster concepts like hazard, risk, vulnerability, resilience and urban security are fundamental to the language of urban disaster studies, and are formally defined in the disaster literature. Drawing on existing literature, brief descriptions for each of these terms is provided as an introduction to further discussion within this document (summarized in Figure 2). Other important terms used in a practical sense in the context of disaster include prevention, mitigation, response, and recovery, but the application of these varies considerably, like much of the terminology used in discussions about disaster and hazard, between different organizations, institutions and academic traditions. Based on the cities studied, we show the variability in the practical application of these terms in city-specific disaster management processes and practices in chapter 3.

- ◆ A **disaster** is a hazardous event or process that has a major impact on a social system
- ◆ A **hazard** is an unexpected or uncertain event or process with the potential for disruption of society
- ◆ A **risk** is the spatial or temporal probability of a hazard occurring
- ◆ **Vulnerability** is the susceptibility of people or structures to be harmed
- ◆ **Resilience** is an entity or system's ability to bounce back or to adapt quickly following a disturbance
- ◆ **Urban security** is the guarantee of safety, and the provision of critical services to the population in urban areas.

Figure 2: Key concepts

Disaster

A disaster occurs when a hazardous event or process has a major impact on a social system. A disaster thus has two dimensions: the actual hazard and the society it affects. An event that has no or only a minor impact on the society cannot be considered a disaster. For instance, while avalanches alone are just fast-moving snow masses, in the proximity of human dwellings they pose a serious risk to lives and assets and can cause a disaster. Accordingly, many researchers see disasters as socially defined phenomena.⁽²¹⁾ Using a purely quantitative definition, the International Red Cross and Red Crescent Association classifies a disruptive event as a disaster if 10 or more people are killed, 100 or more are affected, and when the organization is called to assist in a response.⁽²²⁾ In reality, as the thresholds and scopes of disaster planning and response vary across cities, so do the local definitions of what constitutes a disaster.

Hazard

A hazard is an unexpected or uncertain event or process with the potential to disrupt society. Hazards may have natural (for example earthquakes or wildfires), technical (for instance accidents in chemical production), or societal origins (for example riots or terrorist attacks). Importantly, hazards only become disasters when they interact with society, causing loss of life or property – hazards are the cause of disaster. Hazard activity and the risk it poses to our society is probabilistic by nature.^(23–28) Some hazards are rare (major earthquakes or tsunamis); others are seasonal (floods, droughts); others are new or developing (new risky technologies, modified viruses). Although research in different domains (such as seismology, epidemiology or also conflict research) has made significant progress in recent years to predict hazardous events, there exists no fail-safe ability or mechanism to successfully predict when a hazard will occur, where they might occur, what intensity or consequences they may have, or how long their activity will last. However, in the practice of disaster management, natural hazards are usually attributed some value of likelihood, mostly based on past experiences.

Risk

Put most simply, risk is the spatial or temporal probability that a hazard occurs.^(15, 29) A risk is the product of a hazard's likelihood and its consequences. In turn, a disaster is a risk that has materialized. Based on this model, hazards that occur frequently (on a seasonal basis, like wildfire for example) and that may have devastating consequences whenever they occur, can be considered more 'risky', or potentially disastrous than a "one in one hundred year" event (flood, for example), which might have similar consequences, but is less frequent. Although this is a very simple and often applied conceptualization of disaster risk, its external validity has been increasingly questioned in recent years.

A significant body of research has demonstrated that the probabilistic (*i.e.* the likelihood of occurrence) conception of risk has tended to contribute to public ignorance of the possibility of activity, or the attribution of low priority,^(25, 27, 30, 31) which subsequently reduces the public's predisposition to mitigate the consequences of rare, but potentially devastating events. In particular, if risks materialize in long cycles, exceeding human life spans, the public is likely to underestimate the need to be pro-active. It is important to note that even though likelihood may be low (*i.e.* a low probability), the event could actually occur at any time, resulting in a disaster that people who think only in numerical probabilities are unlikely to be prepared for.

Vulnerability

Vulnerability refers to the susceptibility of people or structures to be harmed.^(14, 15, 32–37) Susceptibility denotes an inability to cope with the adverse consequences of a hazard, so the more susceptible a structure or community is to the hazard, the more vulnerable it becomes,⁽³²⁾ and losses are increased.⁽¹⁵⁾ Structural (of critical infrastructures, for example) and social (minority groups, the poor, the disabled, *etc.*) vulnerability can be determined by assessing a multitude of factors (that are elaborated elsewhere^(38–42)), many of which are interdependent. However, in order to actually be vulnerable an entity must be exposed to a hazard, and must also be sensitive to that hazard.⁽³²⁾ Exposure refers to how much an entity is likely to experience a hazard, while sensitivity is the extent to which the entity is affected by the hazard.^(15, 32) Interdependencies between vulnerability-inducing factors can magnify susceptibilities, thus resulting in greater loss or disruption.⁽²⁾

Resilience

Resilience is derived from the Latin '*resiliere*', meaning to spring or bounce back, and at its most basic

interpretation, is often applied in relation to an entity or system's ability to return to normal functioning quickly following a disturbance.^(43–45) A more nuanced conception of resilience moves away from the idea of strict equilibrium, embracing change through adaptation and learning to ensure the system's functions persist.^(46–50) The idea of systemic resilience is a popular one, and has worked its way from disciplines as diverse as engineering and ecology, to psychology and security – but with differing depths of exploration. There are a lot of studies on the meanings, expression, generation and management of resilience. They are often contradictory which highlights the conceptual vagueness of the term and the difficulty in applying resilience in a robust and meaningful manner.^(51–55) Confusion and contradiction have not diminished the popularity of the concept. It is used to describe individuals and communities, organizations and infrastructure, cities and ecological systems. Such varied use, but normative application, has resulted in a broad resilience vernacular – one that is rarely made explicit, whether in the context of academic or policy settings. Resilience has likely taken a strong hold in the context of disaster studies in recent years because it is said to encapsulate a strongly decentralized approach to disaster management. Importantly, public and private institutions are increasingly recognizing that protecting everyone and everything from disasters all the time is impossible, and the decentralized approach that resilience provides fits well with this recognition. While resilience is often used as the inverse of vulnerability, this is not always the case. An entity that is resilient is not necessarily invulnerable; also, an entity may, in the same risk context, be both vulnerable and resilient.

Urban security

Urban security reflects an objective of maintaining a living environment with low risks to the population, where the supply of social and technical services that

support city life can be guaranteed.⁽⁴⁾ Yet, as Godschalk points out:

While we have learned a great deal about the behavior of various urban systems in recent years, there are still many gaps in our knowledge about how physical and social systems within cities respond to extreme stress.^(20, p. 141)

The veracity of this statement, in the context of urban security, can be illustrated by the marked differences in the security situations following the Katrina (New Orleans, 2005) and Sandy (New York, 2012) storms in the United States. While Hurricane Katrina was followed by disturbing civil unrest, the response in New York was completely different. These differences are likely a result of many factors: lessons learned by city planners and disaster managers, particularly as a result of the Katrina experience; the demographics of the cities; the resources available in times of crisis; the scale of the disasters; and the use of new technologies such as social media

Understanding what contributes to or detracts from ‘urban security’ is a matter of perspective. Clearly, disaster can have implications for the security of the city system, but this position is informed by a disaster management perspective. Recent research being conducted with city officials in Switzerland^{III} is highlighting that perceptions of urban security in Swiss cities is more associated with issues like littering and graffiti, possibly because they indicate some decline in social order. This perspective highlights the ‘broken windows’ theory of snowballing social disorder,^(56, 57) with its urban security implications.

Even if the possibility of major disaster plays only a minor role in the public perception of risks to urban

security, it may be argued that the preoccupation with more regularly materializing risks is in parts due to so-called ‘availability heuristics’ that draw peoples’ attention to those risks that they experience often or recently.⁽⁵⁸⁾ Nonetheless, despite their rarity and due to their potential severity, major disasters remain a key element in concerns regarding urban security.

2.3 The Vulnerable City

Disaster management is ultimately about identifying, recognizing and addressing vulnerability.^(15, 32, 34, 36, 40, 41) As mentioned above, vulnerability can be defined as the susceptibility to harm from a risk or hazard,^(14, 15, 32, 37, 41, 46, 59, 60) and like the city system itself, vulnerability is dynamic through time.⁽³²⁾ A city’s vulnerability to hazard can be considered a function of its exposure and its sensitivity to hazards.^(13, 14, 60, 61) Vulnerabilities in a ‘city system’ can manifest in three general areas: in the society,^(14, 34, 62, 63) in physical or technical structures,^(4, 11, 36) and in relation to the type of hazard.⁽¹⁴⁾ Ultimately, many of the inherent aspects of the global city that confer vulnerability are closely associated with the same characteristics that make them attractive as places for people to live: the economic, social and technical services around which they are constructed.

Many cities are exposed to hazards because of their geographical location, while global cities are arguably more sensitive to those hazards because of their systemic complexity. A city like Los Angeles for example, is exposed to both earthquakes and wildfires, and may be more sensitive because of its globally connected nature and culturally diverse population. For these reasons, Los Angeles is considered to be both socially and technically one of the more vulnerable cities in the United States.^(14, 15)

III This work is the result of a currently unpublished study being undertaken on behalf of the Association of Swiss Cities as part of the ‘Safe Swiss Cities 2025’ project.

In the first instance, reducing disaster vulnerability depends on the nature of the hazard, and especially on the ability to predict the hazard.^(17, 51, 64) While many cities are able to anticipate certain hazards to a reasonable degree, other hazards are both uncertain and unpredictable. Recently, national ‘risk registers’ (inventories of public danger) have been established to focus effort and resources at managing likely risks faced by nations (*e.g.* in the Netherlands and United Kingdom).⁽⁶⁵⁾ Yet such processes could narrow the national or city-scale risk analysis focus and overlook less obvious hazard possibilities, creating a source of vulnerability for the city that is associated with a lack of planning for unanticipated hazard (like those originating from human actors like terrorism or cyber attack).

A second major challenge in reducing vulnerability is that within city contexts vulnerabilities are often heterogeneously distributed. Managing social vulnerability to disasters in cities is particularly difficult where it is connected to the socio-demographic and cultural diversity of the city’s residents. Because different social, cultural and ethnic groups often inhabit geographically distinct parts of a city, vulnerability also varies geographically within the city.^(34, 63, 66) Vulnerability to disasters is often associated with (and possibly determined by) social disadvantage, which can be influenced by characteristics like age, gender, disability (physical and mental), income, levels of education, and political influence.^(34, 67) Importantly, disadvantaged members of at-risk societies have less capacity to reduce vulnerability, often having less access to, or knowledge about how to access disaster management resources or services.^(32, 34, 68)

Technical or physical vulnerability is often considered in the context of critical infrastructures (water and energy supply systems, for example) and the built environment (homes and offices). In the case of critical infrastructures, cities act as nodes that connect local,

regional, national and international networks, and the maintenance of these networks has significant implications for the vulnerability and sustainability of the city itself, and for the other locations connected in the city’s critical infrastructure network.⁽⁴⁾ An important mechanism in managing the technical vulnerability of structures is the need to measure vulnerabilities.^(17, 69–71) Measurement permits relative comparisons of the vulnerability of structures, and analyses can be used to improve the way resources are allocated for decreasing vulnerability,⁽⁴¹⁾ given factors like a structure’s criticality for instance.⁽⁷⁰⁾

Social and technical vulnerabilities increase the likelihood that a city will suffer negative consequences following a disaster. In addition, weak governance, particularly in the course of urban development and disaster planning and management processes, can aggravate the vulnerable characteristics of the city.⁽⁷²⁾ Even in developed cities, poor governance or conflicting policies can affect disaster preparation and response, influence the delivery of critical services, or affect building codes and land use management.^(14, 15, 73, 74) In cities with weak governance structures these problems can be further aggravated. In such contexts, authorities often have little presence and may lack the knowledge and resources (and sometimes the willingness) to ensure basic social services and critical infrastructures are planned and maintained with respect to potential disasters.⁽⁷²⁾ The combination of weak authority and socially vulnerable communities with limited capabilities is referred to as the ‘vulnerability gap’.⁽²²⁾ While ‘good’ governance can limit the social, economic and technical impact caused by hazards, it cannot guarantee that a city escapes disaster.

A particular trend in community-centered disaster mitigation and recovery strategies in the urban context is specific targeting of the most vulnerable social groups. More focus is now being directed to addressing specific vulnerabilities among the poor,

the elderly, disabled or chronically ill, and in cultural or ethnic minorities, as these groups are often the ‘weakest link’ in a city’s mitigation capacity. Providing information to and meeting the different needs of such groups requires a strong understanding of their vulnerabilities and the underlying causes of these vulnerabilities. Identifying the population with special needs affected by a disaster event is complicated because cities are demographically dynamic and wealthy and poor communities can live in close proximity. This makes the effective targeting of response strategy difficult.⁽⁷²⁾

Vulnerability in poor or disadvantaged segments of the urban population can be caused by a lack of resources, capabilities and influence. Poverty and social disadvantage generally result in low coping capacity in case of crises, because resources that might increase flexibility and adaptability are not available. These characteristics exaggerate vulnerabilities and ultimately increase the risks to the poor and disadvantaged population groups. In addition, in underdeveloped countries where the problem of vulnerability is particularly nuanced, poor dwellers are often forced to live on hazard-prone land with unsafe housing and inadequate infrastructure. Problems are multiplied when building code standards are not enforced, when basic infrastructure is not provided, when land-use management and planning is lacking, or when disadvantaged populations cannot afford to relocate to safer urban areas.⁽²²⁾ Many observers therefore emphasize the links between hazard mitigation on the one hand and social justice, sustainability and economic development on the other. In order to establish societal resilience in city contexts both sides must be addressed.⁽²⁰⁾ These illustrations show how the vulnerability of a city is connected to an inability to adapt to disruption,⁽³²⁾ either because of social or technical characteristics, but always with respect to the city’s governance.

2.4 The Resilient City

In a disaster risk management context, the popularity (and importance) of the concept of ‘resilience’ has grown dramatically in the last decade. However, while the term has become central in urban hazard management, its origin is multifaceted, and the definition of resilience consequently varies as much as the uses to which it is put, and the sub-disciplinary contexts from which it has emerged.^(32, 49, 51–53, 55, 75, 76) In the usual practice of urban security, resilience, like vulnerability, is used most widely to denote a general state of an entity like a city, or city system component – this community is ‘resilient’; that infrastructure is ‘resilient’ to flooding; the individual’s ‘resilience’ has decreased, *etc.* Yet, in recent years, different authors have argued against such a static concept of resilience and emphasized the adaptive component of the concept. For example, Norris and colleagues⁽⁴⁹⁾ consider resilience a process linking resources like adaptive capacity, to outcomes like adaptation, readiness and response – all of which contribute to decreasing aspects of community vulnerability.⁽⁷⁶⁾ They suggest resilience and adaptive capacity are components of vulnerability.^(32, 75) Adger^(32, p 268) points out that vulnerability can be reduced by elements of resilience like autonomous self-organization, shock absorption and pre- and post-shock reaction. This notion of ‘resilience elements’ is loosely reflected in Norris and colleagues’ assertion that resilience is determined by a “set of adaptive capacities”^(49, p 136), including economic development, information and communication, community competence and social capital. In the case of natural hazards facing cities, vulnerabilities can be lowered and resilience increased by adaptive capacities that provide the ability to plan and enact (social and structural) preparations, to mitigate exposure, reduce sensitivity⁽⁵⁰⁾, and strengthen response capabilities.⁽⁷⁵⁾

The central objectives in building resilience into risk management and planning in complex and dynamic human systems like cities are the maintenance of day-to-day community activities and functions of society, and the welfare of individuals.⁽⁷⁷⁾ Godschalk^(20, p. 136) suggests that a resilient city is “capable of withstanding severe shock without [suffering] either immediate chaos or permanent harm.” He goes on to point out that “while [resilient cities] might bend from hazard forces, they would not break” and that “resilient cities would become stronger by adapting and learning from disasters.”^(p. 137) Resilience is important because the vulnerability of physical and social systems cannot be fully (or accurately) predicted, making the ability to accommodate change without devastating failure critical. Resilience is considered a useful concept in this respect because it is largely achieved through bottom-up organization and action, which encourages a distributed, but coordinated, approach to disaster risk preparation and response that lends itself well to complex systems like cities, where system components are associated, but often not seamlessly integrated.⁽⁷⁸⁾

A resilient city is a sustainable network of physical systems and social communities that are both strong and flexible. Cities are complex systems organized around technologies, businesses, organizations, infrastructures, and socio-demographic characteristics (population density, social stratification, service delivery, etc.). While each of these components of the system has likely been designed and developed, or is evolving independently, and operates autonomously, in order to be resilient they must be managed, organized and controlled in a distributed fashion that incorporates flexibility.⁽¹⁸⁾ Other important features of the resilient city are redundancy, reorganization and learning, and each characteristic is briefly described below and represented in Figure 3.⁽¹⁾

- ♦ *Redundancy*: Several urban systems provide substitutable services when another system is disrupted.
- ♦ *Flexibility*: Urban systems are able to absorb shocks in ways that avoid catastrophic failure. In case a component or institution fails, there is only minimal impact on other systems.
- ♦ *Capacity to Reorganize*: Urban systems have the ability to temporarily or permanently adapt, change and evolve in response to changing conditions.
- ♦ *Capacity to Learn*: The ability to learn from past experience and to identify and address relevant problems ensures that actions are taken on the basis of relevant information and experiences.

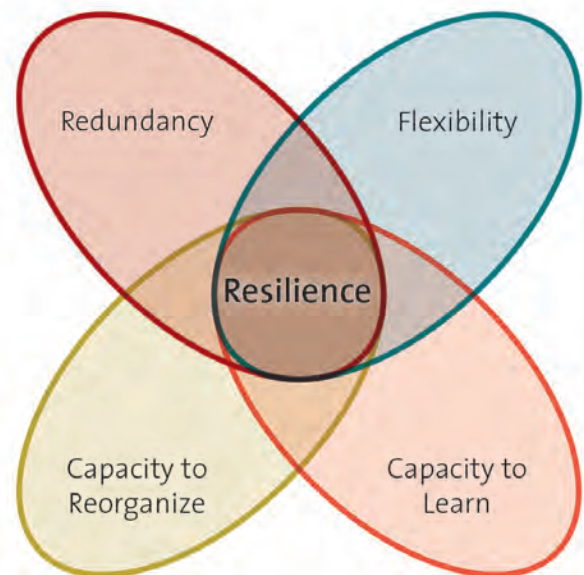


Figure 3: The elements of urban resilience.⁽¹⁾

While acknowledging that large global cities may be more vulnerable to hazards, several authors note that the nature of cities as large, resource and expertise rich centers confers a degree of inherent resilience.^(3, 79) Handmer points out that the vulnerability of ‘mega cities’ to particular hazards can be countered by their inherent resilience, but that this effect is diminished where civil institutions are weak.

(79) This point is also emphasized by other studies on resilience in the international development context. (22, 72) Research conducted in the wake of disasters suggests a model of urban resilience as depicted in Figure 3. According to this perspective, in addition to redundancy and flexibility (or adaptability) inherent resilience in the global city can be built upon if the city system components are also managed for, or characterized by features like diversity, efficiency, autonomy, interdependence, and collaboration.^(6, 20, 37, 64, 80) While some of these characteristics seem outwardly to oppose others, such duality is believed to contribute to the resilience of the whole system. (20) For example, a rail system's energy delivery infrastructure might have in-built redundancy that can overcome power failures, and system efficiency is maintained if the back-up operates quickly and effectively, but only when needed.

At the same time, the concept of resilience is by no means restricted to academic debates, but has also influenced many urban security policies on different political levels in recent years. An oft-cited example from the international level is the 'Making Cities Resilient – My City is Getting Ready!' global campaign launched in 2012 by the United Nations International Strategy for Disaster Reduction (UNISDR). The campaign has been established as a way of fulfilling objectives for the Hyogo Framework for Action (HFA) at the city level.⁽⁶⁾ These objectives are to raise awareness and encourage commitment by local and national governments to make urban disaster risk reduction, resilience and climate change adaptation a policy priority. In the framework of the campaign, UNISDR compiled a handbook in 2012 with a set of "Ten Essentials for Making Cities Resilient".^{IV}

IV With omissions and modifications quoted from: United Nations International Strategy for Disaster Reduction (UNISDR). Geneva, March 2012.

1. Put in place *organization and coordination* to understand and reduce disaster risk, based on participation of citizen groups and civil society.
2. Assign a *budget* for disaster risk reduction and provide incentives for communities to invest in reducing the risks they face.
3. Maintain up to date data on hazards and vulnerabilities. Prepare *risk assessments* and use these as the basis for urban development plans and decisions.
4. Invest in and maintain *critical infrastructure that reduces risk*, such as flood drainage, adjusted where needed to cope with climate change.
5. Assess the *safety of all schools and health facilities* and upgrade these as necessary.
6. Apply and enforce *realistic, risk compliant building regulations and land-use planning principles*. Identify safe land for low-income citizens.
7. Ensure that education programs and *training on disaster risk reduction* are in place in schools and local communities.
8. *Protect ecosystems and natural buffers to mitigate floods, storm surges and other hazards to which your city may be vulnerable*.
9. Install *early warning systems and emergency management capacities* in your city and hold regular public preparedness drills.
10. After any disaster, ensure that the *needs of the affected population* are placed at the center of reconstruction, with support for them to design and help implement recovery measures.

The handbook contains more detailed information on how to implement the ten essentials, including a self-assessment tool, links to electronic resources as well as best practices and examples from participating cities. There is also a web-based information platform with additional tools and information, where cities and local governments can sign up and share their experiences.^V As of January 2013, the campaign

V <http://www.unisdr.org/campaign/resilientcities>.

had attracted 1296 city governments to participate, including two Swiss cities: Davos and Geneva.^{VI}

The strong emphasis of resilience at the local government and community levels reflects the assumption (and evidence) that involving people in the decisions that affect them is important for effective disaster mitigation and recovery. The involvement of members of the public in disaster mitigation and recovery is now articulated in many policy initiatives globally. In addition, the participation of the affected population in decisions about the design and execution of actions ensures a sense of ownership by the community, which raises the likelihood of resilient and sustainable outcome following disaster.⁽⁶⁾ Arguably, where local governments have sufficient capacity and are accountable to their citizens, the resilience approach yields radically multiplied opportunities for disaster mitigation and recovery. Such practices highlight the “evidence that an urbanizing world need not ‘urbanize’ disaster risks.”⁽²²⁾

2.5 Governance in Urban Crisis

Most hazards are unpredictable and their occurrence is uncertain, but appropriate planning and preparation can limit their consequences. In times of crisis, it also determines the way in which a city responds. Yet, the complexity of the city system means that the response is not straightforward: systemic breakdowns in communications, administration, services and public order are nevertheless possible – even if only for a short period of time.^(81–83) As Kapucu and van Wart note, “high performance in catastrophic disasters requires an ability to assess and adapt capacity rapidly, restore or enhance disrupted or inadequate communications, utilize uncharacteristically flexible decision making, and expand coordination and trust

of emergency response agencies despite the hurly-burly of the response and recovery efforts.”^(83, p 280) Recognizing this, most cities have developed sophisticated, multi-layered approaches to crisis response and the processes involved in crisis management.

Governance in crisis has improved in the last century, but the increasing privatization of services and infrastructures in the last decades of the 20th century has added to the complexity of crisis management.^(2, 7, 18) Although slowly changing, governments and their agencies have in recent times been held responsible for developing appropriate responses than in the past, but they did not always play that role.^(74, 83) As Waugh points out, prior to the Second World War, emergency management in its current form was non-existent,⁽⁸⁴⁾ and largely the domain of independent humanitarian organizations.⁽⁸³⁾ During and after the war, intensified efforts in the domain of civil protection in the United States, and in many other countries including Switzerland,⁽⁸⁵⁾ spurred the development and planning processes that have preceded the current contemporary disaster management processes.

In general, governance of crisis encompasses a series of interlinked measures, based on comprehensive disaster risk assessment. Most often, governance of crisis is today conceptualized as a continuous four-stage cycle:⁽⁸⁶⁾

- ◆ *Preparedness* involves building the capability to effectively respond to a disaster, *e.g.* analyses, drafting of response plans, training of first responders, public capability to respond, *etc.*
- ◆ *Response* denotes the actions taken during a disaster in order to minimize injury and damage, *e.g.* medical treatment, evacuation, *etc.*
- ◆ *Recovery* refers to the short-term restoration of key infrastructure and services, as well as the return to a community’s normal functions in the

VI For a list of all participating cities, see <http://www.unisdr.org/campaign/resilientcities/cities>.

longer term, *e.g.* restoring critical systems or services, repairing damages, *etc.*

- ◆ *Mitigation*^{VII} consists of activities and measures that aim at reducing vulnerability to future disasters, *e.g.* relocation of buildings from hazard-prone land, restoration and maintenance of natural protective systems, *etc.*

While these core steps of disaster management have remained rather stable in recent years, the question how each of these steps should be organized and how these steps ought to be interlinked has been lively debated in recent years. In particular, various authors have employed risk and resilience theories to argue that the existing practices of disaster management need to be adapted to the increased complexity of city systems. Sophisticated and multi-layered approaches to crisis management have been developed in recent years in response to the observation that the growing complexity of city systems drives a need for new management strategies. Although it appears impossible to summarize these recent contributions to the realms of urban disaster studies, we can identify three main points around which many debates over managing complex disasters tend to circulate.

- ◆ *Proactive assessment and analysis of potential hazards:* Much of the recent literature agrees that risks to urban security should be identified at the earliest stage possible. In order to detect emerging risks as well as vulnerabilities, risk assessment should be given high priority.
- ◆ *Flexible countermeasures for unpredicted emergencies:* If disaster is unpredictable, planning a suitable response is difficult, and linear response strategies are unfeasible.^(81–83) Under such unpredictability, mitigation strategies should not only be focused

on crisis management, but rather be established as early as possible, even as urban spaces are designed or rebuilt. Consequently, urban planning is seen as integral element of disaster management that can have a major impact on a city's vulnerability to the risks it faces.

- ◆ *Self-organization and networking to cope with complexity:* Strong theoretical emphasis in recent academic contributions has been directed towards discussion about decentralized decision making and human interaction across institutions, agencies and between the public and private sectors. It is generally assumed that under these circumstances, informal networks and collective responses can become as important as formal planning and crisis response processes and practices.^(81, 83, 87–89)

Understanding how research trends are reflected in the daily practices of urban security and disaster management requires an empirical assessment. In the following section, we examine how risk assessment processes and methods, countermeasures as well as processes of cooperation and collaboration between public, private and civil society actors are organized in global cities today. This empirical assessment is based on an extensive desktop analysis and interviews with city officials in eight global cities.

VII *Mitigation and Prevention* are often used interchangeably, having similar, albeit not identical meaning. More detailed discussion on the similarities and differences between prevention and mitigation can be found in section 3.

3 DISASTER PLANNING AND PREPAREDNESS

This section discusses the findings from the desktop analysis and the interviews with city officials. We focus on three specific areas of interest: processes and practices of risk assessment (3.1); the different risk mitigation strategies (3.2); and the institutions and collaboration that are developing in the context of disaster management and planning (3.3).

3.1 Risk Assessment

In the following subsections, we focus on a range of emerging trends or issues relating to risk assessment: the scope of urban risk management and methodologies applied; the new use of mapping tools in identifying and locating risks; new processes in risk identification, particularly in relation to new, emerging or complex risks.

3.1.1 Scope of urban risk assessment

Many cities included in the study are situated in exposed geographic locations. Such locations can both contribute to their growth, but can also place them at risk from natural hazards. For example, while the proximity to water as a means of transportation nourished the growth of cities like Hamburg, Sydney or Singapore, it also exposes them to potential natural hazards like river floods, storm tides and tsunamis. In addition, due to their attractiveness, many urban areas have reached exceptionally high population densities, with technological installations following suit. Population and technological expansion in these cities has also increased their vulnerability to socio-technical hazards such as mass transportation accidents, critical infrastructure breakdowns or terrorist attacks. Consequently, all cities in the sam-

ple assess a broad array of risks, and several assess a large number of risks simultaneously. Los Angeles, for example, is located in an earthquake zone and frequently experiences wildfires, but officials also assess possible risk from tsunami, nuclear accidents, aircraft emergency, terrorism, and electrical power outages. Examples of urban risks assessed by city officials in the current study are listed in Table 1.

Examples of hazards considered in urban risk assessments

| Natural hazards | Socio-technical hazards |
|-------------------------------------|--|
| River floods, storm tides, tsunamis | Power outages |
| Earthquakes | Chemical or nuclear accidents |
| Wildfires | Terrorist attacks |
| Pandemics | Emergencies in mass transportation systems |
| | Breakdown of information infrastructure |

Table 1: Urban hazards

Comprehensive risk assessment procedures do not imply that all kinds of hazards receive the same level of attention. On the contrary, comprehensive risk assessment aims to prioritize hazards that are more consequential or frequent in order to support timely decision making processes. In many cities there is one type of risk that clearly is most important in respect to risk analysis and prevention due to historical experience and inherent geographical vulnerability. For example, in cities vulnerable to flood risks such as Vienna, Hamburg or parts of Sydney, flood risk assessments are far more developed than risk assessments for other kinds of hazards. Several interview respondents confirmed that the specific plans for each risk type are heavily influenced by each city’s record of disasters.

3.1.2 Risk Assessment methods

Although risk assessments are not new *per se*, the methods applied have developed considerably in recent years. Today, risk assessments are frequently conducted quantitatively, either by in-house staff or with support from specialist external experts. For example in Frankfurt quantitative risk assessments are regarded to be advantageous mainly because they allow comparison between different risks that cities face, permit risks to be tracked over time, and also can be useful when communicating changes in risk patterns that might influence policy decisions:

“The city is changing. While some tasks for the fire department are getting easier, other tasks are becoming more challenging. Our quantitative risk analysis helps us to develop strategic responses that enable us to adapt us to new risks. Moreover, risk assessments make us more transparent for our financing principals.” (Representative of the City of Frankfurt)^{VIII}

In some cities, in-house solutions are used in risk assessment activities. In other cities, methods and tools developed by state or national agencies are applied. In general, a trend towards the application of centralized technical solutions can be observed. Such applications are often developed at higher administrative levels and then devolved to risk management professionals at lower administrative levels (Rotterdam, Sydney, London and Hamburg). While a stand-alone risk assessment method can be highly suitable for a specific urban context, the main advantage of a standardized methodology is that it relieves cities from the resource-intensive task of risk assessment instrument development. For example, Hamburg has recently

switched to the method provided by the German Federal Office of Civil Protection and Disaster Assistance (*Bundesamt für Bevölkerungsschutz und Katastrophenhilfe*, BBK), partly because the audit office at the state level recommended this step as cost-efficient. Likewise, in the Netherlands a standardized risk assessment methodology has been developed that is carried out at the national level, in regions (risk assessment for Rotterdam is undertaken at the regional level), and at the local level. A similar process is conducted in the Greater London Area (GLA), and devolved to the numerous boroughs of the GLA. Risk assessment processes in Sydney are coordinated at the State level (analogous to the Swiss *Cantones* and German *Bundesländer*), and undertaken at the Sydney city level.

An alternative to traditional risk assessments, which are mainly based on past experiences, is the application of forecasting efforts based on qualitative assessments. Singapore is an internationally leader in this respect, having invested considerably in the development of foresight and early warning tools in recent years. In this context, an important instrument for proactive risk assessments is the use of scenarios. Scenario foresight techniques are used in a number of cities, for example, in London scenarios have been developed for “reasonable worst case” consequences for risks identified in the risk register. In its scenario exercises, the Greater London Authority includes different emergency management professionals, including stakeholders from the emergency agencies, infrastructure managers, government officials and health service experts. Such scenarios allow city disaster risk assessors to move beyond static models of risk that are traditionally based on probabilities. As one official from Vienna emphasized, technical risk assessments are not assumed to be error-free at all, and are supplemented using other methods:

“If risk assessments are used as the only source of information, important issues can be easily missed. It is there-

VIII The original quote in German language stated: „Die Stadt verändert sich. Die Aufgaben für die Feuerwehr werden leichter oder schwieriger. Die quantitative Risikobewertung hilft uns, uns strategisch auszurichten. Wir können uns dadurch auf neue Risiken einstellen, sind aber auch transparenter gegenüber unseren Geldgebern.“

fore important to add a social perspective to technical risk assessments.” (Representative of the City of Vienna)^{IX}

While quantitative risk assessments are undertaken in many cities included in this study, the disaster management representatives interviewed were generally hesitant to rely on quantitative risk assessments alone. In particular, the Los Angeles official argued that it is impossible to conduct early warning risk assessments for risks like terrorism, cyber-attacks and earthquakes.

Irrespective of the question whether risk assessments are done quantitatively or qualitatively, several respondents emphasized that it is important not to see risk assessment as a singular action, but a continuous process. Therefore, updates and re-evaluations of risk assessments are of key importance. In general, it can be observed that on the operational level, risk levels are steadily assessed. Los Angeles for example assesses the risks of wildfires on a daily basis, sometimes more often than daily if risk levels are high. However, re-evaluations of risk assessments on the strategic level are much less frequent. As the interview partner for Los Angeles described, major changes to disaster management plans are mainly made in the aftermath of a major incident. Yet, to have risk management processes always up-to-date it appears pivotal to adapt risk assessments not only to short-term weather forecasts or long-term climate models, but also frequently update vulnerabilities as well. For example, in urban spaces tall office buildings or whole districts are often established at high speed, posing particular challenges to urban risk management. To keep up with the fast evolution of city spaces, Frankfurt for example, updates its risk assessments for fires every two months.

IX Original quote in German language states: “Dinge können durch den Rost fallen, wenn man nur die Risikobewertung nimmt. Man muss die technische Beurteilung auch einer gesamtgesellschaftlichen Beurteilung unterziehen.”

Interesting differences were identified in the way risk assessments for urban areas have been organized. While in some cities risk assessment is carried out by a single agency, in other cities more subsidiary approaches are taken that situate the responsibility for risk assessments at lower levels of the broader risk management system. Moreover, we found that the strength of coordination mechanisms between various organizations differs substantially. Taken together, we can infer from our observations four different approaches to urban risk assessment (Table 2): First, in *centralized systems*, risk assessments are conducted by a single authority with far-reaching responsibilities. Subordinate units (for example public administration on the borough, or community level) do not conduct their own risk assessments, at best only supporting assessments at superior levels. A good example of this practice occurs in Singapore, which has established extensive centralized risk assessment capabilities in recent years.

| | | Inter-organizational coordination | |
|--------------|------|-----------------------------------|---------------|
| | | low | high |
| Subsidiarity | low | Centralized RA | Integrated RA |
| | high | Distributed RA | Networked RA |

Table 2: General approaches to risk assessment (RA)

Second, some cities follow an *integrated approach*, drawing on contributions from different actors with specific responsibilities and capabilities in their risk assessments. This approach focuses on bringing all relevant information to the table and combining it into a single risk assessment. A good example is London, where considerable attempts have been undertaken to get groups involved in the development of local risk profiles and registers. Even so, it is important to note that in this case ‘community’ refers to experts, rather than civil society.

Third, following a *distributed approach*, multiple organizations are conducting their own risk assessments, focusing on particular hazard types and the development issue-specific strategies. Rotterdam, for example, conducts a specific risk assessment for the heavy industry in the city, dealing with this sector as a separate risk entity and ensuring a more specific response should a crisis occur. In this case though, it seems that no strong institutional mechanisms are in place to ensure coordinated assessments. Instead, coordination and cooperation take place on an ad-hoc basis. In Vienna for example, each department makes its own assessment and only consults other sectors when necessary.

Finally, risk assessment occurs as a *networked system*, where multiple actors are involved. Contrary to distributed approach there are strong links between the organizations conducting the risk assessments, enabling a far more coordinated approach to risk assessment. These networks are not necessarily restricted to governmental agencies alone. As the case of Los Angeles exemplifies, such a network does not have to be restricted to risk management professionals, but can also include social stakeholders, like local community representatives.

The different approaches taken by the cities in this study depend primarily on the political and cultural context of the city, and its risk characteristics. Although in the last decade, many cities have recognized the interdependencies between different administrative domains and consequently aimed for more holistic risk assessments, such steps are frequently hampered by fragmented administrative structures, dispersed responsibilities and particular interests. Because such context factors are mostly hard to change, the establishment of networks appears promising, since it leaves existent responsibilities intact, yet nevertheless improves the unity of efforts in urban risk assessment. Distributed or networked approaches to risk as-

essment may be more suitable than the integrated or centralized approaches in cities that either face a wide variety of risks or where risk characteristics vary between sectors or with geography.

3.1.3 Mapping urban risks

Mapping tools are becoming increasingly important instruments in risk assessment. Yet, hazard and risk maps are not restricted to the risk assessment stage. Instead, they can be used for very different purposes, and in many instances they fulfill different tasks simultaneously. In risk assessment, mapping methods and tools can be very useful in the identification of areas potentially affected by hazards, and in comparing and analyzing locations or assets that are highly vulnerable. For example, in London risk maps are used to establish risk profiles for particular areas, and have been used in applications as diverse as urban planning and emergency management. In Frankfurt, risk maps are used for operational planning of fire brigades to locate areas (or buildings) that exhibit high fire risks. Finally, maps can be effective tools as intermediaries between different elements of the risk and disaster management cycle (see Figure 4).



Figure 4: Applications of maps to urban risk management

In the observed city cases, maps provided to professional expert advisors and those distributed to the public are separate and different. In most instances, the public are given access to maps that only detail areas subject to particular hazards – generally as a risk awareness mechanism, or to influence public perceptions of self-responsibility. By contrast, risk maps that are distributed to professional experts contributing to risk assessment processes often combine geo-informatic risk information with an illustration of possible or predicted consequences. In Rotterdam, access to risk assessment maps illustrating possible consequences are closely restricted for two reasons: risk managers believed that such maps would cause unnecessary and widespread public concern, and secondly that they could be a potential resource for terror planning.

3.1.4 Coping with Emerging Risks

In order to identify and assess risks for particular cities, disaster managers draw heavily upon the experiences made in other cities. In our interviews, the officials repeatedly referred to disasters in other cities as triggering events for changes in their own disaster management strategies. Often mentioned examples included:

- ◆ Prominent **terrorist attacks** in global cities (in New York, London, Madrid, Istanbul, Mumbai, Oslo and elsewhere) have triggered many efforts in terror-associated disaster management and prevention in recent years.
- ◆ Recent fast-spreading **pandemics**, in particular SARS, A/H1N1 and H5N1 are perceived as potentially dangerous side-effects of globalization (international interconnectivity). International hubs (like Frankfurt, Singapore, Los Angeles and London) are particularly vulnerable to this type of risk. The SARS virus outbreak in 2003 caught

the Singapore government by surprise, and this incident has strongly influenced the Singaporean government's risk assessment process, which have been strengthened with personnel and with new skills and techniques, like horizon scanning.

- ◆ Recent severe hurricanes, floods, droughts and winter storms in many different countries are seen by city officials as manifestations of **climate change**, and risk assessment processes reflect the predictions that these risks are likely to become more frequent and severe, with more significant consequences in global cities in the future.
- ◆ The Fukushima **nuclear accident** in 2011 has changed risk perception of nuclear energy in many countries. A greater focus on the risk presented by nuclear energy production in the German cities was clear.
- ◆ Recent major **power outages** (among others a large blackout on November 4, 2006, affecting six different European countries) have increased risk awareness and perception in Europe concerning such interruptions and the consequences, which were historically low so far.
- ◆ The 'Stuxnet' **cyber attack** against nuclear production facilities in Iran in 2010 was interpreted by many observers, and reflected in the interviews undertaken with city officials for this study, as an illustration of the significant cyber vulnerabilities of infrastructures.

To address these and other emerging risks, many cities we observed are currently enhancing their risk assessment capabilities. A general trend seems to be the institutional integration and technical refinement of risk assessment methods in many cities. A case in point is Hamburg, which has switched from in-house developed risk assessment methods to nationally utilized software. In London sub-regional risk assessments have been superseded in a move to undertake risk assessment using the 'Pan London' approach. Also, on the international level integration

and cooperation efforts are on the rise, often directly affecting urban security.

A fast growing number of intergovernmental and supranational institutions is reinforcing its engagement in risk assessment. For example, in the domain of flood risks, the EU Directive (2007/60/EG) has led to unification of the different approaches in risk assessment, now estimates are much more comparable. Another example is the EU Seveso-Directive (96/82/EC) which increasingly regulates urban planning to minimize risks stemming from industrial production. For a city-State like Singapore, fostering and relying on international risk assessment and management collaboration is essential, and its cooperation with neighboring countries in the control and management of recent pandemics (or potential pandemics) is a good model.

3.1.5 Remaining Challenges

Although the need for comprehensive risk assessments is broadly recognized as a key to urban security, in reality breaking down institutional barriers is seen as a tough challenge by many city officials. A frequent organizational deficit seems to be the lack of cooperation in risk assessment between different administrative levels. For example in Rotterdam, due to the decentralized nature of the government, there is generally little incentive to align the regional risk profiles with the national example. Another common challenge seems to be the disconnection between risk assessments and analysis on the strategic level on the one hand and operational disaster and emergency planning on the other, as it can be observed for example in Frankfurt and Sydney. Also, the involvement of external experts is sometimes seen as complicated. As the Rotterdam official described, keeping experts within timeframes and budgets can be a significant limitation in the risk assessment process,

and one that could prevent it from happening regularly and across different levels of government. In general, conducting comprehensive risk assessments for urban spaces are complex tasks that can rarely be completed by a single administrative body acting alone. Consequently, in many cities we observed efforts for joint risk assessments that often engaged with a broad array of public, private and civil actors. Even so, the creation of tight-knit networks for urban risk assessment – as depicted in Figure 5 – has not been achieved in any of the cities under study.



Figure 5: Idealized risk assessment actor network.

3.2 Risk Mitigation strategies

3.2.1 Preparedness in Urban Planning

In general, terms like disaster prevention and preparedness seem to stand for very different things in different cities: For example, prevention can refer to early warning (for wildfires in Los Angeles), protection plans (against floods in Vienna), or it can be a synonym for public risk communication (London). Of particular concern in many cities is the need to

include aspects of disaster preparedness and prevention into urban planning. The city officials interviewed mainly referred to two factors that have driven the increased prominence of preparedness concepts in urban planning. On the one hand, global incidents often function as trigger events for adaptation in urban planning. As several officials confirmed, reviews of disaster coping capabilities are often done *ad hoc* following real disasters elsewhere. For example, the city of Vienna continuously monitors events in other large cities to critically assess its own level of preparedness:

“We are monitoring current developments around the world. If a relevant event occurs, we use it to review our mitigation plans. Coordinate with colleagues etc. in order to analyze whether our own system could cope with a similar event and what additional measures need to be developed.”^X

On the other hand, urban planning standards and regulations have become increasingly geared towards disaster preparedness in recent years. On all political levels, from municipal land-use plans to international planning standards, aspects of disaster preparedness have found their way into urban planning. For example, the so-called Seveso-Directive of the European Union (96/82/EC) demands significant safety zones around chemical plants. Although the directive has been established several years ago, its application has only recently been enforced by court ruling. As one European official described, the continued legislation of disaster preparedness measures sets an increasingly tight regulatory frame around urban planning practices. Figure 6 picts the key factors that influence urban disaster planning based on

the descriptions provided by the officials interviewed for the study.

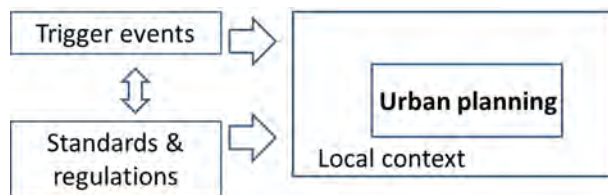


Figure 6: Factors of disaster preparedness in urban planning.

At the same time, despite these general trends, there is little uniformity in urban planning, since local particularities continue to determine local urban planning practices to a large degree. In particular, the level of planning for disaster differs substantially depending on the topographical, technical and social structure of cities. Moreover, several of the interviewed officials referred to financial pressure as a main constraint to more extensive disaster preparedness measures in urban planning.

Consequently, the level of preparedness and preventive measures varies substantially between the different cities. In Rotterdam, preparedness in private organizations is not regulated with specific laws, but can be facilitated by the national government, which provides support to organizations when required. By contrast, in Sydney (and throughout Australia) strong regulations determine the roles and responsibilities of private infrastructure operators in the case of crises or disturbances. Regulation is developed in collaboration with the operator, and sets out the need for emergency response training, specific disaster planning and contingency management. In the most severe incidents, the government reserves the right to take over management of the infrastructure if necessary.

Within-city differences were evident in London. The City of London, also known as the ‘Square Mile’ is the

X Original quote in German language stated: „Wir beobachten auch die Weltlage, und wenn es ein aktuelles Beispiel in der Welt gibt, schauen wir unsere Pläne an und reden mit Kollegen, etc. um zu sehen, wie wäre so etwas im eigenen System bewältigbar, welche Massnahmen müsste man noch setzen.“

central business district, lying within the boundaries of the Greater London Area, where only several thousand people live. Consequently, there is a much stronger focus on managing disaster in the context of business continuity, and securing the built environment (surveillance cameras, building layout, open spaces, transportation, *etc.*). Also, private business organizations are becoming integrated into urban planning for disaster preparedness and prevention. By contrast, risk management in the Greater London Area focuses more on traditional preparedness and prevention processes that have been described previously. In the context of London, there are very different approaches to urban planning and preparedness that vary relative to the occupants of the within-city regions.

3.2.2 Public Crisis Communication

Public crisis communication has always been a central task within urban disaster management. In most cities studied, public alert systems have a long history, particularly in those cities like Hamburg or Rotterdam that have repeatedly experienced large floods in their past. In general, it is important to note that communicating with the public in urban settings is not only a challenge due to the large number of recipients of information to be reached, but also because different urban spaces may require specific communication approaches. For example, alerting large numbers of people in many large office buildings simultaneously can be a major challenge in the case of a disaster. In Sydney, this problem was recognized and a centralized alarm system for business districts was established. However, such a system requires close and ongoing cooperation with managers of the office buildings to ensure contact details are accurate and information about the building's own evacuation processes are communicated. Since its development, the proportion of buildings connected in this contact system has slowly fallen due

to changeover in building management staff and resource restrictions (financial and personnel) that have prevented the city from following up on building information. This example shows how a constant contact between public crisis managers and the population is a necessary condition for successful public communication, which is often hard to achieve in dynamic urban contexts.

Interestingly, in all the analysed cities, public crisis communication today is still based on traditional technologies such as radio alarms, sirens, leaflets, *etc.* Feedback communication from the public to crisis managers has also remained relatively simple, being mainly channeled through emergency hotlines. Designed to operate alongside these traditional mechanisms, in recent years new technologies are being increasingly used to alert large numbers of people facing threats. For example, SMS warning systems have been established in Frankfurt, Hamburg and Sydney to reach the general public in times of crisis. This form of warning system can permit risk information to be distributed in geographically distinct areas (based on mobile phone receiver locations).

However, while considered a fundamental improvement in alerting processes in some cities, we observed that such technological advancements were judged quite differently in other cities. In Frankfurt, after an initial test phase, the SMS alert system was found to be problematic due to low precision and reliability, giving space for some technological skepticism in the local population and bureaucracy alike. In other cities, such as Los Angeles and London, new information and communication technologies (ICT) are already seen as a 'game-changer' in crisis communication. The Los Angeles interviewee noted specifically that the advent of social networking was a positive development since it has enabled the city to change its approach towards public warning – providing information that is timely, personal and closely context specific.

Traditionally, one-way communication channels like radio or sirens played a central role in public emergency communication. Emergency calls *via* telephone were almost the only communication channel that allowed the urban population to contact authorities. Importantly, new ICT like social networks offer valuable opportunities for two-way communication between disaster management agencies and the public (see Figure 7). In London, there is also a trend toward the use of crowd-sourced risk information for disaster management, but the systematic utilization of this material is still in the very early stages. The main issues preventing its use is a natural concern regarding the form of information, how it is created and by whom, and how it can be seamlessly integrated into the existing risk information and planning processes. In order to determine how best to use crowd-sourced information, the London Metro Police Service has initiated a Digital Communications Steering Group to get “ahead of events” rather than being reactive. In Los Angeles, social media is also helping officials to understand how people living in high-risk areas (*e.g.* at the wildland-urban interface where wildfires present a serious threat to the community) are threatened by, responding to, or experiencing disasters.

Depending on the administrative context, crisis communication is organized in different ways. In some cities communication is carried out by regular press offices (tasked to inform the population, coordinate the information flow of the different departments and support the mayor in the public information policy). In many cities, the administrative agency with the main responsibility for crisis communication typically manages a crisis alarm list with contact information of the most important actors involved in crisis management. This list specifies all actors involved in crisis management plans, each actor’s responsibilities as well as contact details. For effective crisis communication, it is essential that the crisis alarm list is constantly updated. In case of disaster, the press offices are normally integrated into the crisis command center, as is the case in Vienna. Another approach is the establishment of specific emergency operation centers which are specially designed to coordinate operational communication between disaster management agencies as well as with the public. In Frankfurt, a specific information bureau (*Kreisauskunftsbüro*) can be quickly established for large-scale disasters, run by the German Red Cross, in order to respond to various inquiries by the public, including the information on the whereabouts of relatives. Similar crisis command

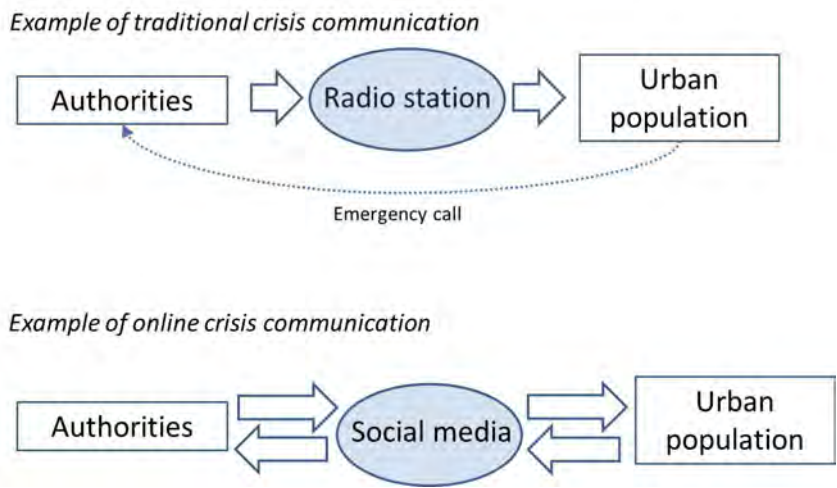


Figure 7: Changes in public crisis communication (Source: own illustration)

centers are established under crisis management policies in Sydney, London and Los Angeles. They are generally established with cross-agency (horizontal integration of city officials from various agencies) collaboration and, in severe crises, with vertical integration of national agency officials.

One of the major challenges in crisis communication we identified is the need to ensure communication channels remain intact during longer periods between disaster events. As the Los Angeles official described, even in cities that face a range of risks, after long period of time without a large disaster interest in alarming the public can wane – this is often demonstrated by a lack of political interest in maintaining what is considered to be, in the short term, an unnecessary expense. The public can also become unresponsive to warnings after long periods of disaster inactivity, and test warnings have become a major practical mechanism to maintain the public's knowledge about, and attentiveness to warnings, as it is regularly done in many countries including Switzerland.

A prime way to ensure effective communication in times of crisis is to go beyond crisis communication in the narrow sense, and to aim for public risk communication that encourages and supports public preparation for the possibility of disasters. In this case, it is important to note that risk communication in urban settings differs from other contexts, because in urban settings it can be a major challenge to reach the target audience effectively, a challenge that is only heightened at the national scale. In this context, social media again presents a new and promising way to reach urban populations. The city of Frankfurt has recently established a YouTube channel to communicate risk information, while Hamburg, London, Los Angeles and Sydney have all developed risk-specific online checklists to assist people to mitigate a variety of risk. Even so, such technical innovations can only advance communication processes to a degree

and must be combined with traditional mechanisms. Additionally, new techniques also require additional resources and effort to develop new capacity (to provide the information or manage the communication platform) in the agency.

Efforts and focus in the realm of public risk communication differ significantly between cities. At one end of the scale, communication of preparation and response measures in Singapore is a central aspect of disaster management. There a special initiative utilizes groups from the community, who are tasked with communicating risk and threat information to the local community. The groups are responsible for developing civil defense approaches (based on centralized processes) that determine who takes responsibility for various aspects of risk management in the local area. By contrast, in Sydney, pre-event communication with the public is managed by the same agencies that are responsible for disaster planning. These agencies develop and distribute information based on each agency's areas of jurisdiction and specialty. In other cities, authorities do not engage in preparedness/risk communication themselves. Likewise, in London, public communication about preparedness for emergency is managed principally by Category 1 responders (first responders like fire service, ambulance and police) themselves, and the Greater London Authority and City of London have no role in contributing to or disseminating risk information. Even so, both organizations together support a working group that focusses on warning and informing the public about risk.

3.2.3 Networks and Resilience-building

In many of the cities attempts to engage stakeholders and the broader population in disaster management processes were observed. These processes have traditionally been dominated by government officials

and experts. The push to devolve responsibility to the broader society (not just official public sector actors) has been spurred by different drivers. These include, as the Los Angeles official pointed out, communities increasingly expecting to participate in decisions about and the handling of the risks they face. Also, as the Greater London Authority official described, changes in government policies (in this case from Labour to the Conservative party) have led to a new focus on ‘resilience’, and particularly on finding mechanisms that help people to help themselves. Lastly, greater community involvement is driven by the realization among disaster management agencies that in many cases the capacity to keep everybody safe from disasters all the time, is impossible. Additionally there is the perception that if people prepare themselves, they can play a central role in mitigating the risks they face, without a significant investment of resources from the agency. Critics of the resilience concept see this approach as a way of ‘responsibilizing’ the population, as a process used by authorities to reduce their own responsibility for disaster management.

In Rotterdam, for example, policy and regulation makes clear that the population has to take care to a large degree for their own safety, therefore emphasis is put on what the individual can do, shifting responsibilities downwards through the disaster management hierarchies. As discussed already in section , this point has led to repeated critique of the resilience concept. In addition, London, Singapore and Sydney have all moved toward encouraging resilience as opposed to relying on agencies’ abilities to ‘command and control’ disasters, as was the traditional approach to disaster management globally.

To date, few cities are attempting to engage the community for greater input into disaster management planning. The Los Angeles official described how communities were becoming more involved in different stages of disaster management:

“This change began as people began wanting a more public service in the case of disaster, with the agencies responding by simply giving information, but now it’s much more of a dialogue between agencies and the public.”

However, commitments to ‘include the community’ or ‘integrate the stakeholders’ are not always meant literally, or do not actually come to fruition. For example, in London ‘community’ refers to the experts who are engaged in the process of risk assessment, rather than members of the civil society. In general, members of the civil society are excluded from the risk assessment process because they are seen to have a different perception of risk than experts or emergency responders – one that would complicate or contradict the official process of risk assessment. In Singapore, community inclusion in risk management basically reflects the perceived need to create awareness, and opportunities for feedback and public participation are very limited. Instead, the Singaporean approach is to foster ‘small unit resilience’ – *i.e.*, to establish groups of people from the community to build a collective approach toward taking responsibility for themselves and encouraging their peers.

In general, based on the results from this research it must be concluded that open dialogue, public involvement and support for self-organization in crisis management, as suggested in the resilience literature, is still in its infancy in the cities under study, despite the popularity of the term or approach (even among interviewed officials). Nonetheless, some remarkable efforts towards increasing resilience could be identified. For example, in Frankfurt, after the end of the Cold War, self-protection (*Selbstschutz*) had lost its importance. Now the city is aiming to strengthen the concept and its practice again, and is attempting to foster self-efficacy. In this case, and others, the fundamentals behind the resilience approach are being applied, though the language used may not be the same as that used in the mainstream literature.

By contrast, in some places resilience has become an overt and all-consuming objective. In London, the aim is to build resilience on the very local level of boroughs, but also increase coordination in response and planning up through hierarchies. In this context, the London Resilience team (LRT) plays a central role, which has recently been subsumed into the Greater London Authority (GLA) since the completion of the London Olympics, when it was established as a focus for their security approach. In Vienna too, attempts to build resilience through close cooperation with partners outside the classic disaster management community have been initiated. Among other activities, the city of Vienna cooperates with private businesses such as energy suppliers, but also with schools in conducting security-oriented competitions for school children. In this context, particularly noteworthy is the ‘*Sicherheits-Kompetenzzentren*’ concept in Vienna.^{XI} These security competence centers are run by the cooperation of first responders (Blauchtlicht-Organisationen) in Vienna and supported by the city of Vienna. They are used to provide the population with security information, but also to enable dialogue between different social actors. These centers can be viewed as a best practice example for creating public dialogue in the realm of disaster management. In 2012, ‘*die Helfer Wiens*’ also organized the ‘*Wiener Sicherheitsfest 2012*’, supported by the local administration. The need to encourage resilience in Singapore is also exemplified by the move to establish the locally empowered community groups to increase and share responsibility for disaster preparation.

Despite such promising initiatives, the results nevertheless demonstrated that ‘creating’ or ‘supporting’ a resilience approach is seldom an easy task. A common problem with resilience approaches is that professional disaster managers frame the public mainly as a problem or challenge, not as a resource. The inclu-

sion of civil society is often regarded as problematic, and one city official even questioned whether the inclusion of lay people in disaster responses is desirable at all, since lay people are normally not trained for extreme disaster situations:

“Die Zusammenarbeit mit freiwilligen Helfern ist eine große Herausforderung: alle wollen gern helfen und bringen sich dann selber in Gefahr.“

Also, in the risk assessment process in the city cases, real empowerment of communities is rare, either because public risk perception is supposed to be ‘different’ from expert risk judgments or because specific risk information is found to be too sensitive for public release. Further, sometimes there are reservations whether the public actually is willing to take responsibility in crisis management or if there exists in fact an over-reliance on professional emergency management. Indeed, in Sydney the official even noted that efforts to encourage preparedness raised the public awareness about the capacity of city and state disaster management agencies, and could be seen to create a situation where responsibility for preparation could be completely transferred by the public *back* to those agencies. This creates a tension that officials from London and Singapore observed: that while the government’s approach might be toward encouraging the population to take care of themselves, the population actually expects the government to take care of them.

Like traditional emergency management, disaster resilience is generally a long term processes. Yet, in comparison with emergency management response, recovery has not always been seen as a top priority for disaster management agencies, even though this focus is beginning to change. In Sydney, a State Emergency Recovery Controller has been recently positioned to undertake community needs assessments following disaster, understand what resources are re-

XI <http://www.diehelferwiens.at>

quired, how they should be delivered, and to agree on the process of assisting recovery. This development has followed insights gained during the last three to five years that have highlighted that to bring communities back to full recovery required a significantly greater investment of resources and time than was previously provided. Now, there are moves to provide better financial support for long-term response and recovery, which is generally still underdeveloped in comparison with short term crisis response. Importantly, as the Frankfurt official pointed out, supporting community engagement and resilience building cannot be done at ‘zero costs’. Yet, in times when the push towards austerity budgets is a priority, especially in Europe, city officials often found it difficult to get financial resources for networking activities and similar ‘non-essential’ disaster management measures.

3.2.4 Tailored Strategies for Vulnerable Sub-populations

In many cities we examined, authorities have been working on, or are planning to work on disaster management strategies aimed at particularly vulnerable urban sub-populations (see Table 3). One of the most commonly reported minority groups that must be considered in disaster management are ethnic groups. Many immigrants, and often also their descendants, have limited capacity to understand and interpret risk and preparedness information, they tend to live in ethnically structured communities,

and sometimes particular moral or religious values may influence perceptions and values about crises and crisis management. As a consequence, these groups are often hard to reach with conventional prevention and risk communication strategies, but in addition require particular attention in crisis situations. In order to adapt to the multi-ethnic realities of urban spaces, many cities have started to publish information in various languages and train language skills of first responders. At the same time, the challenge of disaster management in multi-ethnic cities is not restricted to language barriers. For example, in Hamburg the authorities have introduced mechanisms to acknowledge and include cultural and religious identities in disaster planning in order avoid potential problems – one example has been the use of Christian pastors in disaster relief functions in predominantly Muslim communities.

Another challenge for disaster management that many of the city officials interviewed referred to are socio-economically disadvantaged communities. In many large cities, there are often areas with a high concentration of people with very low living standards. Such communities are seen to be particularly vulnerable to disasters due to poor building standards, their lack of redundancies (e.g. in terms of food or medicines), and their lower financial means. In Los Angeles, disaster management authorities are paying particular attention to the heterogeneity of the population’s socioeconomic situation. In all urban areas, el-

Potentially vulnerable urban sub-populations

| | Ethnic minorities | Socio-economically deprived groups | Elderly and handicapped persons |
|---|---|---|---|
| Exemplary challenges for disaster management | <ul style="list-style-type: none"> • Language barriers • Emergency pastoral care • Culture-specific burial customs | <ul style="list-style-type: none"> • Poor building standards • Low redundancies (e.g. medicals, food) • Low media connectivity | <ul style="list-style-type: none"> • High evacuation effort • Unwillingness to leave homes • Reliance on constant electric power |

Table 3: Urban sub-populations in disaster management.

derly and handicapped persons also require particular consideration in disaster planning, and delivering the optimal support to these groups in disaster situations is an important challenge in many cities. Moreover, with increasing life expectancy, the number of elderly persons in cities is constantly increasing, and due to modern medical technologies, these persons can continue to live in their own homes, rather than specialized facilities. Yet, as the Frankfurt official highlighted, many medical technologies rely on electric power, adding a critical dimension to the often-discussed issue of power blackouts. In order to improve the integration of vulnerable groups into disaster planning, the first step should always be to engage in a fair and participative dialogue with these sub-populations. At the same time, experiences in different cities show that a structural and long-term improvement of the situation for vulnerable groups can hardly be accomplished without additional resources, for example, by building a steady dialogue between authorities and vulnerable groups, or by fostering the multi-language capabilities of emergency organizations.

3.3 Institutions and Collaboration

For many decades, disaster planning and response in urban spaces was the remit of specialized actors, often organized along historically evolved administrative divisions. For example, while infrastructure planning

was typically done by a city building authority located at the mayor’s office, in the case of a major power outage, emergency services would organize crisis response measures to deal with response and recovery. However, as discussed in section 2, such diversified organizational structures have proven increasingly ill-suited to the management of major disasters in urban spaces. Due to the complexity of globalized cities like those examined in this study, the necessity for cross-institution and cross-organization collaboration has become increasingly recognized. No longer can effective disaster planning and response rely on ‘stove-pipe’ solutions to disaster problems or crises. Based on this insight, in all cities we studied, new institutional frameworks have been established in recent years. These frameworks aim to build synergies and collaboration between traditional response and planning organizations in governments and in the private sector. Some reach even beyond national borders. Many of these synergies and collaborative approaches mirror the globalized nature of the cities themselves – where globalization has increased connectivity between business and society; it has also facilitated greater connection fostering knowledge and experience sharing in the realm of disaster management.

In general terms, institutional collaboration was demonstrated to exist at four fundamental levels following discussions with city officials during this study, and this section is structured to reflect these classifi-

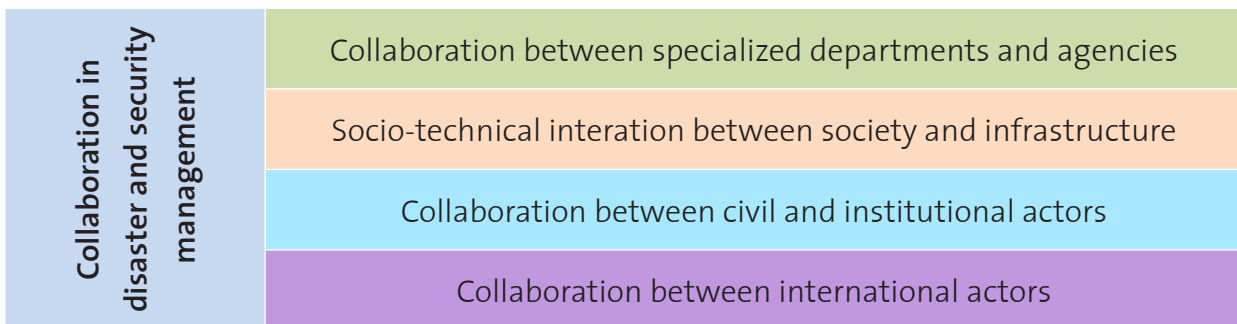


Figure 8: Levels and forms of collaboration in modern disaster and security management.

cations (**Figure 8: Levels and forms of collaboration in modern disaster and security management.8**). Firstly, collaboration between specialized departments and disaster planning and management agencies at all administrative levels is very important in coordinating planning and response to disaster events. Secondly, given the growing complexity of the city, the increasing level of socio-technical interaction between society and infrastructures, and the increasing privatization of these infrastructures in many countries, collaboration between government agencies and the private sector (whether formal or informal) in preparation and planning is increasingly important for maintaining public security and safety. Thirdly, many cities have started to recognize civil society actors as important partners and key resources in disaster planning and response and have undertaken different and interesting attempts to strengthen the ties with these actors. As noted in section 3.2, collaboration between government agencies and community groups is a common goal in many of the cities included in the study. However, the practical mechanics of this form of collaboration remain underdeveloped for the most part. It is therefore of particular interest to discuss the attempts to improve these processes in London, Vienna, Singapore, Sydney and Los Angeles. Fourthly, collaboration with international peers and neighbors beyond national borders is increasingly seen as an effective way of managing the potential consequences of non-geographically bound disasters (like financial crisis, cyber-attack and security, or terrorism), or geographical disasters occurring in close neighbor countries, where the consequences extend beyond the borders of that country (particularly relevant in the European cities examined and in Singapore).

Within this structure we also describe novel overarching strategies, responsibilities, practices and recent changes in collaboration in disaster management planning and response. The section explores plan-

ning features that support these characteristics, like capacity for and a focus on organizational learning, the need for collaborative exercise and training, and resourcing. Additionally, we examine some apparent deficits in planning that could hinder institutional collaboration and cooperation in disaster management processes and actions.

3.3.1 *Disaster collaboration among authorities*

Institutional collaboration between different authorities was described by city officials as important because it helped to facilitate an integrated response to disasters or crises. Importantly, these collaborations should optimally include authorities directly responsible for disaster management. These include fire departments and other emergency services, as well as the institutions or agencies that are indirectly relevant to disaster management in urban contexts (including among others institutions that govern critical infrastructures or responsible for environmental protection). In most cases, mechanisms that encouraged this form of collaboration sought to ensure agencies could work closely in response to crises. The establishment of clearly defined structures to delineate lead and supporting agencies, and roles and responsibilities that were incident specific was highlighted as a fundamental process in cities like Sydney, Los Angeles and Rotterdam.

Recent changes in legislation in London, for example, signify the importance of a holistic government approach to disaster management, which now focuses on encouraging a ‘pan London approach’ to emergency. The Civil Contingencies Act was introduced in 2004 and repealed the Civil Defense Act (1948), partly because the existing legislation (established at a time when civil defense was considered paramount) could not effectively assist the coordination of a whole-of-government response to nationally

important disasters with cascading consequences. While the cue for this change was hastened by the terror attacks in New York in 2001, the new legislation was introduced in direct response to significant and complex disasters that the United Kingdom faced in the early part of last decade: particularly flooding in 2000 and 2003, and the foot and mouth disease outbreak in 2001. To effectively meet such crises, the new legislation redefines ‘emergency’ with a much broader meaning, broadens the number of agencies that play a role in emergency planning and response, and defines how these agencies interact and share information. The historical sub-regional approach was superseded by the ‘pan London approach’, but local boroughs continue to play a significant role in risk mapping and communication through the concurrent establishment of the Community Risk Registers.

The Civil Contingencies Act is one example that illustrates how institutional emergency management operations are increasingly connected through horizontal *and* vertical coordination processes. In London one single agency with oversight across multiple disaster response organizations is responsible for this coordination. In London it is the ‘London Resilience Team’, which directs priorities for emergency management within the Greater London Authority (London-wide strategic authority) and the City of London (authority for the ‘Square Mile’, London’s central business district). Likewise, in Singapore the National Security Coordination Secretariat was established to strengthen “the coordination and integration of government agencies into a cohesive network”.^{XII} The Secretariat is not any more in charge of day-to-day emergency and disaster operations. This task has been assigned to the Emergency Crisis Group within the Home Office. The Secretariat is located within the Prime Minister’s Office and applies a strategic and long-term approach to risk management and

urban security. Both cross-agency organizations in London and Singapore are tasked with overcoming the traditional agency operational ‘stovepipes’ that have sometimes caused uncoordinated operations, even competition for resources between agencies, in response situations. Even where such horizontal, cross-agency coordinating organizations do not exist, incident planning processes often ensure that disaster planning and responses are coordinated across agencies, seeking operational and planning buy-in from all agencies that may respond in a given incident context. This is the case in cities like Sydney, Los Angeles and Rotterdam, where local, regional and national government agencies have legislated interaction requirements to ensure coordination in especially nationally significant disaster events. Yet, effective collaboration can also function rather informally. For example, regular meetings between first responders and city disaster planning officials have improved informal collaboration in the city of Vienna. These informal coordination meetings have become an important mechanism to forestall disaster response coordination problems and to increase first responder trust in strategic disaster planning processes.

On the operational level of urban crisis management, collaboration in response to disaster mostly depends on the type, seriousness, consequences, and extent of the event or incident being responded to. In most instances, the operational mechanisms for collaboration in crisis situations follow the subsidiary principle. In cities like Sydney, Rotterdam, Los Angeles, Vienna and Frankfurt for example, operational responses to disasters within cities are initially under the jurisdiction of local government agencies or ‘first-responder organizations’ – specifically the agency with the closest direct capability relative to the disaster or event. In Sydney, the Ministry for Police and Emergency Services is responsible for coordinating disaster planning at the city level, and in Los Angeles the Sheriff’s department (county level) fills the same role. These

XII <http://app.nscs.gov.sg/public/content.aspx?sid=27>, accessed 08.01.2013.

organizations collaborate closely with State and Federal disaster planning agencies, but have first responsibility at the city level for disaster planning. In Rotterdam, city agencies are responsible for disaster planning. In case of an incident, they are responsible for the first response.

In this context, designated operational collaboration between local, regional and national government disaster management agencies and organizations is important for two reasons. Firstly, this form of operational collaboration ensures that local and regional government agencies can rely on support from national agencies and a wider, more resourceful support network if emergency or disaster conditions exceed local or regional response and management capacities. All cities in our study are population and commerce centers of national importance, where globalization has increased complexity in communication, services and infrastructure. At the same time, the means and methods for responding to urban disaster have often become more complex. It is therefore important and imperative, that they have the possibility to resort to the support from national institutions. Secondly, while ensuring the possibility that lower hierarchical levels of government have support when needed, such collaborative inter-agency structures also prevent an over-allocation of resources (financial, personnel and technical equipment) for emergency management where these resources may not be required on a permanent basis.

Institutional collaboration in resourcing

Financial resourcing and collaboration was an interesting, but also sensitive issue that some of the officials interviewed were reluctant to address. In the context of resilience, which encompasses a fundamentally bottom-up approach, financial resourcing is sometimes viewed as difficult. While government

agencies seek accountability in spending, bottom-up approaches may mean gaining accountability may be more difficult given that decisions behind how resources are used are made outside of government. While devolving resource use decisions may run contrary to the financial accountability imperative that often exists in government, most cities' circumvent this issue by conducting disaster planning processes at the city, or regional level, with funds coming from different administrative levels, but mostly from central governments. In underfinanced cities in particular, the dependency on national funds can lead to tensions between the cities' desire for planning autonomy on the one hand and the central governments' requirements for control and accountability. For instance, the city official from Rotterdam noted that due to the decentralized nature of the government in the country, there is often little incentive for regional risk managers to align their regional risk profile development with national risk management practices and processes. This outcome is rather surprising as the development of regional risk profiles is financed by the national government and expected to foster stronger collaboration between the central and regional governments. This highlights a tension that often exists between different risk management agencies within a nation's risk management hierarchy, regardless of recognized requirements for more extensive collaboration. In many instances, these tensions seem to be a throwback to fragmented institutional approaches to disaster management among organizations at the local or regional levels (other examples of similar issues were mentioned by officials from Sydney and Los Angeles).

Even so, many cities have begun to develop institutionalized vertically mechanisms, for collaboration, particularly the case in large scale disasters when local authorities are not only overwhelmed with regard to equipment and organizational processes, but also financially. In these instances, the affected local

or regional governments could call on central governments to assist in disaster response and recovery. In addition, many cities have institutional mechanisms that national governments could call on to provide special funds for disaster response and recovery (which themselves could become politicized). For example, a disaster with significant consequences in Sydney might be labeled a 'State of Emergency', which then opens the opportunity for the State government to draw on Federal government financial support for response and recovery. Yet, as with disaster planning, central governments normally do not offer such resources without maintaining a certain degree of financial oversight over their spending, which again narrows the space for self-organization at the city level.

Collaboration in recovery

While there have been significant developments in institutional collaborative processes at the strategic and operational levels in disaster planning and response, similar attention has not been afforded to inter-agency collaboration in city disaster recovery processes. While in some cities (like Sydney and Los Angeles) the approach to recovery is changing and more financial resources are being allocated for recovery purposes, institutional collaboration in recovery processes remains reasonably traditional. While recovery planning is undertaken by state government agencies that are also typically in the lead of the recovery process, they often liaise closely with non-government agencies and organizations, which typically have the largest on-the-ground presence in recovery actions. An example is the issue of socio-psychological aftercare, which has received considerable attention from crisis management scholars as well as practitioners in recent years.

Vienna has increased its cooperation with different public and non-governmental organizations to improve the psychological assistance to people (and city emergency workers) affected by disasters. This service particularly focuses on psychological consequences of disasters like post-traumatic stress disorder. In addition, where recovery was historically managed by first response organizations, it is becoming increasingly apparent that these agencies lack the capability, capacity and resources to effect recovery – an issue that is especially relevant in the longer term given the increasing unpredictability and severity of disaster events. Lower capability and capacity is perhaps associated with recognition that prevention, *i.e.* the role of first responders in preparing and reacting to incidents might be less important in large scale and complex incidents. This also changes the way financial resources are allocated. In Sydney, for example, more financial resources are now being directed to recovery activities, where it was once provided primarily to first responders. This mirrors shifts in many national climate change policies (*e.g.* Australia, UK, USA) where the priority for mitigating climate change issues for society is now secondary to adapting to the forecast changes. A similar shift in attention and financial allocation was evident in the Los Angeles Sheriff's department recovery planning.

3.3.2 Government disaster collaboration with the private sector

All city officials noted the necessity to closely collaborate with the private sector in times of disaster and crisis. One of the main areas of collaboration is in the field of critical infrastructure. In this area we can also see the fastest growing relationships between government agencies and private sector businesses in the context of disaster and crisis. In many of the cities included in this study, the majority of the critical infrastructure is owned, operated and managed by

the private sector. Yet these infrastructures provide critical services for urban populations, and whether or not governments are involved in the operation of these infrastructures, they have a responsibility for the population, ensuring they can live safely and securely in the urban environment.

As a consequence, many of the city officials interviewed highlighted their close cooperation with private critical infrastructure operators in the context of crisis management. In most cases, government agencies do not formally regulate their involvement anymore. As a special case, legislation exists in Sydney, for example, that allows the city to take operational control of infrastructure like roads, electric powerlines and telecommunications installations. However, the invocation of this legislation is typically avoided in favor of less formal collaborative approaches to solve problems of critical infrastructure resilience and operation during disturbance. Collaborative approaches and dialogue with private operators are the predominant mechanisms that government agencies rely on when they plan disaster responses. Many cities have developed close working relationships with private operators that permit information sharing, and support open dialogue about risk planning processes.

Interestingly, formal (legally arranged) public-private partnerships (PPP) in critical infrastructure disaster management did not seem to predominate in the cities interviewed. Even though such structures are theoretically considered to be popular in academic discussions about critical infrastructure protection and management, in practice this form of cooperation is less formal and *ad-hoc*.⁽¹⁹⁾ Nonetheless, there are several domains in which public-private partnerships play an important role. For example, some of the city officials highlighted the existence of specific disaster management agreements covering large chemical factories, airports and other infrastructures. Frankfurt, for example, has developed an agreement

with the Frankfurt airport operator that regulates the responsibilities and cooperation mechanisms in case of a major disaster at the airport. Another area where public-private partnerships are important and often applied is in the context of cyber security. The Los Angeles official interviewed noted that the nature of the internet, as a diffuse global entity, with a growing connection to the delivery of critical services in society, meant that cyber security in the United States is increasingly addressed and treated through PPP arrangements. They are built on trust and mutual benefit and reciprocity. Strong cyber-specific PPPs in the United States exist between private business companies and governmental agencies on the county, state and federal level. The inter-relationship between internet providers and other operators as well as the government are deemed necessary to address the potential threat from cyber security issues adequately.

Less formal approaches to collaboration between government and the private sector are heavily reliant on trusting relationships between these stakeholders. In fact, these relationships are often facilitated by the fact that major operators of critical infrastructure are private companies that are at least partly owned by the city, and frequently exchange their leading personnel. While operators are given the freedom to conduct their own risk management processes, these should be conducted in line with government policy and with government support. Yet, this situation raises the question of what happens if agreed positions and actions do not come to pass in the case of an incident (as is most often the case)? Most cities could not answer this question. This is case because there is no experience of major disasters since the city authorities engage in less formal interaction with the private sector. Yet, the Rotterdam official provided a good example that has further encouraged the city's close collaboration with private infrastructure operators. It has also influenced its approach to critical infrastructure continuity management. For example, in

April 2012, a large structural fire destroyed the transmitting capacity of mobile and fixed telephone service provider Vodafone in Netherlands. At the time, this major telecommunications provider was also the central government's phone provider. As a result of the fire, the government was consequently without telecommunications capabilities for a period – a potentially serious issue had the fire been part of larger incident or disaster affecting the city. This kind of incident highlights that while there is an expectation that infrastructure managers undertake adequate risk management and are responsible for the continued operation of the infrastructure, governments must also closely engage with the private sector to assist in maintaining service continuity, but also have a continuity plan for key resources and services such as communication..

In the City of London, where businesses (not individuals) are the main target audience of the City's risk managers, businesses are increasingly being incorporated into risk planning processes. The City of London recognizes that companies actively engage in risk planning and develop appropriate responses to risks, illustrating their interest in addressing risk. To this end, the City of London actively involves businesses in the planning and recovery processes. Businesses on their side are invited to share information that could also assist governments' strategic risk planning. Such reciprocal processes in risk assessment, planning and management bring private and public risk management stakeholders closer together in understanding how disasters or disruptions might be dealt with. It also helped in identifying inadequacies, incapacities or lack of capability in resources, planning or other areas, which can better be addressed before disaster strikes.

As mentioned in section 3.2, Sydney disaster management planners are engaging corporate building managers in alert systems for city workers. Closely

following the establishment of this collaborative early warning system, Sydney city officials had 80% of Sydney central business district buildings enrolled in a system where disaster messages were sent to building managers. Based on this information, they initiated building evacuations or other necessary responses. These building managers were important partners in the city's response to incidents. This is a good example where city officials have found novel ways to engage with private sector partners to contribute to the safety of people living and working within the city's boundary. However, such systems require constant attention by disaster managers to periodically update contact information. The city official mentioned that with recent budget and staffing cuts, the maintenance of the system has suffered. As a consequence, the number of buildings remaining part of the system has declined to only 40–60%.

3.3.3 Institutional collaboration with civil society

In many cities, the involvement of civil society in disaster management continues to grow in response to the increasing demand from the public to be consulted on decisions about risks that have a direct impact on their lives and lifestyles. However, involvement of the broader public in disaster management has largely been restricted to aspects of individual, household and community preparedness for disaster. More technical aspects of disaster risk management like risk assessment and disaster response are still not part of this collaboration arrangement.

It is possible that greater efforts to involve the community in disaster management processes has sharply increased in response to governments' favoring the development of resilient societies. This development can particularly be seen in the non-Germanic cities of this study. However, it could also be argued that resilience approaches also predominate in cities like

Frankfurt, Hamburg and Vienna. Yet, they may not be termed as such. The interview with the Sydney official highlighted an additional nuance that the acceptance of resilience as a popular policy tool or approach may be secondary to the relatively recent realization among risk managers that governments alone cannot effectively mitigate the consequences of disasters on the scale at which they are increasingly occurring. In Sydney at least, official policy positions often specifically highlight that government resources may not be capable of preventing loss under all circumstances. A policy position paper by the Australasian Fire and Emergency Services Council states that:

People should be allowed and encouraged to take responsibility for their own preparedness and safety in bushfires. Fire agencies should support and assist them to manage and prepare for bushfire, and encourage people to understand fire and to take actions necessary for their own safety. People living in bushfire-prone areas should be encouraged to have appropriate insurance to cover the full replacement cost of assets.

The steps that people take to prepare for bushfires are crucial to the protection of lives and property. Fire agencies will provide support and assistance during bushfires when and where possible, but their effectiveness will be compromised if people or properties are not adequately prepared for bushfire.^(90, p. 6)

While there are efforts in cities like Sydney, London, Rotterdam and Los Angeles to increase the involvement of community members in risk assessment processes, the development of effective modes for engaging civil society in risk assessment are in their infancy. Involving members of the civil community in engaging risk assessment processes is not only seen as a way to identify risks and threats in a bottom-up fashion. This practice is also viewed as a useful way of increasing community awareness of risk, of civic responsibilities to respond to risks, and the need for

broad citizen preparation in anticipation of future incidents. The growing popularity of the practice of community involvement reflects the possible scale of incidents, the size of threatened populations, and the corresponding inability of government agencies to ensure the safety of each individual in its response. Even so, there remains the perception that providing too-detailed information to the public about potential risks could have positive and negative ramifications: the latter including excessive fear.

Citizens have long been involved in voluntary roles in disaster recovery in most cities analyzed in this study. However, the growing popularity of volunteering during disasters in recent times has increased the number of civilians in disaster zones. Managing volunteers' activities has become a challenge in itself for government officials in cities like Sydney. In many places (for example, Sydney, London and Los Angeles), international human welfare organizations like the Red Cross and Salvation Army work closely with government agencies to help organize and manage voluntary contributions in times of disaster.

3.3.4 Collaboration with neighbors and peer cities

Many disasters may occur in one location, but the consequences may be far-reaching, even across international borders. In order to address such cross-border or cross-jurisdiction impacts, many city disaster management officials rely on collaboration with international partners to improve disaster management practices. This collaboration also helps to gain wider traction in dealing with disruptions that may occur across national borders. The nature of global cities in this study, as hubs for international transport, finance and communication, underscores their interest in establishing, and drawing on international associations to improve and strengthen local approaches to disaster management.

International collaborations were most notable in Singapore and the European cities in the study. Singapore's double role as city and nation means that it is particularly reliant on close and meaningful cooperation with its neighbors for effective risk identification and assessment, even for assistance in disaster mitigation and recovery. The interviewed city official pointed out that collaboration with Malaysia and Indonesia, in particular, to mitigate Singapore's risks from potential H1N1 and SARS pandemics in the last decade was highly important. The Singapore official noted that diplomacy is extremely important in international collaboration concerning disaster and other potential risks, citing also issues with migration and the necessity to share cross-border information on terrorism activity in the Southeast Asian region. Likewise, the close proximity of countries in Europe, and the already strong political ties between these countries (for example, through membership in the European Union), has fostered strong collaboration in disaster management and response. The Hamburg official noted that while international cooperation is somewhat limited, partnerships in training have occurred in the past.

In Sydney and Los Angeles, international collaboration also occurs, though is more focused on learning from international disaster management specialists and international experiences. For example, both cities face seasonal risks from wildfires. They have developed context and geographically specific experience concerning the way these risks are mitigated, how response is organized and conducted, and how affected communities recover. The Sydney official noted that in the last five years, considerable effort has been directed to sharing research, personnel and equipment between New South Wales and California wildfire management organizations. Although context-specific differences limit some aspects of the benefit derived from working together, such collabo-

ration has positively influenced wildfire management practices on both sides of the Pacific.

In this section we have described the current state of urban disaster management and planning in eight global cities. Many of these trends are reflected on in the context of the background of active research and disaster risk management development that is detailed in section 2. For the most part, while there are some general trends in urban disaster management in the cities studied, there are no clear patterns, or systemic similarities between cities. This pattern can be reflected in the natural acquisition of new processes and practices that is driven by the active and dynamic nature of disaster management. Two points are particularly noteworthy. Firstly, city disaster managers actively develop new practices that suit their circumstances. Both new research and experience help city disaster managers to evolve their approaches to disaster management such that they suit the specific circumstances of their cities. Secondly, disaster managers actively share information and approaches within the disaster management community. Both processes yield a rather haphazard composition of disaster management strategies in the city, but these are invariably tried and tested. When they do not suit the city specific circumstances, new techniques are explored and introduced. While this process of change may not happen overnight, this study illustrates that change does occur in the short to medium term.

4 CONCLUSIONS AND IMPLICATIONS FOR SWITZERLAND

Based on the results presented in section 3, we provide some general concluding remarks about the results in the following subsection (4.1). Drawing from the general conclusion, we outline several implications that may be helpful in the future development of disaster management practices in Swiss cities (4.2).

4.1 General conclusion

At a time of accelerated globalization, urban disaster management is becoming increasingly complex. City officials are responding to the shifting nature of these disasters with dynamism and adaptability. We draw six general conclusions from the research conducted in this study, each of which reflects the changing aspects of disaster complexity and disaster management adaptability. We highlight that modern disaster planning is being characterized by the need to adapt to uncertainty and unpredictability (4.1.1). We illustrate that recovery following disaster is becoming just as important as the response to disaster events (4.1.2). We show that government actors are taking on new roles in the planning and management of disasters in cities (4.1.3). We explore the challenges and opportunities presented by new disaster communication technologies (4.1.4). We highlight the need to target disaster preparedness information at vulnerable sub-populations within cities (4.1.5). Finally, we point out that disaster management agencies and institutions are increasingly thinking beyond traditional jurisdictions or borders in order to address risk from complex crises (4.1.6).

In drawing these conclusions, it is important to note that they are constrained by the information gained from the interviews conducted with the city offi-

cial. This is a typical methodological limitation of interview processes. However, the study's results also draw on information gathered from both desktop analyses for each of the cities as well as from peer reviewed and grey literature. These additional sources strengthen the conclusions' argument. Nevertheless, when referring to trends, we do so based only on the study's results, and do not generalize beyond the cities included in the work. These trends are drawn on and discussed in the context of Switzerland's own city-level disaster management processes.

4.1.1 Adapting to limited predictability

The increasing complexity of urban areas, combined with growing complexity in the nature of risks, inevitably leads to decreased predictability of new risks. In general, we found that city officials are very open to new approaches in disaster management. Disaster management is by no means a static field. City officials seemed to closely follow academic discourses and to apply techniques or methodologies that suited local contexts and circumstances as well as yielded proven results.

Overall, we found that cities adopt a double-track strategy in response to the decreased predictability of potential disasters. On the one hand, cities are improving their capacity to predict new or unforeseen risk possibilities. To this end, all cities have significantly stepped up their capabilities for risk assessment and risk analysis processes in recent years. While sophisticated scenario or forecasting techniques (as can increasingly be found on the national and international level) still remain the exception on the city level, the majority of the cities we examined either has been, or is currently, systematizing its risk iden-

tification practices in order to spot potential hazards and vulnerabilities early. These techniques for risk assessment often build on tailored software tools.

On the other hand, some cities increasingly acknowledge the limits of disaster prediction. As a consequence, many of the reported techniques and the methodological changes in recent times seem to reflect an understanding among city disaster planning officials that they cannot prevent or plan for disaster using traditional linear means-ends rationalities. Instead, new approaches are being developed that allow management processes to adapt to changing risks and new risk environments. Among such adaptation measures, we observed a variety of efforts to increase the flexibility of disaster response. Initiatives like a focus on fostering the self-efficacy of communities, or strengthening the networks among actors involved in disaster management across administrative and territorial boundaries are representative in this context. These trends closely echo the theory-driven resilience approach, discussed in chapter 2 of this study.

In this context, the rise of the resilience approach in disaster management can be viewed as either fortuitous or subsequential. Fortuitous, because the resilience approach is perfectly suited to responding to new or changing risks that (may) require shared responsibility and response. Subsequential, because the recognition that shared responsibility is important may have driven management agencies to seek and deploy new modes of disaster management and response, like that embodied in the resilience approach. Whether fortuitous or subsequential, the insertion of resilience into policy in the last five years reflects both the concept's suitability and popularity. It also reflects the adaptive nature of disaster risk managers and the move away from traditional philosophies and actions concerning disaster prevention. At the same time, we observed that new adaptive measures are not completely replacing the tradi-

tional structures of urban disaster management, but are used in a complementary manner. Traditional approaches to disaster management are deeply rooted in the political and social systems where they originate. In this regard, new technologies, processes or practices are implemented to supplement existing mechanisms or partnerships between governmental agencies and voluntary groups, for example.

4.1.2 *Response and recovery*

An important shift can be observed in urban security practice that embodies a stronger concentration on institutionalized support for recovery following an incident or emergency. This change can be traced back to a common acknowledgement in the disaster management community, where despite the continued refinement of safety mechanisms and risk management systems, there are limits to the return on investment of resources deployed in direct response to a disaster. Historically, most disaster management resources (technical, financial and personnel) have been allocated for disaster response. However, with the changing nature of risks facing large cities, city officials are increasingly focusing on how to best facilitate appropriate recovery. In addition, governments appear to be taking a stronger role in this area, which has historically been the realm of humanitarian organizations, like the Red Cross and Salvation Army (*Heilsarmee*).

While this shift is evident, the lion's share of government resources dedicated to reacting to disasters or emergencies are still directed to the initial disaster response. Even so, ensuring communities, infrastructures, services or systems recover adequately and appropriately, within as short as possible a time-frame remains a fundamental goal of city disaster managers. Returning to 'normal' (where feasible or even possible) is the key objective in disaster recovery.

Importantly, as the complexity of the city-system increases, the ability to bring systems back to full function quickly becomes more difficult. For instance, Haimes⁽⁷⁸⁾ points out that while socio-technical sub-systems of the city (water supply utilities, energy grids, roads and bridges, etc.) may be functionally independent, major incidents may cause snowballing discontinuity in services across a subset of these sub-systems due to their inherent connectivity – a problem that may not have existed 10–15 years ago. In the modern city, Haimes argues, “the chain reaction that characterizes almost all disasters stems from shared resources and shared functionality among the various sub-systems”.^(78, p 1843) Effectively recovering (to ‘normality’) socio-technical systems that are characterized by shared resources and functionalities can be extremely demanding. A stronger governmental investment of resources towards recovery consequently reflects the difficulty and necessity of bringing ‘systems of systems’ back online following an emergency or disaster in modern urban areas.

4.1.3 *New roles for government actors*

The increased focus on flexible and adaptive approaches for coping with urban disasters has had major influence on the organization of disaster management in the cities under study. Disaster responses that can be characterized by a ‘command and control’ attitude and are organized in a purely hierarchical institutional manner are no longer standard practice. The city officials interviewed recognize that without shared responsibility (between governments, the private sector and members of civil society) it is very difficult to deal with today’s increasingly complex emergencies and disasters. Indeed, if Haimes⁽⁷⁸⁾ is correct, then this shared responsibility may magnify the consequences of disaster in modern urban areas, exaggerating connectedness and interdependency. While responsibility sharing may have become a key factor

in disaster management, government institutions nevertheless retain the legal authority (and overall responsibility) for disaster management. Therefore, instead of dissolving their role into a ‘network of irresponsibility’, governmental actors are increasingly found to have redefined their role in disaster management from one of command and control to one focusing on coordinating planning processes, synchronizing responses and encouraging joint exercise and preparation.

Interestingly, few of the collaborations between governmental authorities and other actors we observed were enforced by legal regulations. Interestingly, also cooperations between government and the private sector relied to a large degree on non-binding agreements. Where such regulation did exist, they were secondary to dialogue and shared trust. Arguably, it may be practically impossible to create legal obligations that would govern all the possible cooperative relationships that would be needed for the management of modern disasters in cities, including planning, responding and recovering. Consequently, the emerging system seems to be built on voluntary collaboration, leaving most of the formal responsibilities of the actors involved intact. This coordinated approach not only has the advantage that it keeps the formal duties and responsibilities intact, it also addresses some of the resource limitations that affect governments’ abilities to prepare for or respond to disaster adequately. While city officials are well aware of the utility of measures that foster self-efficacy at the community level or establish stakeholder dialogue about disaster, they also are constrained by scarce institutional resources (financial and personnel particularly). In this sense, building partnerships is seen as a way to deliver long-term goals, like community resilience building.

The city disaster manager can foster resilience ‘from the bottom-up’ by bringing together key social actors

and partners in disaster stakeholder dialogue and by supporting the public outreach activities of partner organizations. An alternative way to engage more directly with stakeholders and the general population is made possible by new information and communication technologies. For example, social media networks facilitate many new opportunities for direct exchange between existing partners and the establishment of new partnerships between authorities, social stakeholders and the general public.

The development and application of scenario exercises are other areas where governments increasingly play an important role. These long-term planning exercises can serve several goals. First, they allow institutions to identify and address risks proactively and facilitate planning for the most probable, not just the most recent disaster. Second, exercises are the best way to determine whether urban systems are prepared for disaster or not. Finally, scenario exercises can be used to strengthen cooperation and coordination mechanisms, but more importantly to build personal networks and mutual trust.

4.1.4 *Putting new technologies in context*

Disaster managers are typically 'early adopters' when new technologies that increase the disaster risk mitigation potential or the effectiveness of the disaster response become available. The application of new technologies, which can be deployed to serve known and particular purposes, are characteristic of all stages of urban disaster management. New technologies that improve disaster communication are generally no exception to this pattern.

In the last five to eight years, social media has grown into an influential form of mass communication. City disaster officials interviewed in this study recognized that social media is a powerful tool to quickly com-

municate to a large number of people about disaster risk and management actions in real time. Many disaster management agencies of the cities analyzed actively communicate through social media. However, the medium's use by disaster management authorities as an institutionalized method of communication is in its infancy and therefore still attracts a modicum of wariness.

One new application that social media has been used for in several recent significant disasters (earthquake in Haiti; flooding in Brisbane, Australia; Hurricane Sandy, New York) is 'crisis mapping'. Geographic information systems (GIS) are already important tools for planning land-use in urban areas, risk identification and assessment. Increasingly, it is also used for situational awareness by professional emergency managers in crisis. Social media is now being used by the general public to communicate about disasters. Usually, volunteers draw this information with specially developed software into a real time 'crisis map'. While such real-time mapping of disaster by the general public is an attractive resource for institutional disaster managers, there are still concerns that the information contained within crisis maps is unverified and not entirely trustworthy. Aside from the mapping and communication possibilities that social media presents for disaster management, new technological systems like social media networks can significantly enhance risk and crisis communication between city officials, other organizations involved in disaster management, and the general public.

4.1.5 *Targeting vulnerable sub-populations*

In cities, the weakest link in the disaster plan and response are often the vulnerable sub-populations or minorities. Cities are diverse, and there can be many sub-populations with own cultural or ethnic identities, poor local language skills, or fewer financial

means. They may not receive, interpret correctly, or properly understand disaster risk management information or warnings. Likewise, the elderly, people with health problems or disabilities require different communication techniques or information than the general public, and may require extra physical assistance, especially during a disaster and in case of evacuation.

Many of the city officials we interviewed were attempting to address these inherent differences in risk awareness and action. This is especially the case because targeting sub-populations is an important means by which disaster managers can improve their city's general response to and recovery from disaster. Managing disaster properly in the city and ensuring urban security, is about bringing the responses of diverse population components together in a holistic and comprehensive disaster management process.

While the issue of demographic diversity is widely acknowledged among disaster managers, the means to address it are often not clear and are certainly sub-population specific. This translates to the need for extra resources to support nuanced risk communication and disaster planning processes. In several of the cities, disaster planners are taking steps to improve the demographic mapping of their cities in order to accurately locate vulnerable sub-populations – a necessity if these populations are to be specifically targeted. Other cities distribute risk information in several languages that correspond to the most important sub-populations. In cities like Singapore (Singapore United) and Sydney (Community Bushfire Units) disaster managers are establishing community-based groups, who are familiar with local risks and disaster management processes. They can communicate important information to the other members of their communities in a contextually sensitive manner. Being derived from the community itself, these forms of communication are often accepted and trusted more than generalist information distrib-

uted *en masse* to the at-risk population.^(91–94) In Los Angeles, closer dialogue between disaster managers and members of the public, particularly using public meetings to obtain feedback on disaster planning processes, has been a powerful means of gaining a stronger understanding of community-specific disaster risk management deficiencies or opportunities. Ultimately, the mechanisms used by cities to target sub-populations must be specific to the cities, to the hazards the sub-populations face, and to the nature of the sub-populations themselves.

4.1.6 Thinking beyond borders

Disaster risk managers and planners are increasingly thinking and planning outside of the traditional jurisdictional boundaries that characterized their historical operational 'territory'. While geography remains the basis for planning, closer consideration of issues beyond traditional planning boundaries is now a fundamental feature of disaster planning. This development mirrors the recognition that cities are geographically expanding, but after all spatially distinct. The need to incorporate beyond-border contexts in modern disaster planning is particularly evident in places that share geographic, cultural or political closeness. For example, Singapore actively cooperates with neighbors Malaysia and Indonesia in its disaster planning and risk assessment processes. Countries in the European Union may be bound to shared agreements that encourage cross-border disaster planning or incident response training – for example between Germany and Austria. Cities like Sydney, which is relatively isolated compared to other cities in the study, nevertheless draw on the international disaster community to improve practice. In the context of wildfire, a hazard that both Sydney and Los Angeles face, personnel, researchers and techniques are often shared. Globalization may complicate disaster responses, but it also connects disaster managers.

The breakdown in jurisdictional adherence in the disaster management field is not only occurring in the geographical sense. Institutional integration, both horizontally and vertically, is now a fundamental characteristic of disaster planning and management processes and practices. The driver may be related to questions of how best to organize systems of responsibility to manage complexity in disaster or threat adequately and effectively. This point reflects the increased need to adapt to new, more complex and unpredictable risks, and is closely connected to the discussion highlighted in sections 4.1.1 and 4.1.3.

4.2 Implications for Switzerland

Switzerland is a strongly urbanized country – around 75% of the Swiss population lives in urban areas (~6 million people).^{XIII} In addition, in the most populated part of the country, north of the Alps, population density averages almost 190 people/square kilometer. Patterns in population and internal migration observed by the Swiss Federal Office for Spatial Development (*Bundesamt für Raumentwicklung ARE*) also show that urban populations are growing at a faster rate than rural populations, mirroring similar patterns that can be observed on a global scale.^{XIV} At the same time, urban areas in Switzerland are characterized by particular vulnerabilities towards disaster events, for example caused by climate change.⁽⁹⁵⁾ Consequently, developing effective urban security and urban disaster preparedness strategies must be a central objective at all government levels of the Swiss federal system. Yet, the very characteristics of Switzerland's urbanization present both advantages and disadvantage in relation to potential disaster.

XIII Schweizer Bundesamt für Raumentwicklung ARE <http://www.aren.admin.ch/dokumentation/00121/00224/index.html?lang=de&msg-id=27412>, accessed 22.01.2013.

XIV United Nations Population Fund, <http://www.unfpa.org/pds/urbanization.htm>, accessed 22.01.2013.

In the context of globalization, the increasing centralization of services in cities, and the issues these present for managing disaster and security in urban areas, the small size of Switzerland, its good transport system, and the country's location at the center of Western Europe (access to resources, assistance, markets, etc.) present strong advantages in relation to disaster management. In Switzerland, these features permit factories and service providers to be distributed throughout the country (even in rural areas) without losing access to central urban markets and international distribution channels. This distributed nature of services reduces the country's vulnerability to disaster and confers a strong element of resilience (in a form of 'urbanized redundancy'), in that if one city or urban area is struck by disaster, not all the services that support that area will necessarily be lost, because they are located away from the disturbance event (unless the disaster affects the whole country, but then the location of the country in the heart of Europe is again advantageous). The same could not be said for cities like Sydney and Los Angeles particularly, where all critical services are generally concentrated within these cities.

However, the planned or historical specialization of particular economic sectors in different Swiss cities is an argument against city-scale resilience to disaster or disturbance. With the federal public sector based largely in Bern, the financial and banking sector located in Zurich, the pharmaceuticals sector in Basel, and the international relations capacity of the country centered in Geneva, the country as a whole becomes vulnerable if a catastrophic event disables the sector situated in one of these cities. For example, given that the banking and finance sector is fundamentally important for Switzerland's economy, a disaster centered in urban Zurich may have significant ramifications for the country's economic stability.

Swiss cities are not only growing in size, but also in complexity. With a large export-oriented business

sector, several international finance institutes, high immigration rates, high volumes of cross-border transport and a high ICT connectivity, Swiss cities are in fact global cities. In order to maximize the security of Swiss cities, all aspects of urban disaster management should reflect the condition of increased technical and social complexity that characterizes modern society. Switzerland's population density, particularly in the country's midland area, mean the area could be considered one 'big city' (functionally at least) so many aspects of disaster management in the global cities examined in this study are also interesting for disaster management at the national level in Switzerland.

4.2.1 *Adapting to, and predicting future risks for Swiss cities*

In recent decades, Swiss cities have experienced few major disasters. Unfortunately, this does not mean that significant adverse events can also be ruled out in the future. While the Swiss population profits from the generally high level of public security, challenges of increased complexity, such as cascading effects, 'black swans' (low probability, high impact incidents – e.g. 9/11 terrorism attacks) or 'perfect storms' (rare combinations of events aggravate a disaster situation – e.g. Hurricane Sandy) might push established disaster management mechanisms and institutions that protect Swiss cities today beyond their limits. As has been discussed in chapter 2, such complex crises are extremely hard to predict and almost impossible to prevent with traditional methods of disaster management. This raises the question: how resilient are Swiss cities in the face of unavoidable complex disturbances?

For several years already, Swiss authorities have realized that the increasing complexity of Swiss cities brings uncertainty to public safety and security.

Adopting long-term risk identification and assessment methods is one way that Switzerland can attempt to reduce unpredictability, and establish proactive strategic and operational mechanisms to mitigate the risks posed by 'black swans' or 'perfect storms'. In this context, increasing the salience of major incidents in a country that does not experience disaster or disturbance on a regular basis is a fundamental challenge. In Switzerland, operational disaster planning and management occurs at the municipality and Cantonal level of government, yet at these levels urban security issues are rather characterized by urban policing issues and concerns, possibly constricting the operational overview of more systemic threats to urban security that might be posed by disaster or significant disturbance. While action to address systemic risks are taken at the federal level by the Federal Office for Civil Protection (*Bundesamt für Bevölkerungsschutz BABS*), integrating the strategic disaster management imperatives identified at the federal level with the operational practices of disaster planning and management at the Canton and municipality levels will be an important step toward addressing future complex risks that Swiss cities may be exposed to.

4.2.2 *Investing in recovery*

Given that Switzerland has not experienced major disaster in recent times, experience with recovery following disaster events is limited. A fast and effective response to disaster can limit the consequences of the event, but can also diminish the likelihood that urban security is detrimentally affected by the event. Similarly, ensuring resources are dedicated to guaranteeing a fast recovery of services following a disaster is also very important. City disaster managers interviewed in this study indicated that the focus on properly resourcing long-term recovery in the event of disaster was becoming an increasingly important

component in disaster management. Many of these cities had traditionally invested heavily in disaster response processes, but recognized that the return on investment made in response mechanisms was limited, especially given the nature of complex disasters. Effective and efficient response *and* recovery are necessary in managing the consequences of disaster, and disaster management resourcing should reflect the dual importance of these steps in the disaster management cycle.

4.2.3 *Optimizing collaboration among Swiss actors*

Our analysis has shown that increased collaboration among all actors involved in urban disaster management is an important step to decrease the impact of potential hazards and optimize disaster response processes. To this end, the Federal administration has taken a proactive approach to develop new cross-institutional collaborations and strengthen existing ones collaborations in Switzerland. In 2012, the national government published a report concerning the country's 'Strategy for Civil Protection and Civil Defense beyond 2015' (*Strategie Bevölkerungsschutz und Zivilschutz 2015+*).⁽⁹⁶⁾ This report illustrates the need to adapt or improve existing civil protection measures. By implementing this strategy, the Swiss civil protection system would become more in line with many of the new practical trends observed in the global cities of this study. Aside from improving the way Swiss institutions respond to disasters or emergencies beyond 2015, the government report outlines ways to better integrate Cantonal and federal civil protection actions. An outcome of the government report was the need to ensure that while the existing Cantonal and federal responsibilities for civil protection remained intact, greater coordination should be encouraged between agencies at both government levels in order to address complex crises (citing the Japanese tsunami and nuclear incident in

Fukushima, 2011).⁽⁹⁵⁾ While the report acknowledges the fundamental responsibility of the Cantons for the operational command of civil protection process and practices, it highlights the need for improved coordination of the overall civil protection system by the federal government. In particular, measures to improve inter-operability between cantonal and federal civil protection stakeholders should be implemented.

In addition, international collaboration will continue to be a valuable practice for improving urban security and disaster management in Swiss cities. This is particularly the case given Switzerland's location at the center of Western Europe, and the likelihood that disaster in neighboring countries may have snowballing consequences (*e.g.* urban safety, economic disruption) for Swiss cities and the population. Using platforms like the trinational workshops on risk analysis and critical infrastructure protection (CIP) with experts from the public and private sector from Germany, Austria and Switzerland, will allow Switzerland to not only to benefit from the experience and concepts of neighbor countries, but also to share the own conceptual developments and practical findings. These platforms also allow risk identification connections to extend beyond the Swiss border by drawing on the risk-relevant intelligence held by these neighbor countries.

4.2.4 *Innovation in disaster management is important*

As noted in section 3.2, the adoption of new technologies that improve disaster management has been a fundamental feature in the practical field. Innovation need not only include technical innovation, but also extends to methodological, managerial or operational developments. Given that the nature of risks, but also of vulnerabilities is constantly changing, the need to innovate in disaster management is impera-

tive. Finding means to identify, test, and finally adopt new innovations in relation to disaster management will ensure Swiss city disaster managers remain at the forefront of this dynamic field.

Communications and risk assessment are key areas where Switzerland can adapt current practices. Using social media platforms will be increasingly important; both to keep the public informed about potential risks or actual incidents and to supplement internal risk information gathering mechanisms. Currently, processes like ‘crisis mapping’ are largely run by self-organizing online communities. Since it is almost impossible to predict in which contexts such bottom-up processes take place, from the point of view of governmental agencies, such instruments tend to be seen as somewhat haphazard. However, dedicating resources towards establishing such technologies so that they can be integrated into more formal risk communication processes could be a highly rewarding investment. This is especially the case, if institutional risk mapping processes are constrained by internal resourcing restrictions. Likewise, by establishing an open dialogue with the broader public about the risks they face as well as their concerns, the Swiss disaster managers will get a better understanding of the contextual or circumstantial factors that might limit or improve the public’s ability to prepare for and contribute to the mitigation of urban disasters.

Long-term strategic methodologies for risk identification and assessment are becoming increasingly conspicuous in the disaster manager’s operational toolbox. Developing the capacity for and undertaking scenario foresighting processes in the identification of risk will improve the Swiss disaster manager’s ability to anticipate future risk. Such techniques are particularly useful in the context of unpredictable risks, or risks not existing in the history of the country or institution, or those with snowballing or systemic

characteristics. To develop capacity in this area, Swiss disaster managers could utilize the already strong relationship with Singapore, a city-state at the forefront of the use of scenario methods in risk assessment and planning.

4.2.5 Reducing vulnerabilities in Swiss cities

Addressing and reducing vulnerability is a fundamental goal of disaster management. Although Switzerland is a wealthy, highly developed nation, disadvantaged sub-populations and minorities exist in each city (the elderly may be a particularly important sub-population worth taking care of in Switzerland). Reducing the vulnerability of these sub-populations strengthens the disaster response and recovery capabilities of the entire population. Applying strong and reliable methods and processes to map demographically specific vulnerabilities in the Swiss population is the first step in addressing these issues. Developing capabilities to understand the characteristics of vulnerable sub-populations will be important in the future. This might be achieved through greater operational contact with communities (visits to community groups by disaster managers, for example, in community meetings or risk briefings), or by institutionalizing mechanisms to closely involve a large share of the public (not just disadvantaged groups) in risk management-related decision making processes that directly affect the population.

The distribution of risk information to increase community preparedness is a central vulnerability-reducing component of a modern disaster risk management approach. However, this information is often very generic. Vulnerable sub-populations are less likely to be able to understand and apply this information than the general public. To overcome this challenge, knowing where vulnerable sub-populations are, and understanding what information they would use be-

comes vitally important. This information should be included in the development of targeted information resources. This necessity also highlights the need to invest in the development of context and circumstance-specific risk communication information.

In general, Switzerland appears to be taking a similar direction in the context of disaster management as the global cities examined in this study. Continued dialogue with Cantonal and international partners (*e.g.*, Germany, Austria and Singapore) about differences in urban disaster management approaches will ensure that Switzerland can keep abreast of the latest trends in planning, preparedness, response and recovery processes. Given the changing nature of risks in the globalized society in general and the dynamic nature of disaster studies in particular, this necessity will only become more pronounced.

REFERENCES

1. Asian Cities Climate Change Resilience Network (ACCCRN). Responding to the Urban Climate Challenge. Boulder, Colorado, USA: 2009.
2. Wenzel F, Bendimerad F, Sinha R. Megacities–megarisks. *Natural Hazards*. 2007;42(3):481–91.
3. Cross JA. Megacities and small towns: Different perspectives on hazard vulnerability. *Environmental Hazards*. 2001;3(2):63–80.
4. Branscomb LM. Sustainable cities: Safety and security. *Technology in Society*. 2006;28(1–2):225–34.
5. Vliet Wv. Cities in a globalizing world: from engines of growth to agents of change. *Environment and Urbanization*. 2002;14(1):31–40. doi: 10.1177/095624780201400103.
6. Molin Valdes H, Rego A, Scott J, Valdes Aquayo J, Birttner P. How to make cities more resilient: A handbook for local government leaders. Geneva, Switzerland: United Nations International Strategy for Disaster Reduction, 2012.
7. Sassen S. Globalization and Cities: Locating cities on global circuits. *Environment and Urbanization*. 2002;14(1):3–12. doi: 10.1177/095624780201400101.
8. Smith RG. World city topologies. *Progress in Human Geography*. 2003;27(5):561–82. doi: 10.1191/0309132503ph4470a.
9. Saskia S. *The global city*. Oxford: Blackwell; 1991.
10. Sassen S. Global cities and diasporic networks: Microsites in global civil society. *Global civil society*. 2002;2002:217–40.
11. Zio E. From complexity science to reliability efficiency: A new way of looking at complex network systems and critical infrastructures. *International Journal of Critical Infrastructures*. 2007;3(3–4):488–508.
12. Batty M. *Cities and Complexity*. Cambridge, Massachusetts: The MIT Press; 2005. 565 p.
13. Benson C, Clay E. Disasters, Vulnerability and the Global Economy. 2003. In: *Building Safer Cities: The Future of Disaster Risk* [Internet]. Washington, D.C.: World Bank.
14. Borden KA, Schmidtlein MC, Emrich CT, Piegorsch WW, Cutter SL. Vulnerability of U.S. cities to environmental hazards. *Journal of Homeland Security and Emergency Management*. 2007;4(2).
15. Mitchell JK. Megacities and natural disasters: A comparative analysis. *GeoJournal*. 1999;49(2):137–42.
16. Korff R, Rothfuß E. Urban Revolution as Catastrophe or Solution? Governance of Megacities in the Global South. *DIE ERDE*. 2009;140:4.
17. Comfort LK. Risk, security, and disaster management. *Annual Review of Political Science*. 2005;8:335–56.
18. Haimes YY, Crowther K, Horowitz BM. Homeland security preparedness: Balancing protection with resilience in emergent systems. *Systems Engineering*. 2008;11(4):287–308.

19. Dunn Cavelty M, Suter M. Public-Private Partnerships are no silver bullet: An expanded governance model for Critical Infrastructure Protection. 2012.
20. Godschalk DR. Urban hazard mitigation: Creating resilient cities. *Natural Hazards Review*. 2003;4(3):136–43.
21. Mileti DS. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington D.C.: Joseph Henry Press; 1999.
22. International Federation of Red Cross and Red Crescent Societies. *World Disasters Report 2010 – Urban Risk*. Dordrecht, The Netherlands: Martinus Nijhoff, 2010.
23. Fischhoff B, Slovic P, Lichtenstein S. Lay Foibles and Expert Fables in Judgements about Risk. *The American Statistician*. 1982;36(3):240–55.
24. Gardner PD, Cortner HJ, Widaman K. The Risk Perceptions and Policy Response Toward Wildland Fire Hazards by Urban Home-Owners. *Landscape and Urban Planning*. 1987;14:163–72.
25. Siegrist M. Communicating Low Risk Magnitudes: Incidence Rates Expressed as Frequency Versus Rates Expressed as Probability. *Risk Analysis*. 1997;17(4):507–10. doi:10.1111/j.1539-6924.1997.tb00891.x.
26. Sjöberg L. Strength of Belief and Risk. *Policy Sciences*. 1979;11:39–57.
27. Slovic P. The Psychology of Protective Behavior. *Journal of Safety Research*. 1978;10(2):58–68.
28. Slovic P. Perception of Risk. In: Cutter SL, editor. *Environmental Risks and Hazards*. New Jersey: Prentice Hall; 1987.
29. UN/ISDR. *Living with Risk: A Global Review of Disaster Reduction Initiatives*. Geneva, Switzerland: United Nations, 2004.
30. Sjöberg L. Factors in risk perception. *Risk Analysis*. 2000;20(1):1–11.
31. Slovic P. Informing and educating the public about risk. *Risk Analysis*. 1986;6(4):403–15.
32. Adger WN. Vulnerability. *Global Environmental Change*. 2006;16(3):268–81. doi: 10.1016/j.gloenvcha.2006.02.006. PubMed PMID: WOS:000239752200005.
33. Eakin H, Luers AL. Assessing the vulnerability of social-environmental systems. *Annual Review of Environment and Resources*. 2006;31:365–94.
34. Cutter SL, Boruff BJ, Shirley WL. Social vulnerability to environmental hazards. *Social Science Quarterly*. 2003;84(2):242–61.
35. Paton D, Smith L, Violanti J. Disaster response: Risk, vulnerability and resilience. *Disaster Prevention and Management*. 1998;9(3):173–9.
36. Gómez C, Buriticá J, Sánchez-Silva M, Dueñas-Osorio L. Vulnerability assessment of infrastructure networks by using hierarchical decomposition methods. In: Ayyub BB, ASCE Council on Disaster Risk Management, editors. *First International Conference on Vulnerability and Risk Analysis and Management (ICVRAM 2011)*; Hyattsville, Maryland: American Society of Civil Engineers; 2011. p. 214–21.

37. Thomalla F, Downing T, Spanger-Siegfried E, Han G, Rockström J. Reducing hazard vulnerability: Towards a common approach between disaster risk reduction and climate adaptation. *Disasters*. 2006;30(1):39–48.
38. Alhazmi OH, Malaiya YK, Ray I. Measuring, analyzing and predicting security vulnerabilities in software systems. *Computers and Security*. 2007;26(3):219–28.
39. Barnett J, Lambert S, Fry I. The hazards of indicators: Insights from the environmental vulnerability index. *Annals of the Association of American Geographers*. 2008;98(1):102–19.
40. Birkmann J. Risk and vulnerability indicators at different scales: Applicability, usefulness and policy implications. *Environmental Hazards*. 2007;7(1):20–31.
41. Hinkel J. “Indicators of vulnerability and adaptive capacity”: Towards a clarification of the science-policy interface. *Global Environmental Change*. 2011;21(1):198–208.
42. Turner BL, Kaspersen RE, Matsone PA, McCarthy JJ, Corell RW, Christensene L, et al. A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the United States of America*. 2003;100(14):8074–9.
43. Manyena SB, O’Brien G, O’Keefe P, Rose J. Disaster resilience: A bounce back or bounce forward ability? *Local Environment*. 2011;16(5):417–24.
44. Sherrieb K, Norris FH, Galea S. Measuring Capacities for Community Resilience. *Social Indicators Research*. 2010;99(2):227–47.
45. Tugade MM, Fredrickson BL. Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology*. 2004;86(2):320.
46. Cutter SL, Barnes L, Berry M, Burton C, Evans E, Tate E, et al. A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*. 2008;18(4):598–606.
47. Grothmann T, Patt A. Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*. 2005;15(3):199–213. doi:10.1016/j.gloenvcha.2005.01.002.
48. Marshall NA. Understanding social resilience to climate variability in primary enterprises and industries. *Global Environmental Change*. 2010;20(1):36–43.
49. Norris FH, Stevens SP, Pfefferbaum B, Wyche KF, Pfefferbaum RL. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology*. 2008;41(1–2):127–50.
50. Smit B, Wandel J. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*. 2006;16(3):282–92.
51. Folke C. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*. 2006;16(3):253–67.
52. Haines YY. On the definition of resilience in systems. *Risk Analysis*. 2009;29(4):498–501.
53. Ungar M. Social Ecologies and Their Contribution to Resilience. In: Ungar M, editor. *The Social*

- Ecology of Resilience: A Handbook of Theory and Practice. New York: Springer Science+Business Media; 2012. p. 13–31.
54. Walker B, Holling CS, Carpenter SR, Kinzig A. Resilience, adaptability and transformability in social–ecological systems. *Ecology and society*. 2004;9(2).
 55. Walker J, Cooper M. Genealogies of resilience: From systems ecology to the political economy of crisis adaptation. *Security Dialogue*. 2011;42(2):143–60.
 56. Sampson RJ, Raudenbush SW. Seeing Disorder: Neighborhood Stigma and the Social Construction of “Broken Windows”. *Social Psychology Quarterly*. 2004;67(4):319–42. doi: 10.2307/3649091.
 57. Wilson JQ, Kelling G. The police and neighborhood safety: Broken windows. *Atlantic Monthly*. 1982;127:29–38.
 58. Tversky A, Kahneman D. Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*. 1973;5(2):207–32.
 59. Clarke SE, Chenoweth E. The politics of vulnerability: Constructing local performance regimes for homeland security. *Review of Policy Research*. 2006;23(1):95–114.
 60. Gerber BJ, Cohen DB, Cannon B, Patterson D, Stewart K. On the front line: American cities and the challenge of homeland security preparedness. *Urban Affairs Review*. 2005;41(2):182–210.
 61. De Sherbinin A, Schiller A, Pulsipher A. The vulnerability of global cities to climate hazards. *Environment and Urbanization*. 2007;19(1):39–64. doi: 10.1177/0956247807076725.
 62. Beall J. Globalization and social exclusion in cities: framing the debate with lessons from Africa and Asia. *Environment and Urbanization*. 2002;14(1):41–51. doi: 10.1177/095624780201400104.
 63. Uitto JI. The geography of disaster vulnerability in megacities: A theoretical framework. *Applied Geography*. 1998;18(1):7–16. doi: 10.1016/S0143-6228(97)00041-6.
 64. Wardekker JA, de Jong A, Knoop JM, van der Sluijs JP. Operationalising a resilience approach to adapting an urban delta to uncertain climate changes. *Technological Forecasting and Social Change*. 2010;77(6):987–98.
 65. Hagmann J, Cavelty MD. National risk registers: Security scientism and the propagation of permanent insecurity. *Security Dialogue*. 2012;43(1):79–96.
 66. Collins TW, Grineski SE, Aguilar MDR. Vulnerability to environmental hazards in the Ciudad Juarez (Mexico)-El Paso (USA) metropolis: A model for spatial risk assessment in transnational context. *Applied Geography*. 2009;29(3):448–61. doi: 10.1016/j.apgeog.2008.10.005. PubMed PMID: WOS:000268352500015.
 67. Bara, C. *Social Vulnerability to Disasters*. Zurich: Center for Security Studies, ETH Zürich, 2010.
 68. Tierney KJ, Lindell MK, Perry RW, editors. *Facing the Unexpected: Disaster Preparedness and Response in the United States*. Washington D. C.: Joseph Henry Press; 2001.

69. Fisher RE, Norman M. Developing measurement indices to enhance protection and resilience of critical infrastructure and key resources. *Journal of business continuity & emergency planning*. 2010;4(3):191–206.
70. Petit F, Buehring W, Whitfield R, Fisher R, Collins M. Protective measures and vulnerability indices for the enhanced critical infrastructure protection programme. *International Journal of Critical Infrastructures*. 2011;7(3):200–19.
71. Roe E, Schulman PR. Toward a Comparative Framework for Measuring Resilience in Critical Infrastructure Systems. *Journal of Comparative Policy Analysis: Research and Practice*. 2012;14(2):114–25. doi:10.1080/13876988.2012.664687.
72. O'Donnell I, Smart K, Ramalingam B. Responding to urban disasters: Learning from previous relief and recovery operations. ALNAP and Prevention Consortium, 2009 Contract No.: No. 5.
73. Comfort LK. Cities at risk: Hurricane Katrina and the drowning of New Orleans. *Urban Affairs Review*. 2006;41(4):501–16.
74. Kates RW, Colten CE, Laska S, Leatherman SP. Reconstruction of New Orleans after Hurricane Katrina: A research perspective. *Proceedings of the National Academy of Sciences of the United States of America*. 2006;103(40):14653–60.
75. Gallopín GC. Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change*. 2006;16(3):293–303.
76. Berkes F. Understanding uncertainty and reducing vulnerability: Lessons from resilience thinking. *Natural Hazards*. 2007;41(2):283–95.
77. Handmer JW, Dovers SR. A typology of resilience: Rethinking institutions for sustainable development. *Organization and Environment*. 1996;9(4):482–511.
78. Haimes YY. Strategic Preparedness for Recovery from Catastrophic Risks to Communities and Infrastructure Systems of Systems. *Risk Analysis*. 2012;32(11):1834–45.
79. Handmer JW. Managing vulnerability in Sydney: Planning or providence? *GeoJournal*. 1995;37(3):355–68.
80. Klein RJT, Nicholls RJ, Thomalla F. Resilience to natural hazards: How useful is this concept? *Environmental Hazards*. 2003;5(1–2):35–45.
81. Comfort LK. Crisis management in hindsight: Cognition, communication, coordination, and control. *Public Administration Review*. 2007;67(SUPPL. 1):189–97.
82. Deverell E. Crises as learning triggers: Exploring a conceptual framework of crisis-induced learning. *Journal of Contingencies and Crisis Management*. 2009;17(3):179–88.
83. Kapucu N, Van Wart M. The evolving role of the public sector in managing catastrophic disasters: Lessons learned. *Administration and Society*. 2006;38(3):279–308.
84. Waugh W. *Living with hazards, dealing with disasters: An introduction to emergency management*. New York: M.E. Sharpe; 2000.
85. Spillman KR, Wenger A, Breitenmoser C, Gerber M. *Schweizer Sicherheitspolitik seit 1945: Zwischen Autonomie und Kooperation*. Zürich: Verlag Neue Zürcher Zeitung; 2001.

86. Olshansky R, Chang S. Planning for disaster recovery: Emerging research needs and challenges. *Progress in Planning*. 2009;72(4):200–9.
87. Kendra JM, Wachtendorf T. Elements of resilience after the World Trade Center Disaster: Reconstituting New York City's emergency operations centre. *Disasters*. 2003;27(1):37–53.
88. Adger WN. Social capital, collective action, and adaptation to climate change. *Economic Geography*. 2003;79(4):387–404.
89. Giroux J, Roth F. Conceptualizing the Crisis Mapping Phenomenon: Insights on behavior and the coordination of agents and information in complex crisis. Zurich: Center for Security Studies for the Bundesamt für Bevölkerungsschutz, 2012 on-tract No.: Focal Report 7.
90. AFAC. Position Paper on Bushfires and Community Safety. Australasian Fire and Emergency Services Authorities Council, 2010.
91. Floress K, Prokopy LS, Allred SB. It's who you know: Social capital, social networks, and watershed groups. *Society and Natural Resources*. 2011;24(9):871–86.
92. Lachapelle PR, McCool SF. The Role of Trust in Community Wildland Fire Protection Planning. *Society and Natural Resources*. 2012;25:321–35.
93. Paton D. Risk communication and natural hazard mitigation: how trust influences its effectiveness. *International Journal of Global Environmental Issues*. 2008;8(1–2):2–16.
94. Siegrist M, Cvetkovich G. Perception of hazards: The role of social trust and knowledge. *Risk Analysis*. 2000;20(5):713–9.
95. Bundesamt für Raumentwicklung ARE. Ecoplan, Urbane Herausforderungen aus Bundessicht. Ein Diskussionsbeitrag zur Weiterentwicklung der Agglomerationspolitik. Bern, Switzerland: Bundesamt für Raumentwicklung ARE, Staatssekretariat für Wirtschaft SECO, 2012.
96. Schweizer Bundesrates. Strategie Bevölkerungsschutz und Zivilschutz 2015+. Bern, Schweiz, 2012.